

Roanoke County Public Safety Training Academy

Programming Requirements and Site Recommendations

**Prepared for the
Roanoke County Police Department**

August 2006



The Community Design Assistance Center (CDAC) is an outreach center of the College of Architecture and Urban Studies at Virginia Tech that assists communities, neighborhood groups and non-profit organizations in improving the natural and built environments through design, planning, policy, and research. Through the integration of the learning and working environment, the Center will execute projects that link instruction and research and share its knowledge base with the general public.

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ACKNOWLEDGEMENTS

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ROANOKE COUNTY ADMINISTRATION

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ROANOKE COUNTY SHERIFF'S OFFICE

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Capt. Barry Tayloe
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Deputy Chuck Hart
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ROANOKE COUNTY FIRE AND RESCUE DEPARTMENT

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VINTON POLICE DEPARTMENT

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Sgt. Ben Cook

FRANKLIN COUNTY SHERIFF'S OFFICE

Capt. Robert Strickler
Lt. Ewell Hunt

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EXECUTIVE SUMMARY

PROJECT: Roanoke County Public Safety Training Academy

LOCATION: Kessler Mill Road, Salem, Virginia

CLIENT: Roanoke County Police Department

PROJECT DESCRIPTION:

The Roanoke County Police Department requested assistance in defining programming requirements and square footage requirements for a new regional public safety training academy that would be used to train police, sheriff, fire, and rescue personnel. In addition, they requested assistance in determining if the County-owned Kessler Mill Road site would be suitable for the new facility.



FINDINGS:

- The Kessler Mill Road site is suitable for the envisioned training facility.
- The Kessler Mill Road site is easily accessible from Interstate 81.
- Locating on the same site as the existing Roanoke Valley Regional Fire-EMS Training Center enhance the training facilities, experiences, and interactions for all public safety officials.
- Conceptual building footprints of 74,000 to 86,000 square feet fit on the site outside of the flood plain and include most of the items on the public safety officials' wishlists.
- Better use of the Kessler Mill Road site would improve one of the first public views of Roanoke County from Interstate 81.
- There are opportunities to make the new academy LEED-certified facility.



I. INTRODUCTION

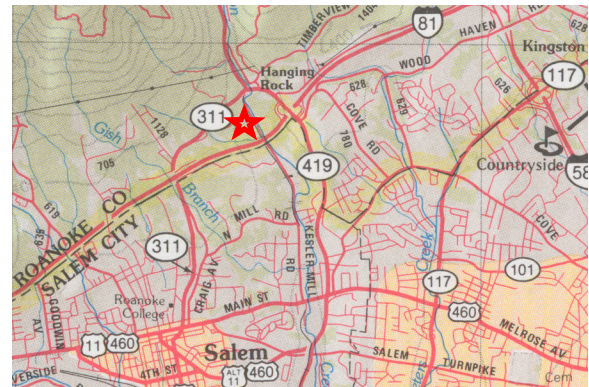
Roanoke County, Virginia is in the beginning phases of defining the programming requirements for a new regional police, fire, and rescue training academy to serve Roanoke County, Vinton, and Franklin County. The Roanoke County Police Department contacted CDAC to help them define programming requirements, square footage requirements, and site recommendations.

With changes to national security, in light of the tragedies of September 11, Roanoke County is encouraging Police, Fire, and Rescue personnel to train together at a single facility. In addition, the County would like to develop several public safety complexes that are near to each other, but which enable individual communities to have a local police, fire, and rescue presence.

The CDAC design team performed a needs assessment to help the various agencies - including the Roanoke County Police Department, Roanoke County Sheriff's Office, Roanoke County Fire and Rescue Department, Vinton Police Department, and Franklin County Sheriff's Office - define their programming requirements. The results are square footage recommendations and recommendations for general siting on the 19.6 acre Kessler Mill site in Roanoke County, the location of the existing Roanoke Valley Regional Fire-EMS Training Center.



Location of Roanoke County within the Commonwealth of Virginia.



Map showing location of the Kessler Mill site in Roanoke County, Virginia.



This view of the Kessler Mill site shows the brick mill building, the fire facility in the right rear, and general services sheds to the left.



The existing Roanoke Valley Regional Fire-EMS Training Center is on the north side of the Kessler Mill site.



The site is shown highlighted in red with the fire facility at the top right, Kessler Mill Road and trail frontage at bottom, and I-81 at bottom left.



The currently 2-mile long Hanging Rock Battlefield Trail passes the Kessler Mill site and could be used for training runs.



This view from Kessler Mill Road shows the existing mill building used by the County and the proximity of Interstate 81.



The view of the Kessler Mill site from Interstate 81 between exits 140 and 141 is familiar to most local travelers.

II. GOALS

During initial client meetings, a number of goals for the project were expressed as described below.

Determine site suitability: The Roanoke Valley Regional Fire-EMS Training Center is located on 6 acres of the 19.6 acre Kessler Mill site. Of the remaining 13.6 acres, the lower portion, where the existing mill building occupied by the Parks and Recreation and General Services Departments is located, is generally flat and lies partially in the flood plain. The upper portion is reached by a steep slope, but has a flat area as well. The site is bordered to the west by an Interstate 81 overpass and to the southeast by Kessler Mill Road and the 2 mile long Hanging Rock Battlefield Trail. Roanoke County officials would like to know if the Kessler Mill Road site is large enough to accommodate a new Public Safety Training Academy.

Unity: Many of the training needs such as classroom, gym, and outdoor space are shared by all public safety personnel. Roanoke County officials would like a single training center on a single site to train all public safety entities in the county including law enforcement, fire and rescue, and corrections personnel.

Public visibility: The current Kessler Mill site contains a number of mismatched buildings and equipment and is a bit of an eyesore for those who notice it as they drive by on Interstate 81. Except for the Kessler Mill site, most of the views of Roanoke County that motorists see as they drive through are trees and forested mountains. That makes the Kessler Mill site critical as a reflection on the County. Roanoke County officials would like to improve the view from Interstate 81 at the Kessler Mill Road overpass through building and landscape design.

Decrease effects of flooding: Flooding from Mason Creek, poor parking lot drainage, and runoff from the steep hillside to the rear of the site result in minor flooding of parking lots and loading docks on moderately rainy days and more serious flooding of Kessler Mill Road, the existing Kessler Mill building, and parking lots. The site is variously in fifty and one hundred year flood plains. Roanoke County officials would like to restructure the site so that flooding becomes less of an issue.

Design for expansion: The Roanoke Valley Regional Fire-EMS Training Center was built about 10 years ago, but has already been outgrown. The four classrooms are full about sixteen hours per day most days. Roanoke County continues to grow in population requiring additional public safety personnel who require additional training. The new regional jail will open in 2008 also requiring a large number of corrections personnel to be hired and trained. It is also expected that other county departments will want to use the classroom space for their own training. Roanoke County officials would like the new Public Safety Training Academy to be designed for expansion.

Connection to existing Fire-EMS Training Center: The Roanoke Valley Regional Fire-EMS Training Center is well-designed, was recently built, and will remain on the Kessler Mill site. Any new buildings on the site should connect to the fire facility through physical structure, proximity, site design, landscape, or other means. Fire and rescue personnel should not feel excluded from the new facility; the site design should encourage use of the entire site by all disciplines.

Sustainable design/LEED: Roanoke County has embraced sustainable design with the new regional jail facility. The new Public Safety Training Center should use LEED principles where possible. More information about sustainable building practices is available in Appendix D.



Mason Creek which runs parallel to Kessler Mill Road and perpendicular to Interstate 81 is one cause of flooding to the site.



The flow of water in the Parks and Recreation Department parking lot creates a small stream on rainy days.



A class on the final day of their training at the Roanoke Valley Regional Fire-EMS Training Center.



A green roof is an example of sustainable design. ([www.onedayvancouver.ca/files/images/YWCA green roof 2.jpg](http://www.onedayvancouver.ca/files/images/YWCA%20green%20roof%202.jpg))



No wayfinding mechanisms make it clear that the Roanoke Valley Regional Fire-EMS Training Center is on the road to the left in this photo.

Wayfinding: While it is easy to see the Kessler Mill site from Interstate 81, it is less intuitive to find the site from Exits 140, 141, and Kessler Mill Road. Signage and other indicators are needed to help visitors find the site.

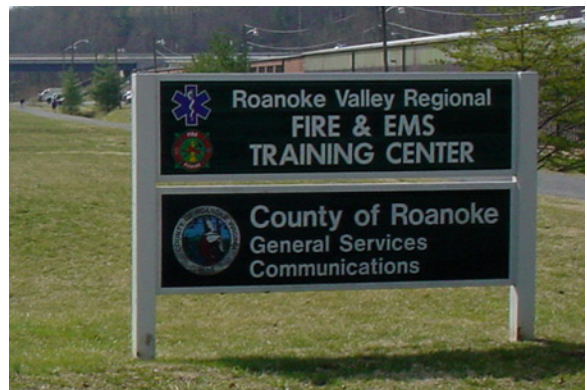
Crime and fire prevention example: Although visible from the interstate, the Kessler Mill site is isolated from other businesses and residences. While alarms and fences can deter intruders, there are landscaping mechanisms that can serve the same purpose, but in a more aesthetically pleasing manner. Using Crime Prevention Through Environmental Design (CPTED) techniques is an opportunity to educate the public about ways to prevent crime at their own homes. CPTED suggestions are presented in Appendix F. Similarly, sprinkling and using other fire suppression and prevention mechanisms within and outside the building provide examples for the public to emulate in their homes and businesses.

III. CONCERNS EXPRESSED

Potential partnerships: Concern was expressed by County and agency officials regarding potential additional partners for the Public Safety Training Academy. Some local police and sheriff's departments use the Cardinal Academy in Salem for training, others use Roanoke City's academy at the Jefferson Center. Will any of the departments using these other academies want to use this new academy instead? If so, how will that change the size of the academy? Will these other entities be willing to help pay for the new academy now? Or will they decide to join later? The partners in the existing Roanoke Valley Regional Fire-EMS Training Center are some of the communities that may be unwilling to participate in police and sheriff training at the new Public Safety Training Academy. How might that affect the viability of the new academy?

“If you build it, they will come”: Once the facility is in place, it is likely that other entities within the county will want to use the classroom space for their training as well. Other local police, sheriff's, and fire departments that have not yet expressed interest in being partners in the new training academy may decide they would like to use its resources once the academy is built. The potential for many additional users, coupled with the current population expansion in Roanoke County means that the academy should be sized for the future rather than today's population. Some have said to double the size it would seem is needed. It is clear that the academy should be designed with future expansion in mind.

Additonal fire training props: Though the existing Fire-EMS Training Center has a number of props used for practical exercises including a burn building, confined spaces, and a trench, there are a number of other large props they would like to add in the future that would likely require reconfiguring the existing site.



Signage for the existing Fire and EMS Training Center.



Classrooms such as this expandable one in the existing Training Center could be used by any number of different groups.



The burn building and other fire training props are on the northern edge of the Kessler Mill site.



The trench is used for rescue training exercises. Other training props are shown in the background.



Sheet flow from the parking lot in the Kessler Mill site's flood plain is a concern when there are heavy rains.



Water pours from the Interstate 81 overpass during heavy rains.



A garbage truck fills up with gas on the site. Interstate 81 is in the background.



The upper portion of the site, not visible from below, is used for county vehicle storage and abandonment.

Flooding: The potential for flooding from Mason Creek, runoff from the hillside behind the site and Interstate 81, and the inability of existing stormwater management pipes to deal with sheetflow on the largely paved site remains a concern. Water pools on the site in heavy rains, but has flooded the site, the existing mill building, and Kessler Mill Road on occasion as well.

Potential site contamination: Due to current and previous uses of the site, there is a high likelihood of contamination. The site's use as a gas station, car/truck wash, and storage and graveyard for county vehicles makes it likely that the ground and stormwater runoff contain petroleum and other potentially harmful products. The site's former use as a furniture mill means that a number of potentially harmful chemicals were used there that may today contaminate the ground.

Proximity to Interstate 81: The site's proximity to Interstate 81 poses noise and potential contamination issues from runoff from the highway. Other possible, but less likely, scenarios mentioned include accidents that could result in vehicles landing on the site or chemical contamination and snipers shooting from the wide breakdown lane area on the overpass.

Timing and politics: The discussion about a new regional academy falls at a time when Roanoke City is looking to replace their police academy at the Jefferson Center, the new regional jail facility will require training of 200 new jailors prior to its opening in the summer of 2008, the Roanoke County Sheriff's Department has pulled out of training at the Cardinal Academy, and the Virginia General Assembly has a moratorium in place for the building of new regional training academies. Each of these things is likely to have an effect on when and where the Roanoke County Public Safety Training Academy is built.

IV. PROCESS

Site visits, inventory, and analysis: CDAC team members visited the site a number of times to photograph and better understand the existing site. A visit in the rain gave insight into the stormwater management issues, views from Interstate 81 provided the more public overview of the site, and a walk on the Hanging Rock Trail gave a local resident's view of the site. Information gathered on the site and from various public sources was analyzed and used to develop the final programming requirements, square footage requirements, and site recommendations. The following pages present site inventory and analysis information including views from within the site to the surrounding area and into the site from the surrounding area; existing site divisions and acreage; slope analysis; topography and drainage; solar analysis; and a composite analysis of the site.

Training facility visits: To help the CDAC team better understand the programming requirements for a public safety training academy and to give the stakeholders some examples of existing academies, CDAC team members accompanied representatives from the Roanoke County Police Department, Roanoke County Sheriff's Office, and the Vinton Police Department to several training facilities in Virginia. These facilities included the Chesterfield County Police and Fire Academy (Eanes-Pittman Training Facility), the Henrico County Police and Fire Academy, and the Central Shenandoah Police Academy in Weyers Cave. The trip focused on police academies due to the focus of the project at that time. Information about each of these facilities was compiled into a spreadsheet for comparison. The CDAC team also toured the Roanoke Valley Regional Fire-EMS Training Center to learn about fire training. Information about the training facility visits is included in Appendix A.



CDAC team members photograph the Kessler Mill site from Interstate 81 with help from the Roanoke County Police.



CDAC team member, Lauren Merrill, tips the topographic model to find the sun angle for the site on December 21 at 8am.



Exploring the Hanging Rock Trail and drainage under Interstate 81 on a rainy day.



CDAC team members visit the Henrico County training facility with members of the client stakeholder group.



CDAC team members interview the Franklin County Sheriff's Department about their training needs.



Stakeholders hard at work "designing" the training academy.



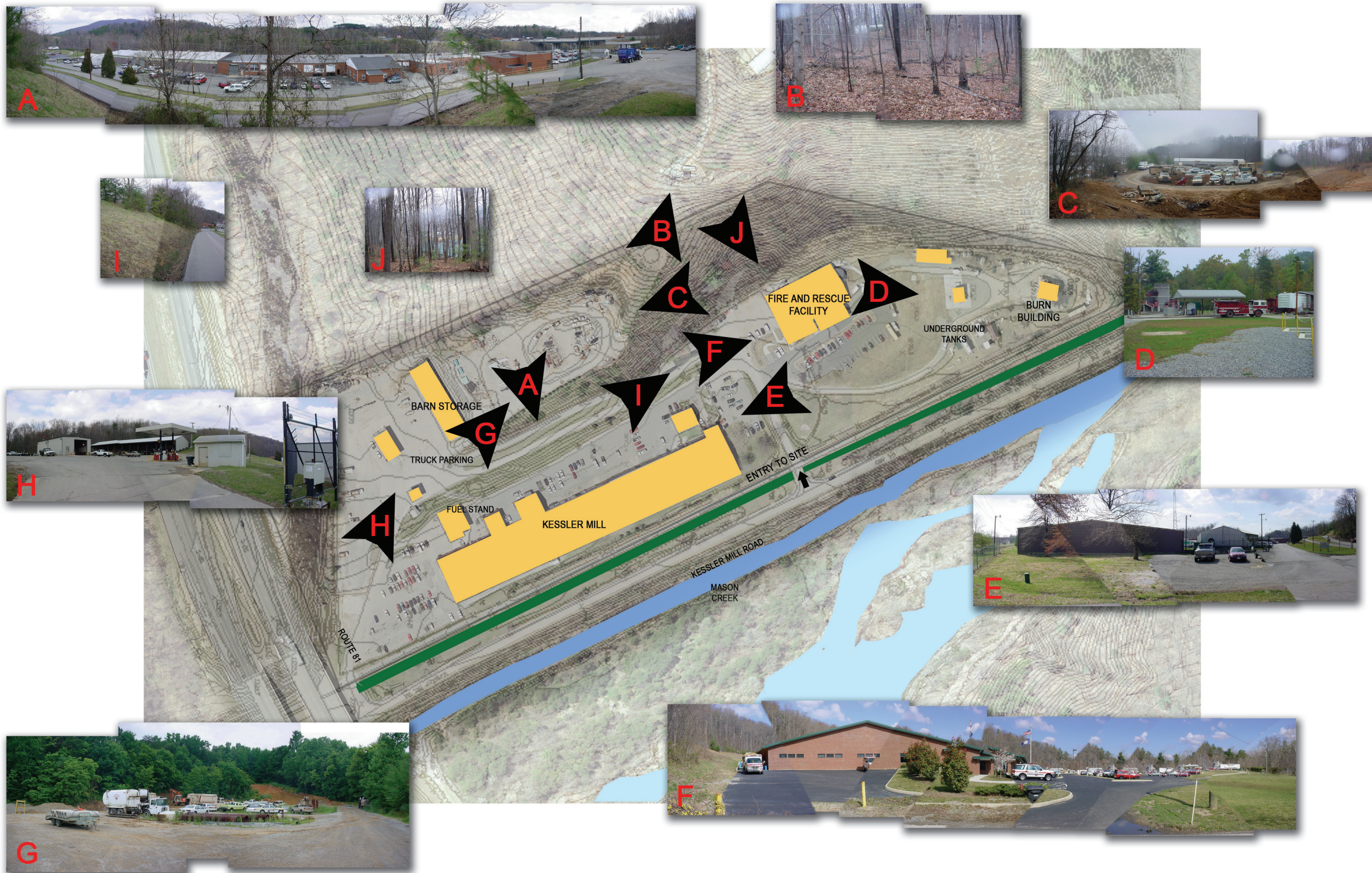
The finished product which could then be translated to a rough floor plan.



The stakeholder group who participated in the working meeting.

Individual stakeholder meetings: CDAC team members met separately with the five identified stakeholder agencies (Roanoke County Police Department, Roanoke County Sheriff's Office, Roanoke County Fire and Rescue Department, Vinton Police Department, and Franklin County Sheriff's Office) to determine their needs and wants in a new Public Safety Training academy. The CDAC team developed a questionnaire that was used to guide conversations. When speaking to the CDAC team separately, the agencies felt freer to describe their training requirements and vision for the new Public Safety Training Academy than they might have otherwise. The results were compiled in a spreadsheet to compare the information gathered. The completed questionnaires and spreadsheet are presented in Appendix B.

Working stakeholder meeting: The volume of information gathered, number of necessary spaces indicated, and potentially differing philosophies among the agencies led the CDAC team to call a working meeting of the stakeholder group. The types of spaces were categorized by general use then assigned a color: classrooms (green), administrative space (blue), physical activity spaces (brown), practical and specialty rooms (purple), auxilliary spaces (pink), and storage (gray). Squares and rectangles were cut from colored paper to represent the spaces. The stakeholders were then asked to work together to determine what spaces needed to be together and how they envisioned the academy being laid out. The paper pieces were moved around on the table as the participants spoke and showed their ideas to each other. By the end of the meeting, a consensus had been reached about a general grouping of spaces and philosophy for education at the academy. This meeting was invaluable for CDAC team members who could then use this rough "floor plan" to lay out the building on the site in a more informed manner.



