CASE STUDY: ONE & TWO POTOMAC YARD

STORIES OF PRACTICE

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Prepared for the U.S. Green Building Council

Case Study Lab
Center for Housing Innovation
University of Oregon

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USGBC Case Study Project:
The U.S. Green Building Council, in conjunction with the University of Oregon, initiated this pilot program of five case studies to gather information on green building practices. Through a series of interviews, selected project team members from One and Two Potomac Yard tell their stories in this case study. The interviews were recorded, transcribed, edited, and compiled to form the narratives on the following pages.

The USGBC intends to use these narratives as educational content for instructor-led workshops, podcasts, webinars, books, magazines, articles, and other research-oriented and curriculum products. The University of Oregon will use the material for educational purposes only, in classes and conferences. The five pilot case studies comprise a cross-section of certification levels, building types, and themes that occur in practice. The USGBC plans to expand its case study database with more project stories covering different themes, to enhance case-based teaching methods.

Written permission has been obtained from all participants in this project, following an extensive edit and approval process, to include their interviews and videos in this document.

Back cover project description from http://www.crescent-resources.com/commer/washington/oneandtwopotomacyard/Default.asp

Supplemental and Appendix images courtesy of Sustainable Design Consulting, LLC.
Each participant has provided his or her own photo

TABLE OF CONTENTS

ONE AND TWO POTOMAC YARD, ARLINGTON, VIRGINIA

INTRODUCTION TO THE CASE STUDY

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One Potomac Yard, in the foreground, is connected to Two Potomac Yard, in the background.

PROJECT DATA

- LEED-NC v.2.0/2.1 Gold; LEED-EB v.2.0 Gold
- Completion: May 2006
- Base Building Cost: 100,000,000 U.S. Dollars
- Tenant Fitout Cost: 30,000,000 U.S. Dollars
- Area: 315,231 ft²

LOCATION

- City: Arlington, VA
- Latitude: 38.83 North
- Longitude: 77.05 West

CLIMATE[2]

- HDD65: 4008
- CDD50: 4739
- Annual Precipitation: 38.6"
- Solar Radiation: 475 kBtu/sf/year

ENERGY METRICS

- Measured EUI:
  - 78.4 kBtu/sf/year (May 2008 - April 2009)[3]

PROJECT DESCRIPTION

"One & Two Potomac Yard was the first office building under construction at Potomac Yard, Arlington County's premier, urban redevelopment project. This twelve story, 650,000 square feet office building was completed in March 2006. The home of the United States Environmental Protection Agency, this is one of the largest LEED Gold certified office buildings on the east cost recognized by the United States Green Building Council."[1]

1 This quote is taken from the Crescent Resources website at www.crescent-resources.com.

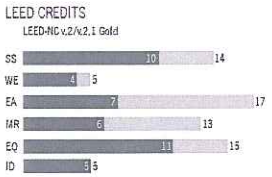
2 The climate data is from the website of the National Oceanic and Atmospheric Administration.

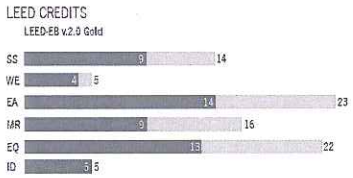
3 The EUI, or Energy Utilization Intensity, estimates given here are based on data extrapolated from electricity and gas bills from provided by Jones Lang LaSalle for Potomac One.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

PROJECT TEAM MEMBERS

Owner/Developer:	Crescent Resources, LLC., Arlington, VA
Architect:	Davis Carter Scott, McLean, VA
General Contractor:	James G. Davis Construction Co., Rockville, MD
Tenant:	EPA, Washington D.C.
Mechanical Engineer:	Girard Engineering, McLean, VA
Structural Engineer:	Fernandez & Associates, Falls Church, VA
Commissioning Agent:	Advanced Building Performance, Potomac, MD
Facility Manager:	Jones Lang LaSalle, Arlington, VA
Energy Consultant:	Econergy International Corporation, Boulder, CO
Landscape Architect:	Oculus, Washington, D.C.
Green Consultant:	Sustainable Design Consulting, Richmond, VA
Lighting:	Moran Coventry Lighting, Washington, D.C.



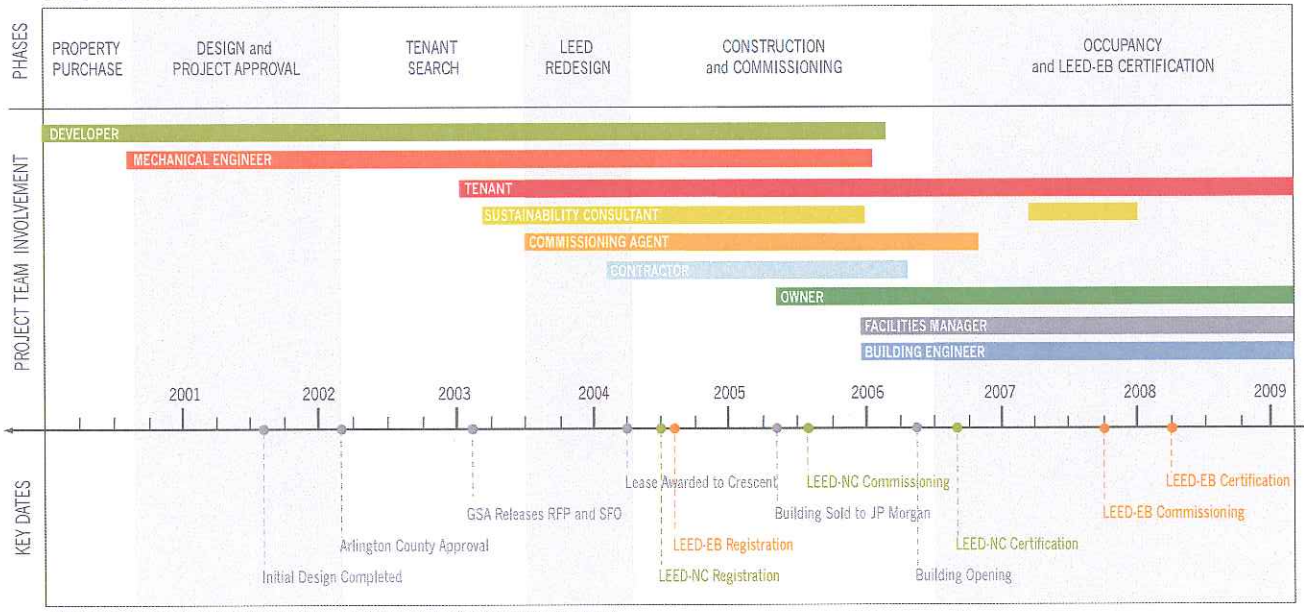


PROJECT AWARDS

- 2008 LEED-EB v.2.0 Gold; U.S. Green Building Council
- 2007 Award of Excellence: Best Building High Rise, Eight Stories and Above; Northern Virginia Chapter of the National Association of Industrial and Office Properties (NAIOP)
- 2007 Federal Energy Saver Showcase Award; U.S. Department of Energy
- 2007 White House Closing the Circle Award
- 2007 Excellence in Design Awards: Finalists, Commercial Design; Environmental Design + Construction
- 2007 Best Building, Environmentally Responsible – Green Construction: Award of Merit; NAIOP
- 2007 Commonwealth Environmental Leadership Awards
- 2006 LEED-NC v.2.0/v.21 Gold; U.S. Green Building Council
- 2005 Green ABBIES Award; Arlington Economic Development Commission & Arlington Chamber of Commerce
- 2004 Lease Project of the Year Award; GSA

ONE POTOMAC YARD PROJECT TIMELINE

LEED-NC v.2.0/v.2.1 Gold; LEED-EB v.2.0 Gold



*This timeline contains an approximation of key dates, project phases, and project team member involvement.

ONE POTOMAC YARD LEED-NC v2.0/v2.1 Gold 43 of 69 possible points

SUSTAINABLE SITES — 10 of 14 possible points

x	x	Prereq 1	Erosion & Sedimentation Control
1	1	Credit 1	Site Selection
1	1	Credit 2	Urban Redevelopment
1	1	Credit 3	Brownfield Redevelopment
1	1	Credit 4.1	Alternative Transportation, Public Transportation Access
1	1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms
1	1	Credit 4.3	Alternative Transportation, Alternative Fuel Refueling Stations
1	1	Credit 4.4	Alternative Transportation, Parking Capacity
	1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space
	1	Credit 5.2	Reduced Site Disturbance, Development Footprint
	1	Credit 6.1	Stormwater Management, Rate and Quantity
1	1	Credit 6.2	Stormwater Management, Treatment
1	1	Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof
1	1	Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof
		Credit 8	Light Pollution Reduction

WATER EFFICIENCY — 4 of 5 possible points

1	1	Credit 1.1	Water Efficient Landscaping, Reduce by 50%
1	1	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation
	1	Credit 2	Innovative Wastewater Technologies
1	1	Credit 3.1	Water Use Reduction, 20% Reduction
1	1	Credit 3.2	Water Use Reduction, 30% Reduction

ENERGY AND ATMOSPHERE — 7 of 17 possible points

x	x	Prereq 1	Fundamental Building Systems Commissioning
x	x	Prereq 2	Minimum Energy Performance
x	x	Prereq 3	CFC Reduction in HVAC&R Equipment
2	2	Credit 1.1	Optimize Energy Performance, 20% New / 10% Existing
1	2	Credit 1.2	Optimize Energy Performance, 30% New / 20% Existing
	2	Credit 1.3	Optimize Energy Performance, 40% New / 30% Existing
	2	Credit 1.4	Optimize Energy Performance, 50% New / 40% Existing
	2	Credit 1.5	Optimize Energy Performance, 60% New / 50% Existing
	1	Credit 2.1	Renewable Energy, 5%
	1	Credit 2.2	Renewable Energy, 10%
	1	Credit 2.3	Renewable Energy, 20%
1	1	Credit 3	Additional Commissioning
1	1	Credit 4	Ozone Depletion
1	1	Credit 5	Measurement & Verification
1	1	Credit 6	Green Power

MATERIALS AND RESOURCES — 6 of 13 possible points

x	x	Prereq 1	Storage & Collection of Recyclables
	1	Credit 1.1	Building Reuse, Maintain 75% of Existing Shell
	1	Credit 1.2	Building Reuse, Maintain 100% of Existing Shell
	1	Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell
1	1	Credit 2.1	Construction Waste Management, Divert 50%
	1	Credit 2.2	Construction Waste Management, Divert 75%
	1	Credit 3.1	Resource Reuse, Specify 5%
	1	Credit 3.2	Resource Reuse, Specify 10%
1	1	Credit 4.1	Recycled Content
1	1	Credit 4.2	Recycled Content
1	1	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally
1	1	Credit 5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally
	1	Credit 6	Rapidly Renewable Materials
1	1	Credit 7	Certified Wood

INDOOR ENVIRONMENTAL AIR QUALITY — 11 of 15 possible points

x	x	Prereq 1	Minimum IAQ Performance
x	x	Prereq 2	Environmental Tobacco Smoke (ETS) Control
1	1	Credit 1	Carbon Dioxide Monitoring
	1	Credit 2	Increase Ventilation Effectiveness
1	1	Credit 3.1	Construction IAQ Management Plan, During Construction
1	1	Credit 3.2	Construction IAQ Management Plan, Before Occupancy
1	1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants
1	1	Credit 4.2	Low-Emitting Materials, Paints
1	1	Credit 4.3	Low-Emitting Materials, Carpet
1	1	Credit 4.4	Low-Emitting Materials, Composite Wood
1	1	Credit 5	Indoor Chemical & Pollutant Source Control
	1	Credit 6.1	Controllability of Systems, Perimeter
	1	Credit 6.2	Controllability of Systems, Non-Perimeter
1	1	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992
1	1	Credit 7.2	Thermal Comfort, Permanent Monitoring System
	1	Credit 8.1	Daylight & Views, Daylight 75% of Spaces
1	1	Credit 8.2	Daylight & Views, Views for 90% of Spaces

INNOVATION AND DESIGN PROCESS — 5 of 5 possible points

1	1	Credit 1.1	Innovation in Design: Exemplary Performance MRc5.1
1	1	Credit 1.2	Innovation in Design: Green Housekeeping
1	1	Credit 1.3	Innovation in Design: Educational Program
1	1	Credit 1.4	Innovation in Design: Exemplary Performance WEc3
1	1	Credit 2	LEED® Accredited Professional

ONE POTOMAC YARD LEED-EB v. 2.0

Gold 54 of 85 possible points

SUSTAINABLE SITES 9 of 14 possible points

x	x	Prereq 1	Erosion & Sedimentation Control
x	x	Prereq 2	Age of Building
2	2	Credit 1	Plan for Green Site and Building Exterior Management
1	1	Credit 2	High Development Density Building and Area
1	1	Credit 3.1	Alternative Transportation, Public Transportation Access
1	1	Credit 3.2	Alternative Transportation, Bicycle Storage & Changing Rooms
1	1	Credit 3.3	Alternative Transportation, Alternative Fuel Vehicles
1	1	Credit 3.4	Alternative Transportation, Car Pooling & Telecommuting
	1	Credit 4.1	Reduced Site Disturbance, Protect or Restore Open Space: 50% of Site Area
	1	Credit 4.2	Reduced Site Disturbance, Protect or Restore Open Space: 75% of Site Area
	2	Credit 5	Stormwater Management, Rate and Quantity Reduction (1 to 2 points)
1	1	Credit 6.1	Heat Island Reduction, Non-Roof
1	1	Credit 6.2	Heat Island Reduction, Roof
	1	Credit 7	Light Pollution Reduction

WATER EFFICIENCY 4 of 5 possible points

x	x	Prereq 1	Minimum Water Efficiency
x	x	Prereq 2	Discharge Water Compliance
2	2	Credit 1	Water Efficient Landscaping, Reduce Water Use (1 to 2 points)
	1	Credit 2	Innovative Wastewater Technologies
1	1	Credit 3.1	Water Use Reduction, 10% Reduction
1	1	Credit 3.2	Water Use Reduction, 20% Reduction

ENERGY AND ATMOSPHERE 14 of 23 possible points

x	x	Prereq 1	Existing Buildings Commissioning
x	x	Prereq 2	Minimum Energy Performance
x	x	Prereq 3	Ozone Protection
5	10	Credit 1	Optimize Energy Performance
3	4	Credit 2	On-site and Off-site Renewable Energy (1 to 4 points)
1	1	Credit 3.1	Building Operation & Maintenance: Staff Education
1	1	Credit 3.2	Building Operation & Maintenance: Building Systems Maintenance
1	1	Credit 3.3	Building Operation & Maintenance: Building Systems Monitoring
1	1	Credit 4	Additional Ozone Depletion
2	3	Credit 5.1-3	Performance Measurement - Enhanced Metering
	1	Credit 5.4	Performance Measurement - Emission Reduction Reporting
	1	Credit 6	Documenting Sustainable Building Cost Impacts

MATERIALS AND RESOURCES 9 of 16 possible points

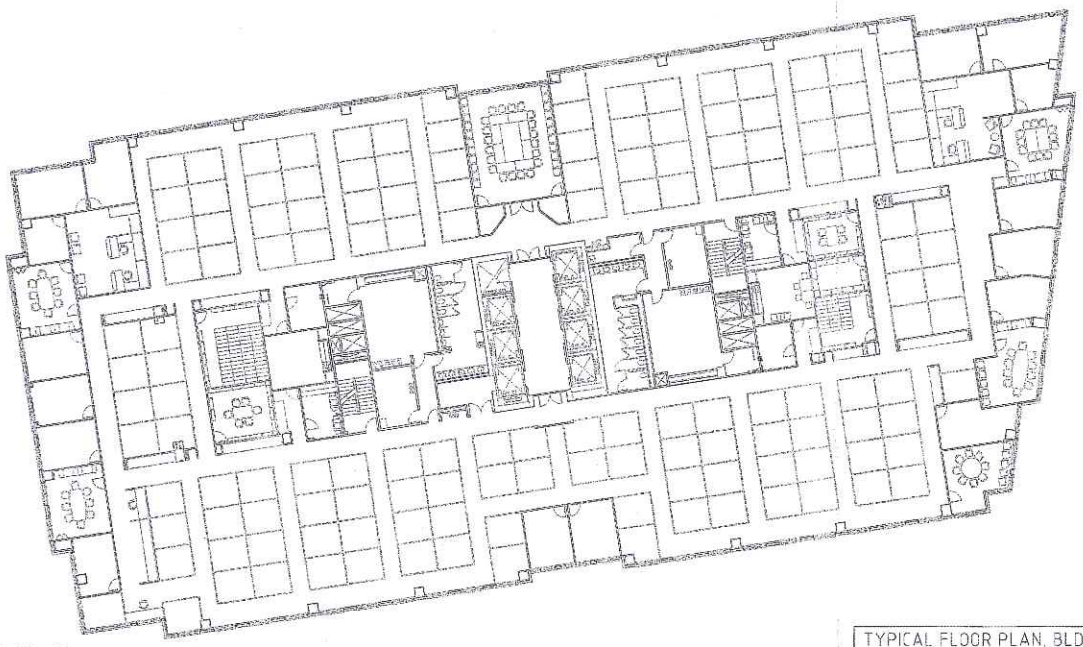
x	x	Prereq 1.1	Source Reduction and Waste Management, Waste Stream Audit
x	x	Prereq 1.2	Source Reduction and Waste Management, Storage & Collection of Recyclables
x	x	Prereq 1.3	Toxic Material Source Reduction, Reduced Mercury in Light Bulbs
1	2	Credit 1	Construction, Demolition and Renovation Waste Management
1	1	Credit 2	Optimize Use of Alternative Materials
2	2	Credit 3	Optimize Use of IAQ Compliant Products
3	3	Credit 4	Sustainable Cleaning Products and Materials
1	3	Credit 5	Occupant Recycling
1	1	Credit 6	Additional Toxic Materials Source Reduction: Reduced Mercury in Light Bulbs

INDOOR ENVIRONMENTAL AIR QUALITY 13 of 22 possible points

x	x	Prereq 1	Outside Air Introduction and Exhaust Systems
x	x	Prereq 2	Environmental Tobacco Smoke Control (ETS)
x	x	Prereq 3	Asbestos Removal or Encapsulation
x	x	Prereq 4	PCB Removal
1	1	Credit 1	Outdoor Air Delivery Monitoring
	1	Credit 2	Construction IAQ Management Plan
1	1	Credit 3	Increase Ventilation
	1	Credit 4.1	Documenting Productivity Impacts and Healthcare Cost - Absenteeism
	1	Credit 4.2	Documenting Productivity Impacts - Other Impacts
1	1	Credit 5.1	Indoor Chemical and Pollutant Source Control: Non-Cleaning System - Reduc....
1	1	Credit 5.2	Indoor Chemical and Pollutant Source Control: Non-Cleaning - High Volume
	1	Credit 6.1	Controllability of Systems: Lighting
	1	Credit 6.2	Controllability of Systems: Temperature & Ventilation
1	1	Credit 7.1	Thermal Comfort: Compliance
1	1	Credit 7.2	Thermal Comfort: Monitoring
	1	Credit 8.1	Daylight & Views: Daylight for 50% of Spaces
	1	Credit 8.2	Daylight & Views: Daylight for 75% of Spaces
	1	Credit 8.3	Daylight & Views: Views for 40% of Spaces
	1	Credit 8.4	Daylight & Views: Views for 80% of Spaces
1	1	Credit 9	Contemporary IAQ Practice
1	1	Credit 10.1	Green Cleaning: Entryway Systems
1	1	Credit 10.2	Green Cleaning: Isolation of Janitorial Closets
1	1	Credit 10.3	Green Cleaning: Low Environmental Impact Cleaning Policy
2	2	Credit 10.4-5	Green Cleaning: Low Environmental Impact Pest Management Policy
1	1	Credit 10.6	Green Cleaning: Low Environmental Impact Cleaning Equipment Policy

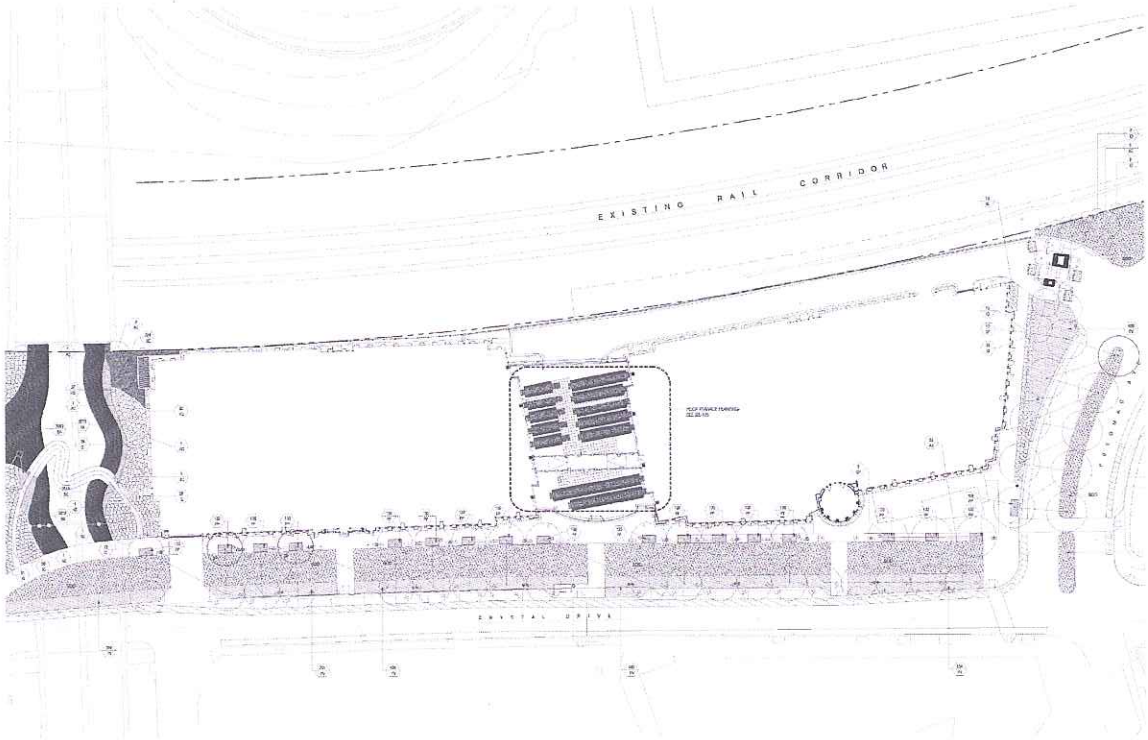
INNOVATION AND DESIGN PROCESS 5 of 5 possible points

1	1	Credit 1.1	Innovation in Operation & Upgrades:
1	1	Credit 1.2	Innovation in Operation & Upgrades:
1	1	Credit 1.3	Innovation in Operation & Upgrades:
1	1	Credit 1.4	Innovation in Operation & Upgrades:
1	1	Credit 2	LEED® Accredited Professional



TYPICAL FLOOR PLAN, BLDG 1

Typical Floor Plan



Site Plan

ELIZABETH ADAMS MCMILLAN

PROJECT MANAGER, CRESCENT RESOURCES, LLC.