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VIEWS FROM WITHIN
ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

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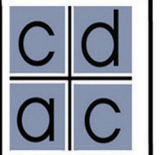
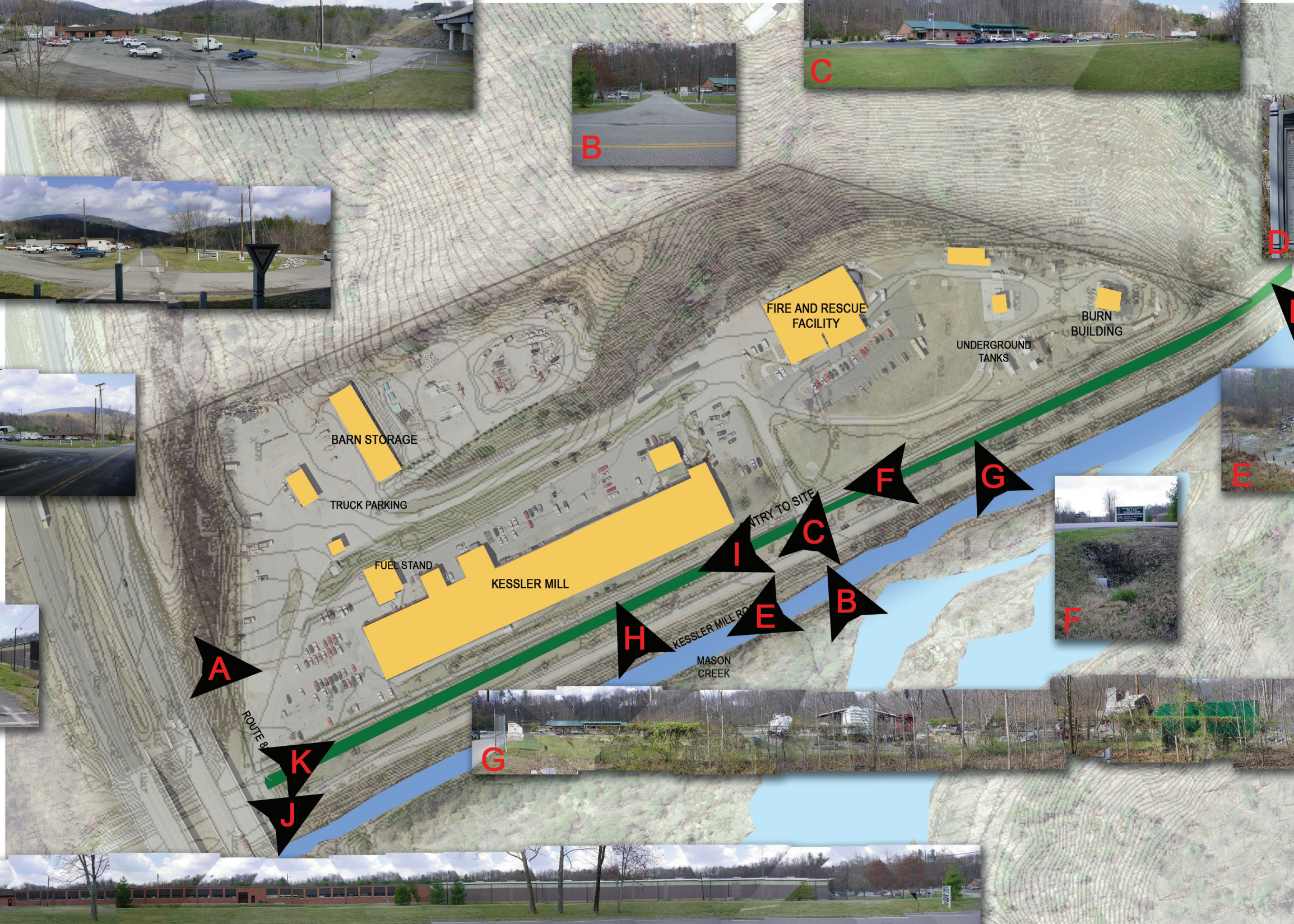
Views from Within

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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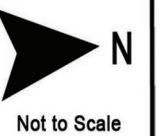


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VIEWS FROM WITHOUT
ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

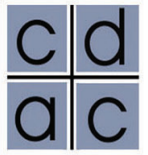


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Views from Without

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

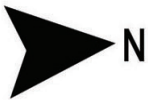
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EXISTING SITE FEATURES

ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY



Site Map

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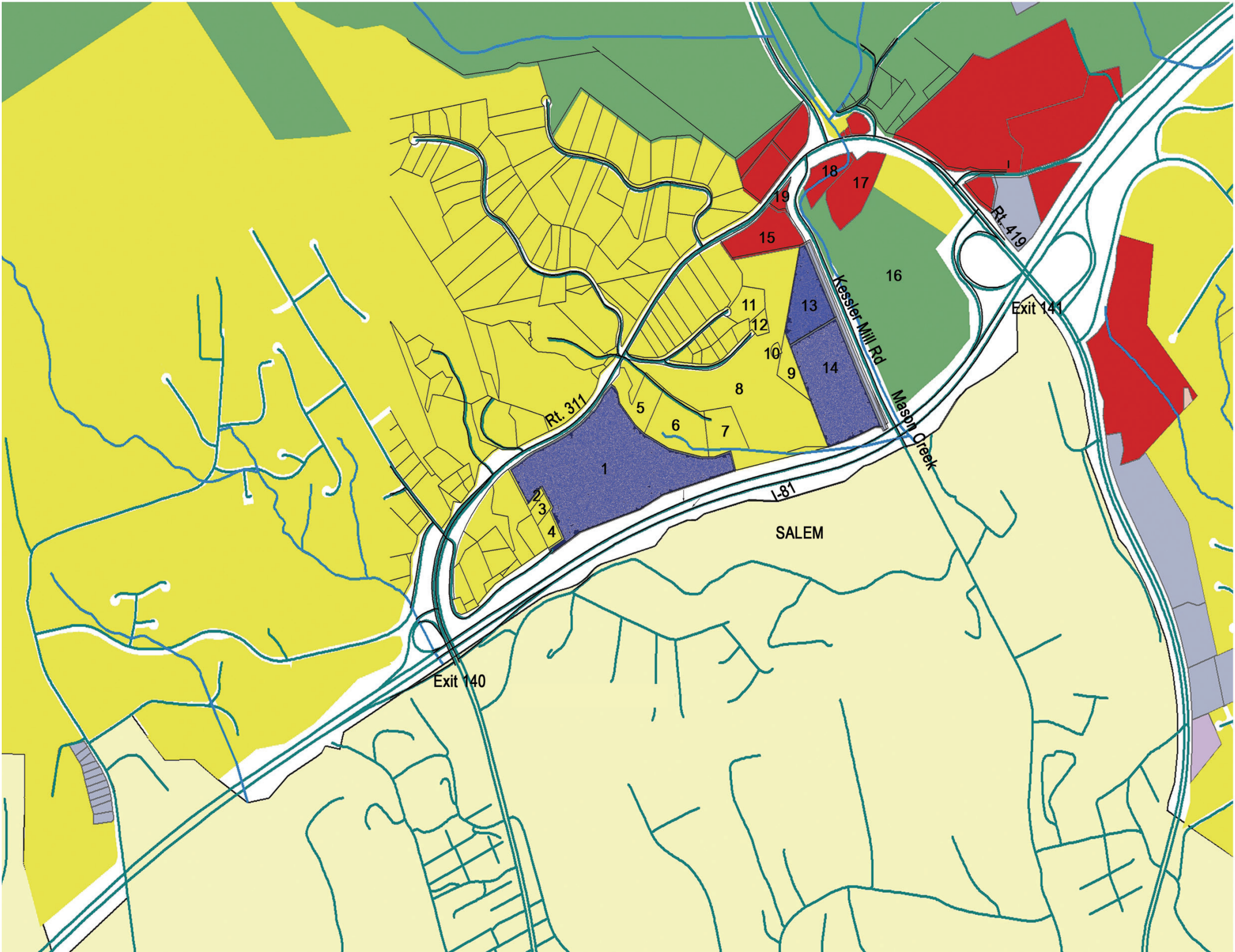
Existing Site Features

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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INDEX

1. VDOT - 32 ACRES
2. THOMPSON - 0.36 ACRES
3. PUGH - 0.64 ACRES
4. SALEM POLICE - 1.0 ACRE
5. COLE - 3.57 ACRES
6. FOCE - 5.81 ACRES
7. FOCE - 4.9 ACRES
8. PARKER - 30 ACRES
9. PARKER - 2.0 ACRES
10. WELL LOT
11. BALLANTYNE - 2.0 ACRES
12. FIELDS - 0.71 ACRES
13. ROANOKE COUNTY - 6.0 ACRES
14. ROANOKE COUNTY - 13.6 ACRES
15. PARKER - 5.0 ACRES
16. HINCHEE - 36.9 ACRES
17. ROANOKE COUNTY - 5.4 ACRES
18. HINCHEE - 2.66 ACRES

LEGEND

- Commercial
- Industrial
- Low-density Residential
- Agricultural Residential
- No Classification

c

d

a

c

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EXISTING SITE DIVISIONS AND ACREAGE

ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

N

Land Use Map

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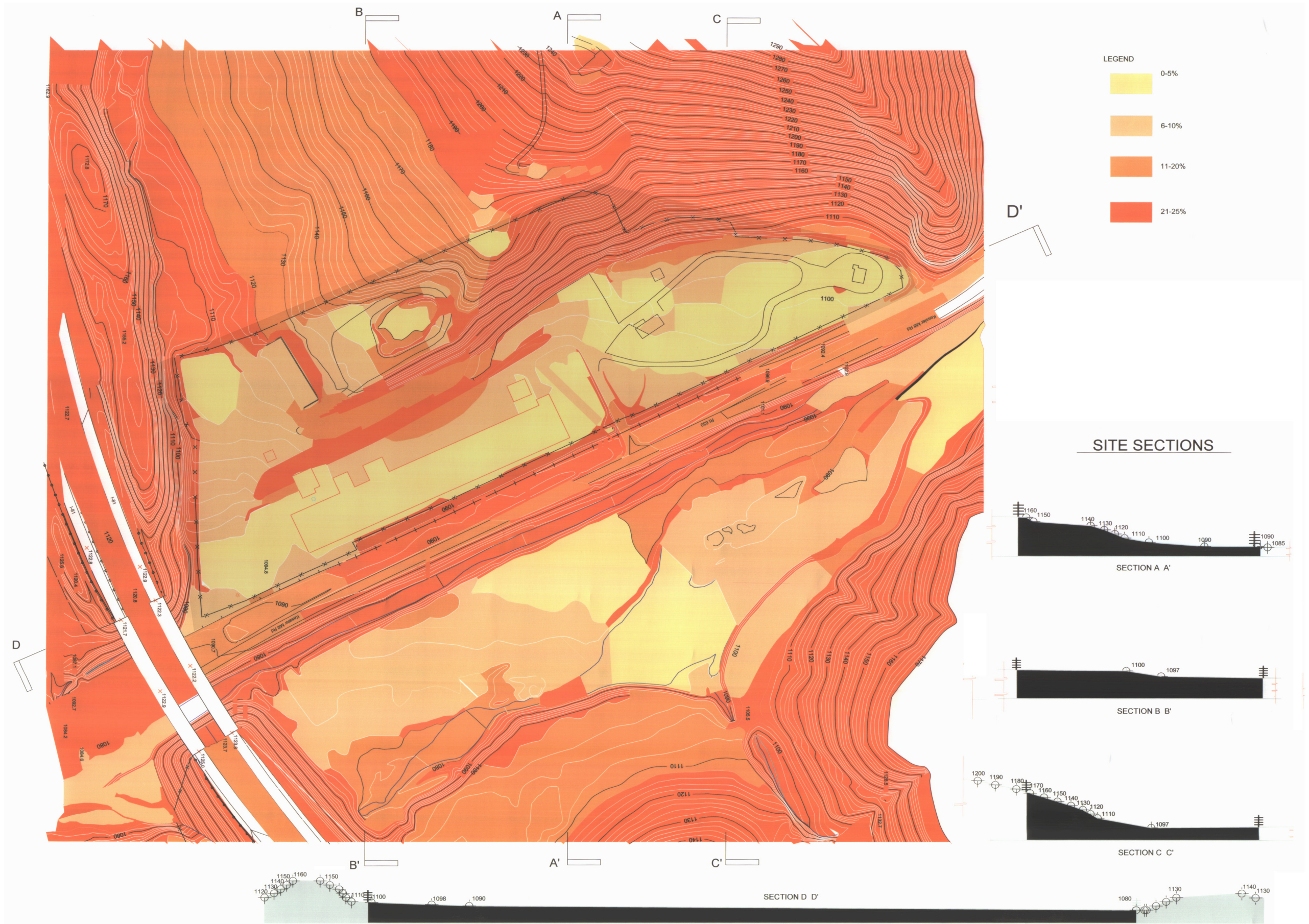
**Existing Site Divisions
and Acreage**
(including land use)

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

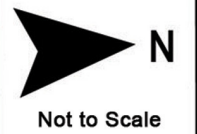
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SITE SLOPE ANALYSIS ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

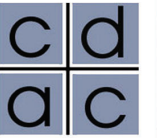
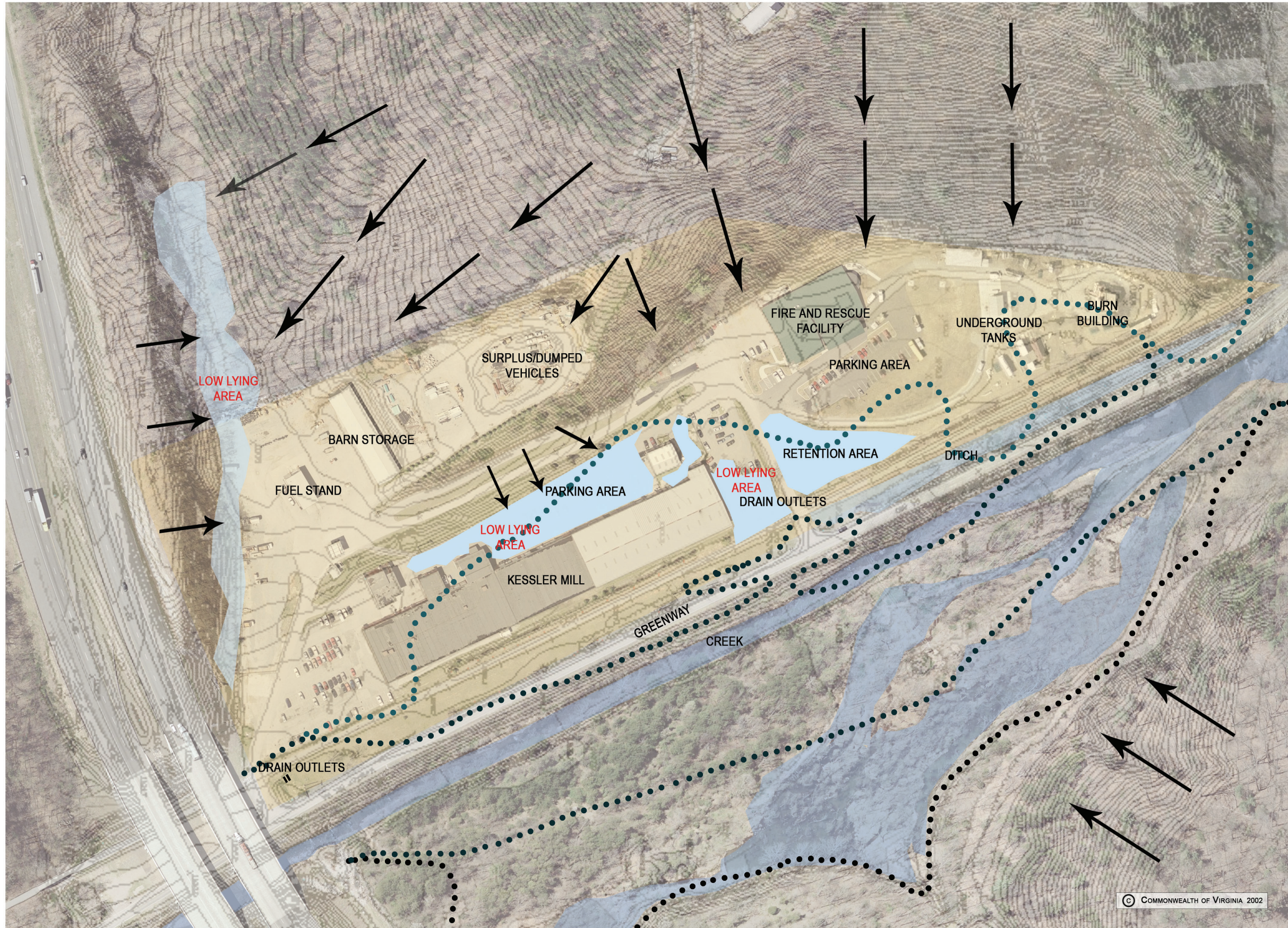


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Site Slope Analysis

Roanoke County Public Safety
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Roanoke County, Virginia

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TOPOGRAPHY AND DRAINAGE ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

LEGEND

- DIRECTION OF RUNOFF
- MASON CREEK
- LOW LYING AREA
- EXTENT OF 500 YEAR FLOOD PLAIN
- EXTENT OF 100 YEAR FLOOD PLAIN
- EXTENT OF 100 YEAR FLOOD WAY



Not to Scale

Topography and Drainage

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Topography and Drainage (including flood plain)

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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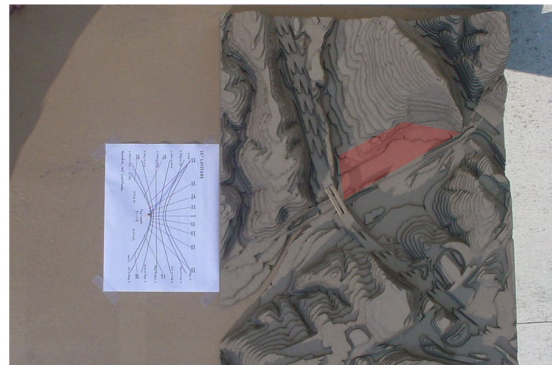
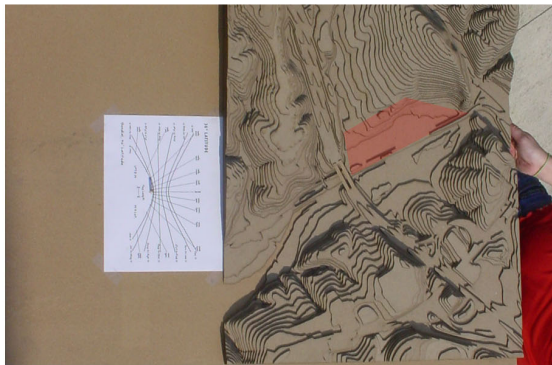


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June 21

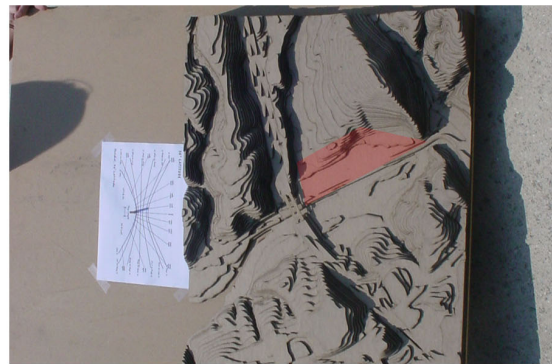
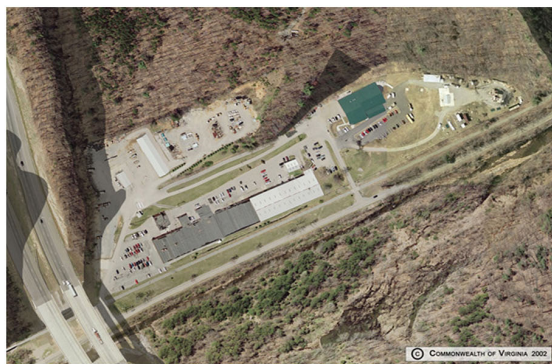
December 21

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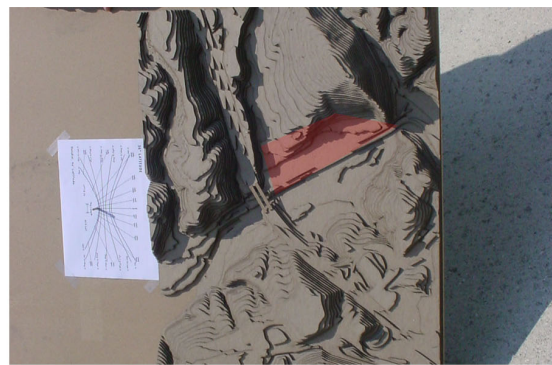
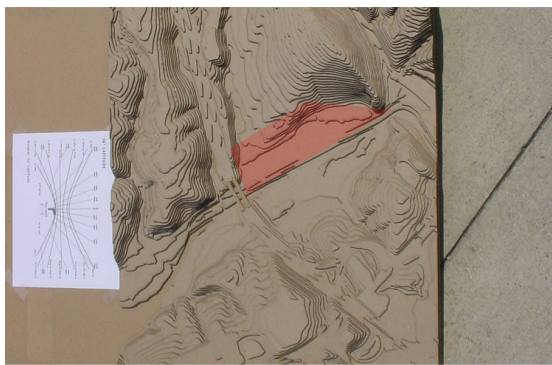
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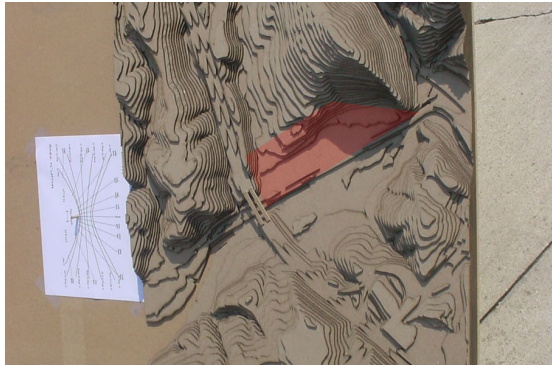
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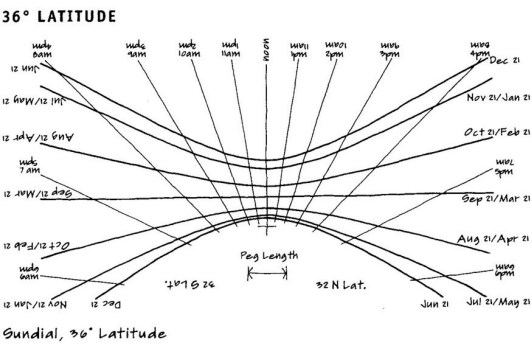


2:00 p.m.

5:00 p.m.



The solar analysis was performed using the sun chart for 36° latitude and a site model with exaggerated topography for the shortest (winter solstice) and longest (summer solstice) days of the year at various times of day. The result shows the most and least extreme shadows caused by topography that are expected on the site during the year.



SOLAR ANALYSIS
ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY



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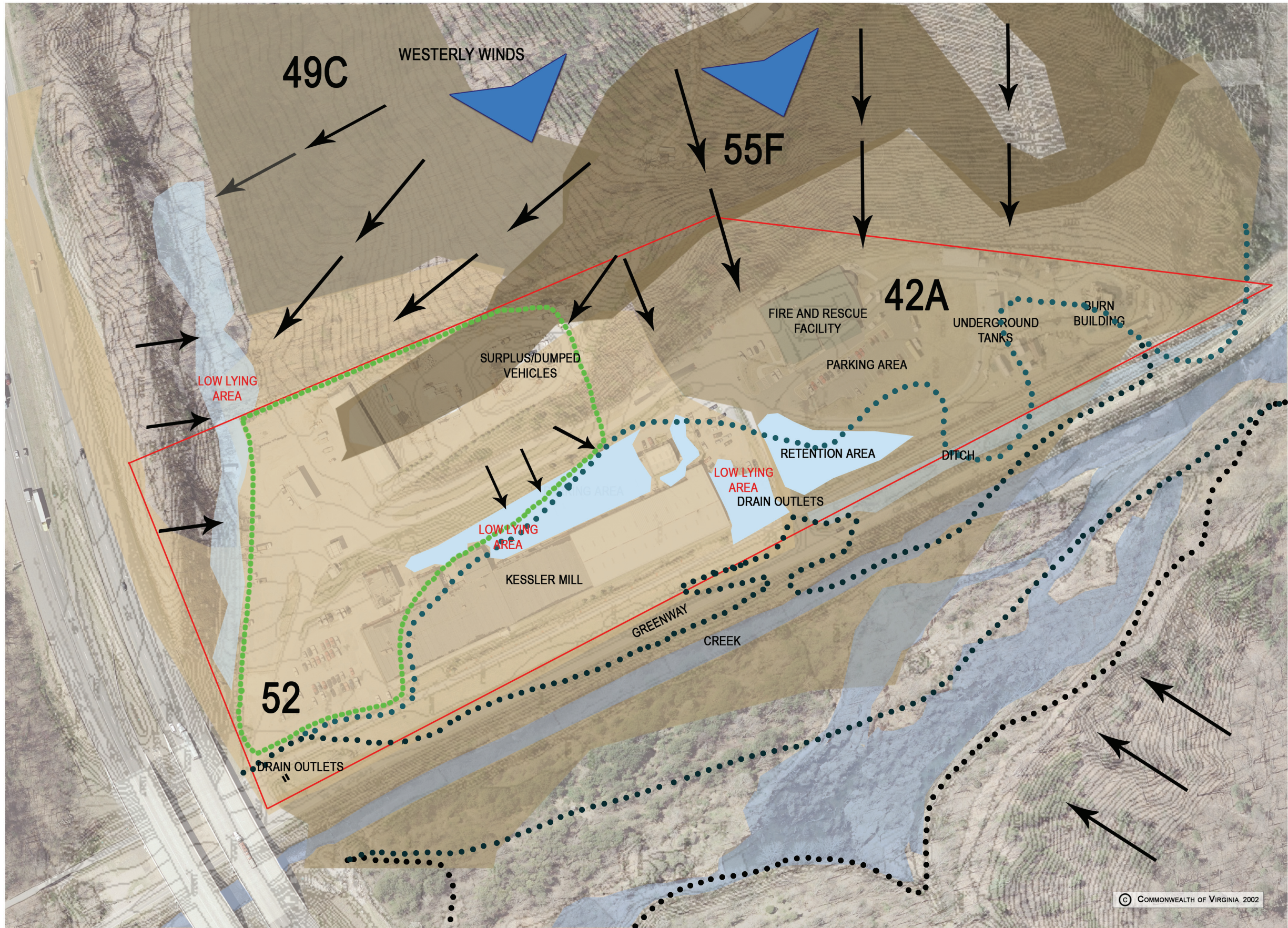
Solar Analysis (summer and winter solstice)

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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COMPOSITE ANALYSIS
ROANOKE COUNTY PUBLIC SAFETY
TRAINING ACADEMY

LEGEND

BUILDABLE AREA

52 - UDORTHENTS
URBAN LAND
COMPLEX

42A - SINDION
LOAM SOIL

49C - TUMBLING
LOAM SOIL

55F - WEIKERT
ROCK OUTCROP
COMPLEX

DIRECTION OF
RUNOFF

MASON CREEK

LOW LYING
AREA

EXTENT OF 500
YEAR FLOOD PLAIN

EXTENT OF 100
YEAR FLOOD PLAIN

EXTENT OF 100
YEAR FLOOD WAY

N

Not to Scale

Composite Analysis

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SOIL TYPES

42A - Sindion loam, 0 to 2 percent slopes, occasionally flooded. This soil is nearly level, very deep, and moderately drained. It is on flood plains. Most areas of this soil are used for pasture or hay. The flooding and seasonal high water table are limitations on sites for dwellings. The flooding and potential for frost action are limitations for local roads and streets. Land shaping during road construction and providing a suitable subgrade or base material helps to prevent the damage caused by flooding and frost action.

49C - Tumbling loam, 7 to 15 percent slopes. This soil is strongly sloping, very deep, and well drained. It is on mountain foot slopes and colluvial fans and benches. Most areas of this soil are used as woodland or pasture. The erosion potential is a management concern. The slope is a limitation on sites for dwellings. Land shaping and grading and using special designs that conform to the natural slope of the land help to overcome the slope. The slope, the potential for frost action, and the low strength are limitation for local roads and streets. Constructing roads on the contour helps overcome the slope. Providing a suitable subgrade or base material helps to prevent the damage caused by frost action or low strength.

52 - Udorthents-Urban land complex. Very shallow to very deep soils and areas of Urban land. Individual areas are generally along major highways and in industrialized areas. Udorthents consist of material that has been graded, cut and filled, or otherwise disturbed during the growth of urban areas and during highway construction. It consists of loamy or clayey material or is shallow over limestone or shale bedrock. The areas of Urban land consist of asphalt, concrete, or other impervious surfaces. The properties and characteristics of this complex are so variable that on site investigation is generally needed to determine the suitability for most uses.

55F - Weikert-Rock outcrop complex, 45 to 70 percent slopes, Very steep, shallow, well-drained Weikert soil and areas of Rock outcrop. It is on side slopes along drainage ways and streams. Usually used as woodland. The slope, the Rock outcrop, and the depth to bedrock are limitations on sites for dwellings and for local roads and streets. This soil type should be avoided for these uses.

(From Ealy, Edward P. Jr. Soil Survey of Roanoke County and the Cities of Roanoke and Salem, Virginia. USDA Natural Resources Conservation Service, 1997.)

Composite Analysis
(including flood plain, soil types,
wind direction, etc.)

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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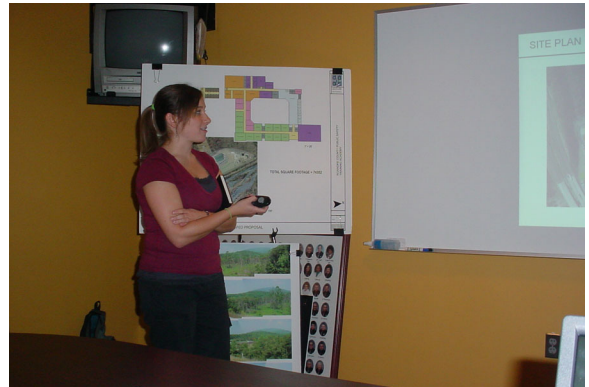


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Site and requirements analysis: After gathering information from other training facilities and project stakeholders, CDAC team members determined the spaces necessary for the envisioned Public Safety Training Academy, the square footage for those spaces, and how the spaces might fit together on the site to create a building. While a floor plan and elevations were not developed per se, the spaces were placed together in a way that would suggest the groupings of services within the building and on the site as well as the height of the building. By developing this very preliminary design, CDAC team members were able to determine possible square footage requirements for the building, determine if and where the proposed academy would fit on the site, and show what the proposed building might look like from Interstate 81. These results were then presented to the stakeholders in a presentation duplicated in Appendix C. The presentation boards are on the following pages with more information about each concept.



The stakeholders look at the presentation boards during the final presentation.



CDAC team member, Lauren Merrill, presents the final results to the client.



The Hanging Rock Trail provides an opportunity for recruits to run somewhere other than on the road.



An example of the steep terrain of the site is shown behind the Fire-EMS Training Center.

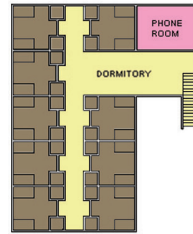


The L-Shaped Concept plan shows the organization of the building by function rather than agency.

V. FINDINGS AND RECOMMENDATIONS

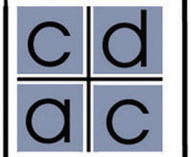
Site suitability: With the removal of the existing Kessler Mill building, the Kessler Mill site is large enough to accommodate a large training facility that includes many of the items from the stakeholders group's wish list while still retaining the existing Roanoke Valley Regional Fire-EMS Training Center building and its various outdoor training props. There is room for the building outside of the flood plain, sufficient parking, and green space for physical activities and practical exercises. The proximity of the Hanging Rock Trail provides additional opportunities for running. The site is easily accessible from Interstate 81. If additional land is acquired in the future, some creativity may be required to use the land due to the steepness of the terrain.

Unity: While the example facilities visited separated the police, fire and rescue, and sheriff training into different wings or floors of the building, meetings with the Roanoke County stakeholders indicated that the facility should be shared by all public safety personnel. Rather than duplicating rooms for each agency, they preferred that the building be organized by function: administrative, classroom, physical and practical training, etc. By definition, this creates unity in the Public Safety Training Academy and the concepts presented reflect this idea. In addition, the stakeholders realized that the building would be used by other entities within the County and perhaps for community programs. By creating a classroom wing and an auditorium accessible from outside, the building becomes more usable for other entities which could provide an additional source of income to the academy.



The Group Concept is a direct result of the working stakeholder meeting. It is a translation of the colored pieces of paper moved about the table into a plan. The office space is separated from, but easily accessible to, the classroom space. The auditorium is accessible from the outside for evening programs that do not require the rest of the building to be open. The louder practical and physical activity areas are separated from the quieter classrooms and administrative space. The dormitory would be above the locker rooms to minimize the need to duplicate facilities. As in all of the plans, outdoor spaces are added for physical and practical training while a "dirty" entrance is provided for direct access to the locker rooms from outside. A childcare facility is included to make it easier to attract recruits who would otherwise need outside childcare.

TOTAL SQUARE FOOTAGE = 86,782



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CONCEPT 1: GROUP PRESENTATION BOARD ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY



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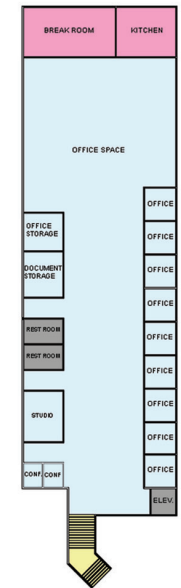
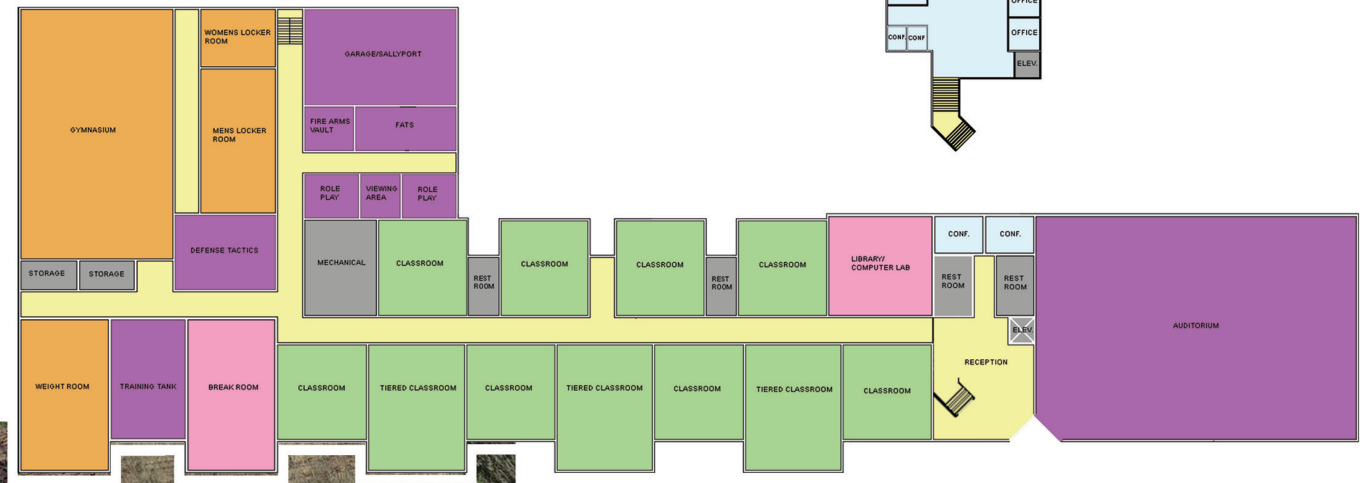
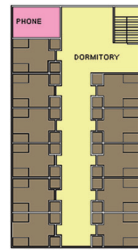
Concept 1: Group Presentation Board

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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The L-Shaped Concept uses the ideas from the Group Concept, but takes advantage of the site topography and opportunities for natural light. By lengthening the building, each room is able to have natural light. The auditorium is still accessible to the public after hours and the classrooms, physical and practical areas, and administrative areas are separated. The dorm would still be placed over the locker rooms to minimize the need to duplicate facilities. The administrative wing, taking advantage of the sloping terrain, is placed at ground level a floor above the main part of the academy. The administrative wing becomes much quieter and more private with its own entrance and parking area.

TOTAL SQUARE FOOTAGE = 74,612



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CONCEPT 2: L-SHAPED PRESENTATION BOARD ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY



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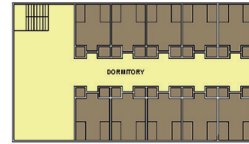
Concept 2: L-Shaped Presentation Board

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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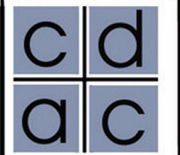


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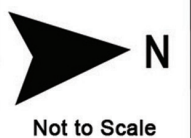
The Ring-Shaped Concept again uses the same principles as the Group Concept, separating the classrooms, administrative, and physical and practical spaces. The auditorium remains accessible for outside uses and the dormitory is over the locker rooms. A central courtyard is created within the "ring" to provide natural light to all of the spaces as well as an outdoor training and/or reception space. In this example, the traffic stop and accident investigation area has been moved to nearer the interstate providing a bit of a noise buffer. In all instances, the child care facility is to the rear of the site to protect the children from the noise and activity of the site and the public nature of the Hanging Rock Trail at the front of the site.