PROCESS | GETTING INVOLVED WITH THE PROJECT

One and Two Potomac Yard[1] was the first vertical construction piece of Crescent Resource's[2] mixed-use development at Potomac Yard. At the time, Crescent was the owner and developer of the building. I was an assistant project manager for the owner, and I worked closely with the LEED[3] consultant. Additionally, I obtained building permits, tracked change orders for the Government and contractor. Crescent had a construction manager and an executive vice president. I assisted from an administrative role.

ELIZABETH ADAMS MCMILLAN, LEED AP has worked for Crescent Resources since 2002. A graduate of the University of North Carolina at Chapel Hill, she is now a Project Manager with Crescent Resources. Elizabeth has attained the Urban Land Institute's Real Estate Development Certificate. In September of 2009, she was appointed as the Vice Chair for the Young Leaders Group by the Charlotte District Council of the Urban Land Institute (ULI Charlotte).

ESTABLISHING PROJECT GOALS

Crescent Resources is based in Charlotte, North Carolina; we made our entrance into the Washington, D.C. market around 1999-2000 with the purchase of Potomac Yard. The project is approximately 300 acres, and it is located outside of Washington, D.C.; half of the project area is in Arlington, Virginia and the other half is in Alexandria, Virginia,[4] right next to Ronald Reagan National Airport.[5]

Once we decided to enter the D.C. market, we started developing this project piece by piece. We completed much of the horizontal infrastructure, off-site improvements, and the roads and utilities for the Arlington section of the project. One and Two Potomac Yard was intended to be the flagship building of the development, and we hired the world-renowned architecture firm Pickard and Chilton[6] to do the design. Historically, Crescent built suburban office projects in the Carolinas, Nashville, and Florida; this project was out-of-the-box. We wanted to make a statement about coming to D.C.

ATTRACTING TENANTS

The building was fully designed and 95% of the construction drawings were complete when September 11th[7] occurred. This event shut down Washington, D.C. and halted much of the leasing activity. I joined the office nine months later, in 2002, when we were trying to market the overall project. We were pursuing law and technology tenants and other clients who had significant energy needs. In 2003, the U.S. General Services Administration (GSA)[8]

1 One and Two Potomac Yard were the first buildings constructed in a new mixed-use development in Arlington and Alexandria Virginia, outside of Washington D.C., and were completed in 2006.

2 Crescent Resources, LLC is a land and real estate development with offices in 8 states throughout the southeastern US. Crescent is known for its world class single-family lake and golf communities, Class-A office buildings, industrial, and multi-family developments.

3 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

4 The City of Alexandria and Arlington County are independent jurisdictions in Virginia southwest of downtown Washington D.C.

5 Ronald Reagan National Airport is located in Arlington, Virginia.

6 Picard and Chilton is an architecture firm based in New Haven, Connecticut.

7 September 11, 2001 was the date of a series of terrorist attacks that took place at the World Trade Center towers in New York City, in rural Pennsylvania, and at the Pentagon complex outside of Washington D.C.

8 The U.S. General Services Administration (GSA) is an independent management agency of the United States government that supports Federal agencies through the management of property, records, and construction.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

put out several Requests for Proposals (RFPs)[9] and Solicitations for Offers (SFOs).[10] One of these was for the U.S. Environmental Protection Agency (EPA)[11] which needed 400,000 square feet of office space to consolidate their Northern Virginia offices. So, they were able to fill roughly two-thirds of our building.

The EPA initiated the LEED certification requirement; One and Two Potomac Yard were the first buildings to fall under the new directives. The GSA initiates and manages many government leases for various government tenants, and the EPA and GSA wanted the LEED requirement to be standard in all of their buildings, both in new construction and in new leases going forward. Because of the way the project was initially designed, we had to reinvent the wheel to meet the requirements of the SFO. The SFO included a number of requirements including Level 4 security,[12] which is difficult to achieve in an urban environment like Arlington, and, at least, a LEED 2.1 for New Construction Silver certification. When we decided to pursue the lease, we went through a process of looking over the LEED checklist to make sure that we were meeting the requirements. The building had been designed for law firms and technology tenants, companies with significant power and lighting needs, so we had to completely redesign the project to meet the criteria of the SFO, which specified that the lease include requirements for commissioning,[13] roof engineering, water chillers, and a number of additional items.

If you plan for LEED certification at the beginning of a project, it saves you a lot of money going forward; that's the biggest lesson we learned during the planning stage for this project.

ASSEMBLING THE TEAM

Crescent put together a team that included Girard Engineering[14] and Davis Carter Scott[15] as the Architects of Record. The team worked through a redesign with the goal of meeting the LEED Silver criteria. We went through the LEED for New Construction (LEED-NC) checklist to see which credits the building could satisfy with minor changes to the design. In addition to the number required for Silver certification, we selected six to eight credits as a kind of insurance. At the same time, we were evaluating the costs in order to bring the rent down, since we were competing with an existing building up the street. This process took three to six months; we were awarded the lease in March of 2004 and construction began in May of that year.

The members of the redesign team were all individuals that we had worked with in the past. We had previously worked with Girard Engineering and Davis Carter Scott and they had demonstrated to us that they could help us get through the LEED process. Six years ago there weren't many LEED APs[16] in the industry, but both of these firms were moving forward in a sustainable direction and they already had the proper staff in place.

PROJECT CONSIDERATIONS

The Level 4 security requirement of the SFO specified a 50 foot setback, which, if you think about it, is a long distance from the back of the curb. Most buildings in Washington, D.C., and elsewhere, have 14 feet of sidewalk because everybody wants buildings and ground floor retail to be close to the street to create a pedestrian-friendly scale. One and Two Potomac Yard has six levels of parking; three are below grade and three are above grade. We convinced the GSA to take the setback line from the back of the curb over to the foot of the building and up the three stories to get to the required 50-foot distance.

Another safety requirement dictated the use of bollards running down the sidewalk that are designed to take a 35 MPH impact. There was a lot of structural engineering that went into the design of those bollards because they

9 A Request for Proposals (RFP) is an invitation for a supplier (in this case, a developer), generally through a bidding process, to submit a proposal for the provision of a specific service (in this case, a rental property).

10 The GSA will post a Solicitation for Offers (SFO) when they wish to lease space from a landlord that will own and develop the space to their specifications.

11 The U.S. Environmental Protection Agency (EPA) is an agency of the federal government that employs 17,000 people. It is headquartered in Washington D.C. and operates 10 regional offices and a dozen laboratories.

12 Level 4 Security is a requirement of the U.S. Federal Protective Service (FPS). FPS is one of five divisions of the U.S. Immigrations and Customs Enforcement (ICE), itself a component of the U.S. Department of Homeland Security (DHS). They protect federal properties, employees, and visitors through regulation and a police force.

13 Commissioning is the process of ensuring that a building is performing and operating according to the design and construction intentions.

14 Girard Engineering is a mechanical and electrical engineering firm headquartered in the Washington, D.C. metropolitan area.

15 Davis Carter Scott is a full-service architectural and interior architectural firm located in McLean, Virginia.

16 A LEED Accredited Professional (LEED AP) is an individual who has passed the LEED Accredited Professional exam and is designated by the USGBC as a LEED AP. The LEED certification process requires that a LEED AP submit the required paperwork.

have to withstand the impact of a van traveling at 35 mph. The safety requirements also determined the spacing of the bollards and the protective window glazing. We were required to have operational control procedures; the entrances to the building had to have metal detectors and there were checkpoints in the garages. These requirements were implemented after 9/11, and now they are typical for all current government projects.

DESIGN | GRANTS AND INCENTIVES

Crescent did not receive any incentives or grants to help with the LEED-NC certification process or the construction of One and Two Potomac Yard. The incentive was actually the reverse of that with a normal project because the GSA required that we meet the Silver certification or face a 10 % rent reduction. We were working toward the LEED certification to ensure that we could obtain the full rental rate from the GSA without penalty. We did look at a few programs in Arlington County that would have allowed additional density if certain levels of LEED certification were obtained. This would have resulted in more space to lease and the total income from the property would have been greater, but because of our location and proximity to the airport, we couldn't build any higher. The road on one side of the site and the train tracks on the other made a tight site and we were unable to expand in any direction; the building height was also limited by the proximity to the airport. The envelope was set by these constraints.

Bike Racks "If you plan for LEED certification at the beginning of a project, it saves you a lot of money going forward; that's the biggest lesson we learned during the planning stage for this project."

COMMUNICATION AND RESOURCES

The whole team had meetings every two to four weeks. These meetings included the engineer, the commissioning agent, and the contractor's representative, and the meeting intervals changed as the project progressed. Fifteen people got together at least once per month to

coordinate the lists of things to do. It took two years to build and submit the documentation for the project; team members worked on the LEED paperwork throughout the process. Sandra[17] did a great job of keeping everybody on track. On the owner's side, we made sure that we were doing what we needed to do via e-mail. The process has changed, but previously you would submit all of the LEED paperwork at the end of the construction, so you had to keep up with it. If the team hadn't stayed on top of those things, I don't think that we would have ever been able to catch-up, especially on a project that large. The EPA was really a great resource; they had been involved with a lot of the drafting of the credits and their representatives were in-tune with the LEED process, which was very helpful.

IMPACT OF LEED ON THE DESIGN PROCESS

LEED reigned over many other things on the project because we were facing a huge penalty. We couldn't even fathom what would happen if we didn't receive the certification; it was a very involved process and influenced the owner's discussions at a higher level. It permeated everything because it had to be a joint effort and everybody had to be on the same page from the subcontractors to the top person at Crescent; we all had to believe in it because it was a big part of the success of the project.

CONSTRUCTION | SELECTING A CONTRACTOR

Out of the three contractors we interviewed, Davis Construction[18] had the best LEED program. Davis Construction had studied LEED and most of the people who were going to be working on the project were a LEED AP or had worked on other projects that were going through LEED at that time. They outshined the other contractors and their numbers were good. Those were the ultimate qualifications we were looking for because the penalty from the GSA for not receiving a LEED certification was so great; we needed a team in place that would help us get though the process.

INVOLVEMENT DURING CONSTRUCTION

Crescent Resources had a full-time construction manager who flew up from Charlotte four days a week to manage construction; we had construction meetings every week and walked the building every day. We were very involved in the construction process. Our office is next to the building so we were there all the time, whether the contractor wanted us there or not.

MANAGING THE PROJECT

Davis Construction had a dedicated LEED AP on staff who was in the building all the time; she was the one walking the floors and monitoring the subcontractors to make sure they weren't smoking or eating food, and to make sure the HVAC equipment was sealed properly. She was also the one monitoring the paints, sealants, and caulking to make sure that all of the materials complied with the recycling credits and VOC[19] credits. She managed the subcontractors very carefully. We made sure that Davis Construction managed the materials and resources because they were responsible for obtaining those specific LEED credits. Davis Construction was on top of it, and Fulya[20] did a particularly great job. We were there to ensure compliance with the other credits.

Davis Construction had weekly meetings with the subcontractors and additional training sessions to help improve the learning curve associated with green buildings. In 2004, the LEED process was new to many of the subcontractors and they wouldn't always know what we were talking about. Davis Construction's commitment to educate the subcontractors helped all of us on this project.

The LEED process did not affect the overall schedule, but there were a couple of issues with material deliveries. I remember the carpet being a problem because the manufacturer was in Atlanta and that was more than 500 miles from D.C. In addition, limiting the offgassing of the carpet was a requirement of the lease. Even though the manufacturer had provided for offgassing during production, we had to rent warehouse space to allow the carpet to further offgas for two weeks. This was a setback we weren't counting on, and it nearly delayed the turnover. The LEED process had an effect on the cost of the project, but that was managed pretty closely. The project cost was definitely higher than it would have been otherwise.

17 Sandra Leibowitz Earley is the Principal and founder of Sustainable Design Consulting, LLC, a sustainable design consulting firm with offices in Richmond, Virginia and Washington, D.C.

18 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia.

19 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

20 Fulya Kocak is a Project Manager for James G. Davis Construction Co., a contracting firm with locations in Rockville, Maryland and McLean, Virginia.

OPERATIONS | CHALLENGES OF THE PROJECT

It's difficult to say if Crescent would have pursued a LEED certification had there not been a rent penalty imposed by the GSA lease. I wasn't the decision maker, but maybe if there had been more incentives, additional density allowances, or faster permitting Crescent would have still looked into it. Arlington County was moving in that direction at about the time we finished the project; there were express permits and other types of incentives in addition to those for increased density. One and Two Potomac Yard was our first LEED certified commercial building, but many of our current buildings are registered. At that time, LEED certification was just starting to become the standard process for buildings of this type.

MAKING IMPROVEMENTS FOR THE FUTURE

One lesson we learned relates to the sorting of the materials for the Construction Waste Management credit. We were 2% shy of satisfying credit MR 2.2, but it didn't seem as though we could have recycled anything more. The recycling was a huge process to manage, especially on a project of this size. We didn't have room to store the materials in one location, so we sorted them on the floors and took them down separately. This process required a lot of extra manpower. If the project were out in the middle of a cornfield, or if there was a little bit more space and not in an urban environment, it would have been easier, but you have to make do with what you have.

ONGOING INVOLVEMENT IN THE PROJECT

Crescent Resources sold One and Two Potomac Yard before the end of construction. We handed it over to the new owner and sold the rest of the project as well. We were pleased with the project overall. When Crescent sold the building, I moved to Charlotte, but people still call me about the project. I'm glad to have worked on it, but Crescent doesn't have any ongoing involvement with the project at this time.

Since Crescent sold the building in 2006, the new owner has achieved LEED-EB certification as well as an ENERGY STAR[21] rating.

THE VALUE OF LEED CERTIFICATION

When we sold the project, we did not see any additional value in the fact that the building was LEED certified. However, full payment was held back until we received the certification. Four years ago, LEED certification was new and not many projects had gone through the process so it wasn't reflected in the selling price of the project. I am not sure how that would change now.

CURRENT LEED STRATEGY

The company as a whole has registered all of our new buildings in the LEED Core & Shell (LEED-CS)[22] program. We have a few buildings under construction, one in Nashville, one in Orlando and a marquis project in Atlanta; they are all going through the LEED certification process now. Potomac Yard started this trend and we've followed it ever since. The process becomes cheaper the more you do it because of the lessons learned from other projects. LEED certification is definitely part of Crescent's long-term plan.

This narrative is based on a telephone interview conducted by Britni Jessup on September 15, 2009.

21 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping Americans save money and protect the environment through energy-efficient products and practices.

22 LEED for Core & Shell (LEED-CS) is a green building rating system for new core and shell construction. Core and shell covers base building elements such as structure, envelope, and the HVAC system and is designed to be complementary to the LEED for Commercial Interiors rating system.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

CATHY BERLOW

PROJECT MANAGER, U.S. ENVIRONMENTAL PROTECTION AGENCY

PROCESS | GETTING INVOLVED WITH THE PROJECT

I work in the facilities office of the EPA[1] where we handle both headquarters, nationwide leases, and owned facilities. At the time of the Potomac Yard project, we were in the process of consolidating many of our headquarter facilities. Most of them are still in the Federal Triangle,[2] in a three-building complex. That, however, did not include three offices in Northern Virginia. So, when we looked at our Crystal City[3] offices, we decided to put them together into a single lease. At that time, I was with another part of the EPA's facilities group: the Sustainable Facilities Practices Branch (SFPB), which is an in-house consultant to the group I'm with now, where I deal with the project management aspects of design and construction.

CATHY BERLOW, AIA, is a LEED AP and registered architect. For over 18 years she has worked for the U.S. Environmental Protection Agency located in Washington, D.C. as a project manager on their Headquarters and nationwide facilities projects promoting sustainable design practices.

ROLE IN THE PROJECT TEAM

When the Potomac Yard project began in 2003, I was asked to assemble additional language to include in the GSA's[4] Solicitation for Offers (SFO).[5] We started with the boilerplate[6] form from the GSA and added in the LEED[7] certification requirement. There was some specification of green strategies in that document, but, at that point, LEED was not mentioned at all. In prior work at our Federal Triangle buildings, we had done many things that would have qualified for LEED points, but LEED didn't exist at that time. We tried to include lessons we had learned from the Federal Triangle into the SFO, by using LEED as a framework. We also added a requirement for an ENERGY STAR[8] building label because, at the time, we were not guaranteed that the involved parties would go after the energy points. LEED energy points were typically more expensive, and because the requirements had been generated from an EPA program, we wanted to make sure that we "walked the talk." Additionally, we added Integrated Pest Management,[9] green cleaning, and increased the requirement for recycled content in materials and finishes; these were requirements beyond those that were already a part of the GSA's boilerplate.

1 The Environmental Protection Agency (EPA), headquartered in Washington D.C., is an agency of the federal government whose mission is to protect human, health, and the environment. The EPA operates 10 regional offices and a dozen laboratories.

2 The Federal Triangle is located between Pennsylvania Avenue, Constitution Avenue, and 15th Street, NW and is part of the Pennsylvania Avenue National Historic Site.

3 Crystal City is an urban sub-market in the southeastern corner of Arlington County, Virginia, south of downtown Washington, D.C.

4 The United States General Services Administration (GSA) is an independent management agency of the United States government that supports Federal agencies through the management of property, records, and construction.

5 A Solicitation for Offers (SFO) is a request for offers or proposals to enter into an agreement with another party on a particular project. An offer is essential to the formation of an enforceable contract.

6 A boilerplate is a standard form contract between two parties, which does not allow for negotiation. This type of contract is often entered into between two, unequal parties.

7 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

8 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping Americans save money and protect the environment through energy efficient products and practices.

9 An Integrated Pest Management Plan outlines the methods and actions needed to ensure pests and other insects do not compromise the lifespan of the building materials.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

In order to ensure that potential building owners met our requirements, we established penalties for falling short of our stated goals. The GSA allowed us to outline those penalties in a clause within the SFO, but they had the ultimate say in the content of the contract. The clause stated that 10 % of the lease costs would be deducted if the SFO requirements were not met. At that point, we didn't outline a specific timeframe to meet the requirements, but now we have benchmark timelines for when a project must be registered and when it must be certified. We also define the required and recommended credits to be achieved for certification. For Potomac Yard, the minimum certification level was Silver.

In addition to the requirements outlined by the GSA, LEED, and ENERGY STAR, the EPA includes requirements that reflect our own goals in all new leases. We have a program called GreenScapes[10] that deals with using fewer chemicals and no irrigation for the landscaping. We have a green team that participates in the review of the building operations and maintenance. They're constantly trying to increase recycling and reduce pollution through periodic meetings with the building manager. To help monitor the building's sustainable practices after occupancy, the SFO also includes requirements for ongoing reports for the consumption of energy and water, recycling, and green product purchasing.

COMMUNICATION AND RESOURCES

The EPA had been involved with LEED all along and it seemed like a good way to incorporate the elements we ask for into a brand that a lot of people could identify. We were already doing those things without that label of LEED, but it made it easier to address our sustainable priorities and strategies. During the Potomac Yard project, the developer's team embraced the process and many became LEED APs[11] while working on the project. This was one of the few projects where we had LEED APs in all of the different groups of the project team, including the contractor's and the developer's. That's becoming more of a normal situation, but at the time, it was very rare.

REFINING PROJECT GOALS

We refine our process and our requirements based on what we learn from each building. We put time and money into our buildings' sustainable designs. If they're not maintained, we'll lose the value of our investment. We felt that LEED-EB[12] could be used to maintain the standards and levels of energy and water efficiency that were required in the building at the initial certification. Potomac Yard is the first building that has required LEED-EB as part of the ongoing lease requirements.

DESIGN | COMMUNICATION WITH THE DESIGN TEAM

The city of Arlington, Virginia required that, when the building owner went before the city to get original permits, they consider using LEED standards where possible. However, they were not required to register for LEED. As far as I understand, they did not consider registering the project for LEED certification until they went to bid for our project.

Potomac Yard was a low-bid project, and we were not involved with the GSA's review of the actual bids. A low-bid project is where the bidder has to meet the requirements that are in the SFO and is selected based on lowest cost. In this case, the building was awarded to a speculative building that had not been constructed at the time of the award.

Once the building award was completed, we began discussions with the development team about LEED. Through these meetings, we worked with the project team to find solutions that met both of our requirements. We requested more usage of fly ash[13] in the concrete by bringing in technical experts from the EPA and the concrete industry. However, the post-tensioned floors require a certain amount of time for blast furnace slag concrete to harden. Had we required the blast furnace slag content in those areas, we could have slowed the overall construction time frame. However, we were able to find a compromise: they put the slag concrete into the foundations where there wasn't post-tensioning. In addition, we were able to remove the PVC from the installation of the white roof. Independently of the

10 The EPA's GreenScapes program provides cost-effective and environmentally friendly solutions for landscaping.

11 A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

12 LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

13 Fly ash, or blast furnace slag, is a byproduct of the combustion of coal. A residue, this byproduct is a pollutant. Recently, however, efforts have been made to reuse this material in a variety of industries. When used in concrete production, fly ash is used as a mineral admixture for the energy-intensive Portland cement concrete.

EPA, the developer installed dual flush toilets in the women's bathroom to earn extra points. That was very impressive.

From the initial permitting stage, when it was still considered a speculative building, to the time we completed the project, we gained an additional 16 LEED credits, earning Gold certification for both buildings One and Two. The SFO required that the project team achieve 33 points and a minimum of Silver certification.