TOTAL SQUARE FOOTAGE = 74,352



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CONCEPT 3: RING-SHAPED PRESENTATION BOARD ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY



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Concept 3: Ring-Shaped Presentation Board

Roanoke County Public Safety
Training Academy
Roanoke County, Virginia

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Public visibility: While the new Roanoke County Public Safety Training Academy could be a low well-landscaped building, inobtrusive on the site, there is an opportunity to make the site distinctive. One method is to incorporate a tall memorial onto the site that attracts attention to the site from the interstate. The memorial could be a stand-alone tower, a feature of the academy building, incorporated into a tower of a new burn building, or an art feature. The site is also highly visible from Kessler Mill Road and the Hanging Rock Trail. By developing a landscape plan that creates an entrance to the site, a connection between the buildings on the site, and parking and outdoor activity areas interspersed with trees and green space, the site will be more inviting and more in keeping with other sections of the rural road and trail. The building's entrance should be distinctive as well, perhaps with a high covered entrance area to accommodate cars and trucks alike and protect visitors from the weather.

Decrease effects of flooding: Removing the large Kessler Mill building and its surrounding paved areas will improve the flooding situation on the site. The new academy building will be smaller and should be placed outside of the flood plain. Parking will be placed within the flood plain, but can be designed using porous pavement or pavers that enable stormwater to infiltrate rather than run off. The increased green space shown in the site plan for outdoor activity areas will absorb the rainwater rather than enabling sheetflow. Any plant material that absorbs the water will decrease the amount of potentially polluted runoff reaching Mason Creek. Additional recommendations include the inclusion of rain gardens in the landscape plan and mechanisms for collecting rainwater from the roof of the new building. Collected rainwater can be drained more slowly after the storm has passed or used for watering landscaping or flushing toilets. It may also be possible for the Fire and EMS classes to use the rainwater to supplement the water needed for training exercises. Additional information about



A view from southbound on the interstate shows the public visibility of the Kessler Mill site.



A view from the Hanging Rock Trail shows the existing training center. Other current views include the parking lot and brick building wall.



An example of a rain garden in Blacksburg that pools and absorbs and filters stormwater.



Pavers are used for the parking spaces in this lot while the driving areas are regular pavement.



In the Ring-Shaped Concept, hallways in the gymnasium and classroom areas could be extended for expansion.



A view to the Fire-EMS Training Center from the direction of the current Kessler Mill building.



Connection to the existing Training Center can be through shared landscape areas such as the agility course shown above.



A white EnergyStar roof lowers the temperature of the roof by reflecting the sun. ([/www.hersheyphilbin.com/news/css/images/londonderry.jpg](http://www.hersheyphilbin.com/news/css/images/londonderry.jpg))

stormwater management is presented in Appendix E.

Design for expansion: The conceptual designs for the Public Safety Training Academy along with the existing 3-4 classrooms and other spaces of the Fire-EMS Training Center should provide adequate training space for the foreseeable future. Each of the conceptual designs considers expansion through the extension of the hallway near the classrooms or gymnasium. Another possibility for expansion would be the addition of other buildings in a campus-like setting - the Fire-EMS Training Center is an example. A limiting factor for expansion however, could be the site - even if additional land is purchased behind the Kessler Mill site, the terrain will be steep and require some creativity to be built upon.

Connection to existing center: Care must be taken to ensure that the existing Fire-EMS Training Center and its students are not alienated from the new building. A strong pathway connection between the two buildings, orientation of the new building towards the old, the use of similar materials in the new building, and shared spaces between the buildings are several ways to make the connection.

Sustainable design/LEED: Just as with the new regional jail facility, a number of opportunities are available for incorporating sustainable design into the Public Safety Training Academy. The LEED (Leadership in Energy and Environmental Design) Guidelines for New Construction offer points to follow in the redevelopment of the Kessler Mill site. More information about sustainable design, LEED, and each of the suggestions discussed below is presented in Appendix D. In addition to the specific points discussed here, stormwater management techniques such as those described above are an important component of sustainable design.

Roofing material: A large expanse of roofing such as that of the proposed academy can

create a heat island when the summer sun hits a traditional large black roof, raising the temperature of the building and the surrounding area. EnergyStar roofing is a white surface that reflects the sunlight, reducing cooling load. A green roof is another option that creates an outdoor space on the roof using plant materials, absorbing stormwater, and lowering the temperature of the roof.

Solar energy: The Kessler Mill site receives significant sunlight throughout the day and throughout the year, making it a candidate for the use of photovoltaics to offset some electricity needed on the site. Photovoltaics come in many shapes and sizes today. For example, photovoltaics can be integrated into roofing material, wall facades, and skylights making them less obtrusive than they once were.

Daylighting and views: The use of natural light and views whenever possible not only creates a better indoor environment for employees, but is a LEED design point. Louvres can be used to reduce the amount of heat entering the space and reduce the cooling load.

Recycling: While it is important to incorporate recycling of everyday items such as paper, cans, and bottles into the plan for the new Training Academy, just as important is to consider the recycling of construction waste. In this case, the old Kessler Mill building will be removed to make way for the new building. Recycling the construction waste will mean money savings in the long run because the haulage fees to the landfill will be reduced. The diversion of 50-75% or more of the construction waste from the landfill results in LEED design points.



An example of a green roof as an educational garden in New York City. (www.calhoun.org/uploaded/building/web_roof1.jpg)



Photovoltaic cells have been used to create roofing shingles. (www.oksolar.com/images/solar_panels_unisolar_shr17_b.jpg)



An example of louvers on a building blocking the sun. (www.hunterdouglas.cl/english/products/sun/photos/zoom/Aero01.jpg)



Recycling construction and demolition waste can ultimately reduce the cost of a project. (www.ecocycle.org/faq/images/resourceyard.jpg)



Sustainable landscaping does not require a lot of maintenance or watering. (www.urban-water-conservation.com/images/mp_lawn_low-res.jpg)



An example of a recycled rubber floor with color and shape. (www.diamond-safety.com/images/big/agri2_big.jpg)



The Forest Stewardship Council logo signifies wood that has been harvested in a sustainable manner. (www.fsc.org)



A sign such as this is a simple method of providing wayfinding to a site. (www.archnewsnow.com/features/images/Feature0138_12x.jpg)

Landscaping: Maximizing open space on the site and minimizing paved and built out surfaces helps with stormwater management and helps lower the overall temperature of the area. The use of water-efficient landscaping will ensure that water resources are not wasted keeping the landscaping green. Using native species of non-invasive plants helps to keep landscaping needs at a minimum. Collected stormwater can also be used to irrigate the landscape when necessary. Rain gardens are an example of a landscaping feature that is drought-resistant, yet thrives on the overflow of rainwater.

Materials and finishes: There are a number of environmentally friendly materials that can be used within the building including Forest Stewardship Council-certified wood, recycled rubber flooring, and low-VOC paints.

Wayfinding: Signage guiding students and visitors to the Training Academy from Interstate 81 exits 140 and 141 and from Kessler Mill Road in downtown Salem would be helpful for wayfinding. These signs do not have to be large and spell out the name of the academy, but could be small, circular signs with an academy logo and an arrow that are recognizable and provide reassurance that the visitor is heading in the right direction.

CPTED and fire prevention: Landscaping features can be used as examples for the public of ways to reduce crime and fire around their own homes. Placing trees and shrubbery away from the building and in a manner that does not obscure the windows reduces places for people to hide and increases the “eyes on the street” or natural surveillance by people who are able to look out the window and keep an eye on the grounds. Plants like holly or hawthorns when planted close to each other can create an impenetrable barrier that is more aesthetically pleasing than a chain link fence. Good examples

of landscape design, lighting, and fencing can be duplicated by the public or developers at residences throughout the county. More information about Crime Prevention Through Environmental Design (CPTED) is available in Appendix F.

VI. REFERENCES

USDA Natural Resources Conservation in cooperation with VT. Soil Survey of Roanoke County and the Cities of Roanoke and Salem, Virginia. July 1997. Sheet 6 and p. 83-84, 93-94, 97-98, 100-101.

DCJS. Criminal Justice Training Reference Manual. Academy Certification Standards. September 1998.

APPENDIX A

POLICE AND FIRE ACADEMY VISITS

On February 24, 2006, CDAC team members Elizabeth Gilboy, Terri Fisher, and Bharati Karmarkar accompanied Roanoke County Police Captain Tim Lisk and Lieutenant Jimmy Chapman, Roanoke County Sheriff's Deputy Beth Jones, and Vinton Police Captain Kip Vickers on visits to the Chesterfield County Police and Fire Academy (Eanes-Pittman Training Facility), Henrico County Police and Fire Academy, and Central Shenandoah Police Academy. These academies provided examples of modern training facilities in buildings designed specifically for that purpose. The visitors were able to ask questions of the training facility personnel to find out how well the facilities work for them and whether they had any wishes, needs, or tips that should be addressed in a new academy. Information and comparisons of the police academies is included as a spreadsheet in this chapter along with photographs of some of the interesting features. The DCJS Academy Certification Standards are included as well.

Because at the time these visits took place the client had discussed a police academy, police training was the focus of these visits. The CDAC team also visited the existing Roanoke Valley Regional Fire-EMS Training Academy on two separate occasions. Information about those visits is included at the end of this appendix.



Chesterfield County Police and Fire Academy also known as the Eanes-Pittman Training Facility.



Henrico County's police, sheriff, fire, and rescue personnel train in a building within the county government complex.



Central Shenandoah Training Academy in Weyer's Cave adjacent to Blue Ridge Community College.



Roanoke Valley Regional Fire-EMS Training Center side view.

	Chesterfield County	Henrico County	Central Shenandoah
BASIC INFORMATION			
size	about 70,000 sq ft	61,000 sq ft	57,000 sq ft
acreage	within county complex	within county complex	8 acres?
number served	1300 = 500 Chesterfield officers, 300 sheriffs, 350 fire personnel, 50 Colonial Heights, 50 Hopewell, 50 Emporia	700 sworn police officers	1733 full-time sworn officers from 58 agencies in law enforcement, jail, emergency communications dispatch
year built	1996	1998	2000
usage	police, fire	police, fire	police only
other users	community groups, college classes, citizens police academy	human resources, other county agencies	none
number of hours per day	16	16	10
configuration	1 police wing, 1 fire wing, 1 shared wing, 1 911 call center	police on one side of hall, fire on other, sheriffs in their own wing	police only
number stories	1	2 (3rd floor occupied by emergency communications)	2
outdoor facilities	none and no space	none and no space	some



The Central Shenandoah facility has ample outdoor space for traffic stops and other training activities.



Classrooms like this one at the Chesterfield County facility are partitioned to expand with the class size.

	Chesterfield County	Henrico County	Central Shenandoah
CLASSROOMS			
typical class size	12-15	25-30	40-45
biggest class size	30		45
number regular classrooms	4 per wing		5
classroom capacity	45 per room	45 per room	
flexibility?	tables and chairs are movable	tables and chairs are movable	tables and chairs are movable
wired?	yes	no	yes
number dividable classrooms	1 - divides into 4 rooms		none
classroom capacity	300	60 per room	
flexibility?	tables and chairs are movable	tables and chairs are movable	
wired?	yes	no	
number tiered classrooms	2	2	2, but floor is flat
classroom capacity	40	55	70/rated for 120
flexibility?	no	no	no
wired?	yes		yes
electronics	on AV carts	built in AV	built in AV
computer classroom		yes	yes
wet bar in classroom	no	yes, some	
auditorium	no	no	no



Traditional classroom at the Chesterfield County facility configured in a U-shape for teaching.



The large classrooms at the Central Shenandoah facility hold 70 people, but are not tiered.

	Chesterfield County	Henrico County	Central Shenandoah
ADMINISTRATIVE SPACE			
staff size		5	9
conference rooms	1 (more?)	1	1
offices	cubicles	closed, some cubicles	some closed, some cubicles
document storage	yes	yes	expansion files
general storage	chairs, tables, equipment	equipment	property storage
instructor briefing room			yes
lesson plan room			yes
mail area	yes		
copy room			yes
computer server room			yes
reception area	yes	yes	yes



A computer classroom at the Central Shenandoah facility may be unnecessary in the future if recruits all have laptop computers.



Shared office space for instructors at the Central Shenandoah facility.



The podium and whiteboard in this Chesterfield County classroom aid in teaching classes.



8-person conference room at the Henrico County facility.

	Chesterfield County	Henrico County	Central Shenandoah
TRAINING SPACE			
fitness area	yes	yes	yes
multi-purpose room	full basketball court; applicant testing; volleyball; mats; padded walls; mustering place; emergency shelter	basketball; agility testing; ropes; mats	full basketball court; water fountains
defensive tactics room	no	no	yes
range and driving facilities	off site	off site	off site
role playing area	domestic scenario, warrant serving, rooms also used for conferences and classes		living room; bedroom/hotel room; office
gun and ammo vault	yes		yes
garage/sally port	yes		yes
forensic lab	unused		yes
darkroom	unused		
fire arms training simulator	yes		yes
simulated jail environment	no	no	yes
interrogation room			yes
finger printing room			yes



The dedicated defensive tactics room at Central Shenandoah enables instructors to leave the mats rolled out all the time.



The garage or sally port at the Chesterfield County facility is used for training as well as storage.

	Chesterfield County	Henrico County	Central Shenandoah
AUXILIARY SPACES			
first aid room			yes
study room	no	no	yes
prep kitchen	no	yes	
coat room	unused		
phone room	unused		
lounge	yes		
break room	yes	yes	yes
library	yes, underused, but nice space	yes, but minimal	no, space needs to be created
memorial room	yes		
laundry	not used		
ice machine	yes	yes	
locker rooms	M/F	M/F	
outdoor patio	yes		
TV studio	yes	yes	
HVAC system			geothermal with 42 wells



Simulated jail at the Central Shenandoah facility includes cells, common area, and sally port.



The television studio at the Chesterfield County facility enables them to make and broadcast training videos.



The multi-purpose room at the Henrico County facility includes a basketball court and space to roll out mats.



The Fire Arms Training Simulator (FATS) at the Central Shenandoah facility takes up the entire classroom space.

	Chesterfield County	Henrico County	Central Shenandoah
ADDITIONAL FEATURES			
electronic display board	yes	yes	
gun lock boxes	unused		
bulletin boards	halls, classrooms, well-used		cork strips
dorms	no	no	yes



The Central Shenandoah facility includes a wing with dormitory rooms for students staying overnight.



The main hallway at the Chesterfield County facility provides space to display awards and class photographs.



The library at the Chesterfield County facility is an inviting space with lots of natural light.



The Henrico County facility has a kitchen in the break room that includes refrigerators, a microwave oven, and an ice machine.



This weight room at the Henrico County facility is an example of the weight and fitness rooms needed at an academy.



The break room at the Central Shenandoah facility provides physical and visual access to the outdoors.

	Chesterfield County	Henrico County	Central Shenandoah
WISHES			
security	video surveillance monitoring		cameras to monitor/record classrooms
	card access		
classrooms	larger tiered classroom (60)	more classrooms	some smaller classrooms
	door at back of classroom rather than front		
	wet bar in some classrooms, particularly the tiered classrooms that are rented out		
training tank		pool	
offices	enclosed offices		lesson plan room could be bigger
	registrar for classrooms		conference room could be bigger
kitchen/cafeteria	full kitchen for caterers including loading and food prep area		
training			cameras in role playing rooms so evaluators can be in different rooms
			sound baffles in multi-purpose area would make it more multi-purpose (i.e., use for graduation)
storage	more	more	more
auditorium		300 seat auditorium	
loading docks	facility support including loading docks		
outdoor athletic area	it would be nice to have a small outdoor athletic area with a playground and obstacle course		

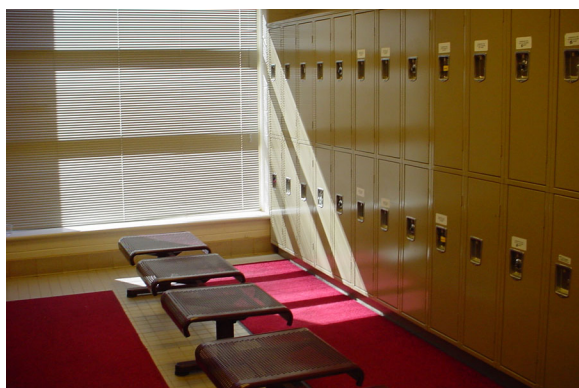


Personnel at each facility said that you can never have too much storage space for the variety of odd-shaped training objects.



A view from the podium of the 40-person capacity tiered classroom at the Chesterfield County facility.

	Chesterfield County	Henrico County	Central Shenandoah
COMMENTS			
joint facility	joint facility has problems because of different roles, missions		
	further from government center would be better - building is used for all kinds of training because close by		
space	parking problems!	go as large as you can!	building has room for growth/expansion
noise		noise issues between floors and divided classrooms - carpeting may correct this	
library			computers are used more than books in library
locker rooms		men and women should have separate changing facilities	
mock court room		mock court done in actual courtroom	
materials		terrazzo is best flooring material; regular flooring requires a lot of cleaning and buffing maintenance; faux concrete walls chip; wear and tear of tables and chairs moving on flooring	
auditorium			auditorium is luxury item



This locker room at the Henrico County facility features short, wide lockers that might not be large enough for all equipment.



These taller lockers at the Central Shenandoah facility are long enough to hold uniforms and other training gear.

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<http://www.dcjs.virginia.gov/standardsTraining/documents/CJTrainingReferenceManual/50cerfin.pdf>

1. Purpose

A. The purpose of this policy is to verify that the entity seeking academy certification is eligible for academy certification and has developed policies and procedures sufficient to comply with all certification standards pertaining to administration, personnel and instruction. In addition, all physical facilities must comply with certification standards. Obviously, during the initial certification process, it is impossible to determine how well the policies and procedures are being followed. Newly certified academies are, however, subject to scheduled and unscheduled visits by field coordinators and other members of the Division of Operations in which adherence to certification standards will be evaluated. Academy certification is valid for one year. Academy certification expires on June 30th of the year after the academy was certified. In order to maintain certified status an academy must successfully complete the recertification process prior to the expiration date.

2. Academy Certification Eligibility

A. To become a certified academy, a state or local unit of government must demonstrate a need which contains the following elements:

1. The inability to obtain adequate training from existing academies or a sufficient hardship which renders the use of other existing academies impractical.
2. Based upon a training needs assessment, a sufficient number of officers to warrant the establishment of a full-time training function for a minimum of five years.

B. In addition, the state or local unit of government must make the following commitments:

1. Provide a full range of training to include entry-level training, in-service training, instructor certification and recertification training and specialized training.
2. Assignment of one position with primary responsibility as academy director and one clerical position to support training and training related functions.
3. Maintain a training facility adequate to conduct training in accordance with academy certification standards.
4. Commitment of sufficient funding to adequately support the training function.

C. Process to Determine Eligibility:

1. The state or local governmental unit shall submit a justification, as outlined in § B above, to the Committee on Training which shall review the justification and make a recommendation to the department as to whether or not the establishment of an academy is warranted.
2. If the Committee on Training recommends the establishment of the proposed academy, the department shall make a determination as to whether or not the establishment of the academy is warranted.
3. If the establishment of the academy is approved by the department, the proposed academy must successfully complete the academy certification process.

D. Academy Certification Process

1. The DCJS field services coordinator will provide guidance and assistance to the prospective academy by identifying the requirements for certification, analyzing the adequacy of existing facilities and providing an estimate of what needs to be accomplished prior to formally requesting academy certification status.
2. A staff member of the Division of Operations will establish a mutually agreeable date for an on-site inspection with the academy director and conduct the on-site assessment for academy certification.
3. An academy which has been certified is subject to scheduled and unscheduled visits by the field coordinator and other members of the Division of Operations to check items required for continued certification.
4. If at any time it is determined that the certified academy does not meet one or more certification standards, the academy will be given a reasonable amount of time to correct the situation, not to exceed 60 days. The director of the academy will receive written notification of the standards which have not been met and the date when a reassessment will be conducted.
5. A staff member of the Division of Operations will conduct the reassessment. If one or more of the standards still have not been met, the Chief, Sheriff, Agency Administrator or Board Chairman of the academy will be notified in writing that upon reassessment the standard has not been met. The academy will have a maximum of 30 days to comply with all certification standards.
6. A staff member of the Division of Operations will conduct the second reassessment. If the academy is still not in compliance with all certification standards at the time of the second reassessment, the matter will be referred to the Academy Certification Committee. The committee will review the findings of the second reassessment in which the academy was not in compliance with all certification standards and make a recommendation to the Committee On Training of the Criminal Justice Services Board.
7. The Committee on Training will review the recommendation of the Academy Certification Committee, giving both the academy and the Academy Certification Committee an opportunity to make a verbal presentation, and, based upon all pertinent information, recommend appropriate action to the Department of Criminal Justice Services.
8. Certification is valid for one year from the date of certification. Academy certification expires on June 30th. In order to maintain certification status, an academy must successfully complete a recertification process prior to the expiration of the original certification. The recertification will extend the expiration date for three years.

3. Academy certification standards

A. Definitions

1. Academy: a facility in which training programs are conducted. It houses classrooms and offices for instructors and staff. Other facilities such as a firing range, driver training track, multipurpose training areas, library and satellite locations are considered to be part of such facility but need not be located at the same site.
2. Academy Director: an individual designated by the chief, sheriff, agency administrator or academy board who is responsible for the conduct and operation of training conducted by the academy.

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3. Assistant Director: an individual predesignated by the director of the academy responsible for the conduct and operation of training in the absence of the director. In the event the designated individual is not an employee of the academy/agency, prior approval for such designation must be obtained from the chief, sheriff, or agency administrator.
4. Directive: a written statement of policy procedure or rule/regulation addressing each respective area in the certification standards, duly approved and signed by the academy's governing authority and made a part of a manual available for inspection and guidance in the operation of the academy.
5. Satellite Facility: a facility, located away from the certified academy facility, which the certified academy uses to conduct mandated training. This definition specifically excludes firing ranges, driver training sites and physical fitness or defensive tactics sites which may be located away from the certified academy facility. Commercial conference and training facilities such as hotels and motels, which are used for mandated training, are specifically excluded from this definition.
6. Academy Certification Committee: The Academy Certification Committee reviews the certification and recertification standards and recommends changes as necessary to the Division of Operations. This committee also reviews the circumstances and facts surrounding the non-compliance with certification standards by any certified academy in order to make a recommendation to the Committee on Training of the Criminal Justice Services Board. This committee is composed of five members who represent a regional academy, a sheriff's academy, an independent academy and a state agency academy. The fifth member is an at-large member representing all types of academies. Committee members are selected by mutual agreement between DCJS and the President of the Training Directors Association.

B. Administration standards

1. An academy shall be governed by the chief of police, sheriff or agency administrator or in the case of an academy providing services for several political subdivisions, a governing board shall be composed at a minimum of criminal justice executives of participating jurisdictions.
2. A written directive shall identify the goals and objectives of the academy.
 - a. A three-year plan, updated annually, shall be available.
 - (1) The three year plan shall be approved and signed by the agency administrator, or in the case of regional academies, approved by the Academy Board Chairman and distributed to all members of the executive/governing board of the academy.
 - (a) There shall be a process which allows all participating agencies to address questions and concerns regarding the three year plan.
 - (b) The three year plan should address the following areas as they apply to the academy:
 - (i) Administration
 - (ii) Personnel
 - (iii) Staff Training
 - (iv) Programs

- (v) Equipment
 - (vi) Facility enhancement
3. A written directive shall establish the academy's administrative functions.
 - a. The directive shall include the academy's authority and responsibility to primarily train criminal justice practitioners.
 - b. The directive shall include the academy's organizational structure.
 - c. The directive shall include the academy's training activities and functions.
 - d. The directive shall outline the budgetary process for training, its cost, and sources of income.
 4. A written directive governing student attendance shall be available.
 - a. Shall include procedures for documenting attendance.
 - b. Shall define eligible absences from training and the permissible length of such absences.
 - c. Shall document procedures for attending and/or completing any training missed due to absence.
 5. A written directive shall explain under what conditions training will be provided for outside agencies/non-members.
 - a. Shall include the cost of such training.
 6. A written directive shall establish procedures for testing and re-testing of students, if applicable
 - a. Shall include established pass/fail criteria
 - b. Shall include guidelines on the development and format of testing (i.e., types of questions such as multiple choice, true or false, fill in the blank and essay).
 - c. Shall include circumstances and timetables for re-testing, remedial training, and dismissal from the academy.
 7. Academies shall maintain a training record/file on each student attending the academy. This file shall include records pertaining to that student while attending that academy sufficient to document that all performance objectives have been successfully completed.
 8. Academies shall maintain an administrative file that pertains to each class it conducts. This file shall include curriculum/ schedule, attendance records, discipline records, counseling records, test-answer sheets, and course evaluation or summary. This file may be combined with the training record/file on each student file specified above at the discretion of the academy.
 9. Academies shall have a policy covering records maintenance and a retention/destruction schedule approved by the state library. (NOTE: The current policy of the Virginia State Library and Archives is that training records may be destroyed after three years. The Department of Criminal Justice Services does not accept responsibility for the destruction or

retention of records. That decision is the sole responsibility of the academy. The Department of Criminal Justice Services will continue efforts to support academies and agencies by providing training records for official purposes, when necessary. It is not the role of DCJS to act as a records repository for individuals seeking information for their own personal reasons. As the originator of training records, the academy should provide such information. Therefore, we strongly encourage all academies to maintain at least minimal training records which would satisfy most requests from individuals. If an academy cannot comply with a particular request, the requesting individual should be advised that DCJS may be able to provide information but that a fee shall be required and that it may take up to 120 days to receive a response. In addition, academies should encourage all individuals to maintain their own training records throughout their criminal justice career...)

10. A written directive shall establish safety rules for skill training (firearms, defensive tactics and driver training) and practical exercises.
 - a. Directive shall be distributed at the beginning of the school to all students.
11. A written directive shall establish a policy governing student dress.
12. A written directive shall establish a policy on student conduct.
 - a. The policy shall detail circumstances under which students can be expelled or suspended.
 - b. The policy shall detail circumstances under which students can be re-admitted.
13. Academies shall have a policy for post-graduation evaluation of entry-level training.
 - a. Shall occur from six months to one year after leaving the academy.
 - b. Shall assess the job-relatedness of entry-level training.
14. Academies shall have documented evidence of general and professional liability insurance coverage.
15. Academies shall have a policy for insuring the physical fitness of students assigned for entry-level training.
 - a. Shall include a procedure for ensuring that agency medical personnel performing physical examinations are aware of the rigors of entry-level training.
 - b. Shall have physical performed within twelve months prior to training.
16. Regional academies shall maintain a charter which shall be updated annually.
17. Academies shall have a policy on the minimum and maximum number of students in classes.
 - a. Mandated training will not be scheduled for classes of less than six students nor more than thirty-five.
 - b. Exceptions to this standard may be granted by the Field Services Coordinator in the region where the academy is located. A written request shall be submitted to the Field Services Coordinator and shall specify the reasons why an exception is necessary. The Field Services Coordinator shall evaluate the request to determine if sufficient cause exists

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to grant an exception. If an exception is granted, the Field Services Coordinator will document the exception in writing to the academy director and forward a copy to the Director of the Division of Operations. For large academies which have suitable facilities and sufficient staff to routinely conduct classes of more than thirty five students, and ongoing exception may be granted.

18. Academies shall comply with all administrative procedures set forth in applicable rules promulgated by the Criminal Justice Services Board.

C. Personnel Standards

1. Each academy shall have a minimum number of staff available for the duration of any mandated training course. These shall include but not be limited to:
 - a. An academy director or designee.
 - b. One clerical support person. In the case of satellite training locations, this individual need only be at the main academy facility.
2. There shall be written position descriptions for each staff position including:
 - a. Selection and Retention Criteria
 - b. Performance Standards
 - c. Pay Scales and Benefits
3. Academies shall have written standards of conduct and disciplinary procedures for staff.

D. Facility Standards

1. Academies shall have classrooms and offices for staff physically present at the academy. Other facilities such as firing range, driver training track, multipurpose training areas, library and satellite facilities are considered to be part of such a facility but need not be located at the same site.
 - a. All satellite facilities shall conform to the standards contained in this section.
2. Academies shall be inspected by appropriate local and/or state authorities to ensure compliance with fire, health and building regulations. Copies of inspections shall be maintained and furnished upon request.
3. Classrooms used for lecture-type training shall provide a minimum of 20 square feet of floor space per student. Such classrooms shall have a posted occupancy based upon this standard.
 - a. Shall be equipped with an adult-size desk and chair or chair/table combination.
 - b. Shall have overhead lighting measuring no less than 50 foot candles at desk level.
 - c. Windows shall have shades or blinds capable of reducing ambient light for viewing of visual aids.

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4. Separate rest room facilities for males and females shall be provided.
5. Academies shall have designated areas for performance testing.
6. Academies shall have office space for employees.
 - a. Shall have space designated for use by adjunct instructors which shall include a desk and chair.
7. There shall be storage space for equipment and materials.
8. Shall have the following instructional aids:
 - a. Chalkboard/dry erase board (minimum 10 sq. ft.)
 - b. Projection screen (min. 10 sq. ft.)
 - c. Overhead projector
 - d. Videotape recorder/player
9. Shall have slides, transparencies, videotapes and other audio-visual aids suitable to supplement instruction.
10. Where applicable, shall have scheduled access to driver training facility which shall include:
 - a. Vehicle maintenance facility (on or off site)
 - b. Insurance for users
 - c. Adequate for courses prescribed by regulation
 - d. Skid pan, if applicable
11. Shall have scheduled access to firing range which shall include:
 - a. Shotgun/tear gas capabilities
 - b. Adequate for courses prescribed in Department of Criminal Justice Services
 - c. Insurance for users
 - d. Adequate storage facility for ammunition at the academy or range. Facility should have posted signs in accordance with law and should be protected from illegal entry and fire.
12. Ranges shall have at least 5 firing points if used for basic training.
13. Academies shall be adequately equipped with first-aid equipment.

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14. Academies shall be equipped with a telephone. Communications shall be available at all training sites.
15. Academies shall have a library which provides a representative sample of resources for subjects taught and also includes current applicable sections of the Code of Virginia, background and supplementary reading material representing varying viewpoints, and procedures to allow availability of materials to students and faculty.
16. Regional academies shall develop a housing policy applicable to students who must travel significant distances to attend classes.

E. Instruction Standards

1. The academy shall have a model curriculum for all entry-level and instructor training conducted. Such model curriculum shall contain the subject matter to be instructed, and where appropriate the designated performance objectives and times of instruction. In addition, all related material such as the memorandum of transmittal to the field coordinator, a copy of the training curriculum as actually conducted and a completed Form 41 Training Roster shall be available.
2. The academy shall maintain documentation for all in-service and instructor recertification training sessions conducted consisting of a memorandum listing session type, location and dates; a copy of the final curriculum and a Form 41 Training Roster.
3. The academy shall require lesson plans for all training courses.
 - a. Shall include a format for lesson plan development.
 - b. Shall include a statement of performance objectives, references, resources, a detailed outline of the course content, instructional aids required, and any testing/ evaluation instruments.
4. In the case of courses taught by contracted consultants or other outside instructors, only a course syllabus will be required.
5. A written directive shall specify the approval process for lesson plans.
 - a. Lesson plans shall be updated on an annual basis.
 - b. Lesson plans shall be on file at the academy.
6. All instructors must meet minimum standards established by Department of Criminal Justice Services.
7. The Academy shall establish quality control methods for ensuring adequate instruction. All of the items listed below shall be documented in writing.
 - a. Written student evaluations of instructors.
 - b. Periodic and random monitoring of instruction provided to ensure that:
 - (1) Lesson plans are being used.

- (2) Appropriate audio-visual aids are available and used properly.
- (3) The instructor is holding student attention.
- (4) The instructor is in control of the students.
- (5) The instructor is addressing the objectives.
- (6) Classroom conditions such as lighting, noise levels and temperature are acceptable.
- c. Appropriate action is taken to follow up on any student complaints regarding instructors or the training process.
- d. Results of testing are analyzed and evaluated.
- 8. The academy shall maintain an up-to-date copy of the Reference Manual provided by the Division of Operations.

F. Satellite facility standards

- 1. A satellite facility is a facility, located away from the certified academy facility, which the certified academy uses to conduct mandated training. This definition specifically excludes firing ranges, driver training sites and physical fitness or defensive tactics sites which may be located away from the certified academy facility. Commercial conference and training facilities such as hotels and motels, which are used for mandated training, are specifically excluded from this definition.
 - a. All satellite facilities where mandated training is conducted must meet the standards in the facilities portion of this policy.
 - (1) Satellite facilities must be inspected by the academy to ensure they meet the standards for satellite facilities before any credit can be awarded for mandated training which is conducted in such a facility.
 - (a) The academy shall complete the Satellite Facility Worksheet for each satellite facility.
 - (b) The Satellite Facility Worksheet shall be maintained by the academy
 - (2) The academy shall periodically monitor all satellite facilities, not less than once per calendar year, to ensure that all training conducted conforms to DCJS requirements. The academy shall maintain written reports documenting such monitoring.

ROANOKE VALLEY REGIONAL FIRE-EMS TRAINING CENTER

The CDAC team toured the existing fire and rescue academy on the Kessler Mill site. The general consensus is that the facility is performing well, but is not large enough for current and future demand.



The burn building, enclosed spaces, and other props are on one end of the Kessler Mill site.



The dividing walls in the classrooms can open up to connect the three classrooms into a larger space.



Administrative space used for meeting and putting together classroom materials.



A class in action.



Storage space and lockers for dirty gear including clothing, helmets, boots, and air packs must have good ventilation to allow wet gear to dry.



Training officers work in cubicles. While this enables them to easily configure the space, cubicles can pose an information security risk.



This trench is one of many outdoor training props requiring dedicated space.

APPENDIX B

INTERVIEWS WITH PARTICIPATING AGENCIES

Included in this appendix are the questions used to guide interviews with the participating agencies, answers each department provided, and a spreadsheet comparing departmental training needs and wishes. Agencies interviewed were the Roanoke County Police Department, Roanoke County Sheriff's Department, Roanoke County Fire and Rescue Department, Vinton Police Department, and Franklin County Sheriff's Department. Agencies were given the questions prior to the interview with CDAC team members. The content of the questions was driven by earlier meetings with the client and observations from the three training academies visited and described in Appendix A. Interviews lasted approximately two hours and were conducted at the offices of the department being interviewed. One to three members of each agency who were involved in training activities were interviewed. In some cases, additional information was requested via e-mail by CDAC team members after the interview to clear up questions.



Capt. Robert Strickler and Lt. Ewell Hunt participate in an interview with Lauren Merrill and Terri Fisher of CDAC.

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

1. How large is your department?
2. How many males? Females?
3. How often do department members attend academy training? How long are typical classes? Hours per day? Days per week? Weeks?
4. How big are typical classes? Is that too big? Just right? Too small?
5. How many classes are usually going on at once? Do classes interact with one another?
6. What happens in the classroom? What are classes like? Are they just books and a lecturer or is there more to it?
7. Do you always need tables and chairs? Are those pushed aside at times to create open space? Are they reconfigured to rows vs. a circle?
8. If you have been an instructor, what spaces/features would help you be more effective in your job?
9. What kinds of special purpose spaces do you need? How big? Office size? Conference room size? Gym size? Outdoors?
10. What kind of training equipment do students bring? Does it need to be stored?
11. What kind of training equipment is kept on-site?
12. How could your learning academy experience be enhanced by the academy's design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)
13. Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)
14. How do your department's training needs differ from other departments that might use this facility?
15. What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)
16. What other academies have you trained at or visited? What did you like about them? What did you dislike about them?
17. If money and space were no object, what training features would you like to have?
18. Any other comments?

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

Roanoke County Police Department: Lt. Jimmy Chapman, Capt. Tim Lisk

CDAC: Elizabeth Gilboy, Terri Fisher

Date: April 21, 2006

1. How large is your department?

As of January 2007, there will be 134 sworn officers, 35 communications, 10 civilians (records clerks, records manager, budget manager, secretaries)

2. How many males?

104 sworn, 12 communications and civilian

Females?

18 sworn, 33 communications and civilians. The department works to maintain the standard of at least 14% female sworn officers in the department. Currently at 17%.

3. How often do department members attend academy training?

- 40 hours every 2 years is minimum required DCJS training – Roanoke County doubles that (40 hours per year)
- Other training is also required, such as sexual harassment training. Some of this is done through HR, some has multiple agencies attending, some is done in-house.
- Different types of academy training also: recruit, management, detective, patrol, etc.

How long are typical classes?

It depends on the class!

Hours per day?

- 4-8, 4 hours is minimum for DCJS credit
- Primarily 7-5. However, periodically, facility may be used for additional recruit training, or community based education programs (i.e. VASAP, Driver Improvement, etc.).

Days per week?

1 day to week long

Weeks?

1-2 to 27 weeks (6 months) for recruit training

4. How big are typical classes?

- Average 20 up to 35
- DCJS says 6-35 per class and 20 sq. ft. per student
- Classrooms should be big enough for 35 even if class is smaller
- 75 is largest they'd want – don't forget to consider the support rooms and parking needed for that

Is that too big? Just right? Too small?

It depends on the class, what size is right, but 35 is generally max.

5. How many classes are usually going on at once?

2-4 at Roanoke City

Do classes interact with one another?

Not usually, though jailers and Department of Corrections classes might

6. *What happens in the classroom? What are classes like? Are they just books and a lecturer or is there more to it?*

- Lectures, hands-on role-playing, PowerPoint, dry erase boards, handouts, computers (report writing)
- Firearms and driving training have classroom component as well before they move to practical training at the other facility

7. *Do you always need tables and chairs?*

Yes

Are those pushed aside at times to create open space?

Yes, for role-playing

Are they reconfigured to rows vs. a circle?

Yes, horseshoe also

8. *If you have been an instructor, what spaces/features would help you be more effective in your job?*

- Shelving unit for reports, maybe box-shaped against wall
- Internet access in the classroom
- Resource table with stapler, 3-hole punch, etc.
- Garage bay that can be used for evidence processing and vehicle checks and washed down later

9. *What kinds of special purpose spaces do you need?*

- Training tank (consider management and upkeep including ventilation to remove chlorine smell)
- Tiered "showcase" classroom for minimum 75 to improve professionalism preferably with food prep room
- Weight and fitness rooms
- Portable stage
- Central weapons locker (depending on philosophy about guns in building)
- Armory for fire-arms, ammo, pepper spray, etc. Requires steel door and ventilation for ammo
- Library
- Large break room with kitchen and ice machine including outside access for caterers and patio space for seating
- Mail/copier/supplies, etc.
- Records room
- Storage off of gym for training equipment
- Memorial room
- Mock courtroom
- First aid room

How big? Office size?

4 full-size offices with doors + clerical space

Conference room size?

- 2 conference rooms for 15-20
- 2 conference rooms for 8-10
- New hires and promotional process will be moved to academy – this would provide place for background investigations and testing (10-15 for written exam)
- Can also be used for lesson planning

Gym size?