IMPACT OF LEED ON THE DESIGN PROCESS

One of the biggest energy expenses is lighting; we had defined requirements for that portion of the design. We use the ENERGY STAR approach where we take the lighting out of the ceiling and use 30 foot-candle[14] ambient lighting instead of the 50 foot-candle ambient lighting, which is the GSA standard. We use task lighting to make up the difference. In order to use only thirty foot-candles, we usually use a secondary lighting system to artificially make the room seem brighter. We prefer to use pendant lighting for that; however, since Potomac Yard was already designed, they had already specified a standard lighting layout. We worked with the project team and ended up settling on lighting fixtures that were splayed to give a broader light source. We were then able to use desk task lighting and daylight to make up the difference between the 30 and the 50 foot-candles. I don't think that the design team would have made those decisions without our involvement.

Dual Flush Toilets "Independently of the EPA, the developer installed dual flush toilets in the women's bathroom to earn extra points. That was very impressive."

INVOLVEMENT IN THE DESIGN PHASE

During the LEED certification process, we oversaw what Sandra[15] and the owner were doing. We provided

14 A foot-candle (fc) is a unit of illuminance or light intensity. The SI unit for illuminance is the lux: 1fc=10.764 lux.

15 Sandra Leibowitz Earley is the Principal and founder of Sustainable Design Consulting, LLC, a sustainable design consulting firm with offices in Richmond, Virginia and Washington, D.C.

Entrance "We consulted experts within the EPA on each issue and had them explain why we wanted to accomplish these goals."

support with some of the sustainable building elements during the tenant fit-out. We were also involved in providing the credit documentation for the Integrated Pest Management and green cleaning materials. We consulted experts within the EPA on each issue and had them explain why we wanted to accomplish these goals. They were all very interested in making sure that the choices made for the building represented their interests. These experts generally focus on implementing strategies through written policy, and gained insight into our difficulties in applying policy to this project. It was very difficult to implement these changes in some cases, but it was a worthwhile process for everybody.

LESSONS LEARNED FROM POTOMAC

For the most part, everything in the base building had been designed before we got involved. If we had started earlier in the design process, we would have considered a more energy efficient centralized mechanical system. The current system is typical of a speculative office building with mechanical rooms on every floor.

Since Potomac Yard, we've added additional requirements into our SFOs. We've included a list of required points, instead of only listing preferred points and points of interest. We're hoping to focus project teams on incorporating points with our significant sustainable goals in mind and not just based on cost, like points such as energy and commissioning. We haven't really worked with LEED 2009 versions yet, which may change our approach.

We used LEED-EB as a follow-up requirement to NC certification to ensure protection for our investment. It's about the maintenance. If you don't maintain it, why build it? The biggest benefit you can have is running the building as designed.

CONSTRUCTION | INVOLVEMENT DURING THE CONSTRUCTION PROCESS

During the construction process, I went to all the construction meetings and other team meetings as needed. We

had separate LEED discussions on a regular basis, just to monitor the points, and we did periodic walkthroughs of the building.

CHALLENGES DURING CONSTRUCTION

One of our biggest focuses on the punch list was to make sure that the systems were being protected to maintain indoor air quality after construction. At the end of a project, the sequencing gets crunched; that's when things can fall apart. During the construction meetings, I try to make sure that LEED requirements remain a high priority. It is important to have somebody at the meetings to remind the project team of what's included in the requirements, both in terms of LEED and the SFO. There really is no magic to it; it's just about being persistent.

OPERATIONS | SHARING INFORMATION AND RESOURCES

The employees of the EPA are educated about sustainable practices; they expect their facilities to implement what we're educating others about. For their use, we provide an occupant handbook, as well as brochures to help explain the sustainable features of Potomac Yard. When employees and visitors walk through the building, I don't think it's obvious which parts of the project are really sustainable. Signage on features helps, but I don't think people can really see all the aspects of the integrated design.

BUILDING OPERATIONS

Skilled operations staff is necessary when using more technical systems to control the lighting and mechanical systems. If the operation of the building management system and equipment is not well maintained, it will compromise the original building design performance for energy and water consumption.

It is not always apparent that the selection of furniture, the lights at a desk, and the placement of the furniture affect the performance of a building. Once they start shifting things around, such as changing colors, putting up walls, or not using glass, it can ruin water and energy efficiency. The designed buildings, as given to the occupants, are well-oiled machines; that's probably where the education needs to be increased the most. You can't pull one feature out of the project and not affect a long chain of events.

OCCUPANT FEEDBACK

I don't have much information about the occupant feedback because I am not in the Operations Branch. I have heard that there were some issues with the mechanical system's heating and cooling, such as complaints about it being uneven. Those problems have all been taken care of now. Other than that, I haven't heard of any complaints; we've gotten lots of awards, so that tells me we're doing a good thing.

ONGOING COMMUNICATION WITH THE PROJECT TEAM

Sandra is probably the only person from the project that I've worked with on other projects. I had not worked with her before Potomac Yard, but I was very impressed with how easy she made it for both sides, the Government and the building owner.

MAKING IMPROVEMENTS FOR THE FUTURE

Our goal is to have a boilerplate SFO that we can use all the time but, so far, we have been reinventing that document. LEED continues to change and all of our requirements concerning sustainability keep changing. Every new lease is changed and tweaked; we look at all of the factors and tailor the contents for each project. For example, someone might not be able to get regional materials as easily in a particular place.

FUTURE OPERATIONS

Our dream project would be a project where the owner takes the lead on implementing all of the sustainable features. There are some market trends toward sustainable design; a lot more people are aware of LEED, and we're working with people who understand what they're getting into with a LEED project. I'm not sure that they would have built sustainably if the EPA didn't occupy the building.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on September 29, 2009, at the offices of the U.S. Environmental Protection Agency in Washington, D.C.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

FULYA KOCAK

PROJECT MANAGER, JAMES G. DAVIS CONSTRUCTION CO.

PROCESS | GETTING INVOLVED WITH THE PROJECT

I had always wanted to work on a LEED[1] project. I was the second LEED AP[2] with my company, James G. Davis Construction Corporation (DAVIS). I wanted to learn more about LEED certification, but at the time of Potomac Yard, there were not many projects with a LEED certification requirement. When this opportunity came along, I was the first person that DAVIS[3] thought to include on the project. There was a contractual requirement for the building to achieve LEED Silver certification, so it was a big deal for our client. It was a great project, and we learned a lot.

Potomac Yard was our first project with Crescent Resources.[4] DAVIS was, and still is, a leader in the industry when it comes to green buildings, not just LEED certification. We started building green buildings a long time ago, and we had a sustainability director on-board. This history shows that we care about the environment and that we know how to build sensitively to the environment. That was our biggest advantage in the bidding process; the client knew we would make it happen.

FULYA KOCAK, LEED AP, serves as a project manager for James G. Davis Construction Corporation. She has a diverse educational background and over nine years experience in the building industry. Fulya holds a Master of Architecture and Master of Architectural Engineering with a Construction Management option from Pennsylvania State University. Fulya's graduate studies focused on "whole building design" and integration of disciplines and building systems to achieve high performance buildings.

ROLE IN THE PROJECT TEAM

I wasn't involved in the LEED portion of the project before construction began. At that point, the design team ran the LEED process. Once the construction phase began, I played a large role in the LEED certification process.

We were primarily responsible for following through on the LEED construction points. We worked with the design team to achieve any available construction points. For example, you can achieve two points for using local resources. The design team would go for one and our goal was to make it two, if possible. The same went for recycled content or waste management. The biggest thing that we did was to give the design team additional credits, beyond what they had hoped for, and that helped us raise the certification level from Silver to Gold.

CONSTRUCTION | GUIDING THE SUBCONTRACTORS

At the time, the subcontractors we partnered with had no experience with LEED; it was a first for everybody. When we started construction in 2004, we had to explain the LEED certification process to many of the individuals involved in construction. Many subcontractors perceived LEED as a big

1 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

2 A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a LEED AP. The LEED certification process requires that a LEED AP submit the required paperwork.

3 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia.

4 Crescent Resources, LLC, is an owner and developer of commercial office buildings headquartered in Charlotte, North Carolina.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

risk because they had never done it before. Some subcontractors excluded LEED from their bid or raised their fee 10%. We had some people who didn't even bid because it was a LEED project. The big players, the ones that have experience with construction, didn't see it as a risk, but rather as an opportunity to learn.

In order to have a more successful project, we worked closely with the subcontractors so that they would understand the LEED process. Each subcontractor affects the LEED process differently; there are big players and there are smaller players. We focused our attention on the important trades that would impact the indoor air quality, recycled content, and points for local materials. We knew that HVAC, electrical, drywall, and potentially concrete were significant players, so we made sure that we had people in those positions who would take this very seriously. We included LEED as a requirement for the scope of work in every subcontract, so everyone followed the LEED protocol. That was very important because I had some incidences where subcontractors came to me for additional pay for their work or when there were some things that they didn't want to deal with. Having the LEED requirement in the contract helped them to realize that they were required to comply with our standards. Most of the subcontractors were excited to learn more about LEED, and that helped us out. Once the others realized that we were serious about LEED, they cooperated.

We outlined the scope of responsibility for each subcontractor, line by line. That enabled subcontractors to know their responsibilities without having to understand the entire LEED scorecard. The scorecard is very intimidating to somebody who has never used it before, and we would rather specify every single line item to make it easier for the team. Any subcontractor would have done well with those outlines.

SHARING INFORMATION

I communicated information to the subcontractors mostly through phone calls; I made several phone calls. For all the big subcontractors such as drywall, electrical, concrete and HVAC, we had a series of meetings as soon as the contracts were awarded. We would explain what they were supposed to do and what they were responsible for. The meetings were not just for the Estimator or Vice President; they were for the Project Manager, the Superintendents, and the Foreman. These were the people who were going to build the job, and they needed to understand what LEED meant. We had preconstruction meetings that included the environmental scope for the project.

We tried to catch any problems right away. We had regular subcontractor meetings where we would give updates on whether or not people were following the proper protocol. By talking about issues every week, the subcontractors knew that they had to care. I would follow up with phone calls after each meeting. Getting the documentation was not easy because, often, the subcontractors didn't understand the forms that we would give them or the terms present in the forms. We would have to explain these items. For example, subcontractors didn't always know what "post-industrial recycled content" meant; we had to explain these terms one-by-one to every single subcontractor doing the documentation. That was my job, calling subcontractors and patiently explaining these issues over and over again. It took a lot of time and patience on everybody's part. Since the Potomac Yard project, some of them have called me to thank me for teaching them because it has made their next job easier.

The LEED process requires a lot of paperwork, and documenting those sustainable efforts takes time. We spent extensive amounts of time training the subcontractors to get the forms back to us. Despite the additional time required, and due to the team's efforts, the documentation process didn't have an impact on the project schedule.

MAINTAINING THE CONSTRUCTION SCHEDULE

The indoor air quality requirements did impact the project schedule. For example, after painting the walls, we had to wait 48 hours before installing anything absorptive so that the materials wouldn't absorb the gases. These materials included carpet and ceiling tile. We had to incorporate these activities into our schedule. We had to work the indoor air quality testing schedule around the paint procedure. Additionally, there was the commissioning process. Advanced commissioning takes significant amounts of time, and that was a very detailed part of our schedule. We had to make sure that every single piece of equipment was working correctly before construction was completed; not every job has that requirement.

MANAGING THE PROJECT

I did a lot of fieldwork on the project. Some of the installers would ask me to look at their paint to make sure that it was the right product. That was necessary because a few times we found, for example, a sealant that somebody brought in a backpack. For every LEED requirement,

I would check every single piece of material being installed and make sure that it was the right one. A few times I caught installers using the wrong materials. When this happened, I would stop work and call their project manager right away, which meant that they couldn't do the work that day. That had a big, positive impact on the entire project. Consequently, when I checked back with the same workers, they were using the correct materials and the workers next to them were using the right materials. The subcontractors knew that we were checking their work, and once they knew that, they did it correctly. We photographed the materials coming onto the site, such as the certified wood.[5] One time, I was driving in at six o'clock in the morning and I heard people yelling that I had to rush and see something. They told me that trucks were delivering certified wood, and they wanted me to take pictures of it before it was piled and covered. I ran out there and took the pictures. We were on top of everything, and the subcontractors knew that.

COLLABORATION DURING CONSTRUCTION

We were building an environmental project for the EPA,[6] which was a big deal, and we wanted to make sure that we were on top of everything. It took some time for the EPA to realize how dedicated DAVIS was. We had several LEED meetings and we spent time explaining our operational approach. Our indoor air quality plan went through three revisions. The revisions were minor, but the EPA had to make sure that we were doing it correctly. The basic plan that we currently use on LEED certified projects is the indoor air quality plan that was approved by the EPA. That was great for us, but it was very detailed work on the part of the EPA. They came to the jobsite to look at all our submittals, LEED submittals and environmental submittals, to make sure we were doing everything right. Once they saw that everything was organized and being done correctly, then they were comfortable and trusted DAVIS to complete their project. It worked out very well and we learned from them. Now our indoor air quality plan is not just LEED compliant, but also EPA approved. We had stricter requirements from the EPA than from any other LEED job. If you look at the VOC[7] list, you'll see that it's very different from the LEED required material list. There were no heavy metals or urea formaldehyde in any materials, not just wood products. We watched everything very carefully and followed the EPA's requirements that had been outlined in the specs.[8]

The developer's role during the construction was to make sure everything was done right, because they were facing a large lease penalty for not achieving LEED Silver. We had regular LEED meetings with more than 25 people: some EPA folks, the GSA, the developer, the LEED consultant, the commissioning consultant, and the DAVIS team. It was a very good team of people and having the regular meetings helped significantly. Our scorecard kept changing from the start of the project; sometimes we would have charrettes[9] and when we put our heads together, we came up with better ideas. Crescent's role was to make sure that everybody was doing their best. It helped that the team took it very seriously, and there were no big challenges as far as I'm concerned. We just solved the problems as they came at us. They kept coming, but we had the solutions, and we had the right people.

CHALLENGES DURING CONSTRUCTION

The most challenging aspect of the project was the roof. Choosing the right roof product took three months. The EPA required that we not use PVC,[10] which meant that we didn't have any TPO[11] roof options. It had to be a white roof, and a ballasted roof wasn't a part of the LEED version 2.1 requirements then; therefore, we were looking for a white roof that was not ballasted and was not a green roof. White EPDM[12] was the only option left and this material is not very common. We went through all the options to make sure it would work, because we had lightweight concrete insulation under it. We did not realize that it does not stand up well in cold weather. Unfortunately, the weather became cold and rainy, which made the insulation wet; therefore, we were not able to secure the roof product to the insulation. We had to cover much

5 Certified wood products are those that are certified by organizations, such as the Forest Stewardship Council (FSC), to have been harvested from sustainably managed forests.

6 The U.S. Environmental Protection Agency (EPA), headquartered in Washington D.C., is an agency of the federal government whose mission is to protect human health and the environment. The EPA operates 10 regional offices and a dozen laboratories.

7 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

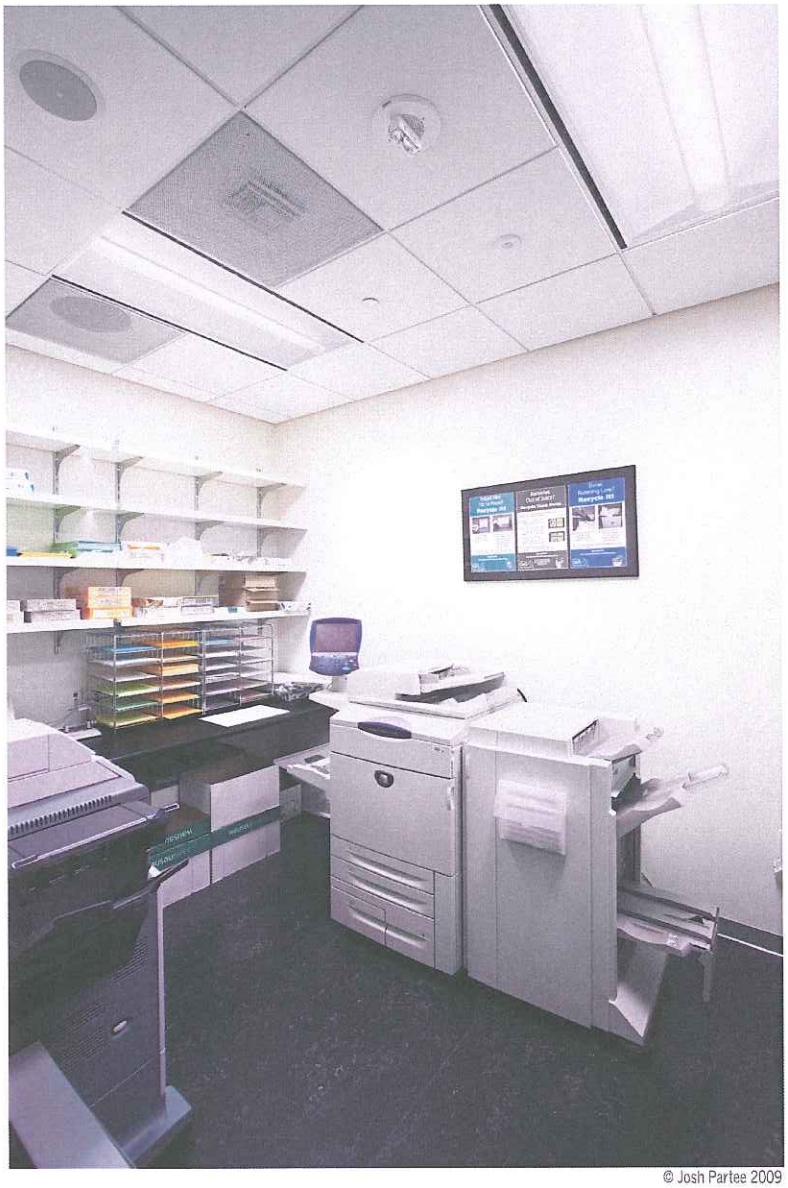
8 Spec is an abbreviation for specification, which is a set of requirements for materials, products, or services that must be satisfied as part of the contracts for building construction projects.

9 A charrette is a collaborative work session where groups or sub-groups quickly generate solutions to a design problem.

10 PVC is an acronym for Polyvinyl Chloride, a thermoplastic polymer widely used in the chemical industry.

11 TPO is an acronym for Thermoplastic Olefin and is often used in roofing materials because of its residence to degradation by ultra violet radiation.

12 EPDM is the acronym for Ethylene Propylene Diene Monomer, a type of synthetic rubber that is used in waterproofing and roofing materials.



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Copy Center "When printers were placed on top of them, the countertops started to sag... There is some risk in trying new products, but as the market shifts and competition increases, products have to be improved for people to want to use them."

of the roof and delay the installation until the weather improved. This had an impact on our schedule. The details didn't work correctly, but we ended up installing a white roof with no PVC. I don't think this effort was worth it because of all the money, effort, and schedule impacts that occurred. For some projects a white roof makes sense, but this building is right next to an airport and a railroad. I doubt that the roof is white now. Sometimes we do things just for the sake of the point even though they don't make sense. We have learned that in the future, we need to evaluate each component for each specific project to make sure that it makes sense in the long run.

Another challenge on this project was the curved roof. We had a curved roof that had been specified and ordered when we found out that it wasn't tested according to the LEED standards. All of a sudden, we had a curved roof that was about to be delivered, but which was not LEED compliant. We found a paint that matched the requirements, and we painted the white roofing material white. We already had a white roofing material that should have worked, but we had to paint it, which required money and effort. That example again shows that some things don't make sense for a particular project — even though they might be a good idea, theoretically. There is one example that I always give about Potomac Yard. We had this nice, inexpensive countertop material that looked cool. The countertop material was picked for the copy centers at the EPA. When printers were placed on top of them, the countertops started to sag. We chose a material that was fairly new and had never been used in other projects. The longer the LEED program is in business, the more we learn from it and the fewer mistakes we repeat. That initial testing and learning curve is really large. There is some risk in trying new products, but as the market shifts and competition increases, products have to be improved for people to want to use them. A material has to be made well or it is taken off the shelf. As we do more and more LEED projects, we learn which materials work.

OPPORTUNITIES DURING CONSTRUCTION

Waste management was one thing that we realized was an opportunity during the construction phase. Huge buildings produce a lot of construction waste and we had piles and piles of separated waste on every single floor. That is a significant safety hazard. We had to have laborers come in on the weekends to remove the debris, because the hoists were being used during the weekdays for material hoisting. Now, on a large project like Potomac Yard, we will co-mingle the waste and have the dumpster companies separate it at the landfill. We spent a lot of labor to make that happen on Potomac, and it did affect the project schedule. We learned from that experience and we improved.

RESOURCES DURING CONSTRUCTION

My primary resources were within DAVIS. Our company had done sustainable buildings before LEED certification was put in place by the USGBC, so there were other project managers that had done these types of jobs. I would call them, and a few times I went to their offices and looked at their books to see what they did for documentation. Being able to see samples helped me a great deal. It was a matter of asking to see how they had done things and what went wrong on their projects. Knowing what didn't work on their jobs was a big help. Our sustainability director was very experienced as well, so it was not hard to find resources.

LESSONS LEARNED

Since Potomac Yard, some things have changed. I was the second LEED AP at the company. Now, over 30% of our employees are LEED Accredited Professionals. We have 12 Gold certified or registered jobs, a bunch of Silver and regular Certified buildings, as well as four Platinum projects. Two of them are being done for the U.S. Green Building Council's headquarters and another is the first redeveloped office building on the East Coast. When you have so many people doing certification on projects, they come up with great ideas. In a week or two, we are reissuing all of our documentation forms because we took the improvements from every project's forms, picked various, successful features, and assembled new forms that are very easy to use, detailed, and have all the requirements in them. We have used those forms on 20 projects. When someone comes on-board who has never done a LEED certified project before, all they need to do is use the forms that have already been developed. This serves as a resource for the company, and a way to distribute information and report to our clients.

We also have a field checklist that combines all the requirements for Superintendents. If they have never done a LEED project before, they know the exact duties they have to fulfill. We tell them not to worry about reading the whole book if they are not a LEED AP, but to take the checklist and make sure that everything is right. It's very easy now, but it wasn't like that before because we had to teach them.