- Full-size with locker rooms
- Training equipment: mats, AV, ropes from ceiling
- Basketball court

Outdoors?

- Minimum 100 yard long agility course: jump three 4-foot chain link fences, run 100 yards, drag dummy 30 feet in 51 seconds – they are in the process of changing this course
- Run 1½ miles
- Mock crime scenes
- Traffic stops
- May do more training outside on nice days given the space

10. What kind of training equipment do students bring?

- Pens
- Paper
- Laptops
- PDAs
- Notebooks
- Leather gear (belt, holster, mag holder, glove holder, flashlight holder, baton holder, radio holder) - Students are likely to keep their leather gear at their feet
- Boots
- Vest
- Firearm

11. What kind of training equipment is kept on-site?

- Red guns
- Pepper spray
- Jump ropes
- Basket balls
- Additional leather gear
- Vests
- Dummy

12. ***How could your learning academy experience be enhanced by the academy's design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)***

- Yes, all of these!
- Door in rear of classroom
- Higher & smaller windows that students can't look out
- User friendly technical equipment
- TVs at ceiling (limits room configuration) or on cart (more flexibility, but harder to see)
- Entry like Chesterfield's with flags at front for recruits to raise

13. ***Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)***

Wings or separate floors would be best with 1 clerical person for scheduling all

14. ***How do your department's training needs differ from other departments that might use this facility?***

Similar except water training tank

15. ***What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)***

- Storage
- Armory
- Videos
- Garage for several cars
- Dumpster
- Shred-It truck access (perhaps through garage bay)
- Shred-It boxes are 3'x3'x4' keyed inside building
- "Classified" information is kept in director's office file cabinet if any is on site

16. ***What other academies have you trained at or visited?***

What did you like about them?

- Natural light
- Showcase tiered classroom
- Gym
- Weight room
- Portable stage
- Entrance at Chesterfield
- Library at Chesterfield

What did you dislike about them?

Playacting rooms are too small – wasted space

17. If money and space were no object, what training features would you like to have?

- Full-size lockers for all gear (uniforms, leather, etc.) – 60 male, 30 female
- 4 shower stalls for males
- Media room to make 15 minute practical videos
- Outside camera system for garage, gym, etc.
- Training tank
- FATS
- Driver simulator
- Leave room on site to accommodate additions for growth
- Brick and masonry building

18. Any other comments?

- A separate computer room is not necessarily needed. If the recruits were provided a laptop they would use them in their assigned classroom. With a fully integrated network, recruit officers could access e-mail, complete and submit assignments from their laptop.
- An auditorium is a lot of space for something that would have limited use. The same environment can be accomplished with a mobile stage or by opening a series of three divided rooms.
- Build it and they will come: other County entities will probably train here also
- Will employees be permitted to use the gym/weight room after hours?
- Darkroom is probably not needed.
- Interrogation Room is not needed.
- Laundry room is not needed.
- Separate space to make phone calls is not needed, especially with the common use of cellular phones. If it is something important the student could always use an office line.
- A separate Lounge Space isn't needed - the break room is sufficient, plus the Library is available.

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

Roanoke County Sheriff's Department: Sheriff Gerald S. Holt, Captain Barry Tayloe, Deputy Beth Jones, Chaplain Greg (?)

CDAC: Elizabeth Gilboy, Terri Fisher, Lauren Merrill

Date: May 9, 2006

1. How large is your department?

117 current but will increase by 200 with the addition of the new Regional Jail. 19 of current Sheriff's Department jobs will move to the regional jail in Fall 2008.

2. How many males?

89 males

Females?

28 females

The ratio of males to females will remain approximately the same even with the added members for the jail. These numbers are based on only requirements for gender specific jobs, not certain ratios to meet. Both sexes must be present on each shift due to requirements for searches.

3. How often do department members attend academy training? How long are typical classes? Hours per day? Days per week? Weeks?

- The basic academy training at the Cardinal Academy lasts for 10 weeks, 4 days per week, 10 hours per day.
- Basic training at the New River Academy in Dublin lasts 9 weeks, 5 days per week, 8 hours per day.
- Re-certification is required every 2 years some is currently done on-line through Cardinal Academy.
- Also 40 hours of training in-house is required each year by the American Corrections Association.
- In-house training includes classes such as CPR and defense classes that all officers must complete.
- Training varies from ½ day to 5 days for other select positions and 1 day practicals such as key control, tear gas, tasers, etc.
- 12 weeks of training will be required by Cardinal due to new standards starting July 1.

4. How big are typical classes? Is that too big? Just right? Too small?

- Typical classes include approximately 15 members or more.
- The maximum number of students would top off at 26 or 27 at Cardinal.
- During basic training there is approximately one evaluator for every 3 or 4 students. The maximum number of students in a basic training class is 30-40 with groups of 5-6 for practices.
- Practical classes are completed usually in a one day period, aside from some training like range and driving that require up to a week.

5. ***How many classes are usually going on at once? Do classes interact with one another?***
- Multiple at once for basic training.
 - In-house classes usually only occur one at a time.
 - Interaction only as certain overlapping standards such as firing range, driving, and defense tactics training.
6. ***What happens in the classroom? What are classes like? Are they just books and a lecturer or is there more to it?***
- Classes are mostly just lecture and note-taking with some demonstration. These lectures are done through PowerPoint presentations, video, DVD, etc.
 - There is computer lab access but computers are not required for each student during class.
7. ***Do you always need tables and chairs? Are those pushed aside at times to create open space? Are they reconfigured to rows vs. a circle?***
- Tables and chairs are flexible but necessary to be placed in rows at certain distances apart – very structured.
 - Tiered classrooms are preferred – possibly an auditorium that could house 50-60 for large events and special lectures. Or maybe even 200 as a nice showplace for graduations.
 - Partitioned walls are possible but concerns with sound-proofing between classes.
 - Usually move to another room if they need space rather than moving chairs aside.
8. ***If you have been an instructor, what spaces/features would help you be more effective in your job?***
- Good lighting, either natural or artificial, necessary.
 - Audio-visual needs require up-to-date equipment.
 - Chalkboard or white-board.
 - Storage Area to store equipment when not used.
 - Doors in back of room preferred.
9. ***What kinds of special purpose spaces do you need? How big? Office size? Conference room size? Gym size? Outdoors?***
- Gymnasium
 - Conference room (1 or 2 holding 30-40 people)
 - Outdoor training facilities (running, track, physical agility course)
 - Weight room good for all departments
 - Jail Cell?
 - ICAT Simulated range lab
 - NIMS training (mandated for all county workers by Homeland Security)
 - Computer training
 - First aid training
 - Always growing and changing so room to accommodate growing needs.
 - Gun lockers – guns not allowed in academy

- 3 regular classrooms and 1 tiered classroom
- 1 office for one member of the training staff
- Sallyport
- Library (with good light)
- Memorial room
- Outdoor patio space off the break room

10. What kind of training equipment do students bring? Does it need to be stored?

- Duty issued equipment (gun belt, vest, etc.)
- Locker Rooms with showers for both male and female students because must wear street clothes outside, but must wear uniforms to classes.

11. What kind of training equipment is kept on-site?

12. How could your learning academy experience be enhanced by the academy's design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)

- Acoustics extremely important because usually housed in older buildings with poor acoustics.
- Good lighting.
- Wireless internet possible but not demanded. (concern about stealing connection)

13. Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)

Prefer campus style design

14. How do your department's training needs differ from other departments that might use this facility?

- Fire Department needs completely different.
- Sheriff and Police are similar.
- Some basic training classes could include students from all departments.
- Career development opportunities.
- Sheriff's Department has three types of training: Administrative, Corrections, and Court Security

15. What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)

- Obvious office materials and space, filing, putting things away
- Storage areas necessary.
- Breakroom with kitchen appliances (stove, refrigerator)
- Receptionist for entire facility
- Coat room
- Phone room

16. What other academies have you trained at or visited? What did you like about them? What did you dislike about them?

- Have trained all over VA as well as rest of country. Most important common factor is that all facilities function as learning places with good acoustics, being able to see and hear speaker, and appropriate material.
- Liked Chesterfield's library/memorial room

17. If money and space were no object, what training features would you like to have?

- Simulated Range Lab (ICAT)
- Visual and sound necessities – most up-to-date equipment
- Dormitories due to large commutes for some individuals since facility is used by people over such a large area. Must be gender specific.
- Locker rooms with small and large lockers to house larger equipment
- Water training tank not needed. (If the water is that high in the jail, they have bigger problems!)
- Big screens for visibility in each classroom.
- Brick building with flag poles

18. Any other comments?

- No weapons allowed but basic does not yet have them.
- Most important is to design for the future of the department.
- There are two basic training sessions per year (Jan – April, July - Sept) but not efficient. Police must hire from street to academy but academy not always readily available for new students due to only 2 windows of opportunity to begin the training. Sheriff can hire, but new hire must be with a deputy at all times until he goes through academy. Makes more sense to have 4 week intervals of training sessions that alternate to accommodate students beginning at different times.
- Develop curriculum for advanced training networked with other facilities.
- Trainers come from department so if there is more training, then there will be need for more trainers so may need more employees.
- Would like to develop career development courses for supervisors, etc. possibly creating a training facility that will attract other jurisdictions for career development. It currently takes 8-10 years to get into premier training facilities such as Quantico (FBI), Southern Police Institute in Louisville, or Northwestern in Chicago.
- Mandated training keeps increasing.
- The new jail will have 200 people to train and 45 days of funding prior to opening to train those people. This might work in a perfect world where there is room to train 200 people and all of those people work out. It is likely it will take 3-4 years to get all 200 people. It would cost \$4M for 6 months funding to train all 200. This is a \$79M facility. Should start up be gradual or immediate? The 3 jails it will replace/enhance are at 3 times capacity now.
- Interagency Operability (communications) is now part of field training, but perhaps should be included in the academy so that everyone can communicate together
- No cell phones allowed in Cardinal Academy.

- Several rooms are needed for each practical because, in some of the practicals there are multiple stages that the student must complete. The gym would be used for defensive tactics training rather than having a separate dedicated room with mats rolled out all the time.
- Role playing rooms set up semi-permanently for a certain scenario aren't needed.
- One story facility preferred.
- Natural light in classrooms can come from windows or above.
- Forensic lab, fingerprinting room, interrogation room, TV studio, and darkroom aren't needed
- No need for a driving simulator - the Sheriff's Department in Roanoke County handles mostly corrections rather than law enforcement
- Card key security for staff within building

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

Vinton Police Department: Capt. Kip Vickers

CDAC: Elizabeth Gilboy, Terri Fisher, Lauren Merrill

Date: May 26, 2006

1. How large is your department?

31 total consisting of 22 sworn in officers, 6 dispatchers, and 3 other employees (secretary, evidence records, accreditation)

2. How many males?

22 males (19 sworn and 3 dispatchers)

Females?

9 females (3 sworn, 4 dispatchers, 2 others)

3. How often do department members attend academy training?

There is always someone attending academy training but every officer must attend 40 hours per year which is usually completed by attending for 2 or 3 weeks. Because the department is so small the officers are usually responsible for more than one task or hold more than one position - this leads to lots of training.

How long are typical classes?

It depends on the class but most last 1 week (Mon-Fri)

Hours per day?

10 hours usually

Days per week?

4

Weeks?

Depends on the class

4. How big are typical classes?

Depends on the subject but usually between 10 and 35.

Is that too big?

Yes – 35 is too big for coordinator or instructor but not for the student

Just right?

22-23 for basic and role playing – depends on subject

Too small?

No class unless 10 people

5. How many classes are usually going on at once?

4 at once (basic law enforcement, basic jail techniques, 2 specialty)

Do classes interact with one another?

Not usually but yes with physical training after other classes end or fire-arms training

6. ***What happens in the classroom? What are classes like? Are they just books and a lecturer or is there more to it?***
- Lots of role-playing and hands on activities; lectures.
 - Require a great deal of room to make the scene realistic
 - Often chairs and tables are pushed aside for role playing, but specific role playing rooms would be better and more realistic
7. ***Do you always need tables and chairs?***
- Yes and lots of them – moveable (even rollable) for convenience.
 - Facility always being used by other members of community: voting, meals, Blue Ridge Chiefs' meetings
 - Extra sets of chairs and tables in storage would be helpful
- Are those pushed aside at times to create open space?***
- Often pushed aside and restructured depending on the class
- Are they reconfigured to rows vs. a circle?***
- Both shapes used often – circle used during presentations or examples.
 - Also small study groups configured.
8. ***If you have been an instructor, what spaces/features would help you be more effective in your job?***
- Fixed audio-visual devices.
 - Role-playing devices (fist suits, evidence collection items, red guns, drag dummies, etc)
 - Space to store equipment when not being used. (always must be put away when not being used because other classes use same room)
 - Space to use it.
9. ***What kinds of special purpose spaces do you need?***
- Training tank would be good but not necessary
 - Role-play rooms: Jails, House rooms (living room, etc.)
 - Live-rounds/shoot house (could be combined with fire's smoke house, but needs sand-filled tires to stop bullets)
 - Defensive tactics room so don't have to waste time rolling up mats every day
- How big? Office size?***
- Size large office (Vinton chief's was 12 concrete blocks wide), training coordinators could have smaller offices
- Conference room size?***
- Large and abundant amounts (others always want to use the space)
 - 20-25 people at least, could be used as classroom if needed
 - Smaller room for 10-12 is useful too
- Gym size?***
- Full court size
 - Weight room/physical fitness room

Outdoors?

- Range
- Driving training track
- Outdoor track not needed because officers can run the roads, etc.
- Wooded area for searches (near range?)
- Half football field plenty of room (did use small baseball field to perform physical activities like running, pushups, sit-ups – good for flexibility)
- Law Fit Course – permanently set up, now portable

10. What kind of training equipment do students bring?

- Tactical, Firearms gear
- Accident investigation – protractors, tape measures, etc.
- Depends on the subject of the class
- Books, pens, paper (normal classroom supplies)
- Most training equipment should be available at academy

Does it need to be stored?

Yes for basic – oversized lockers best because uniforms – small lockers not big enough for storage. Located near the padded room which could also be locked and gear left there overnight

11. What kind of training equipment is kept on-site?

- Dummies
- Examples of narcotics
- Handcuffs, chains, shackles
- **LOTS** of storage space needed

12. How could your learning academy experience be enhanced by the academy's design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)

- Audio-visual equipment
- Tiered classrooms for better visual for students
- Windows – both helpful and harmful, good and bad
- Natural light good
- Wireless network necessary

13. Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)

- Helpful and harmful – but not a major problem
- Scheduling conflicts, noise, etc...
- Sharing equipment, rooms, etc. is helpful
- Set-up together not a problem, but wings probably more likely

14. ***How do your department's training needs differ from other departments that might use this facility?***

Similar needs but smaller department (needs on a smaller scale)

15. ***What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)***

- Large storage area for paperwork, files, copying, books, etc.
- Shelving in this large room – 12 concrete blocks wide is size
- Kitchen and cooking area; dining
- Padded/defensive tactics area
- Conference rooms (several)
- Reception area (for whole academy)
- Library not used that much so not huge – conference room
- Memorial room (link with conference room space?)
- Outdoor patio (not huge), picnic tables
- Training tank

16. ***What other academies have you trained at or visited?***

- Henrico, FBI, DEA, Roanoke, Bristol, New River in Radford, etc.
- FBI academy good setup (located at Quantico)

What did you like about them?

- Henrico – tiered classrooms with good audio-visual, Indoor range
- Dorms good but not always necessary

What did you dislike about them?

New River – too small and old (many training academies are built in old, renovated buildings)

17. ***If money and space were no object, what training features would you like to have?***

- Indoor gun range
- Pursuit driving facility – like at Fort Pickett – small and long (7mi) pursuit with skid pad

18. ***Any other comments?***

- Gun lockers optional because officers can store them in car.
- Coat room necessary, particularly for Chiefs' meetings – others could put coats on rack in classroom
- Online classes are more popular now (like blood born pathogens) and often more efficient than in person class because videos and tests on subject matter.
- Divided classrooms – yes
- Garage – yes – good place for skid car, finger printing, gun solvents, concrete floor, blood spatter classes

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

Roanoke County Fire and Rescue Department: Chief Richard Burch, Jr.; Daryell Sexton, Battalion Chief-Training; Steve Simon, Division Chief Administration

CDAC: Terri Fisher, Lauren Merrill

Date: June 8, 2006

1. How large is your department?

- 700 people use training center (whole valley: Roanoke County, Roanoke City, Salem City, Vinton also Western Virginia EMS)
- 400-450 = career; other = volunteer

2. How many males?

Approx. 90%

Females?

Approx. 10%, More in rescue squad

3. How often do department members attend academy training? How long are typical classes? Hours per day? Days per week? Weeks?

- There are 6 different shift trainings that occur 6 times throughout the year, equaling 24 days.
- Paramedic training consists of 2 days per week for 11 months.
- Recruit training is everyday for 15 weeks.
- 1 department has a one day class every week
- Others from county call in to use
- 1 unit = 4-8 hours, over the last year, 40 agencies completed 1369 units at the academy (see spreadsheet on page B22)
- Classrooms (3) are full: 4 days per week, 2 weekends per month, 2-3 nights per week
- A fourth classroom (a double wide) is used as a lab for clinical activities as well as demonstrations or when students are still suited up ("dirty")
- Volunteer training academy is September through February – evenings and weekends

4. How big are typical classes?

10-30 students (maintain 6:1 ratio)

Is that too big? Just right? Too small?

24 students to be beneficial but not too big

5. How many classes are usually going on at once?

4 classrooms usually full

Do classes interact with one another?

- Sometimes – depends on class
- Partitions used between classrooms for flexibility between rooms

6. What happens in the classroom?

Practicals, demonstrations, lectures

What are classes like?

- Audio-visuals
- Computers w/ wireless networking over whole training ground
- Computer Lab good – laptops eventually for note-taking, etc.
- Smart board used for writing and displaying computer screen

Are they just books and a lecturer or is there more to it?

Lots of practicals and demonstration

7. Do you always need tables and chairs?

Majority of the time yes

Are those pushed aside at times to create open space?

- Depends on instructor but sometimes
- Tiered classroom = AMPHITHEATER for seating between 40 and 60 people; stage useful; should be a showplace that can be used for other meetings public hearings, homeland security meetings, etc.

Are they reconfigured to rows vs. a circle?

- Both; also U-shape, etc.
- Flexibility is key.
- The 3 classrooms can be split into as many as 5 or as few as 1 – works well – noise isn't usually a problem

8. If you have been an instructor, what spaces/features would help you be more effective in your job?

- Flexibility with audio-visual equipment and how to use it
- TV on wall in specific area does not help when space opened up to larger rooms and different shapes
- Entrance in back of room

9. What kinds of special purpose spaces do you need?

- Conference rooms (10-12)
- Break out room
- Weight room (35 people – current weight room not large enough)
- Equipment storage rooms – LARGE and LOTS (CPR mannequins, stretchers, baby seats, defibrillators and IVs must be locked up, etc. – all Roanoke County and City EMS and fire training equipment is at the academy)
- Place for dirty gear with ventilation to prevent mildew (perhaps rack cleaning system) separate from personal lockers where uniforms can be kept
- Break room for up to 35 people away from classrooms with chairs, tables, sofas, microwaves, snack machines, stove? (unsupervised stove not safe)
- Bay for truck
- Bunk room for 6-8 people

- Commercial washer and dryer to clean gear
- “War room” for putting together training manuals
- Library – mostly videos

How big? Office size?

- 6 offices size of normal to large office room
- Cubicles need to be sectioned off by locality for security reasons
- State lease for satellite offices of EMS and fire certification?

Conference room size?

10-12 people, current 8-person is a little small

Gym size?

Beneficial – can be shared with other departments – but not necessary

Outdoors?

- Training tower (5-6 stories) – useful also for SWAT team -25'x25' to 30'x30' footprint - combine with new burn building using propane instead of wood-based
- Training/physical fitness center for agility test – like par course
- Universal building for dirtier activities – concrete flooring – very large space would let them pull trucks in or roll out hoses to dry – could also be used for CPAT which takes up space of entire Salem Civic Center or about the size of the paved area in the academy parking lot (ex - Prince William County)

10. *What kind of training equipment do students bring?*

- Depends on class – different departments bring different equipment
- Gear, airpack
- Books, Backpack, etc.

Does it need to be stored?

- Very large lockers needed
- OSHA requires personal protective clothing not kept with regular, everyday uniforms
- Special commercial washing machine and dryer on side of room to clean protective uniforms

11. *What kind of training equipment is kept on-site?*

- Approx. 3 large rooms (the size of the 6 person conference room we were sitting in) for equipment with shelving required
- fire room, EMS room – both need own large room
- limited access space
- EMS and fire equipment locked up

12. *How could your learning academy experience be enhanced by the academy's design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)*

- Current facility works well but not large enough
- Classrooms good for function and flexible
- Wireless needed for flexibility

13. ***Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)***

Because the fire academy already exists, build individual buildings with common areas for all departments to have access to (at common overlapping activities)

14. ***How do your department's training needs differ from other departments that might use this facility?***

15. ***What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)***

- Large file room existing – “kinkos” type area across the hall
- Reception area (shared or individual) depends on layout of facility - Can be shared but not if far from other buildings

16. ***What other academies have you trained at or visited?***

- Virginia Beach – has “bombed” building for training
- Newport News – nice cafeteria and break area
- Phoenix – premier training academy in U.S.
- Prince William County – physical agility test – if we were to go see a fire academy, we should see this one
- Fairfax – as a building where they can raise a ladder 100ft inside

What did you like about them? What did you dislike about them?

- Botetourt – Greenfield Center has a nice amphitheater with a stage that holds about 60 people
- Current facility has storage closets accessible from hall and classrooms

17. ***If money and space were no object, what training features would you like to have?***

- Amphitheater
- Tower
- 100' x 300' open area/warehouse type environment
- Training tank possible
- 15' x 35' Training pad = concrete slab for car fires, etc.
- Editing/studio production room needed to record own videos
- Fire house with single bay for 2 week training to simulate life in the fire house, storage for a fire truck, bunk room for 6-8 people (could also hold out of town visitors to the academy), and kitchen

18. Any other comments?

- Staff rooms such as large locker rooms, office, break room for chain of command
- Facility must have all the latest fire protection equipment for the building including sprinklers – practice what you preach!
- Security of site important
- Fire hydrant not on meter
- Ample amounts of fire hydrants
- Parking Lot is not large enough; asphalt needs to be thick to hold the weight of the truck
- Hard floors better than carpet due to possibilities for dirt from outside practicals
- All Roanoke County fire fighters must also become paramedics
- Driver training takes place in a large, empty parking lot like one of the high schools or the Civic Center
- Most additional training things they would like are outdoor facilities specific to fire like the training tower, rather than indoor things

[illegible]

	Class 1	Class 2	Class 3	Conference	Library	DW	Burn	Maze	Tower	Trench	Total
DCJS	4										4
VDH		2	2								4
Fire Marshall's class	2	2									4
Page Dealer		2		1							3
Vinton									2		2
State Police								2			2
McGraw-Morgan	2										2
RC Schools		2									2
MACOM		2									2
DSS Training			2								2
Campbell Paperless System		2									2
Norfolk Southern			2								2
Comm of VA	2										2
CIP Committee		1	1								2
Valley CHS									2		2
Roanoke Gas			1								1
RCPD						1					1
City PD									1		1
LRV				1							1
DOT			1								1
Chamber of Commerce			1								1
Defensive Driving			1								1
Leadership Roanoke				1							1
Allied Resources	1										1
Scott Town Hall Mtg	1										1
Total Outside Agency Use	139	68	129	17		7	5	2	31		398
Total Usage for 2005											1767

INTERVIEW QUESTIONS FOR ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY

Franklin County Sheriff's Department: Lt. Ewell Hunt, Capt. Robert Strickler, Capt. Overton

CDAC: Elizabeth Gilboy, Terri Fisher, Lauren Merrill

Date: July 27, 2006

1. *How large is your department?*

- 97 – full capacity at current time (not counting 4 secretarial and 1 part time)
- 800 new people coming to community each year (approx. 16 per week)
- 1 deputy allotted for every 1500 people.
- Public Safety Enforcement also sends approx. 5 to training.
- New jail should flatten out the growth.

2. *How many males?*

80

Females?

17

3. *How often do department members attend academy training?*

- Training is done at the Cardinal Academy. In-service training requires 40 hours per every 2 years (much of this training is now done through online classes instead of in person).
- Recruits require 20 hours of basic training.
- Dispatchers complete 8 days.
- Additional or specialty training is done as it becomes available and as needed (officers travel to wherever available).

How long are typical classes?

Duration varies depending on type of training.

Hours per day?

10 hours per day

Days per week?

4 days per week

Weeks?

Varies

4. *How big are typical classes?*

Mostly consist of approximately 25 students. The state requires 15 in order to provide an instructor and allows 35.

Is that too big?

Over 20 students can sometimes be too many when doing defense tactics, etc, and the class must break into groups.

Just right?

20-25 is a good number for a typical class.

Too small?

Must have 15 for state to send instructor.

5. *How many classes are usually going on at once?*

3 or 4 (3 main classes and 1 large multi-purpose room)

Do classes interact with one another?

- Recruits and Corrections students begin together (then break off and corrections graduates after 2 weeks).
- Firearms and other practicals are often done together.

6. *What happens in the classroom? What are classes like?*

Mostly lecture and some practicals.

Are they just books and a lecturer or is there more to it?

7. *Do you always need tables and chairs?*

Yes, long and movable/flexible.

Are those pushed aside at times to create open space? Are they reconfigured to rows vs. a circle?

Horizontal rows mostly unless moved to make circular depending on interaction with students in class (circle is more interactive between instructor and student).

8. *If you have been an instructor, what spaces/features would help you be more effective in your job?*

- Audio-visual equipment.
- FLEXIBILITY.
- Stadium seating/tiered (minimum of 50 seats to be effective).
- Lots of desktop space for student materials.

9. *What kinds of special purpose spaces do you need?*

- Open room for multi-purpose activities
- FATS separate from gymnasium.
- Defense tactics room with mats out constantly.
- Role-playing rooms (living room, bar, etc.)
- Mock courtroom and jail cell.

How big? Office size?

- Yes for administration – one overall for facility as well as individuals.
- Training officers, director – minimum of 5.

Conference room size?

20-25 people – library type of space

Gym size?

Outdoors?

- Obstacle course; high school track with 4-5 lanes.
- Physical training area – physical fitness open spaces.
- Practical tactics training for pulling cars over. (“vehicle stops”)
- Old house types of building for hostage situations and officer down rescues. (“urban assault”) (possibly use burn building existing on site) – now use abandoned farmhouse in Botetourt County
- Wooded search and survival area.

10. What kind of training equipment do students bring?

- Vehicle
- Weapon
- Asp (retractable nightstick)
- Books, etc.

Does it need to be stored?

Weapons must be stored in a lock box area

11. What kind of training equipment is kept on-site?

- Anything involved in defense tactics – dummies, suits, etc.
- Decontamination area (sink and fans)
- Less-than-lethal-force training equipment

12. How could your learning academy experience be enhanced by the academy’s design? (e.g., outdoor activity space, classroom configuration, more/less natural light, wireless network, less noise, etc.)

- Dividable classrooms – students breaking at different times;
- Sectioned areas with shared general classroom space
- Natural light but not large windows (maybe light from above)
- Entrance into classroom in rear of room
- Non-flammable Room
- Breathalyzer Equipment needs own room (state mandate)
- Dorms ideal to be overnight facility for people traveling from far or could contract with a local motel
- Shower and locker room facility
- Weight room

13. Would it be helpful or a hindrance to train in close proximity to another specialty? (i.e., police and fire have their own separate wings in Chesterfield County, but are just separated by a hallway in Henrico County)

More interested in separated areas with general shared spaces

14. How do your department’s training needs differ from other departments that might use this facility?

15. **What seemingly obvious features would you want to be sure are in an academy? (e.g., reception area, copy room, etc.)**
- Media room
 - Power-point and other audio/visual equipment
 - Storage areas
16. **What other academies have you trained at or visited?**
Piedmont, Southwest, Cardinal, Lynchburg, Central Virginia - Midlothian
What did you like about them? What did you dislike about them?
- Cardinal seems to be the most up-to-date
 - Most are just older buildings turned into training academies which limits the flexibility needed in the facility
 - Ample parking is necessary
17. **If money and space were no object, what training features would you like to have?**
- Training tank would be useful because of Smith Mountain Lake
 - Dormitories for overnight stay or contract with nearby hotel
 - Cross-training both sheriff and police students to prevent the need to send officers back to receive more or different training later on
 - College type of program curriculum
 - Open to people not yet hired by agencies – officers currently are not able to get DCJS certification if not already with an agency and are not allowed to graduate with fellow students until hired.
18. **Any other comments?**
Break room with a kitchen necessary (especially if over night facility)

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
BASIC INFORMATION					
number served	134 sworn officers, 35 communications, 10 civilians	117 officers but will increase by 200 with addition of the jail	31 total officers, 22 sworn, 6 dispatchers, 3 others (secretary, accreditation)	400-450 = career; 700 including volunteer all divided between 4 localities	97 total (not counting 4 secretary and 1 part-time) - 1 deputy per 1500 people; also 5 public safety officers, county growing at rate of 800/yr
male	104 sworn, 12 non-sworn	89	22 (19 sworn, 3 dispatchers)	approx. 90%	80
female	18 sworn (14%), 33 non-sworn	28	9 (3 sworn, 4 dispatchers, 2 other)	approx. 10%; more in rescue	17
training frequency	40 hours/year in-service	40 hours/year in-house	40 hours/year (2-3 weeks total)	4 different shifts at 6 times equaling 24 days; paramedic is 2 days per week for 11 months	40 hours per 2 years in-service; many classes now available online; additional training as necessary, recruits 20 days, corrections 12 days, communications 8 days
hours per day	4 minimum - 8	8 to 10 hours	10 hours	12+ hours	10 hours
length	1 day to 1-2 weeks to 6 months for recruit training	5 days for 9 weeks or 4 days for 10 weeks	4 days per week	varies 1 day to 11 months	4 days per week
usage	2-4 classes at once, spring is usually busiest	multiple classes at once, in-house one at a time	4 classes at once usually (basic law enforcement, basic jail, 2 specialty)	4 full usually all the time	3 or 4 classes at once (includes 3 classrooms and gymnasium)

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
interaction between classes	none	when training standards overlap	none except physical training, fire arms training	Sometimes, partitioned classrooms helpful	Recruits and Corrections begin classes together; firearms, etc. shared
other users	other County entities likely, community-based education programs (VASAP, Driver Improvement, etc.)	fire and police training, others for NIMS training	other members of community, education based programs	VDOT, Virginia Western Community College, other groups in community	
number of hours per day	7am-5pm, but gym/weight room might be used after hours, possibly community-based education programs in evening	10+, each recruit must clean up space when class is done.	10	usually all day; as well as 2-3 nights per week and 2-3 weekends per month	classes always going on during day
configuration	wings	campus	no preference	Campus with shared areas	separated areas with central shared space
number stories	or one entity on each floor (3 stories)	one story			
outdoor facilities	run 1.5 miles, agility course of 110 yds, traffic stops, mock crime scenes	running area, track, physical agility course	range, driving training, wooded area, half football field of area	training tower (5-6 stories); physical fitness center; universal building for "dirty" activities	obstacle course, track of 4-5 lanes, open spaces for fitness, wooded area, old house for hostage situations

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
CLASSROOMS					
typical class size	20	15 and up	depends- between 10 and 35	24	25 average size
biggest class size	75	40	35	30	20-25 is best
total number classrooms	5	4		4	3 or 4
number regular classrooms	1	3		3 + 1 "dirty classroom"	approx. 3
classroom capacity	35	26 or 27	22 or 23	30	35
flexibility?	yes	yes, maybe	yes	yes	yes
wired?	yes	no	yes	yes	yes
number dividable classrooms	1			all need to be dividable	very large dividable space
classroom capacity	35 x 3			35	
flexibility?	yes	yes	yes	yes	yes
wired?	yes	no	yes	yes	yes
number tiered classrooms	1	1	large conference room	1 larger room	1 large room
classroom capacity	75	50-60	20 or 25	>30 to <60, 40-45	min. 50 to be effective
flexibility?	no	no	yes	no	no
wired?	yes	no	yes	yes	yes
electronics	projected PowerPoint or DVDs, TV with VCR	PowerPoint, Video, DVD, TV	fixed audio-visual equipment	flexible audio-visual; smart board; projector; TV; DVD	some fixed audio/visual equipment; powerpoint accessibility; projector
entrance	rear of room	rear of room		rear of room	rear of room

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
additional space needs	place for recruits equipment, supplies, course materials	storage area	LOTS of storage area for equipment	lots of storage for equipment	storage necessary for on-site equipment
	boxy shelving unit for reports	very structured row set up	space for demonstrations		lots of desktop space for students and instructor
	resource table with stapler, 3-hole punch, etc.				open space for various activities
other	Internet used by instructors in classrooms	chalkboard, up-to-date electronic equipment	moveable chairs and tables	smart board built in	high windows you can't see out of
	at least one classroom with soundproof walls			very flexible chair and table set up	
computer classroom	not if recruits assigned laptops and other classrooms have wireless access	only need computer lab access		must have wireless, eventually computers for each student	wireless plus computers in classrooms; computer lab also
wet bar in classroom	no	no	no	no	
auditorium	lots of space, limited use	yes (tiered) for larger events, as showplace, up to 200 for graduation		yes (for 40-60 people), no for a larger space for graduation which would have limited use	tiered seating type of space with minimum 50 seats

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
ADMINISTRATIVE SPACE					
staff size	5	1		6:1 student-teacher ratio	
conference rooms	2 for 15-20 and 2 for 8-10	1 or 2 for 30-40	many	1 large one (10-14 people)	20-25 people; library type of space
offices	4 + clerical with doors	1	1 large one	6 offices	minimum of 5 including overall director of facility
document storage	yes	yes (filing space)	yes	yes	yes
general storage	training equipment: red guns, jump ropes, additional leather gear, vests, dummy, etc.	lots of storage	lots of storage (dummies, audio visual equipment, etc)	Lots of storage for large and bulky equipment	lots of storage
instructor briefing room	use conference room	no	no	no	
lesson plan room	use conference room	no	no	no	
mail area	yes				
copy room	yes	yes	yes	yes	typical office space
computer server room	yes	yes	yes		
reception area	yes + for entire academy (shared clerical person?)	receptionist for entire facility	receptionist for entire facility and all departments	yes (can be shared depending on layout of site)	yes, for overall facility and individual departments
shredder receptacle	3'x3'x4' keyed box	shared among all departments			

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
TRAINING SPACE					
fitness area	yes	yes	yes	yes	yes
weight room	yes	yes	yes	yes	yes
multi-purpose room	yes, full basketball court, ropes,	yes, gymnasium for different training drills	yes (full size gymnasium and garage)	shared gymnasium; prefer large outdoor/ dirty area	large gymnasium space shared
defensive tactics room	roll out mats in multi-purpose room instead of wasting space	roll out mats in multi-purpose room instead of wasting space	yes so don't have to keep rolling out mats	no	yes to keep mats out continuously
range and driving facilities	off-site	yes	yes	no	possible on site driving track; place for pulling cars over for training
role playing area	would rather use open classrooms than waste the space on smaller rooms	not set up for specific purpose, but would need several rooms for each practical	yes (house rooms, jails)	no	yes - living room, mock court room, jail cell, old house for hostage situation training
gun and ammo vault	yes, steel door, ventilation requirements for ammo, pepperspray goes here as well	no	not necessary	no	yes - lock box for firearms
garage/sally port	yes, for several cars	sallyport	yes for multi-functions		yes
forensic lab	use garage space instead so can be hosed down	no	no (use garage for labs)	no	yes - space for fingerprinting on computer, DNA swab, initial DCJS-required forensic training - must have climate/ humidity control
darkroom	probably not needed	no	no	no	no

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
fire arms training simulator	new version trains multiple operators, with glass room for operator	simulated range lab		no	yes - needs own room
driving simulator	yes	no	no (want real thing)	no	
simulated jail environment		yes	yes	no	yes
interrogation room	not needed	no		no	
finger printing room	use garage space instead so can be hosed down	no	no, use garage	no	yes
training tank	yes, but with adequate ventilation for the chlorine smell	no	yes but not necessary	maybe	helpful because of Smith Mountain Lake
mock court room	yes	no		no	maybe
dispatch console	yes, with viewing room	no			
decontamination area					for use after pepper spray drills, includes sink and fan
non-flammable room					for concussion bombs
breathalyzer room					separate room with fresh air to keep machines accurate

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
AUXILIARY SPACES					
first aid room	yes (learning? or giving?)	yes (learning)		yes	
study room	no, use library	yes/student lounge area		use library/lounge	
prep kitchen	yes	yes	yes	yes	yes
coat room	no	yes	yes		
phone room	no	yes			
lounge	no, break room and library sufficient	use break room and kitchen area	use dining area/kitchen	yes, large enough for 35 people	use break room
break room	yes, large	yes with kitchen	use dining area/kitchen	yes, lounge	yes with full kitchen area also, away from classrooms
library	yes, similar to Chesterfield	yes, like Chesterfield's, should have good lighting	not huge (maybe use also as conference room)	yes, mostly check out	yes but not too large - possibly attach with conference room
memorial room	yes	yes	yes (conference room)		
laundry	not needed	no		yes, for both regular clothes and protective clothing	if overnight facility then yes
ice machine	yes	yes		yes	
locker rooms	full-size lockers for all gear (uniforms, leather, etc.) - 60 male, 30 female - 4 males shower stalls	yes - various size lockers in gender specific locker rooms with showers	yes with full-size lockers to fit uniforms and personals	yes with very large lockers to store protective clothing, gender specific but larger male room	large gender specific locker rooms with large, high school size lockers
outdoor patio	yes	yes	yes but not huge		yes
TV studio	yes, if it was there, they would use it to make practical 15 minute videos	no		yes for making videos and also cable access	could be helpful

	Roanoke County Police	Roanoke County Sheriff	Vinton Police	Roanoke County Fire and Rescue	Franklin County Sheriff
HVAC system	yes, must have controls in each room (DCJS)				
loading docks	not necessary	not sure			
services	dumpster				
ADDITIONAL FEATURES					
electronic display board					
gun lock boxes	yes, depending on philosophy of academy regarding guns	no	not necessary	no	yes
bulletin boards					
white boards	yes	yes		yes - smart board	yes
dorms	no	yes	maybe but requires someone to always be there	bunk room for 6-8 people	maybe, or contract with outside hotel
security	outside camera system, gym, etc.	card keys		lots of security for site and for building	
portable stage	yes				
materials	brick and masonry	brick		hard floors, not carpet	
room for expansion	make academy able to handle growth by adding on	yes due to new jail and addition of 200 new officers		already outgrown current facility so yes	yes because of new jail facility
entrance	curved entrance with place for US, VA, and Roanoke County flags to be displayed	flag poles			
other					provide vehicle (and place to store vehicle) for those who come to academy but aren't members of an agency

APPENDIX C.