Everything that we did on Potomac became the starting point for our future projects. And, it's working. The only regret we had was related to the available dumpster companies at the time. We spent a lot of premium cost on the waste management for Potomac Yard. It's almost free now and we currently have more options. Now, the waste companies come to us to tell us what they can do, how they can help us fight costs, and what documentation they have available. That makes a big difference.

OPERATIONS | THE COMMISSIONING PROCESS

For an advanced commissioning job, several people have to witness the testing and we have a commissioning agent who is running the show. Typically, the subcontractor does the commissioning and they own the job, but in advanced commissioning, a third party is overseeing the subcontractor and telling them how to do the testing. It's more thorough when there is an objective set of eyes watching. Paul Tseng[13] led the project commissioning[14] and prepared the plan. DAVIS along with the mechanical and electrical contractors, were the big players. It was a back-and-forth process between the subcontractors and Paul to make sure that everything fit this project. It was a collaborative effort.

We started meeting a few months before the commissioning testing started. The process took at least three or four months, not including the prep work ahead of time. It took a long time because it was advanced commissioning[15] and we had two buildings, each with a number of systems to commission. The prep work for the commissioning began in

13 Paul Tseng is a Principal with Advanced Building Performance, Inc., a high-performance building consulting practice located in Washington, D.C.

14 Commissioning is the process of ensuring that a building is performing and operating according to the design and construction intentions.

15 Advanced Commissioning, also called Additional Commissioning, is a LEED certification point available for commissioning work completed by a third party commissioning authority in addition to the Fundamental Building Systems Commissioning prerequisite.

the middle of the job, during the summer. We started getting the drafts from Paul for the commissioning plan because we had to have a plan before the commissioning could start. We went through three or four versions of the plan and then we began the start-up forms for functional performance testing. Paul saw every single submittal that was related to the commissioning, including the building envelope. Not every job does it like this, but the building envelope was included in the commissioning for Potomac.

When permanent power was available to the building, we were able to run the equipment and begin the commissioning process. The biggest chunk of commissioning, the physical testing, happened closer to the end of the job. We had so much to test and very little time. It worked out well because Paul's team was on the job almost every day. If we called them to say that a piece of equipment was ready to be tested, he would run over to the site. This was helpful because we didn't have to schedule his visits a week in advance. He was there most of the time and I, or someone else, was available to help. We had three or four people testing the equipment. We tested the VAV boxes, the cooling towers, and everything else. It was time consuming, but it went smoothly.

MONITORING BUILDING PERFORMANCE

Eleven months after the project was done, we had to make sure that all the equipment was working before any warranties expired. We contacted the building manager to make sure that everything was functioning and to verify that they hadn't had any problems. We haven't received one call from the building management since the project closed; that shows me that the commissioning process was a success and that everything's running fine.

MAKING IMPROVEMENTS FOR THE FUTURE

As I mentioned previously, we did some things just for the sake of the LEED points. The new version of LEED addresses some of these issues, because not all of the points are equal now. For example, we ended up installing alternate fuel stations and chargers in the garage. They were expensive and I doubt they have been used much. When we were finishing the job, I called the manufacturer of these charging stations to see which vehicles could use them. We found out that there was one Ford truck that could use them, but that it was no longer being made. There are some things like that, or the roofs, that just weren't worth the trouble or the expense. Why not spend the money to make the building better in some other way with more efficient equipment or light fixtures? This happens sometimes with the LEED process because we end up being very ambitious and we want to get the points so badly that we spend money, time, and effort on something that just won't work for the project. Not every building's the same. That's one of the lessons learned for me. I will be more vocal about things that don't make sense.

SHIFTING SKILLS

I feel that the contractor's knowledge and skill sets have shifted in the past few years. Potomac Yard was one LEED job out of a few at the time. Now, more than half of our projects require LEED certification or, at least, ask for an alternate price to see how much it will cost. LEED certification is not as expensive now because it's becoming more commonplace, people are more interested in it, and it's marketable. Contractors, including the smaller subs, try to learn more about LEED and they have LEED Accredited Professionals on-board. It hasn't been long since I finished the Potomac project, but five years has brought dramatic change in the thought processes and operational procedures of LEED design and construction.

MAINTAINING OPERATIONS WITH LEED-EB

I wasn't involved when Potomac Yard pursued the LEED-EB[16] certification. Maureen[17] and the building management cared so much about the environment that they decided to pursue the additional certification; they learned the building inside and out. After you get the LEED certification, the building does not get inspected to ensure that everything stays as it was when certified. But, Maureen and all the building engineers made sure that everything was what it should be and they spent a lot of effort trying to make the building run correctly and environmentally. LEED-EB was a way for them to show more interest in the building and to make sure that it was operating as it was intended.

16 LEED for Existing Buildings: Operations and Maintenance (LEED-EBOM) is part of the 2009 suite of LEED certification ratings and is a newer version of LEED-EB.

17 Maureen Dowling is the Property Manager for One and Two Potomac Yard and represents Jones Lang LaSalle, the property management company involved in the operations and maintenance.

THE COST OF LEED

The additional construction costs for LEED certification on Potomac Yard was around 1-1.5 % for LEED Gold. On small jobs the percentage is higher because the client is paying more for all the premiums, for the commissioning agents, and for the general contractor to do the same paperwork that would be done for a large job such as Potomac Yard. Recently we have seen our material costs go down. Certified wood is still a premium material, but many jobs are using it now and as a result there's more competition out there. Subcontractors know more about materials, so they won't charge us an extra cost for using materials required by LEED. Our forms also take me less time to prepare. I'm not teaching as much, so less money is charged to my general conditions.[18] Nevertheless, we're still paying for the big-ticket items like the HVAC system, and we're still paying the additional money for commissioning. With this in mind, if we're paying for equipment, it's for our own good. We're going to make that money up. There's still a premium for that equipment, which won't change, but it's the right way of building buildings. If a client is going to keep and maintain a building, then they want it to be efficient.

Car Charger "We end up being very ambitious and we want to get the points so badly that we spend money, time, and effort on something that just won't work for the project. Not every building's the same."

THE IMPACT OF LEED ON FUTURE OPERATIONS

One of the biggest changes for us as a company is that over 30% of our employees are LEED Accredited Professionals. We have more people who have worked on LEED certified or registered projects. That number continues to grow. Everybody knows what LEED is. If somebody told me these facts five years ago, I would have thought that they were kidding me. Now we're trying to make buildings even better than LEED, because LEED is not the only way of being green. Company-wide, our goal is to see if we can make our typical jobs greener and more

18 General Conditions are incorporated into owner-contractor agreements for large construction projects. They outline the rights and responsibilities of the owner and the contractor and are prepared by the architect.

environmentally sustainable, even if LEED certification is not required. We're looking into ways of making any typical job, small or big, more environmentally friendly. As a company, we have a LEED and Sustainable Construction Committee that was established several years ago. I am proud to say that I run that committee. We have set up training classes with Project Managers and Assistant Project Managers, and we have trained more than 100 people within the company. We've also started to implement green toolbox talks where we teach everyone: our foremen, laborers, carpenters, and all the people who are on the job site. We now train the people who work for us, which has made a big difference.

We are also starting to run LEED orientation in the same way that we have a safety orientation for every job. LEED and sustainable construction orientation will be a requirement as well. Whoever works on the job has to go through this training. They get a number that goes on their hardhat. If we are on-site and we don't see a number on a hardhat, we know that person cannot be there. We are no longer training the Project Manager or the Estimator over the phone. Now, we are training the project team and the construction workers as a whole. I think this will make a difference, if not this year, then maybe next year. Those people will continue onto future jobs and we won't need to teach them anymore. They will perform green and sustainable processes without thinking about it. It takes an effort at the start but in the long run, it will be a huge benefit for our company and the environment as a whole.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on September 28, 2009, at the offices of James G. Davis Construction Co. in Rockville, MD.

BRENDAN CULLEN

MECHANICAL ENGINEER, GIRARD ENGINEERING

PROCESS | GETTING INVOLVED WITH THE PROJECT

I wasn't involved with the early stages of the project, before the GSA[1] came on board. The group that first developed the concept for the core and shell probably wasn't focused on being environmentally friendly; that wasn't one of the main project goals at the time. The initial development strategy was to design a competitive building that provided space and amenities comparable to other buildings on the market. When LEED[2] was introduced into the equation, it set a higher bar for the HVAC and electrical designs, in particular. The team players changed: various consultants were introduced to the team to help us understand what it meant to create a LEED certified building. The whole concept was fairly innovative at the time, and definitely new to this area; I don't think there were many local LEED projects. We all needed to understand the LEED criteria; it changed Girard Engineering's[3] thought process about how we approached the design.

Stephen Millnick[4] was the project manager for Girard. The two of us took a great interest in understanding the LEED criteria; it was just as new to us as it was to others on the project.

BRENDAN CULLEN, PE, LEED AP, is an active representative in the U.S. Green Building Council and the American Society of Heating, Refrigerating and Air-Conditioning Engineers. His experience includes project management and lead mechanical engineering for new commercial buildings and tenant fit-out projects, as well as comprehensive renovations.

DESIGN | CHOOSING LEED CERTIFICATION

The design for the core and shell of the building was essentially completed before the government tenants entered the equation. Girard Engineering already had design concepts in place, which limited how far we could go once the EPA[5] and the GSA began negotiations with the owner. When the government tenants came on-board, we were tasked with implementing the LEED design criteria over the pre-existing groundwork. That was a challenge, but we took the concepts we had and tweaked them to meet the new project goals. We were involved from the early phase which had nothing to do with LEED, through the initial LEED certification, and, finally, during the LEED-EB[6] certification.

I became familiar with LEED during my undergraduate education, but it was still new. People were aware of it, but not everyone was convinced that LEED would catch on. It was a new movement, and many professionals seemed indecisive about how seriously to take it. There has been a paradigm

1 The United States General Services Administration (GSA) is an independent management agency of the U.S. Government that supports Federal agencies through the management of property, records, and construction.

2 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

3 Girard Engineering is a mechanical and electrical engineering firm headquartered in the Washington, D.C. metropolitan area.

4 Stephen Millnick is a project manager and mechanical engineer with Girard Engineering. He has almost 25 years of experience.

5 The U.S. Environmental Protection Agency (EPA), headquartered in Washington D.C., is an agency of the federal government whose mission is to protect human health and the environment. The EPA operates 10 regional offices and a dozen laboratories.

6 LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

Mechanical Room "On this project, we were given architectural and structural limitations that needed to be worked around. So, one of the challenges was delivering an efficient design within our limited options."

shift recently, and now both education and industry are highly focused on energy efficient design, LEED, and ENERGY STAR.[7] I had a personal objective to understand the LEED project goals, and I became involved with the USGBC.[8] Since then, I've subsequently been involved with a number of LEED projects.

The redesign took a collaborative effort between our sustainable design experts, the GSA, the EPA, the commissioning team, the architects, as well as other consultants. It took a team effort to come together and find solutions in-line with the LEED criteria. As is common with LEED jobs, this project definitely required a collaborative effort.

During Schematic Design[9] and Design Development,[10] Girard Engineering met weekly or bi-weekly to discuss and review the details. We made sure that the core systems were in place and that they were compliant with both the owner's objectives and LEED goals. We participated in some very long meetings and strenuous discussions about the LEED scorecard; we also had to be cognizant of the GSA Solicitation for Offers (SFO),[11] which was basically the building lease. Girard Engineering had to meet the GSA goals, while still keeping the core design in place;

7 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping Americans save money and protect the environment through energy efficient products and practices.

8 The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

9 The Schematic Design phase is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

10 Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

11 A Solicitation for Offers (SFO) is a request for offers or proposals to enter into an agreement with another party on a particular project. An offer is essential to the formation of an enforceable contract. An offer and acceptance of the offer creates the contract.

we did not have the luxury of going back to rethink the concept. For instance, a chilled water HVAC system would have been the most efficient approach from a mechanical perspective, but given the timetable in which the building needed to be delivered, we did not have the luxury of starting with a clean slate and redesigning that system.

As mechanical, electrical, and plumbing (MEP) consultants, Girard Engineering needs to make everything fit within the architect's parameters. That is one of the biggest challenges that we face. On this project, we were given architectural and structural limitations that needed to be worked around. So, one of the challenges was delivering an efficient design within our limited options.

Because of LEED, Girard Engineering incorporated many upgrades into the design that we otherwise would not have, given the previous owner's objectives. For instance, we added CO_2 control to the building. We had both zone and system-level sequences of operation for fluctuating outdoor air quantities in the most efficient manner possible. That was not originally slated for the project; it was a necessary upgrade intended to meet LEED criteria. I'm not sure if there were other things that could have been done differently, besides a complete change of the HVAC system.

I'm not entirely sure that LEED-EB certification was on the horizon at the time of the original EPA tenant fit-out. Somebody may have been planning to pursue it, but we didn't know about that decision during the design. If a building is designed to achieve the LEED-NC or LEED-CI[12] criteria, then LEED-EB is usually within reach. It can sometimes be a matter of digging up the old documentation and implementing a few new strategies. For LEED-EB, Girard developed a specification and a replacement plan for the lighting in the building. We did calculations to confirm that the mercury content in all the lamps was within the appropriate limits. We developed a plan for future purchasing to make sure that the client was maintaining that goal.

DESIGN STRATEGIES AND TECHNOLOGIES

As an MEP consulting firm, Girard Engineering is most heavily involved with the design phases of creating a building. Once construction is near completion, we don't suddenly divorce ourselves from the project, but typically, when it's delivered to the customer, our role becomes minimal. At that time the building begins a new phase in its life-cycle, which is when LEED-EB comes into play. LEED-EB covers one of the more important aspects of a building's lifecycle. It ensures that the building is operated and maintained to the design intent, which is very important.

Since the design was near completion when the government came on-board, we were limited in how much we could deviate from our original design concepts and strategies. In terms of collaborating with all of the project players, we wouldn't have done much differently. Challenges can arise when you work with an entity like the government because of the hierarchy and because of all the necessary approvals for design decisions. There were numerous meetings where different ideas and concepts were bounced off a variety of people. There was a very large group of consultants brought onto the project to weigh in on the various design approaches and provide expert opinions.

A number of energy efficient strategies were already put into place at Potomac Yard. We are professional and licensed engineers at Girard Engineering. With that professional title comes the responsibility for delivering safe, functional, and efficient buildings. Our adherence to these ethics was no different on the Potomac Yard project. Though for Potomac Yard, there was that extra emphasis on the efficiency. Girard Engineering certainly made an effort to incorporate MEP design strategies that were as efficient as possible, yet within the realm of practicality for this particular building. One example of that extra emphasis is the CO_2 control for the outdoor air that enters the building. That strategy, which took a collaborative effort between Girard Engineering and the commissioning team, certainly provides energy savings to the building.

ASHRAE[13] is the group that keeps its finger on the pulse of innovative technologies. Many Girard Engineering employees, including myself, are actively involved in ASHRAE. We make a concerted effort to keep up to speed with the latest ASHRAE guidelines and publications. The ASHRAE organization is comprised of a large group of highly intelligent, innovative experts who strive to keep the industry focused on strategies and systems that are on the leading edge of energy efficiency. There has been a paradigm shift globally to come up with efficient solutions, and ASHRAE is the engineering industries largest source of information and expertise. ASHRAE does a great job of providing opportunities for continuing education and updating their resources. They have large groups of industry experts who update standards and guidelines

12 LEED for Commercial Interiors (LEED-CI) is a benchmark for the tenant improvement market that gives the power to make sustainable choices to tenants and designers.

13 ASHRAE stands for The American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Office Hallway "The EPA was a unique customer; they have a sincere interest in documenting real-time information and understanding how buildings consume energy."

constantly. The U.S. Government has implemented requirements for efficient buildings; the Energy Policy Act of 2005 requires that we deliver buildings that are 30% more efficient than ASHRAE Standard 90.1. So, we keep our eyes on certain government publications. The USGBC is another resource with links to interesting reports and white papers posted and updated on its website.

WORKING WITH THE PROJECT TEAM

When Girard Engineering worked on Potomac Yard, we used LEED version 2.1. With that rating system energy modeling was optional, but a consultant was hired to perform a full building energy model. That information was used to predict energy consumption and to confirm that the systems we designed were efficient when compared with conventional buildings.

Girard Engineering sat down with the energy modeling consultant and had numerous phone calls to ensure that our system was clearly conveyed. An energy modeler is tasked with having an intimate understanding of how the building systems work, so that the model reflects actual operating conditions. That can sometimes be a challenge; we have to work closely with the energy modeling consultant to make sure that we are all on the same page.

Energy modeling and sustainable design consultants often come to us with innovative ideas and concepts. They look to our industry expertise to fully comprehend how those ideas will function and whether or not they work with the proposed systems. We are always open to new ideas and concepts so that we can make our designs as efficient as possible. That certainly occurred with the Potomac Yard project; there were many suggestions from the commissioning consultant, the energy modeling consultant, and the sustainable design consultant.

CONSTRUCTION | CONSTRUCTION CHALLENGES

I don't recall any specific challenges during construction. The design was good, in terms of allowable space. As an MEP consulting firm, Girard Engineering is often faced

with the challenge of integrating systems and equipment to meet the spatial parameters of the architectural design. Potomac Yard was fairly forgiving in that regard; the architecture was developed to keep both form and function in mind. We did not encounter any major disparities between what was shown on the design documents versus what was installed in the field. The construction was relatively straightforward. Davis Construction[14] led a great effort; they are an excellent team of contractors. One of the biggest challenges was staying on schedule. Davis Construction and the entire design team stayed focused and had the building up and running in an amazing amount of time. Both Davis Construction and Davis Carter Scott's[15] Construction Administration[16] team deserve a great deal of credit for delivering the building in a very limited amount of time.

COLLABORATION DURING CONSTRUCTION

We had a relatively open line of communication with the contractor. The design and construction teams had the luxury of having worked with each other before, so the expectations were understood. The common goal of delivering the building in a timely and efficient manner was accomplished through a collaborative effort. We all made great efforts to be as responsive as possible and to be thorough in our review of the construction coordination.

INVOLVEMENT DURING CONSTRUCTION

Girard Engineering's role in the construction phase was to periodically visit the site to monitor progress and relay our observations to the building owner. We kept a close eye on what was being installed, how it was installed, and whether or not the contractor was maintaining our design intent. We also made sure that everything that was installed was in compliance with the design documents, as well with the LEED criteria. Site visits were conducted on a biweekly or monthly basis. The intent of our visits was really to perform visual inspections and pull together site visit reports, which included items that we felt needed corrective action. Site visit reports also typically include general MEP construction progress observations.

OPERATIONS | ONGOING COMMUNICATION WITH THE PROJECT TEAM

As MEP consultants, we don't have control over how the building is operated. Girard Engineering designs the systems and develops specifications for how the building should be operated, but it is ultimately up to the building operator to put our intent into action. As part of our design, we create sequences of operations for the owners and operators, which include instructions for how the system should function and how it should be operated on a daily or seasonal basis. The LEED-EB system takes us to the next level, in that it requires an expert to further assist in verifying that the sequences are being applied properly. As part of seeking LEED-EB certification, engineers must take real-time information and provide real-time feedback to ensure that the building is operating as efficiently as possible.

A building that pursues the Measurement and Verification[17] credit may require a different methodology for operating the building systems. This credit was pursued in this project, so we enhanced the building control system to allow them to log building energy consumption.

The EPA was a unique customer; they have a sincere interest in documenting real-time information and understanding how buildings consume energy; they go to great lengths to develop reports and studies to make sure that our country's buildings are efficient.

THE COMMISSIONING PROCESS

The commissioning process began during the design phase of the project. Advanced Building Performance had reviewed Girard Engineering's documents and provided valuable feedback. Paul Tseng,[18] with Advanced Building Performance, had some great comments that we incorporated into the design. In terms of the construction phase of the project, our involvement in the commissioning process was fairly limited. The commissioning agent worked closely with the contractors to make sure that everything was installed and operated as intended. While Girard Engineering did provide clarification when the commissioning agent was unclear on our intent, our role in the overall commissioning process was somewhat peripheral; we were mainly there to clarify our design intent when the commissioning agent had questions.

14 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia.

15 Davis Carter Scott is an architectural and interior architectural design firm located in McLean, Virginia.

16 Construction Administration (CA) is the final portion of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

17 Measurement and Verification (M&V) is a formal, systematic process for determining the functional and energy saving performance of a building's energy-using systems.

18 Paul Tseng is a Principal with Advanced Building Performance, Inc.,a high-performance building consulting practice located in Washington, D.C. He acted as the Commissioning Agent for One and Two Potomac Yard.

Advanced Building Performance had many ideas for maximizing system efficiency; however, some ideas unfortunately were just not practical given the limitations of the core systems that were designed prior to the GSA lease negotiations. For this particular project, the commissioning agent's input may have been more limited than it likely would have been if we had the opportunity to start from the ground up.

Many of the experts who came on-board with Potomac Yard are individuals that Girard Engineering has since turned to on many projects. They are experts we have recommended on other projects. It was a great opportunity for Girard Engineering, because we were introduced to a lot of high quality professionals that have a big stake in the local and national development. It was really a good opportunity for us to learn, as well as maintain valuable contacts.

It is important to get a large group of people together to collaborate and share ideas, and the industry is going that way with LEED and with building information modeling, for that matter. It was a big group with a lot of experts; I think we pulled together and did a good job.

MONITORING BUILDING PERFORMANCE

Girard Engineering is not currently tracking or monitoring Potomac Yard's performance. I believe Jones Lange LaSalle[19] is operating and maintaining the building; they're keeping tabs on the systems' trends and how much energy is consumed in the building. They are involved with maintaining the ENERGY STAR rating and the ongoing LEED criteria. I assume that they bring in consultants to analyze the data, or perhaps they have their own analysts in-house, but since our primary function at Girard is as MEP design consultants, we are not involved with that.

We are always interested to see building performance data to understand exactly how the systems that we design function. At a project's beginning, clients ask us to provide input on the life-cycle efficiency of any system that we recommend. So, we are continually looking for opportunities to learn how Girard Engineering's buildings operate.

There are efficient strategies, including cost-effective options, available today that might not have been available in years past. Girard Engineering performs on a level to maintain pace with the ever-evolving standard industry practice.

THE FUTURE OF LEED

LEED can keep up with the latest standards and raise the bar higher as the technologies progress and as design strategies become more efficient. One of the drawbacks to that, though, is that if you push too hard, you outpace the current market and you create an unobtainable goal. There is a fine line in pushing designers, engineers, and architects to create efficient buildings while still keeping design criteria practical and realistic.

We are definitely seeing a push to look at existing buildings and how they are operating. My sense is that we are seeing that now more than we might have in recent years because of the economy and the fact that new buildings simply cannot be financed at the current moment. People are looking at what they already have in their portfolio and trying to make them more efficient.

There has been a paradigm shift to be more cognizant of the energy efficiency guidelines and standards. For example, at Girard Engineering, I was one of three LEED APs[20] three years ago; now there are 15. There definitely has been a push to understand the LEED system and the USGBC's goals. It has caught on and it's industry-wide; the entire engineering industry is familiar with the LEED system. Almost every large project that Girard Engineering does these days is required to obtain LEED certification; even if it is not required, the owner is interested in it. We are even going back and figuring out how to get projects certified that were not originally built to LEED standards. It is an interesting challenge, and it's indicative of the local market and the desire of commercial developers to build LEED certified buildings.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on September 30, 2009, at the offices of Girard Engineering in Falls Church, VA.

19 Jones Lang LaSalle is a financial and professional services firm specializing in real estate services and investment management. They are the property management team for One and Two Potomac Yard.

20 A LEED Accredited Professional (LEED AP) is an individual who has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

SANDRA LEIBOWITZ EARLEY

PRINCIPAL, SUSTAINABLE DESIGN CONSULTING, LLC.

PROCESS | GETTING INVOLVED WITH THE PROJECT

Throughout the new construction project, I worked directly for Crescent Resources.[1] I was awarded the contract through a referral from a colleague of mine, and I was working on the project before Crescent Resources had confirmed the lease with the EPA.[2] Crescent Resources hired me to do an evaluation of the project as it was initially designed to see what it would still need to meet the requirements of the EPA's Solicitation for Offers (SFO).[3] At that time, the SFO had just come out. This was something that Crescent Resources had been anticipating for some time, so once it was released, there was a rather intensive LEED[4] feasibility study done on the project. I coordinated this effort, but it involved a number of other team members, including the Property Manager who was assigned at the time of the SFO. There was an extensive effort to figure out what needed to be achieved in order to fulfill the LEED prerequisites and to obtain a LEED Silver Certification. Additionally, we were contracted to help determine the costs associated with the certification.

SANDRA LEIBOWITZ EARLEY, LEED AP, was Sustainable Design Specialist for three Washington, D.C. area architecture and consulting firms before she founded Sustainable Design Consulting. She has worked on over 200 green building and LEED-related projects.

ESTABLISHING PROJECT GOALS

The original project design provided a good starting point, but there were a few things that needed to be addressed. For example, the entire commissioning process was in addition to what was planned for the project. One and Two Potomac Yard came at an interesting time in Arlington County's history because the county has been progressively raising the bar on requirements for the private sector. Virginia is a by-right state, so the County only has the opportunity to insert green building requirements when there is a re-zoning or site plan approval process. As a result, the designers already had some green criteria required of them by Arlington County. A partial green roof was already part of the design, and there were a number of alternative transportation requirements based on the site plan conditions, which had been negotiated with the County. The original mechanical system needed to be enhanced in order to achieve the target level of performance, which, at the time, was 20% above the 1999 version of ASHRAE 90.1.[5] That is starting to sound like ancient LEED history because all of the standards have evolved since then. Given the fact that this was a fully designed pair of buildings, a complete mechanical redesign was out of the question; it became a matter of modifying some of the system components, the fan powers, and the lighting.

1 Crescent Resources, LLC is an owner and developer of commercial office buildings, headquartered in Charlotte, North Carolina.

2 The U.S. Environmental Protection Agency (EPA) is an agency of the federal government that employs 17,000 people. It is headquartered in Washington D.C. and operate 10 regional offices and a dozen laboratories.

3 Solicitation for Offers (SFO) outlines a collection of requirements, defined by a potential tenant, which a building must meet in order for said tenant to consider it for occupancy.

4 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

5 ASHRAE stands for The American Society of Heating, Refrigerating and Air-Conditioning Engineers. ASHRAE Standard 90.1 addresses commercial building energy codes in the United States.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

ROLE IN THE PROJECT TEAM

I was the LEED coordinator on this project. By training, I am an architect and tend to focus on building materials, indoor environmental quality, and, to some extent, water efficiency. I am not an engineer, so I tend to focus less on the mechanical and electrical systems. My involvement began during the initial feasibility studies, and once the decision was made to award the lease to Crescent Resources — a few developers were competing for it — I was involved in a mad-dash, 30-day process to implement all of the redesign elements that were necessary in order to achieve LEED Silver certification. That was an intensive effort. From that point forward, I coordinated the team and tracked everything to make sure that the design revisions, or the design criteria that related to LEED, were upheld throughout the entire process.

DESIGN | WORKING WITH THE PROJECT TEAM

Potomac Yard was a very complicated team process. In addition to the LEED criteria, there were additional requirements included in the SFO. For example, there was a strong emphasis on the use of recovered materials. One of the main offices of the EPA, housed at Potomac Yard is, in fact, the Office of Solid Waste and Emergency Response; they wrote the Federal Government's recovered material criteria several years prior to this project. It was a very important point for them, and it was a complicating factor that became the subject of several meetings. Overall, it was just a very large team. There were a number of GSA[6] team members, EPA team members, lawyers from both sides of the table, the developer, team members from Davis Construction,[7] and the MEP[8] engineers at the meetings. Typically, the meetings were very large; it was a very high-profile project for all the firms, so everybody put their "A" team onto the project.

IMPACT OF LEED ON THE DESIGN PROCESS

We had 30 days to implement the redesign elements. Whether that was through meetings, emails, or conference calls, we coordinated amongst ourselves as effectively as possible. As a green building consultant and someone who has dedicated my whole career to green building, I wanted to ensure that everything that was environmentally and realistically achievable on the project happened. The developer's requirement, as stipulated in the lease, was for a LEED Silver building although, in this case, we divided it up into two different certifications: one for Building One and one for Building Two. We well-exceeded the required level by going above and beyond the level of LEED Gold. We weren't close to Platinum, but we were well over LEED Gold for both building certifications. Part of the reason for the additional points was to have the greatest level of assurance to the developer that the project would earn at least LEED Silver. Otherwise, it was a deal breaker for the lease agreement, and Crescent would have incurred a 10% rent penalty for all of the approximately 405,000 initial square feet throughout the 10 year life of the lease. That was quite a driver for the developer. It was my job, as the LEED coordinator, to make sure that it all happened and that nothing got dropped at any point in the process. As soon as we finished that 30-day redesign process, the contract for construction was awarded and the project got underway.

THE INCENTIVE OF GREEN LEASES

The lease structure on this project is not unique in the metropolitan Washington D.C. area, but it is unusual throughout the rest of the country. The Federal Green Lease Program[9] is a strong driver of green development in this area, and the GSA is, in increasing numbers, putting those requirements into its lease negotiations and SFOs. In downtown Washington D.C., and surrounding areas like Arlington, there are an increasing number of speculative office buildings that, as a matter of course, are being built to at least a LEED Certified level and usually a Silver or Gold level of certification. That certification then pre-qualifies them for obtaining Federal tenants.

There is also a large contribution made in this area by the state and local governments. The District of Columbia,

6 The United States General Services Administration (GSA) is an independent management agency of the United States government that supports Federal agencies through the management of property, records, and construction.

7 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia.

8 MEP stands for Mechanical, Electrical, and Plumbing. MEP engineers oversee the heating, ventilation, and air-conditioning (HVAC) in addition to the plumbing systems.

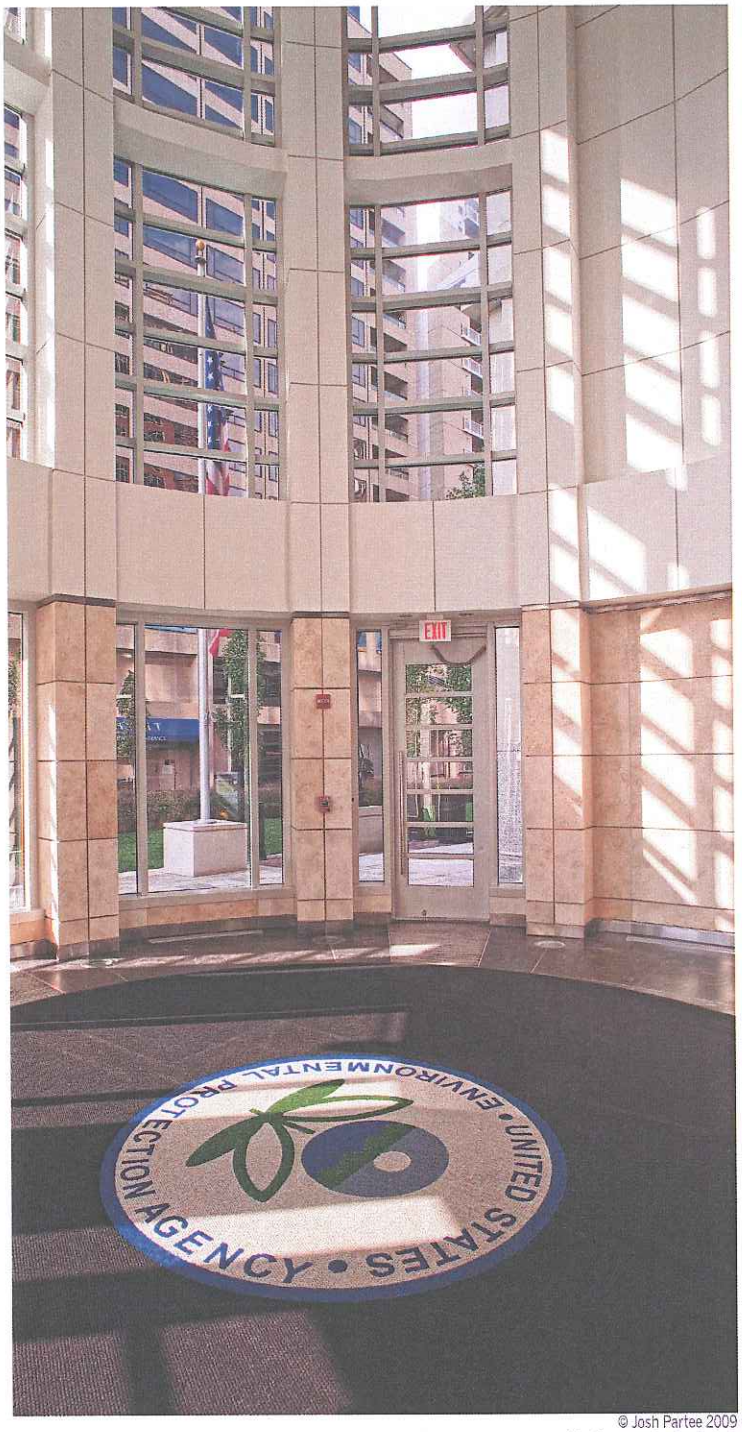
9 The Federal Green Lease Program or the U.S. General Services Administration (GSA) Green Lease Policies and Procedures for Lease Acquisition was first introduced in 2000 with the intent of providing GSA's realty specialists with a framework for complying with the then-current Executive Orders on greening the government. The template is constantly being updated.

Montgomery County, Arlington County, and Prince George's County have been implementing a variety of requirements for their own buildings. In particular, they have been requiring sustainable construction of public schools and recreation centers. Arlington had long ago gone above and beyond by placing certain requirements on the private sector through the site plan conditions. They have been steadily increasing the levels of those requirements over time.

One of the other things that made this project very unique was that, in addition to the LEED requirements for Silver certification and the set of preferred and expected points that the EPA had put in the lease, there were a number of additional Federal green criteria. In some cases, these other requirements slightly conflicted with LEED; as such, this was a multi-layered, green building exercise. Arlington County requirements included alternative transportation and the partial green roof on the connector building, but the SFO included requirements for low-emitting materials, which responded to different references than the LEED categories. With each product, we had to evaluate which categories it fit into and follow the more stringent requirement. There were also some additional requirements related to Indoor Air Quality (IAQ), and in some cases, the level of HVAC filtration required was even more stringent than LEED required. These requirements had to be referenced simultaneously in order ensure that we were meeting both criteria.

TOOLS AND RESOURCES

Our biggest resource on projects like this is our own, internal experience. This was, for some project team members, a very early LEED project in their careers, but we had already completed several LEED projects when we began Potomac Yard. We had a lot



Lobby "We had developed the resources to find low VOC adhesives for every application needed; a lot of the information that we had collected in-house served as a valuable resource for us during this project."

of anecdotal information, internally, about LEED credit interpretations, material and system availability, and the market availability of products. For example, we had developed the resources to find low VOC[10] adhesives for every application needed; a lot of the information that we had collected in-house served as a valuable resource for us during this project.

We have a number of tools at our disposal, some of which the USGBC has provided and some of which we have created ourselves. We call our basic tool a "LEED Tracking Tool" and, traditionally, it has been an Excel[11] file, but we've manipulated Excel to do the greatest number of things that we can do to track different types of data. That has been our central organizing tool, although we're considering evolving into something web-based in the future. LEED Online, for the LEED-EB[12] process that followed the LEED-NC[13] process, was convenient because we were able to simply upload the documentation. The LEED-NC process, which was NC version 2.1 for both Building One and Building Two, required a binder submittal. The older, paper-based system was more cumbersome than LEED Online. The online submittals streamlined the process, but there were still a few quirks. We gave feedback to the USGBC throughout the process. Overall the documentation was a bit challenging for the LEED-EB certification; there simply hadn't been as many LEED-EB projects done as LEED-NC projects at that point. A few things in the reference guide didn't quite match what the LEED Online template said; we had to find the best of both worlds as we went along.

Certainly, the USGBC credit interpretations became a big part of our process. Even though it was an office building and LEED was written for office buildings, there was always some amount of interpretation that had to be done. For product research, we use BuildingGreen's[14] online Green Spec Directory. They keep that current and it's a thorough and reliable source.

LEED CREDIT CHALLENGES

Based on the site plan, the approved design of the overall building, and the elevations that were approved through the site plan process, there was to be another roof, a metal structure, over the mechanical equipment on the roof. The product of choice for this second roof came with pre-finished metal panels, but the coating for those metal panels was tested for emissivity with a testing methodology that was not referenced by LEED. Credit ruling after credit ruling confirmed that it wasn't accepted. In fact, this white metal roof system which was affordable, reliable, and the right choice for the project, had to be field-coated with a product that had been tested with an approved testing methodology.

Another challenging credit, and one we withdrew from the submission, was the light pollution reduction credit.[15] Arlington County has a standard light fixture for use throughout the county; it's an acorn-type fixture. Even if it has refractors on the inside of the fixture, it still doesn't meet the full cut-off criteria of that version of LEED. Arlington County wants as many projects as possible to meet the LEED criteria, but they have a bit of a stumbling block with their own lighting requirements.

The electric vehicle charging stations were something that I advocated against. I knew that, at that point in time, no one was using plug-in electric vehicles. I thought we should have spent the money on something else that has a more tangible environmental benefit. Now, though, we're in the era of the plug-in hybrid gas-electric vehicle. The pure electric plug-in technology, which became obsolete, will possibly have a renaissance due to new recharging opportunities. At the time, though, those additional points were extra assurance that we would achieve LEED Silver.

Most of the occupants of these two buildings and garages are EPA staff. The thing that always strikes me is how empty the parking structure is compared to every other parking structure in the entire metropolitan D.C. area. They maximize the use of bicycle commuting; there's a shuttle that goes straight from the Crystal City[16] metro stop to the front door, and many people participate in carpooling. There's a relatively low percentage of garage users who come in a single occupancy vehicle, and that's great.

10 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

11 Microsoft Excel is a spreadsheet application written and distributed by Microsoft.

12 LEED for Existing Buildings: Operations & Maintenance (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements and maintenance.

13 LEED for New Construction (LEED-NC) is designed to guide and distinguish high-performance commercial and institutional projects.

14 BuildingGreen, LLC is a publisher of environmental building news and information resources for practitioners of sustainable design.

15 LEED Credit SS-8: Light Pollution Reduction seeks to eliminate light trespass from the building site, while improving night sky access and reducing developmental impact on nocturnal environments and species.

16 Crystal City is an urban neighborhood in the southeastern corner of Arlington County, Virginia, south of downtown Washington, D.C.

DESIGN STRATEGIES AND MATERIALS

I was able to make some suggestions for rapidly renewable and bio-based materials for use in some of the interior millwork. There were two separate packages: the design intent drawings were done by Metropolitan Architects and Planners,[17] and Davis, Carter, Scott[18] did the Architect of Records documents. I worked with both firms to be creative about material selection. For example, we put a lot of thought and research into the carpets. The carpet drives every other interior design decision that is made, so that was an important component in this project.

There are certain things, like FSC[19] certified wood, which are affordable for a larger office building since, relatively speaking, there's not a lot of wood used in the base building. That was a very good opportunity for a large project like this. My goals also included seeing construction waste recycling and indoor air quality management done to their very best during construction. We were fortunate to have the assistant project manager for the contractor functioning as their LEED coordinator. She did a great job of being thorough with the submittals and documentation and making sure that all of the subcontractors understood exactly what they needed to do. She comprehensively reviewed almost everything before it came into my hands; there was almost nothing in the construction phase that was an error or oversight, and that almost never happens.

CONSTRUCTION | INVOLVEMENT IN THE CONSTRUCTION PROCESS

The extent of my involvement in the construction process was in part a result of my involvement in the very short design process, or the 30-day redesign push. There were a number of remaining issues that needed to be resolved, so in the early stages of construction we were still working out the final design issues. I played a large role during that portion of construction, but there was a lot of assurance and quality control on my part throughout the process. Any submittal that had the potential for having a LEED, EPA, SFO, or green requirement implication all crossed my desk for review. That was an important role during the construction process. The contractor did a great job with the documentation on their end, and they produced record sets of submittal binders that were just about the construction submittals, in case we ever needed to go back to anything. Because this was pre-LEED Online, and before the design phase submission could be separated from the construction phase submission, the entire submission was at the end of construction. We spent the whole construction period preparing for the final package submission.

COLLABORATION DURING CONSTRUCTION

My role, and this is typical for LEED projects that we work on, was not to be a site inspector. We came to the job site to attend meetings, but I didn't do a walk-through of the building at any time. On-site monitoring was part of the contractor's general quality assurance; if they saw something that hadn't been approved through the submittal process, they would correct it.

Davis Construction monitored the Indoor Air Quality Management Plan.[20] One of the ways in which I verified it was through the submission of digital photos of the protective measures that were done on the site. It was understood that the contractor would handle certain things, but there were other things that the EPA, as tenant, as the U.S. Environmental Protection Agency, wanted to make sure that they were not going to have any problems with in this building. The construction indoor air quality management plan was one of these areas and it received a higher level of scrutiny than I've seen on any other project.

CHALLENGES DURING CONSTRUCTION

It's important for the sustainability consultant to be involved in the construction process. I am astonished when I hear that some LEED projects have either an in-house coordinator or a separate consultant who stops consulting as soon as the design is done. Having a good, solid coordinator, like Davis Construction had on this project, is a large part of getting certification, but you still have to have an outside, non-construction personnel review. This doesn't just ensure that things are being done correctly, but it also ensures that the sequence of things is correct.

17 Metropolitan Architects and Planners, Inc. is a firm that specializes in predesign work, client representation, and facilities management services. They are located in Alexandria, Virginia.

18 Davis Carter Scott is an architectural and interior architectural design firm located in McLean, Virginia.

19 Forest Stewardship Council (FSC) is a certification system that provides internationally recognized standard-setting, trademark assurance and accreditation services to companies, organizations, and communities interested in sustainable forestry.

20 The Indoor Air Quality Management Plan establishes a protocol for the prevention of construction-related air contamination in order to ensure long-term installer and occupant health and comfort.

Getting the installation and submission sequence in place is something that takes a fair amount of attention to detail. It's very important that somebody be present who is responsible for coordinating the LEED credits from the beginning to the end of the project. Things can change during the construction process: substitutions happen and the price of materials changes. The market availability of green products changes all the time, so you have to be able to think on your feet and find acceptable substitutes when something becomes unavailable. When you work on a number of projects, you deal with every extenuating circumstance that you can imagine. We serve as a resource during construction because of our knowledge of products that we have collected through experience.

OPERATIONS | BUILDING OPERATIONS

We kept the building operations and maintenance in mind during the LEED-NC process. We earned an innovation credit for our green housekeeping plan and we earned an innovation credit for user education. Those ideas connected the design and construction to the overall operations. When you're thinking long-term about energy savings, you're trying to do what's right for the building over time. The long-term success of Potomac Yard will depend upon those who will succeed the people who have been so deeply involved in the LEED process. There needs to be a continuous passing on of information and a continuous training of staff. Making sure that the staff is properly trained and that the building is properly managed is all a part of LEED-EB.

THE IMPACT OF LEED-EB ON OPERATIONS

The requirements for obtaining both the LEED-NC and LEED-EB certifications were included in the lease. It was a fairly seamless effort to start the LEED-EB process for Building One. We did initial feasibility studies in 2006 before we had completed the LEED-NC process; we were already starting to think ahead to LEED-EB certification. We officially began the LEED-EB process in 2007 and completed the certification in 2008. That was another case where the lease required an EB Silver certification, and we were able to exceed everybody's goals by achieving Gold.

The NC certification put us in a good place for the EB certification. We were using LEED-EB version 2.0, which had a certain amount of overlap with LEED-NC credits, but it surprised me how much reinvention of documentation had to be done for that submission. It was not a perfect transition between the two rating systems and it was more labor-intensive than we thought when we began the process. That's one of the biggest lessons we learned about EB and, more specifically, version 2.0: it can be a lot of work for the property manager.

Knowing the building as well as we did throughout the LEED-NC process was a huge advantage. We have done LEED-EB certifications on projects where we had no involvement in the building design, and we've had to learn about the building before we can get started. Even the things that had been thoroughly vetted during the NC process — for example, an innovation credit for the green housekeeping plan that was developed — had to be revised substantially for the level of detail required by the LEED-EB credits. In EB, that falls under several different credits that address housekeeping products, equipment, and practices. The LEED-EB certification helped clarify the monitoring of the systems. We developed checklists to try and figure out the right frequency of monitoring for the bicycle storage and the filter changing. Going through the EB process was very helpful and will continue to be over the life of the building.

MONITORING BUILDING PERFORMANCE

Much of our knowledge about building performance was gained through the LEED-EB process. We worked intimately with the commissioning consultant, the energy consultant, and the building engineer. The LEED-EB credits have a greater level of detail and expectations on policies and monitoring than we anticipated in the beginning. It's not up to us to dictate building policy, but during the EB process we got more involved with policy and review, and, in some cases, we drafted documents for approval. That was a good learning experience for us and is really the main way in which we've been involved since the completion of the project.

LEED-EB gets into more depth on such topics as the Integrated Pest Management Plan and the Housekeeping Plan. To know how to affect those decisions, you have to understand how the processes work through the property management system and who's responsible for purchases. In the case of Potomac Yard, all of these things are handled by the same person, so it can be a relatively centralized process. We've also worked with LEED-EB on multi-tenanted buildings and done some initial LEED-EB consulting on the Pentagon. The more people you have who are involved in facilities management and

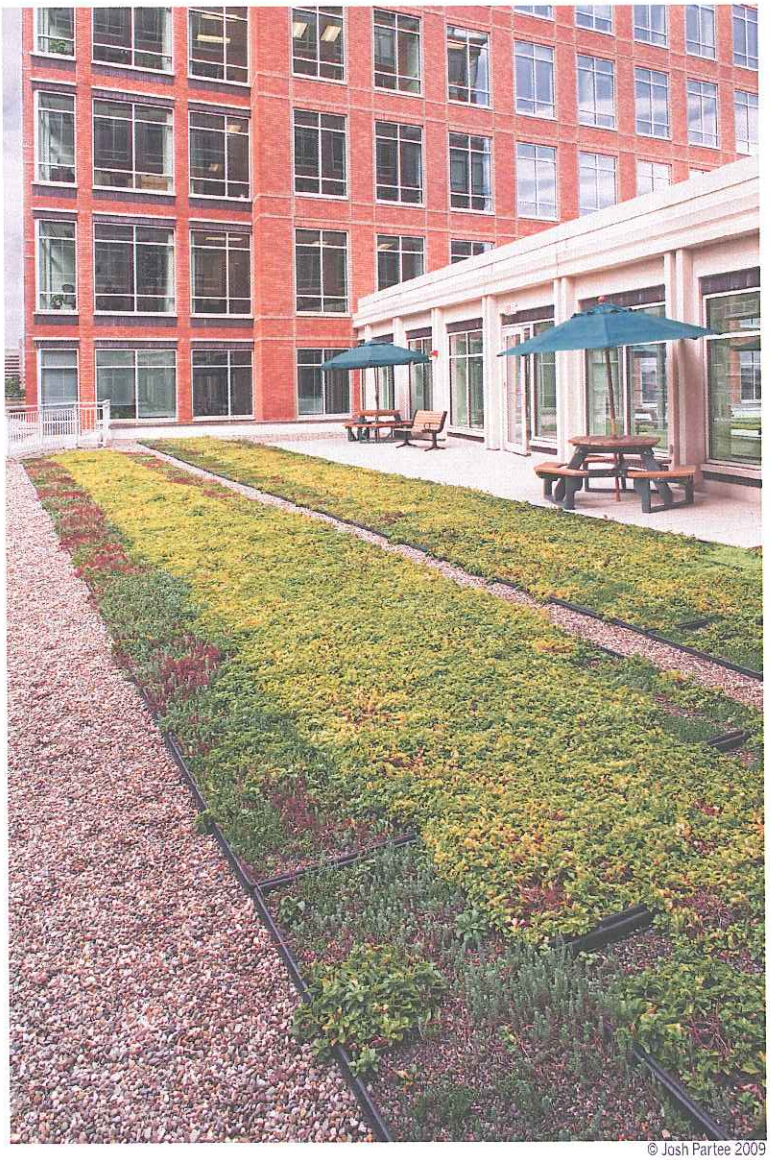
purchasing, the crazier it becomes to track, because you have to coordinate with dozens of people. It's a challenge to keep everything coordinated in large institutional buildings and multi-tenanted buildings.

CONTINUED PROJECT INVOLVEMENT

We've been involved with some of the buildings' ad hoc issues. For example, a tenant going into a space in Two Potomac Yard has a greater number of computers than are usually in an office space. We were hired separately to make sure that the energy use of that set of computers was not going to exceed or compromise either the LEED-EB criteria or the building's ENERGY STAR[21] certification. We are sometimes called upon with purchasing decisions that have to be made, whether about furniture or building materials. We are contacted just to have extra assurance that a decision is going to meet all of the criteria for this building. We've served as another set of eyes for all aspects of this project.

THE LEED CERTIFICATION PROCESS

Sustainable Design Consulting does a lot of other things, but most of the time we're sought after for LEED consulting because we have a lot of experience. Project teams can become fixated on the points, but we try to stay focused on the larger credit intents. We always try to look at the overall environmental intent of the credit versus trying to do gymnastics in order to get a point.



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Roof Garden "Arlington County requirements included alternative transportation and the partial green roof on the connector building, but the SFO included requirements for low-emitting materials, which responded to different references than the LEED categories. With each product, we had to evaluate which categories it fit into and follow the more stringent requirement."

LEED is evolving; it's getting easier to get away from a point-driven mentality and into the more rigorous environmental issues. The market, and the industry in general, is getting more mature; it's less of a novelty to have a LEED scorecard in front of you. More people are making long-term decisions.

21 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping Americans save money and protect the environment through energy efficient products and practices.

The tenants for One and Two Potomac Yard created some of the environmental guidelines found in LEED and some of those that had preceded LEED. LEED is used largely throughout the Federal Government; it will be interesting to see whether their existing standards get absorbed into LEED over time or whether they continue to have a separate set of environmental criteria. Ultimately, having too many different standards, especially on the same project, can be problematic. As we already know, this project used both LEED-NC and LEED-EB, but those were not concurrent exercises. One of the possibilities brought up during the process was that Building One, which is fully leased by the EPA, might have used (and did end up using) LEED-NC, but Building Two, which was only partially leased by the EPA, could have used LEED for Core and Shell (LEED-CS),[22] which had just come out as a pilot at that time. If that had been the case, they would then have required the tenant space to be separately certified under the LEED-CI[23] rating system, which was completing its pilot stage at that time. If they had chosen this path, there would have been three, concurrent rating systems in use on the project. It would have meant three different types of tracking and perhaps even three different sets of team meetings; I think we would have all gone crazy. I advocated for keeping it simple by doing the whole project under LEED-NC. Ultimately, that was the decision that was made.

There were slight differences between Building One and Building Two, and we decided to break them into separate projects for the purpose of LEED certification. Building Two has space that will be leased by tenants other than the EPA, so we had to include green building considerations into a tenant guideline document to ensure that new tenants would comply with all the credit requirements.

THE TENANT-DRIVEN LEED PROCESS

From the perspective of the Federal Government, or GSA's Green Lease Program, this is a Green Lease success story, because the SFO requirements and the lease "carrot" drove this speculative building from being a relatively light shade of green to a much deeper shade of green. It would have been easier for everyone if the LEED process had started earlier in the design, but in the end, we were able to make a number of changes that improved the environmental performance. The tenant is happy, the building owner is happy; everybody is happy.

THE EVOLUTION OF LEED

It has been several years since we began this project. We started working on this project during the summer of 2003, more than 6 years ago, and LEED has already evolved in a number of significant ways. I have yet to wrap my brain around LEED versions released in 2009 because we're still working on so many projects that use the prior rating systems. The USGBC has collected a lot of feedback from projects of each type, and they have put a great deal of thought into the necessary changes. We're in a new era of continuous improvement, and that's where we need to be.

Washington, D.C. is a relatively mature market because it has a legacy of Government requirements and incentives. State and local governments have also been drivers in this area. The Washington, D.C. area has many architects, development professionals, engineers, and contractors who have become LEED Accredited Professionals;[24] by now, many of them have developed fluency by working on a number of LEED projects. Although there is an expectation that everybody knows LEED really well, it's impossible to know it really well without constantly working on a variety of projects. We try to stay ahead of the curve by keeping up with the latest information and working on a variety of different project types with different LEED products.

A firm might have a number of architects who have worked on one type of LEED project and that can be helpful and good, but that's a limited knowledge base. When they have to do something completely different, it throws them off. I think there are certain, basic LEED projects that can sometimes be done without a LEED consultant, but project certification takes a committed set of personnel on staff; that's often the missing piece. Offices sometimes assume that if someone is a LEED AP, then they can manage all of the work, but that is doubling their job description. We're seeing that the market is driving us to a more advanced level where we're working on more complex, multi-faceted projects. LEED consultants are leading the field, not just working on a path that's already been laid by other people.

22 LEED for Core & Shell (LEED-CS) is a green building rating system for new core and shell construction. Core and shell covers base building elements such as structure, envelope and the HVAC system and is designed to be complementary to the LEED for Commercial Interiors rating system.

23 LEED for Commercial Interiors (LEED-CI) is a benchmark for the tenant improvement market that gives the power to make sustainable choices to tenants and designers.

24 A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a LEED AP. The LEED certification process requires that a LEED AP submit the required paperwork.

Conference Room "Once we established a bit more trust and a spirit of collaboration, information started to be shared more freely."

LESSONS LEARNED

This project would have been very different if LEED had been in the picture from the beginning, but that wasn't the case. It was a constant exercise of figuring out how far you can push the envelope within the constraints. The reality is that you cannot change the schedule, you cannot dramatically alter costs, and you cannot come up with some brilliant innovative technology halfway through construction because nobody's going to want to hear from you; you have to figure out what's realistic and go from there.

In the beginning, with this large team and tenant on one side of the table and the developer on another side, and then all of the associated team members, it was very formal. Once we established a bit more trust and a spirit of collaboration, information started to be shared more freely and so did back-up documentation. The process became more fluid, in a good way, and it became smoother at that point. There are methodologies for communication that I have developed over time by trying to determine the best way to stay on the same page, especially with a large team like we had on Potomac Yard. Communicating action items has worked the best for us; people are very task-oriented in the design and construction process, as they should be since things have a deadline. Giving people clear deadlines and narrowing their focus seems to work best.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on September 28, 2009, at Potomac Yard in Arlington, VA.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

PAUL TSENG

PRINCIPAL, ADVANCED BUILDING PERFORMANCE, INC., COMMISSIONING AGENT

PROCESS | GETTING INVOLVED WITH THE PROJECT

When the project was first conceived as a green building initiative, I was invited to join the team by the architecture firm, Davis Carter Scott,[1] and the engineering firm, Girard Engineering.[2] I was involved with the project from an early stage, immediately following conceptual design.[3]

ESTABLISHING PROJECT GOALS

It is common, in commercial developments, for a developer to make a decision to "green" the project for a specific tenant after the design has been completed. Current market pressures cause this to happen more frequently. It is a competitive advantage to be able to present a new building as being environmentally responsible and energy efficient. This is especially true in a speculative project with a tenant who may end up paying the bills. On Potomac Yard, there was a major effort to infuse energy efficiency and other green features into the existing design; we had a fairly rigorous redesign effort. We had to evaluate the entire envelope, in terms of its energy performance, and we were fortunate to have a seasoned energy modeler who helped us look at the performance of the glazing in relation to the mechanical system that had been designed. There were a number of constraints, but there were also opportunities that we were able to take advantage of.

WORKING WITH THE PROJECT TEAM

In any successful office building, especially in a speculative office building, the key player is not the design team. The key to success is that the designers receive clear mandates from the developer. We were directed to meet a particular mandate of the U.S. General Services Administration (GSA),[4] and we were told to deliver a building that was energy efficient and cost effective. We had many design charrettes and design meetings in order to evaluate the various opportunities.

DESIGN | ASSEMBLING THE TEAM

With LEED for Core & Shell (LEED-CS)[5] projects, we typically deal with developers; we don't always get seasoned design teams that are savvy

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1 Davis Carter Scott is an architectural and interior architectural design firm located in McLean, Virginia.

2 Girard Engineering is a mechanical and electrical engineering firm headquartered in the Washington, D.C. Metropolitan area.

3 The Conceptual Design phase (or Schematic Design phase) is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

4 The United States General Services Administration (GSA) is an independent management agency of the United States government that supports Federal agencies through the management of property, records, and construction.

5 LEED for Core & Shell (LEED-CS) is a green building rating system for new core and shell construction. Core and shell covers base building elements such as structure, envelope and the HVAC system and is designed to be complementary to the LEED for Commercial Interiors rating system.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

Meeting Room "On Potomac, we added features such as an economizer for the mechanical system and daylighting sensors for the lighting system in order to optimize the energy performance without changing the design intent."

with LEED or green design in general. In the case of Potomac Yard, the developer had formed a team with some of the best consultants in this field, including the sustainable design consultant.

ROLE ON THE PROJECT TEAM

There are two key things that a typical commissioning consultant needs to assist with during the design phase. The first is to help the design team focus on the energy performance and sustainability goals that need to be obtained by the end of the project. In order to do this for Potomac, we addressed some of the basic design assumptions; lighting power densities, air change rate, basic efficiency, and the system type that we wanted to incorporate. We then, typically, look at the envelope and the potential daylighting opportunities. On the Potomac project, we had to re-examine every energy system that had an impact on the performance of the building. Even though we were finished with the Design Development[6] phase, we went back to the beginning and assessed the design in order to achieve our ultimate project goals.

DESIGN STRATEGIES AND TECHNOLOGIES

We had a top-shelf design team on the Potomac project; they knew their business, and they were incredibly disciplined. At that time, I offered a menu of features to the design team for consideration. We didn't have a lot of time for a redesign, but we were able to adjust to each one of the opportunities. The one basic constraint with a speculative office building is that a developer needs to devise and implement a mechanical system that is flexible. They may have a single tenanted or multi-tenanted building; they need to consider how to install an energy efficient

6 Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

system that allows flexibility in leasing to the ultimate occupants. After several design iterations, we ended up with a floor-by-floor, self-contained, high-performance, variable air volume (VAV)[7] system. A central chiller plant probably would have been more efficient, but it would have constrained the developer in terms of leasing, metering and billing, and the accommodation of different tenants on different floors. Our team also focused on lighting, and we benefited from a well-thought through lighting design. The lighting fixtures in Potomac Yard are leading edge fixtures, and in 2006, the watts per square foot for these fixtures were on the high-end of performance.

A common misconception by many design firms involves insulation; they think that adding insulation is always good. For an office building, which is cooling dominant, a super insulated building is actually counterproductive. With Potomac, we had to convince the architect not to spend money in the envelope, but rather to invest that premium into the building glazing system. In the end, a substitution occurred, and the glazing system that was installed was not the one that was in the design. As a result, we had to reassess the performance of the system assembly as a whole. Many designers are comfortable looking at the U-values[8] and transmission values of the glass, but beyond that, they need to look at the shading coefficient and the light-to-solar gain ratio of an assembly. A lot of people don't look at this last ratio, and that's very important criteria. That tells you how much lighting benefit you get for the heat gain acquired through the glazing materials.

THE IMPACT OF LEED IN THE DESIGN PROCESS

As a commissioning consultant, I facilitate the attainment of various LEED objectives. I always encourage the design team, in addition to obtaining the prerequisites, to look beyond the prerequisite into achieving performance. Often, if the design team meets the LEED prerequisites or the code requirements, they feel as if they have met the performance requirements. This is a systemic challenge within the design profession as a whole; we have to go beyond the minimum requirements and take an intense look at energy performance. That requires that we look at the assumptions made during system selection to see how we can optimize that particular perspective. On Potomac, we added features such as an economizer[9] for the mechanical system and daylighting sensors for the lighting system in order to optimize the energy performance without changing the design intent.

DESIGN TOOLS AND TECHNOLOGIES

We rely upon the energy model to predict building performance; primarily, we use eQUEST[10] as a predictive tool. At the time, we were not able to use existing projects to check our model's performance predictions because we did not have projects of the same magnitude and capacity necessary to do a comparative analysis.

We also implemented the most rigorous, and at the time the most expensive, measurement and verification (M&V) protocol.[11] This building is fully instrumented for M&V; we implemented metering throughout the whole building. For example, the daylighting portion of commissioning involves performance verification of all energy systems related to daylight. For Potomac, we calibrated all of the daylight sensors by fine-tuning their sensitivity. We measured the available exterior daylight and the foot-candles (fc)[12] at 30 inches off the floor; then we mapped foot-candle measurements for the whole building. We calibrated all of the sensors that were implemented to meet LEED credits; temperature, CO_2, outdoor air delivery, and airflow for ventilation. We verified all of these components, and we scrambled to sufficiently rewrite the acceptance criteria with the design engineer, Girard. In fairness to the contract, we needed to define what constituted acceptance.

LESSONS LEARNED DURING DESIGN

For the design phase of the Potomac project, I would have recommended that the design team, the project owner, and developer not prejudge the mechanical system selection before an energy model could fully evaluate the costs and benefits of a variety of different options. On

7 Variable Air Volume (VAV) is a technique that enables the capacity of a heating, ventilating, and air-conditioning (HVAC) system to be controlled.

8 U-value is a measure of the non-solar heat gain or loss through a material or assembly. A lower U-value indicates a greater resistance to heat flow.

9 An economizer is a heat exchanger used to reduce energy consumption by preheating fluid in a mechanical system.

10 eQUEST is a whole building energy use simulation tool developed with funding by the U.S. Department of Energy (DOE).

11 A measurement and verification (M&V) protocol is a set of established metrics that are used to define baseline performance as well as to verify intended building energy performance.

12 A foot-candle (fc) is a unit of illuminance or light intensity. The SI unit for illuminance is the lux: 1fc=10.764 lux.

Potomac, I don't feel that I was sufficiently involved with the cost analysis of the building systems; this is often the painful reality. I would like to see, as part of the initial system evaluation, cost analysis be done in a more holistic manner by looking at the energy performance, operating costs, lifecycle impact, and the first cost. Speculative office building is first-cost driven; the way to address first-costs as part of the design review, required by enhanced commissioning, is to correctly size the systems. If every commissioning team helped the design team to correctly size the system, they could deliver performance without costing the project an additional premium. That would be a great achievement.

CONSTRUCTION | INVOLVEMENT DURING THE CONSTRUCTION PROCESS

The reality of construction is that the schedule does not move. So, my advice on commissioning is this: the best commissioning task is the one that you don't have to do. You can infuse commissioning requirements into the beginning of the design phase. If we are able to infuse, for example, energy performance into the construction design and specifications, then part of the commissioning is really verification. It's not trying to troubleshoot or diagnose issues that could have been prevented. Preventative measures are the best approach for commissioning, and we did a lot of that during the design reviews on Potomac. We had 300 to 400 comments on the mechanical systems, the lighting design, and the envelope in order to help the design team to refine the early details.

COLLABORATION DURING CONSTRUCTION

I am fortunate to have worked with a very robust mechanical contractor, W.E. Bowers, Inc.[13] The people there were very cooperative, and they had a commissioning coordinator; most contractors do not have that kind of personnel. Potomac One was Davis Construction's[14] first LEED projects, but they also had a very savvy LEED coordinator as part of the construction management team. The construction team was top-shelf and that was very helpful.

We have monthly meetings at the beginning of construction, but once the equipment gets set and permanent power is available, we step up to bi-weekly meetings. In the last three months of the project, we were at Potomac almost on a daily basis. We have to fit commissioning into the progress of construction; a lot of times, we are not able to have the contractor stop construction for us, so we have to find time when we can test our different systems. For instance, the dimming control system was state-of-the-art, at the time, but that system was cumbersome in terms of commissioning. We had to set the baseline in the middle of the night, when there's no contribution from ambient light. We were on site at 3 a.m. in order to establish the baseline; then, we came back during the day to calibrate the sensors.

CHALLENGES DURING CONSTRUCTION

During testing and balancing controls, we included the major trades: the contractor, the mechanical engineer, the electrical engineer, down to the subcontractor level. Everyone knew that this was an important project, so we got commitments from the corporate executive level to make sure that we delivered a building that was fully commissioned. There was a definite deadline for when the building had to be ready for the tenant; the challenge was to fit all of these tasks into the tenant-fit-out period. We looked at anything that could impact the mechanical system. For example, we looked at construction indoor air quality management issues and encouraged the construction manager to police the filter change out of the MERV-8 filters.[15] We also did some spot checks through what I call a "black glove test"; this was basically making sure that the interior of the ductwork was kept as clean as possible in order to prevent drywall dust from getting into the air distribution system.

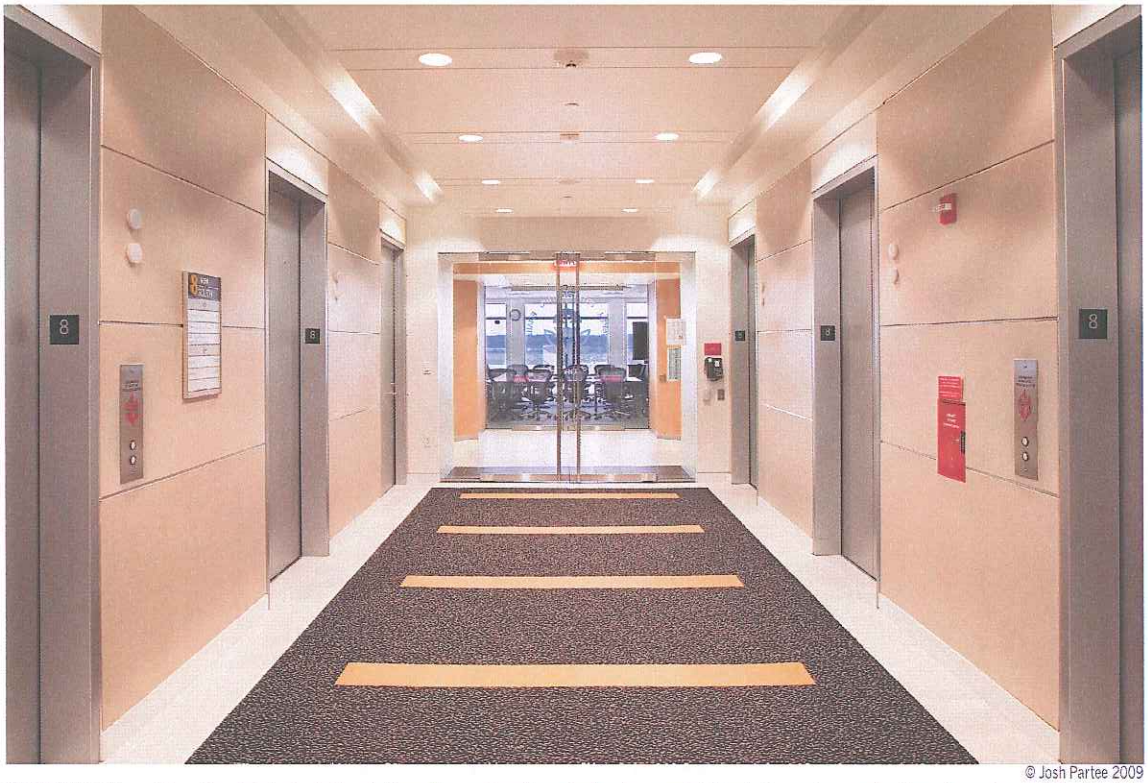
LESSONS LEARNED DURING CONSTRUCTION

One of the major failures in this project is that when the building was built there was a huge amount of construction surrounding the site. As a result, the air around the building was full of construction dust, and the dust got into the cooling towers that were serving the air-handling units. Within two months of occupancy, we were experiencing frequent "nuisance trip outs" or random shut downs of the mechanical systems. We had to do a forensic investigation,

13 W.E. Bowers, Inc. is one of the largest mechanical contracting firms in the Washington, D.C., metropolitan area. It is located in Beltsville, Maryland.

14 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia.

15 MERV stands for Minimum Efficiency Reporting Value. This standard was developed by ASHRAE and indicates a filter's efficiency at trapping airborne particles.



Elevator Lobby "Speculative office building is first-cost driven; the way to address first-costs as part of the design review, required by enhanced commissioning, is to correctly size the systems."

and we found out that, within this short period of time, there had been substantial fouling of the piping system. We had to clean every one of the air-handling units in order to remove the fouling from the tubing so that we could maintain system operation. That was a very painful exercise, and it stressed to us the importance of detail. During the check-out phase, we should have insisted that the air feeding the mechanical system be kept as clean as possible.

The challenge of integrating commissioning tasks into the overall project schedule is always a difficult integration issue; we did not have the time to fully test the system in sufficient detail. I mentioned the issue of nuisance shutdown of air handling units, and I wish that we had time to put the system through its paces. Instead we had to address that as part of the occupancy troubleshooting, and that could have been done so that the occupant did not have to suffer through this unanticipated glitch. Ultimately, our role as commissioning agent is to detect systemic failures that would occur either as a result of installation or lack of a full system test. If we can accomplish that then we have achieved a lot.

OPERATIONS | POST-OCCUPANCY EVALUATION AND MONITORING

It is crucial that the commissioning agent remain involved with the project beyond the occupancy of the building. Commissioning, or any functional performance testing, is done in an idealized setting with no occupants. Full commission of the building needs to be done in real-time, once the occupants are using the building; that allows us to determine a pattern of behavior for these mechanical systems. We were involved for the fundamental and enhanced commissionings for Potomac, so we actually did a pre-warranty commissioning review. This is basically a Post Occupancy Evaluation (POE) where we convened with the building management team to discuss issues that have occurred with the mechanical system, the VAV boxes, and the lighting control. Ten months after occupancy, there was still some fine-tuning that needed to be done. This is complete commissioning; it is something that needs to be written into the contract. Before the final payment to the contractors, there should

be a final warranty review. I think that should be included in the contract deliverables.

SHARING INFORMATION AND RESOURCES

During the turnover stage, we worked very closely with Wayne,[16] the building engineer, to ensure that the building automation system was tailored to his needs. We emphasized the graphic front of this system to ensure that it provided what was needed to operate the building. We handled that training, orientation, and customization of the operational requirements, but I wish that we had a more continued interaction with Wayne. We basically left him to his devices after the training and came back a year later to do part of the LEED-EB commissioning.

ONGOING COMMUNICATION WITH THE PROJECT TEAM

I was involved in the first couple of years of the LEED for Existing Buildings (LEED-EB)[17] certification. With the LEED-EB, we worked with the building engineer to review the trend data that we were able to gather. We had to evaluate these trends in order to assess the performance of these systems, and we made a number of recommendations as a part of that process. We recommended simple things like set points on the thermostats and an adherence to occupancy schedules. This building is theoretically operating 24/7; the occupant requires that flexibility, but from an energy performance standpoint, we can optimize that by knowing when we need to cycle the main pumps or cooling towers in the units. Similarly, with the lighting systems, we recommended a way to allow flexibility by the user without having the lights turn on when they weren't needed.

THE FUTURE OF LEED

The fact that commissioning is part of energy and atmosphere (EA) credits for LEED clearly indicates that the energy performance measure is a key performance parameter for green buildings. Unfortunately, without M&V, commissioning only gets you to a certain point. I would recommend strengthening the link between commissioning and performance through M&V. The USGBC[18] is moving in that direction, but I would recommend that measurement and verification focus be better defined so that it's easier to implement. Currently, the M&V criteria are very loose which means that they are open to interpretation and gaming. I would recommend that a feedback loop be established between M&V and commissioning as a part of the enhanced commissioning of the warranty review process. LEED 2009 is moving in that direction, but currently, each credit is stand-alone, and there are really no linkages between them in terms of energy performance. I have been preaching this for many years, but commissioning is not simply doing functional tests on equipment that's installed. The purpose of commissioning is to ensure delivery of the energy performance intended in the project design.

THE EVOLUTION OF COMMISSIONING

The commissioning profession and the commissioning process are still evolving. There is a level of rigor that varies from project to project; there is a guideline[19] defined by ASHRAE,[20] but compliance with that guideline varies all over the map. In order to deliver high performance buildings, commissioning needs to be faithful to the intent of the integrated design process. The commissioning team needs to offer value to the entire project process, beginning with conceptual design. They need to assist the design team in making wise system selections by scrutinizing the design document details in order to ensure that the intent can be realized. During construction, the team must follow through with performance verifications with a degree of rigor that is still not quite common yet.

Technology is enabling the commissioning process to make a very robust offering to building operators with the advent of wireless technologies, the ability to view operations from the web, and the potential to do trending and tracking. We will give not only the design team, but also the building operator, the tools they need to monitor and control the building performance in real-time. This

16 Wayne DeGroat is Jones Lang LaSalle's Chief Engineer for One & Two Potomac Yard.

17 LEED for Existing Buildings: Operations & Maintenance provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

18 The United States Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

19 Guideline 0-2005, *The Commissioning Process*, from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) describes how to verify that a facility and its systems meet the owner's project requirements. This guideline also defines sustainable development goals for the project.

20 ASHRAE stands for The American Society of Heating, Refrigerating and Air-Conditioning Engineers.

enables them to anticipate and troubleshoot problems that are evolving and developing. The commitment of the team to real performance is critical, and that needs to happen from the beginning with a firm commitment by the developer. This requires not just a commitment to green design; it requires making a commitment to deliver a functional building.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on September 28, 2009, at Potomac Yard in Arlington, VA.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

MAUREEN DOWLING

BUILDING MANAGER, JONES LANG LASALLE

PROCESS | ROLE ON THE PROJECT TEAM

As the Property Manager for One and Two Potomac Yard, I'm charged with operating the building, keeping the tenants happy, and keeping it financially stable. In order to have an efficiently operated building, I have to make sure that the tenants want to stay in our property and that the owners are able to make money. I oversee the operation of the building, but I obviously don't do this alone. Any successful project is done by teamwork; it is done in conjunction with the engineering team, the office staff, and the tenants.

MAUREEN DOWLING, LEED AP, leads Jones Lang LaSalle's Property Management team at Potomac Yard. She is responsible for the physical, financial, and administrative management including reporting, budgeting, and property performance. She is charged with applying and maintaining leading edge thinking and sustainability practices through Jones Lang LaSalle's policies, programs, and business processes. Maureen joined the company in 2006 and has more than 20 years of professional experience in the commercial real estate industry.

GETTING INVOLVED WITH THE PROJECT

I came onto the project at the very end of the construction phase; it was January or February of 2006. The tenants moved into the building in May of 2006. I was fortunate to be able to get acquainted with the building and start getting the systems in place in anticipation of their move.

WORKING WITH THE PROJECT TEAM

When I came onto the project, the LEED for New Construction (LEED-NC)[1] certification for Potomac One was being finalized; all of the data was being collected and organized for submission. At the time, I was not familiar with LEED, so I needed to educate myself in order to take the project to the next level and manage the building operations. I asked questions of the members of the project team and I read the LEED-NC Reference Guide. At that time, I didn't realize that there were different designations for LEED, or that the owner was planning to pursue LEED for Existing Buildings (LEED-EB).[2] At that point, I was focused on acquainting myself with LEED and trying to figure out how to maintain a building with sustainable features.

The developer, Crescent Resources,[3] had a couple of LEED AP[4] staff members; in the beginning, we worked with them on a routine basis. Additionally, we consulted with our sustainable design consultant, Sandra Leibowitz Earley.[5] We've retained our relationship with Sandra, and she has been excellent in keeping us up-to-date on the things we need to know to maintain sustainable building operations.

1 LEED for New Construction (LEED-NC) is designed to guide and distinguish high-performance commercial and institutional projects.

2 LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements and maintenance.

3 Crescent Resources, LLC, is an owner and developer of commercial office buildings headquartered in Charlotte, North Carolina.

4 A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

5 Sandra Leibowitz Earley is the Principal and founder of Sustainable Design Consulting, LLC, a sustainable design consulting firm with offices in Richmond, Virginia and Washington, D.C.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

TOOLS AND RESOURCES

We educated ourselves by speaking with experienced individuals and by researching information through the U.S. Green Building Council (USGBC).[6] We read the LEED reference guides and took the LEED courses. We were then able to break down, for ourselves, each LEED credit to draw out the things that we needed to do to ensure the intended operations. The Chief Engineer and I became LEED APs, and now other individuals within our department are aiming for that accreditation.

ESTABLISHING PROJECT GOALS

When you take on a new building, whether it's a LEED building or not, you're charged with a difficult task. The property manager and the engineering staff have to ensure proper building operations. Specifically, we set up the programs, including the cleaning programs and address the small things that no one else thinks about.

When I came onto One Potomac Yard, there were already certain protocols in place that were mandated by the LEED rating system. For example, we already had a Green Housekeeping Plan[7] and an Integrated Pest Management Program[8] as a result of the LEED-NC certification. Our next step was to facilitate trash removal and then, following that, get contracts in place to staff our engineering team. A lot of work goes into the beginning of a project; I was initially involved in staffing the building, getting the right people trained, and learning about our mechanical systems. In addition to the normal start-up activities, we were pursuing LEED-EB standards and had to educate ourselves on the process; that was a large part of the initial building operations.

CONSTRUCTION | INVOLVEMENT DURING THE CONSTRUCTION PROCESS

When I came on, the construction team was still testing their systems in order to make sure that everything was working properly. I became more involved once the tenants scheduled a move-in date; I facilitated the tenant's move in and installation.

OPERATIONS | OCCUPANT AND USER EDUCATION

The U.S. Environmental Protection Agency (EPA)[9] had a team that created an informational packet; these were handed out to the tenants at move-in. These packets gave the tenants an overview of the building and its operations. The tenants moved from older buildings where everybody had private offices; it was a hard adjustment for people to come here and have an open space plan and modular furniture. A lot of people weren't used to having their neighbor so close or being able to overhear conversations. It was a challenge for them to learn the etiquette, but they got past that. They were surprised with everything when they moved in; they had new computers, new telephone systems, and many new features in the building. Most of them have adjusted to the change.

The education of the tenants is probably the greatest challenge in maintaining this building. We have to teach our tenants about LEED. Most of them are familiar with the terms "sustainable" and "green," but everyone has a different adjective or description as to what those mean. Our biggest challenges are to define what's sustainable about our practices and to get occupants to buy into our program to makes it a success.

ONGOING COMMUNICATION WITH PROJECT TEAM

Even today, I still talk with Elizabeth McMillan[10] and Dan Kohlhepp[11] from Crescent Resources. Dan headed up the project team for the developer, but has since retired. I occasionally speak with Paul Tseng.[12] Wayne DeGroat[13] talks with Paul more often than I do. Wayne

6 The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

7 A Green Housekeeping Plan outlines the use of non-toxic cleaners, paper products, and other materials used in the upkeep, cleaning and maintenance of the building.

8 An Integrated Pest Management Plan outlines the methods and actions needed to ensure pests and other insects do not compromise the lifespan of the building materials.

9 The U.S. Environmental Protection Agency (EPA) is an agency of the federal government that employs 17,000 people. Its headquarters are in Washington D.C. and also operates 10 regional offices and a dozen laboratories.

10 Elizabeth McMillan is the Project Manager for Crescent Resources, LLC involved in this project.

11 Daniel Kohlhepp is the President of Crescent Resource's commercial division.

12 Paul Tseng is a Principal with Advanced Building Performance, Inc., a high-performance building consulting practice located in Washington, D.C.

13 Wayne DeGroat is Jones Lang LaSalle's Chief Engineer for One and Two Potomac Yard.

contacts him if he needs advice with an issue or problem. More frequently, I pick up the phone and call Sandra. I try to stay ahead of the curve to make sure that we don't violate any of the sustainable or monitoring features that accompany the new LEED-EB requirements.

ONGOING CERTIFICATION

The pursuit of LEED-EB was a requirement under the lease agreement. The ownership was the driving force behind pursuing and obtaining both LEED-NC and LEED-EB.

The LEED-EB certification didn't have a large impact on our operations because we had been applying sustainable objectives since the beginning of the building. In order to apply for LEED-EB, we had to record everything that we had already been doing. It was black or white: either we were doing it and earning the point, or we weren't. I spent a lot of time recording all of the programs and procedures so that they could be uploaded. Most of the credits we earned, we had been fulfilling all along and had already been preparing to document them for an extended period of time.

We began the LEED-EB process within two years of our initial LEED-NC certification. During this process, we retained the relationships with Paul Tseng and Sandra Leibowitz Earley that Crescent had developed during the pursuit of LEED-NC. This is one of the only buildings that has transitioned from LEED-NC to LEED-EB certification; everybody was excited. The LEED-EB process had a large impact on our chief engineer, but it didn't have much of an impact on the everyday life of the tenants. Wayne and I were documenting the programs that were already in place, to satisfy the requirements.

ADVICE FOR FUTURE PROJECT TEAMS

Teamwork is the most important factor in being able to successfully monitor a building of this type; one person can't do this alone. Everybody has to be on-board, including the engineering staff, the tenants, and the ownership. Once you get everybody involved, it actually becomes fun. There are so many interesting and fascinating new technologies out there. I frequently see new technologies and think that, one day, maybe not today or tomorrow, but perhaps in a couple of years, we could adapt the technology for use in this building with little cost to the ownership. I'm very excited about looking into the addition of solar panels in order to offset the cost of the hot water heater. There is fascinating information available, and it's interesting to delve deeper and see how we can apply it to the building.

SHIFTING SKILLS

I don't see a difference between maintaining a sustainable building and maintaining a building that has not been designed with sustainability in mind. I have trained myself to be more conscious of the environment and to be more careful with the chemicals that we do or don't use; it's a different way of approaching building operations. From this point forward, I will be operating all buildings as sustainably as possible. It makes more sense and is more cost effective; there's no reason to do it any other way.

OCCUPANT AND USER RELATIONSHIPS

Our new green protocols are becoming less of a hurdle to overcome with our tenants. We're now seeing our tenants wanting to be more sustainable and, while they may be used to something that is more convenient and less sustainable, they are often willing to meet us halfway. Overall, everybody is now more conscious about the environment.

Most tenants enjoy it here. We're always open to input and suggestions for improving our operations. Generally, we don't speak directly with the tenants, but we have had some town hall meetings and discussions on various things that we do within the building. We host a series of different programs for the tenants throughout the year in order to explain our operations, and we've received direct feedback in that manner. For a facility this large, the EPA has an on-site facility office. We coordinate primarily with their facility manager to implement our programs. We get most of our occupant feedback through their team.

MONITORING BUILDING PERFORMANCE

At the end of every year, we collect all of our data in order to analyze our operating expenses. We've seen savings reflected in our energy consumption, as well as from recycling rather than paying for full trash disposal. We may have higher expenses in some categories, for example, the MERV-13 filters,[14] but we don't have to change them as often. There are tradeoffs with everything but, overall, it's cheaper to be green.

14 MERV stands for Minimum Efficiency Reporting Value. This standard was developed by ASHRAE and it indicates the filter's efficiency at trapping airborne particles.

Recycling Staging Area "At the end of every year, we collect all of our data in order to analyze our operating expenses... There are tradeoffs with everything but, overall, it's cheaper to be green."

An interesting feature of Potomac Yard is the harvesting of daylight. There are three rows of light fixtures around the building perimeter that dim or intensify in response to the available daylight. They are set to maintain a certain threshold throughout the day, which saves us a lot of energy, as long as the tenants don't close the blinds. There's a catch to everything. We also have motion sensors that shut the electric lighting down at night, which saves us another enormous amount of money in terms of energy use. Our overall operating expenses are lower in general. We've found that it is cheaper to run a green building.

LESSONS LEARNED

We do put language in our leases, as part of the build-out, to try and keep tenants engaged in sustainable practices. A LEED for Commercial Interiors (LEED-CI)[15] certification is not a requirement because of the high cost associated with that certification; it is expensive for a tenant to pursue LEED-CI. With that said, we do run each job as if it were pursuing a CI certification; we monitor all that you would monitor during the build-out.

There were some minor challenges with materials on this project. For example, we tried to use recycled rubber flooring in our stairwells. However, we were unable to find a glow-in-the-dark product. We ended up choosing a non-recycled rubber for the stair treads because of the life-safety issue. Since that was a few years ago, I bet that now I could find a recycled, glow-in-the-dark rubber.

FUTURE CERTIFICATIONS

One Potomac Yard and Two Potomac Yard are different. One Potomac yard is 100% occupied and we haven't done any additional construction. Currently, we don't have a certification for Two Potomac Yard beyond LEED-NC, but we have one tenant that just finished their build-out and recently submitted to earn a LEED-CI Gold certification. They're still waiting to hear the results of their submission; we're very excited to learn of the outcome.

15 LEED for Commercial Interiors (LEED-CI) is a benchmark for the tenant improvement market that gives the power to make sustainable choices to tenants and designers.

SHIFTING SKILLS

The skills to be a property manager are always evolving and changing. A good property manager must understand asset management and green strategies. This is a good change; it doesn't make building operations more difficult, it just makes them different.

In 2006, we were training our vendors and nobody knew what we were talking about when we said "low VOC."[16] They would look at us like we were speaking another language. Now everybody is on-board and we're seeing the changes in the available products. Most of the contractors are also on-board. Everything is easier now than it was just three short years ago; it's amazing.

FUTURE GOALS FOR THE PROJECT

LEED is the baseline for everything we do. The LEED reference manuals are our primary resources and we try to build upon those. There may be goals that we set for the future that are unobtainable now. For example, we currently divert over 50% of our waste through our heavy recycling program. Our goal is to get that number up to 60-65% by next year. We're going to revamp all of our recycling and try to capture some of our wet trash and recycle that as well. It's going to be a bit of a sticky situation because we're limited in terms of the space that we have available for dumpsters. We have to think outside the box with everything that we do here because of our specific constraints. We need to take a fresh look at things and be creative about how we accomplish our future goals.

THE FUTURE OF LEED

I think that LEED is evolving, but I almost think that it may be evolving too quickly. In order to keep our LEED certification, we have to keep up on all of the changes. I constantly have to get new reference books and read them in great detail. I'm always trying to keep up-to-date on the new strategies and technologies. Overall, the changes being made to LEED-EB are positive. For instance, we used to have to separate bottles, glass, and cans for our recycling, but now they accept a single stream. Obviously, that reduces our operating costs, which is wonderful news to us.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on September 28, 2009, at Potomac Yard in Arlington, VA.

16 VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

WAYNE DEGROAT

CHIEF BUILDING ENGINEER, JONES LANG LASALLE

OPERATIONS | ROLE IN THE BUILDING OPERATIONS

I'm the Chief Engineer for Jones Lang LaSalle[1] at One and Two Potomac Yard. I monitor daily operations, tenant comfort, and building security. I came in July of 2006, just after the property had turned over from the developer to the new owner.

WAYNE DEGROAT is a LEED AP and the Chief Engineer at One and Two Potomac Yard. He has more than thirty years of experience as a building engineer.

CHALLENGES OF THE PROJECT

In some aspects, having a LEED[2] building is more difficult to run because someone is looking over your shoulder all the time. With all the trend data to record, we need two portals to the building information system; it's just too much for one computer to handle.

The Government — our tenant — has set points and parameters that they're supposed to stay within. Getting the building conditions and occupants to adhere to those can be a big challenge. It's common for all properties to have challenges staying within parameters; the challenges here aren't so different from any other property. We just have different equipment to play with.

One of the challenges in the first three years has been getting familiar with the EMS.[3] It's a state-of-the-art system and you have to become familiar with all of the controls for the equipment to make it live up to its potential. At the time, we were finding out what the parameters and potential were for the system. For example, we have CO_2 sensors on all the floors, which can override the normal system settings. I learned to understand how they affect day-to-day operations and how they interfaced with the mechanical equipment. There are so many different aspects of the EMS.

I'm not sure who came up with the idea that MR16s[4] are energy efficient bulbs, but they're not; they're labor intensive. I've been going through the process of changing out the bulbs for LED[5] bulbs that will function with the current ballasts. Some of them need a different ballast to drive the LEDs. That's one area where we made an improvement during the EB[6] process. Other than that, I'm just keeping up with the equipment, which isn't uncommon for any property.

1 Jones Lang LaSalle is a financial and professional services firm specializing in real estate services and investment management. They are the property management team for One and Two Potomac Yard.

2 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

3 Environmental Management System is a performance tracking tool that has the ability to monitor and supply information regarding building policies, planning, implementation and operation, checking and corrective action, and management review.

4 MR16 light bulbs are a standard format for halogen reflector lamps made by a variety of manufacturers.

5 A light-emitting diode (LED) is an electronic light source. They offer benefits in terms of energy consumption, longer lifetime, improved robustness, smaller size and faster switching. The can be relatively expensive and require more precise current and heat management than traditional light sources.

6 LEED for Existing Buildings: Operations & Maintenance (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements and maintenance.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes, prepared this narrative.

Elevator Room "Just by tightening belts, greasing the equipment, reducing friction, and adjusting the lighting loads — which is one of the largest energy uses in a property — you can conserve a lot of energy."

LEARNING TO RUN THE BUILDING

It usually takes a year or so of going through several seasons to get comfortable with the processes in a new building. At Potomac, in addition to that, we were learning how to use the equipment to collect information for the LEED credits; commissioning can be a basic task for turning over a new property, but whether the building is LEED certified or not, that process can be very cumbersome. Sometimes it is more cumbersome than bringing the antiquated property up to date.

It's always been my job to reduce energy consumption, but in this building, I have more tools and a whole lot more information being collected to support more informed decisions. Sometimes engineers have to go through a trial and error process because they're not exactly sure how their decisions will affect the building. For example, they mandate a certain amount of fresh, outside air per square foot, but only half of the typical occupants are present on that floor; so, then that calculated amount is not actually required and a lot of energy is wasted to condition all that outside air.

JOINING THE PROJECT

In the beginning, we were working with Davis Construction[7] for the warranties and commissioning,[8] and with Bowers,[9] the mechanical contractor. The SCUs[10] are all Trane[11] units, which interface with the Siemens VMS[12] system. The best-case scenario is having all the equipment

7 James G. Davis Construction Co. is a construction services company headquartered in Rockville, Maryland with offices in McLean, Virginia. Their work includes new construction, renovations, and interiors for corporate, government, educational, retail, and food service clients in Virginia, Maryland, and Washington D.C.

8 Commissioning is the process of ensuring that a building is performing and operating according to the design and construction intentions.

9 W.E. Bowers was the mechanical contractor. As a company, they provide mechanical construction and HVAC service to general contractors, high-tech companies, property managers, government agencies, and institutional clients.

10 A System Control Unit (SCU) is the method through which HVAC systems are monitored and controlled in a building.

11 Trane manufactures and services HVAC equipment.

12 Vessel Management System (VMS) by Siemens is the computer system and portal through which all of the data collected by the Trane unit is packaged and available for use by the Chief Building Engineer and his employees.

work well together. Since in Potomac Yard project, Trane equipment communicates with Siemens equipment, there is a greater probability of having problems because of the translation of the information. In the beginning, we had to bring everything together carefully.

When I came onto the project, they had just finished the initial commissioning for the new construction and the tenant build-out for the EPA.[13] I wasn't very involved with the initial commissioning. I wish I had joined the project six months earlier; I could have acclimated myself to the equipment and worked with the commissioning agents. I would have gotten to experience, hands-on, what they were doing and what they expected the equipment to do. I came in on the tail-end of the process and had to shoot from the hip.

MONITORING BUILDING PERFORMANCE

The maintenance and fine-tuning of the systems are ongoing, but that's true with any property. We're still educating ourselves. Just by tightening belts, greasing the equipment, reducing friction, and adjusting the lighting loads — which is one of the largest energy uses in a property — you can conserve a lot of energy. We did extensive commissioning but had no major problems. We reduced the water flow through the condensers to almost two GPM[14] per ton; in normal operation you can get up to three GPM per ton. So, we tend to check our condensers on an annual basis. At a lot of properties, that's only required every five years.

We monitor everything through our EMS. It represents our whole mechanical plant. It shows us whether we're in mechanical cooling mode or economizing mode. I can see water temperature, wet bulb readings, outside air humidity, and the outside air temperature. I can look at the commands for the cooling tower drives and the pump drives, and I can monitor the temperature and pressure differentials.

It's important to have a way of observing and monitoring all of this. There is no way that an individual could physically keep track of all this trend data. When you submit for LEED-EB,[15] you have to be able to prove everything: water flow, water usage, the percentage of your water that goes to the Sloan[16] fixtures and to the mechanical cooling.

With this amount of data, there's more to stay on top of. Sometimes it gets too technical, which creates more problems and more areas where things can go wrong. That hasn't happened with Potomac Yard to a great extent. It's all been pretty good, and it's been a really good experience. If I had to do it all over again, I would.

ONGOING COMMUNICATION WITH THE PROJECT TEAM

Scott Nelson[17] confirms ENERGY STAR[18] on an annual basis. He and his company did the commissioning and the re-commissioning, which were pretty costly for the owners. They commissioned the building, and then, two years later, they re-commissioned it for LEED-EB. I believe the LEED-EB requirements for re-commissioning have changed because of the total cost.

I was extensively involved in the re-commissioning process. I made sure that Scott had access to the EMS and all the daily trend data that the computer logs. For example, there are about 35 VAV[19] boxes per floor and there are 10 floors. Each VAV box takes a reading every 1/2 hour, and that is just one point. There's a lot of trend data. We didn't really have any problems arise in the re-commissioning; everything was working pretty much as it was sold and installed, which had a lot to do with the commissioning that took place upon turnover.

SUCCESSES OF THE PROJECT

The way the whole system functions together — the thought process behind the system — works well. As Paul[20] says, "Everything here is integrated." Many properties

13 The U.S. Environmental Protection Agency (EPA), headquartered in Washington D.C., is an agency of the federal government whose mission is to protect human health and the environment. The EPA operates 10 regional offices and a dozen laboratories.

14 GPM stands for gallons per minute, a common unit for measuring flow rates.

15 LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

16 Sloan is a bathroom fixture company that specializes in flush efficiency. They are located in Franklin Park, Illinois.

17 Scott Nelson, of Summit Building Engineering, is the ENERGY STAR representative and is responsible for collecting and checking the submitted data for the yearly ENERGY STAR rating.

18 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy which helps Americans save money and protect the environment through energy efficient products and practices.

19 Variable Air Volume (VAV) is a technique that enables the capacity of a heating, ventilating, and air-conditioning (HVAC) system to be controlled.

20 Paul Tseng is a Principal with Advanced Building Performance, Inc., a high-performance building consulting practice located in Washington, D.C. He acted as the commissioning agent for One and Two Potomac Yard.

have VFDs[21] installed on their pumps, but not their towers. At Potomac, we have VFDs installed throughout the whole mechanical system, down to the air handlers, and even the pumps that feed the air handlers. We don't waste energy pumping any more than what's required. We can tune the system to handle the right load and give the cooling towers that capability by upgrading them from a pony motor to a larger motor. With the drives in place, you've got a tighter control on energy usage.

When I got here, we installed VFDs on all our backup pumps. There are three sets of pumps. They had one main pump that was tied into the VFD and a backup pump that was not. With the VFDs installed on the backup pumps, we don't waste energy even if they come into play or if we exercise them. That implementation came down to having the support of the owners, because it was expensive.

I haven't had to deal with this amount of extensive trend data on other projects. In the past, I might trend something when I was troubleshooting or looking for a problem. To have this ongoing data collection means that we have a massive amount of data. The more information that we can collect and analyze, the more informed decisions we can make. All of the data is backed up through Siemens. During the commissioning process, the commissioning agents had to go through all of that data.

OCCUPANT AND USER RELATIONSHIPS

Accommodating the occupants can be a challenge. Our occupants are a little bit different than most; the EPA occupies the building. Some people would consider that an asset to running a green building, but sometimes it is quite cumbersome to educate them about the parameters we're maintaining. I usually handle it one call at a time. In any building, there are people or areas that will have problems. When we get a call, we check the EMS, get a readout on the floor, and find the corresponding temperatures. We can usually find the problem immediately, if there is one. The computer readout is a cartoon, and you have to bear in mind, it's just a tool that you can work with. If you really want to know what's happening, then you have to go to that floor and verify the information. Too many times, I've seen computers showing what looks like the correct data, but they are just showing the last data that they recorded which isn't necessarily showing accurate, current conditions.

Because of the discrepancies, we verify every call. With temperature issues, we have to visit the person who made the call. First, my staff checks the seating location of the individual in the open bays. The new seating arrangement in the open bays had a learning curve for the tenants. A lot of the people came from different properties where they had individual offices; now they're in open bays, which they didn't like at first.

Everything is running pretty well now. New tenants have an adjustment period where we're trying to locate their comfort level. Everybody has their own comfort level, and our goal is to find it while staying within our parameters.

SHIFTING SKILLS

There are a lot of skills that future building managers will need. Personally, I think that we're behind the curve; we should have been thinking along these lines 80 years ago. Keeping up-to-date with current technologies and being able to implement them — even though technology is changing rapidly these days — is important. Saving energy is nothing new for my trade; it's what I get paid to do. I am always looking to see where I can trim back. This building can be challenging because somebody tried to think it all out for me.

This was all new for me; there was a big learning curve. I've been in this trade for almost 30 years and found the new challenge of trying to grab hold of this building and get it under control exciting. I encouraged my staff to learn more about all the strategies and systems because the more they know the more credible and effective they can be. There's nothing out-of-the-ordinary here, nothing that you wouldn't find in other buildings, but there is a learning curve for the individuals who have to deal with the equipment.

I've got to be up-to-date with my equipment and, like I said, I have to be capable of making this system function like it's designed to. I try to get it to exceed the design expectations. I take pride in the fact that sometimes I can make the equipment do more than it was designed to do. When it's designed so that it doesn't live up to the expectations, though, that's when I have problems. Even if one of the portals to the building information system turns off, I don't need it to run the property; everything can work independently of that system.

21 A variable-frequency drive is a system for controlling the rotational speed of an alternating current electric motor by controlling the frequency of the electrical power supplied to the motor.

BECOMING A LEED ACCREDITED PROFESSIONAL

I went through the whole LEED AP[22] course, which was an experience. I've never failed anything, and I failed that exam. It seemed like some of the questions came without any context or preparation. I was surprised to see that I had to pick three answers out of five on some questions; this is not what most people are used to with multiple choice exams. Some of the answers were so close that I had to stop and remember what category the question was about, since one credit can reference another credit.

THE LEED CERTIFICATION PROCESS

Going through that process, I learned what the USGBC[23] is trying to accomplish. Is everything perfect? No, this is the first generation of the program and a lot of the equipment. They're making improvements now. We sometimes won't know whether our efforts will work until we've put the equipment out into the field and tested it. At least people are trying to make progress and trying to make change.

LESSONS LEARNED

Getting this building to work well requires all the players to play in line. The tenants have to do their recycling and I need their reports to show all the paper that they shred. Sometimes I can't believe that we have such a hard time getting this information from the EPA; in many instances, they're the ones who mandated the regulations in the first place.

OWNER INVOLVEMENT

The current owner of the building is fantastic. They want to be on the forefront of energy issues, which makes my job much easier. I've worked at properties where I had to try to run things on a shoestring. It's unbelievably inefficient when you have to pillage from one thing to keep something else going.

If the owners weren't concerned with conservation, I wouldn't have the tools to do what I need to do; I couldn't do it without their support. They listen to my recommendations, which is not always the case in my experience.

THE FUTURE OF POTOMAC YARD

I'm more motivated to get this building to perform exceptionally well because of its visibility. I want to know how far I can go. It's very important for me to grasp the new technology and be able to apply it as it pertains to this property. I also need to realize when something isn't going to be worthwhile; that comes from experience. That comes from playing with things that come down the pipe, or sometimes, letting other people try things out first.

I've deployed a "green" chemical system for our cooling towers because we need inhibitors to prevent scale and erosion. We need biocides to keep the water moving freely and prevent pathogens from spreading. Right now we're using products with low sulfates, but there is a nonchemical water treatment being developed. I've let somebody else try it for a while to see what it does to his pipes. I'll keep an eye on what's going on and then make updates if I need to. Why sacrifice both buildings when he's doing it anyway?

Maureen[24] and I set new performance goals for the building all the time, but we've been given something that's already top-of-the-line. Until there's something new that's mind boggling, I have to wonder if it's really going to be useful or cost effective. I have an obligation to the owners to give them a return on their investment. For example, we had just spent all of that money going through the commissioning two years ago and I had a hard time swallowing the requirement to re-commission the building. When you re-commission, you have to track all of the equipment. I even had to track the air pressures in the janitorial closets.

How do you explain to the owners that this re-commissioning was going to cost around $100,000 and be very similar to what they had done two years ago? It seemed like I was spending $100,000 to show them how to save $20; the math wasn't convincing to me. But they were willing to carry out their obligation and take that extra step. LEED requirements have changed since then. Now things have to be more cost-effective for an owner to want to take on a project like this. On the other

22 A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

23 The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

24 Maureen Dowling is the Property Manager for One and Two Potomac Yard and represents Jones Lang LaSalle, the property management company involved in the operations and maintenance.

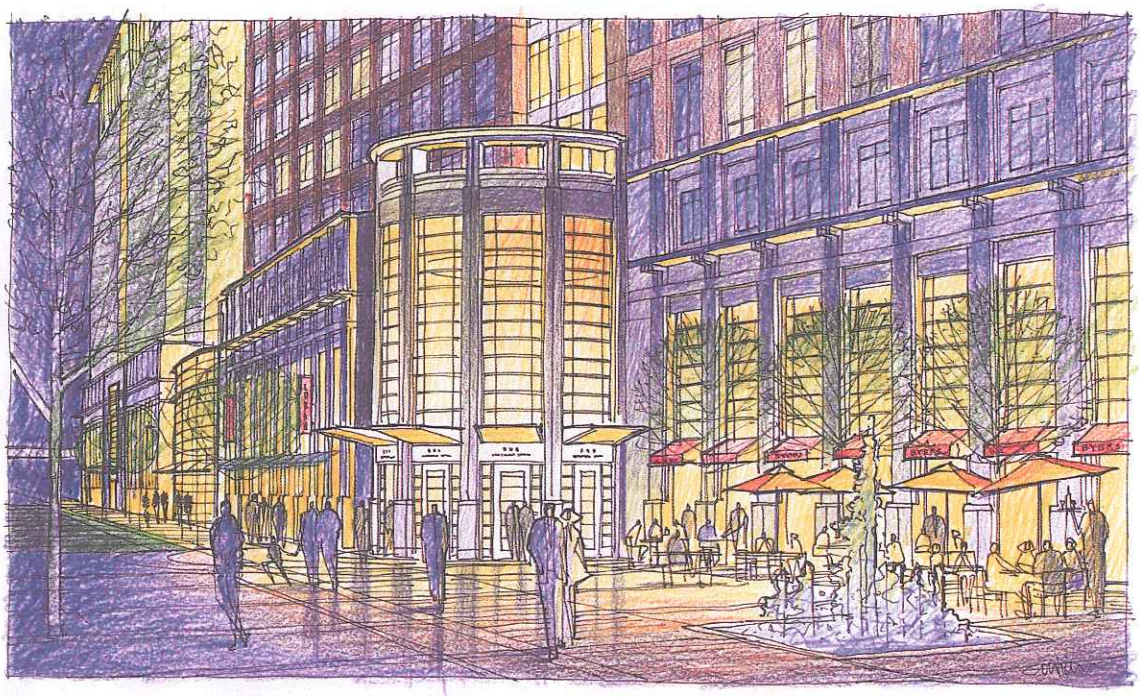
hand, you can't just make a straightforward monetary argument; you have to consider if the project is really going to have long-term value for the owner. At Potomac Yard, they have tried to implement projects that look good but are very labor intensive. For example, a certain new strategy might save something on our electric bill, but when we have to pay someone to go up and down a ladder, changing a bulb fifty times, we're not accomplishing much in the end.

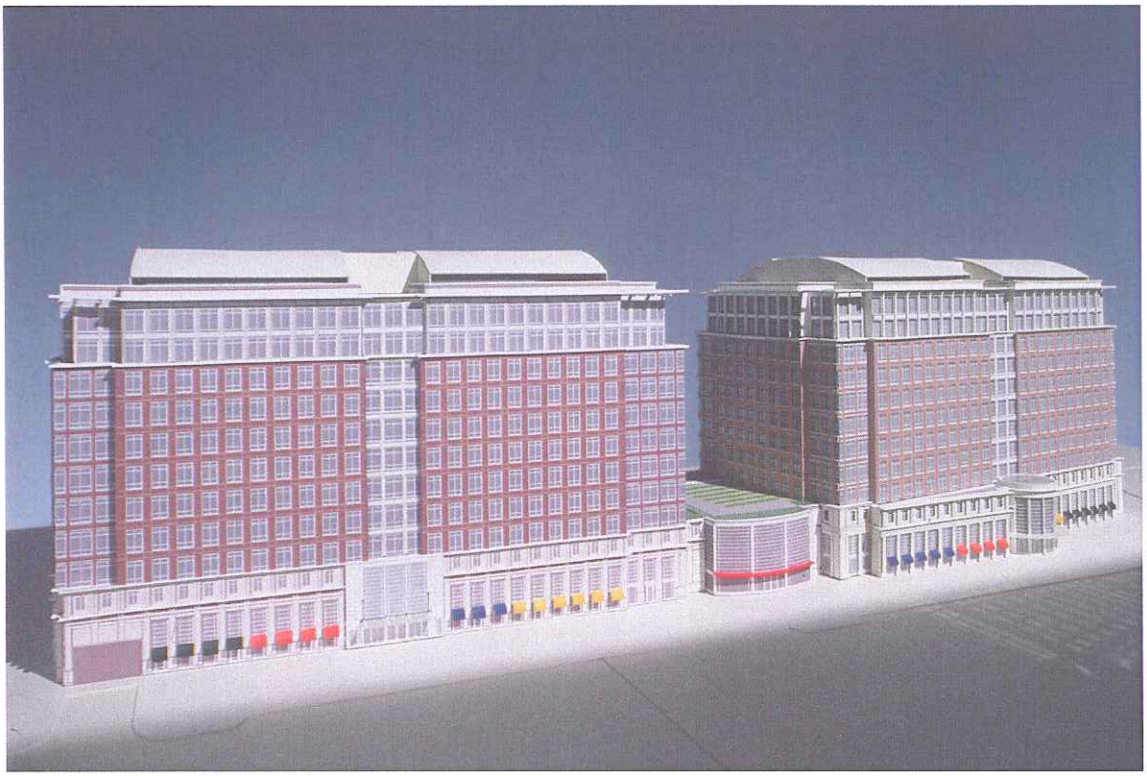
The owners are willing to invest the time and money into this project; they're pushing LEED across the board. Sustainability has been a driving force for both the owners and for Jones Lang LaSalle. The Chief Engineer meetings that they have out in Arizona every year are amazing. They have a lot of classes and you spend several days going to seminars and listening to what other people are working with and where you can go with it. Both companies are teaching their teams what LEED is all about and understand that this is where the world is going. It's even on the Disney channel; they've got kids talking about unplugging their cell phone chargers when they're not in use and asking them what they can do to conserve energy. It's unbelievable where these ideas have manifested themselves and it is positive for a change.

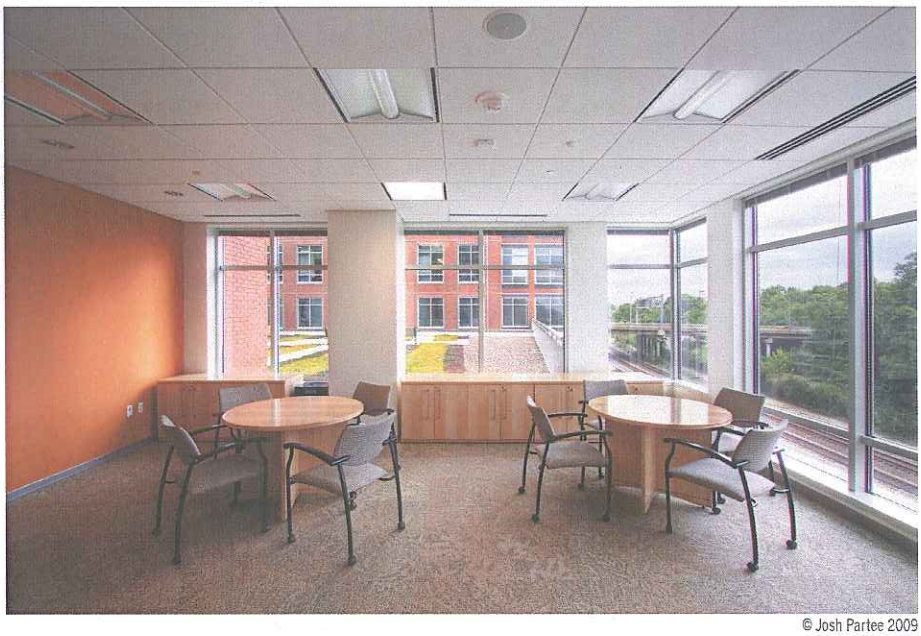
This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on September 29, 2009, at Potomac Yard in Arlington, VA.

APPENDIX A

IMAGES







"One & Two Potomac Yard was the first office building under construction at Potomac Yard, Arlington County's premier urban redevelopment project. This twelve story, 650,000 square foot office building was complete in March 2006... Minutes from Downtown DC, the Pentagon, and Ronald Reagan National Airport, this highly secure office complex is in the middle of it all."

Prepared for the U.S. Green Building Council by the Case Study Lab of the Center for Housing Innovation at the University of Oregon, this book documents the visioning, design, construction, and operation of One and Two Potomac Yard in Arlington, Virgina. Interviews with members of the project team comprise this volume:

Elizabeth Adams McMillan, Project Manager, Crescent Resources
Cathy L. Berlow, Project Manager, U.S. Environmental Protection Agency
Brendan Cullen, Mechanical Engineer, Girard Engineering
Wayne DeGroat, Chief Building Engineer, Jones Lang LaSalle
Maureen Dowling, Building Manager, Jones Lang LaSalle
Fulya Kocak, Project Manager, James G. Davis Construction Co.
Sandra Leibowitz Earley, Principal, Sustainable Design Consulting
Paul Tseng, Principal, Advanced Building Performance

The U.S. Green Building Council (USGBC) is a 501(c)(3) non profit composed of leaders from every sector of the building industry working to promote buildings and communities that are environmentally responsible, profitable, and healthy places to live and work.

Principal Investigator: Alison Kwok
Advisor: Nicholas Rajkovich
Researchers: Rachel Auerbach, Kristen DiStefano, Britni Jessup, and Amanda Rhodes
Photographer: Josh Partee