FINAL PRESENTATION: AUGUST 25, 2006

The Community Design Assistance Center at Virginia Tech was charged with determining if the Kessler Mill site in Roanoke County is large enough to fit a new Public Safety Training Academy.

Preliminary site analysis was presented at a meeting on March 31, 2006. The topography of the site causes water to drain towards the current buildings. Observations on a rainy day showed many locations where water pools around the old mill building. Across the road, Mason Creek provides additional flooding opportunities. Proper engineering and an increase of porous surfaces can help reduce the amount of water that stands on the site.

The composite map shows the flood plain and types of soil on the site. The soil types correspond to disturbed soil from interstate construction, soil found in a flood plain, and soil found on a slope. Winds are generally westerly in Roanoke County. The example facilities shown on the site are about 50,000 sq. ft. each and correspond to the size of the academies we visited.

To determine whether the site would be a good candidate for solar options, a topographic model of the site was built. Using sun charts, the model was tipped at different angles to approximate the sun at different times of day on different days of the year. The summer solstice of June 21, the longest day of the year, was chosen as one extreme to identify shading.

ROANOKE COUNTY PUBLIC SAFETY TRAINING ACADEMY Site Recommendations



KESSLER MILL ROAD SITE
ROANOKE COUNTY, VIRGINIA

The drawings in this presentation are conceptual and were prepared to show approximate location and arrangement of site features. They are subject to change and are not intended to replace the work of a professional engineer. The client should consult appropriate professionals before any construction or site work is undertaken. The Community Design Assistance Center is not responsible for the negligence or omissions of third parties.

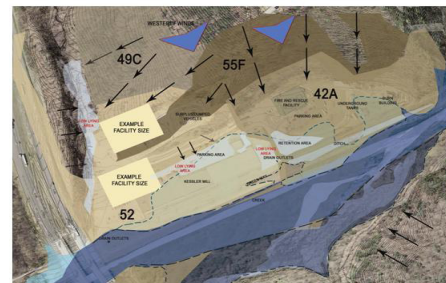
View of Kessler Mill site from Interstate 81.

TOPOGRAPHY AND DRAINAGE ON SITE



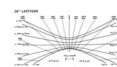
Direction of natural drainage, low-lying areas, and location of Mason Creek with respect to the Kessler Mill site.

COMPOSITE MAP OF SITE



Drainage, flood plain, soil types, wind direction, and example 50,000 sq. ft. buildings on the Kessler Mill site.

SOLAR ANALYSIS



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8:00 AM



11:00 AM



2:00 PM



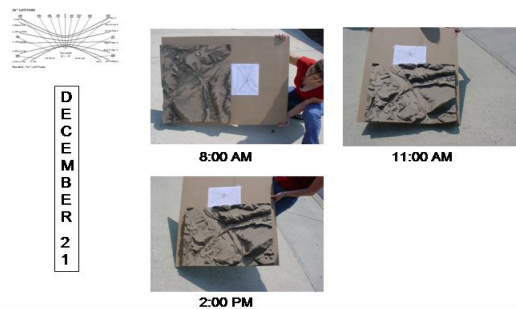
5:00 PM

Model showing sun and shade on the site at different times at the summer solstice on June 21st.

SOLAR ANALYSIS

Most shade on the Kessler Mill site on June 21st is near the existing Fire and Rescue Academy building in the late afternoon.

The photographs of the model were then translated into shadows on the aerial photograph. On June 21st, the sun reaches the Fire and Rescue Academy in the late afternoon. The rest of the day, the site is generally shade-free.

SOLAR ANALYSIS

Model showing sun and shade on the Kessler Mill site at the winter solstice on December 21st.

December 21st, the winter solstice, was chosen as the other extreme as the shortest day of the year and the day that would show the most shadows on the site.

SOLAR ANALYSIS

The Kessler Mill site has little shade throughout most of the day even on December 21st.

While there is additional shade on the site caused by the Interstate 81 overpass and the shadows near the Fire and Rescue Academy start earlier in the afternoon, the site remains generally sunny for most of the day.

MEETINGS WITH INDIVIDUAL AGENCIES

Shown is CDAC interviewing Franklin County representatives regarding their training academy wants and needs.

The CDAC team met with each of the individual agencies that will be involved in the new Public Safety Training Academy including the Roanoke County Police Department, Roanoke County Sheriff's Department, Roanoke County Fire and Rescue Department, Vinton Police Department, and Franklin County Sheriff's Department. Each agency answered a questionnaire and discussed their training needs and wants.

After collecting agency needs and wants, the CDAC team called a group meeting of the agencies to get them to talk through how they visualized such an academy fitting together. Agency members used color-coded pieces of paper as a discussion tool to show the proximity of uses and spaces.

The result of the meeting was a very rough “floor plan” that guided the development of proposals for the site. It is important to note that the other academies visited had separated the police, fire, and sheriff’s department into separate wings or floors. The result of the meeting is that this academy will share classrooms, administrative, and other spaces and will not separate the different departments.

The Group Proposal translated into a more refined floor plan.

The L-Shaped Proposal is a variation on the Group Proposal. The color-coding is the same for each proposal.

GROUP MEETING – “HOMEMADE LEGOS”



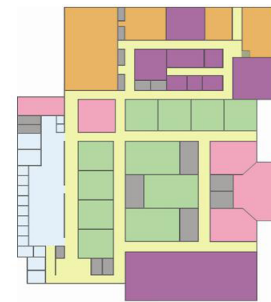
Agency representatives are shown developing an academy plan at the August 9, 2006 group meeting.

GROUP MEETING RESULTS



The result is groupings of usages representing a building plan.

GROUP PROPOSAL

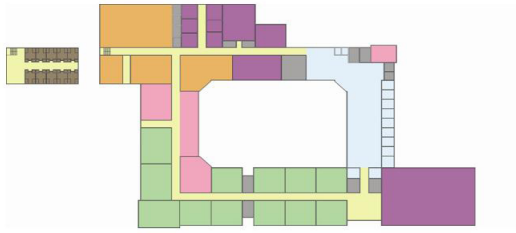


A more refined version of the group proposal is shown.

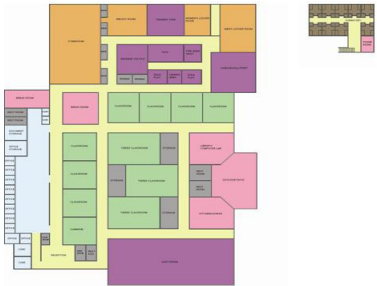
L-SHAPED PROPOSAL



The L-Shaped Proposal is a second proposal that keeps the usages together, but adjusts the layout.

RING-SHAPED PROPOSAL

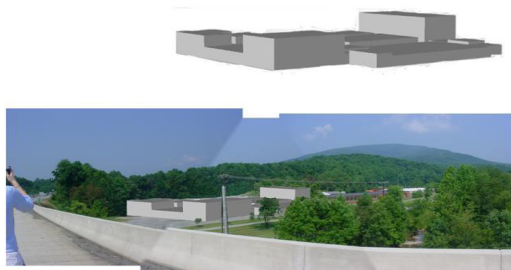
The Ring-Shaped Proposal also retains the usage groupings, but gives another layout option.

GROUP PROPOSAL: PLAN

The Group Proposal separates administrative space, classroom space, and space for practical exercises, locker rooms, etc.

GROUP PROPOSAL: SITE PLAN

The Group Proposal fits on the Kessler Mill site outside of the flood plain and on a relatively level area of the site.

GROUP PROPOSAL: VIEW FROM INTERSTATE 81

An idea of how the Group Proposal might translate into a volume as seen from Interstate 81.

The Ring-Shaped Proposal is a third example based on the group proposal.

The administrative area is to the left in light blue. Classrooms are in green, practical and specialty rooms in purple, physical activity areas in orange, auxiliary spaces like the library and breakroom in pink, and storage and restrooms are in gray. Circulation spaces such as hallways are shown in yellow.

The group plan is shown fitting on the site along with parking, an area for practicing traffic stops and accident investigations, wooded and grassy areas for practical exercises, and a location for a child care facility.

Most of the building is a single story, except for the gymnasium/multi-purpose room which would be taller, creating a low-profile building visible from the Interstate.

The L-Shaped Proposal retains the same organization of spaces, but elongates the plan to create more opportunities for natural light. The administrative area would be located on a second level that fits into the topography of the land, roughly where the County vehicle graveyard is now, creating a quieter, more private area for the training staff.

The site plan for the L-Shaped Proposal is similar to that for the Group Proposal. The administrative wing would have its own parking area and entrance.

The L-Shaped Proposal would also have a low profile from the Interstate. The gymnasium/multi-purpose area and dorms are two stories. The administrative wing, though on a second level, fits into the topography of the site.

The third proposal called the Ring-Shaped Proposal provides opportunities for natural light in each from of the academy. The central outdoor green space could be used for the agility course or for a reception space after graduation, for example.

community design assistance center

L-SHAPED PROPOSAL: PLAN



Administrative space is located on a second level, creating the "L" and making the space more private.

community design assistance center

L-SHAPED PROPOSAL: SITE PLAN



The administrative second level naturally fits at the higher elevation of the rear part of the site.

community design assistance center

L-SHAPED PROPOSAL: VIEW FROM INTERSTATE 81



An example of how the L-Shaped Proposal might look from Interstate 81.

community design assistance center

RING-SHAPED PROPOSAL



The Ring-Shaped Proposal offers more natural light because most spaces have access to the outside.

RING-SHAPED PROPOSAL: SITE PLAN

The Ring-Shaped Proposal fits on the site, with an opportunity for exterior space at the center of the building.

RING-SHAPED PROPOSAL: VIEW FROM INTERSTATE 81

An example view of the Ring-Shaped Proposal from the Interstate overpass.

LEED CERTIFICATION - MATERIALS

This work-out room floor is made of recycled rubber glued together. Not only does it help to save the environment by reducing the amount of waste leftover, but helps with the acoustics of the room.

This gymnasium floor is made from rubber that has a similar appearance to actual wood. It also helps to save on lines as well as improving the acoustics of the room.



This wood floor in a dance studio is made from FSC (Forest Stewardship Council) certified wood.

A number of sustainable, LEED-certified materials are available for the multi-purpose room floor.

LEED CERTIFICATION – MECHANICAL ROOM

This mechanical system is equipped with separated boilers and chillers to manage the water of the facility. Having the boilers/chillers separated like this allows them to act independently of each other, and reduces the amount of unnecessary energy used.



The site plan is generally similar for the Ring-Shaped Proposal. The traffic stop and accident investigation area has been moved closer to the Interstate to help buffer the rest of the site from the road noise. In each plan, the child care center is located in the upper part of the site to protect the children from the noise and activity of the site and the public nature of the trail that crosses the front of the site.

The Ring-Shaped Proposal also has a low profile from the Interstate. If a higher profile is wanted, one method might be to erect a taller monument on the site memorializing public safety personnel or incorporating a memorial into a taller smoke house/tower for fire and rescue training.

A number of materials are available that could be used to develop the Public Safety Training Academy as a LEED-certified building. Examples are flooring materials such as recycled rubber or wood certified by the Forest Stewardship Council.

A number of options exist for heating and air conditioning as well that will use less energy than the traditional system. One way is to separate the boilers and chillers. Another option seen at the Central Shenandoah Training Academy was the geothermal heat pump system that uses the temperature within the ground to regulate heating and cooling.

Heating and air conditioning options are available that save energy and building operating costs.

Porous paving allows rainwater to run into the ground rather than running off the surface as sheet flow during storms. In this example, the porous pavement is used in the drive ways, while the parking spaces have regular pavement to keep oils and antifreeze from running into the ground. Use of this pavement would help keep water from standing on the Kessler Mill site.

Water draining from the roof of a large building can also cause drainage problems. One way to reduce runoff is to collect stormwater in a storage tank. The water can then be used for gray water usage such as flushing toilets or watering lawns. It might also be used to supplement water for fire training needs on this site. It can also be released slowly, after the pouring rain, when it would be better absorbed.

Louvres can be used to create an aesthetic statement on a building. Their more important use is to shade a building from direct sunlight, thus reducing the cooling load on the building. When designed properly, they will keep out the hot summer sun while letting in the warming winter sunlight, thus reducing heating in winter as well.

Energy Star roofing, which will be used on the new regional jail facility, is a white roofing system that reflects the sunlight. This simple idea, drastically reduces the heat of the roof, the cooling load on the building, and the temperature of the surrounding area. Another roofing option is a green roof which has the same properties, but also reduces stormwater runoff - the green plants on the roof absorb the water for their own use.

LEED CERTIFICATION – POROUS PAVING

Porous pavement uses a filtering system that allows water to run through back to the groundwater supply. It is especially useful for large parking lots, like the ones that will be found on the Kessler Mill Site, to prevent excessive runoff. In this example porous pavement was used only in the areas where vehicles would be in motion to prevent an excess of oil from being filtered through.



Porous paving allows water to be absorbed, thus reducing sheet flow in large paved areas.

LEED CERTIFICATION – WASTEWATER STORAGE



Water storage tanks, sometimes referred to as pickle barrels, are a good way to prevent an excess of water on a site. Oftentimes the water collected during rain storms can be used in the facility for non-potable resources. In a site like Kessler Mill these tanks could be helpful to slow rainwater drainage.



Stored rainwater that would otherwise run off of a roof can be used to offset the building's water needs.

LEED CERTIFICATION - LOUVRES



Louvres on windows can help attain LEED certification by reducing the amount of sunlight and heat entering a building, and therefore reduce the amount of energy used to cool the space. On a site like Kessler Mill they can be helpful due to the lack of shade during the day.



Louvres can be used to help reduce the sun and heating load on the building to lower cooling costs.

LEED CERTIFICATION – ENERGY STAR ROOFING



An Energy Star roof is a white roofing material that can help to reduce a "heat island" effect. Since this material reflects the sun's heat it can reduce a building's energy cooling needs by up to 15 percent and can reduce the roof temperature by up to 100 degrees. It's especially helpful for large buildings that occupy a large footprint.



An Energy Star white roof can reduce cooling load on the building by reflecting the sun and reducing heat absorption.

APPENDIX D

SUSTAINABLE BUILDING PRACTICES

Roanoke County has demonstrated an interest in sustainable building practices and “green” building with the new regional jail facility. There are opportunities to continue this commitment to sustainability in the development of the Public Safety Training Academy. Information about LEED; LEED Guidelines for New Construction; LEED-Certified buildings in Virginia, Maryland, and North Carolina; green roofs; EnergyStar roofs; and the use of photovoltaics are included in this Appendix. Any specific product discussions in this section are meant to be informational and are not endorsements of any particular product or supplier. Opportunities for sustainable building are not limited to the technologies presented here.



National Conservation Training Center in West Virginia has sun shading and other features to limit its energy load.



Virginia Tech's entry in the 2006 Solar Decathlon was able to be fully self-sufficient.



Green roof blending with the landscape. (login.condomagazines.com/images/sections/green roof 2.jpg)



Photovoltaics do not limit the architectural features of a building. (www.visionengineer.com/expo/curved_photovoltics.jpg)



LEED-NC[®]

Green Building Rating System
For New Construction &
Major Renovations

Version 2.2

For Public Use and Display

October 2005

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October 2005

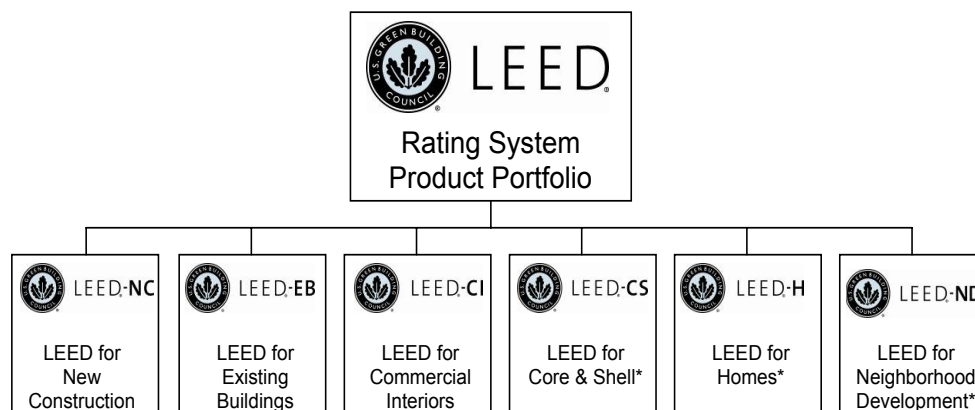
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Leadership in Energy and Environmental Design (LEED®)

Buildings fundamentally impact people's lives and the health of the planet. In the United States, buildings use one-third of our total energy, two-thirds of our electricity, one-eighth of our water, and transform land that provides valuable ecological resources. Since the LEED Green Building Rating System for New Construction (LEED-NC version 2.0) was first published in 1999, it has been helping professionals across the country to improve the quality of our buildings and their impact on the environment.

As the green building sector grows exponentially, more and more building professionals, owners, and operators are seeing the benefits of green building and LEED certification. Green design not only makes a positive impact on public health and the environment, it also reduces operating costs, enhances building and organizational marketability, potentially increases occupant productivity, and helps create a sustainable community. LEED fits into this market by providing rating systems that are voluntary, consensus-based, market-driven, based on accepted energy and environmental principles, and they strike a balance between established practices and emerging concepts.

The LEED rating systems are developed by USGBC committees, in adherence with USGBC policies and procedures guiding the development and maintenance of rating systems. LEED-NC version 2.2 is only possible due to the generous volunteer efforts of many individuals, and has been in development for over 2 years. LEED-NC is one of a growing portfolio of rating systems serving specific market sectors.



**Under development as of October 2005*

LEED for New Construction (& Major Renovations)

The LEED-NC Rating System is applicable to new commercial construction and major renovation projects.

Why Certify?

While LEED Rating Systems can be useful just as tools for building professionals, there are many reasons why LEED project certification can be an asset:

- Be recognized for your commitment to environmental issues in your community, your organization (including stockholders), and your industry;
- Receive third party validation of achievement;

LEED for New Construction Version 2.2
October 2005

3

- Qualify for a growing array of state & local government initiatives;
- Receive marketing exposure through USGBC Web site, Greenbuild conference, case studies, and media announcements.

Certification Process

Project teams interested in obtaining LEED certification for their project must first register online. Registration during early phases of the project will ensure maximum potential for certification. The LEED website, www.leedbuilding.org, contains important details about the certification review process, schedule and fees. The applicant project must satisfactorily document achievement of all the prerequisites and a minimum number of points. See the LEED-NC project checklist for the number of points required to achieve LEED-NC rating levels.

Additional LEED Resources

Visit the LEED Web site for available tools and support, such as the LEED-NC Version 2.2 Reference Guide (essential for all LEED-NC project teams), technical support via Credit Interpretations, and training workshops.

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October 2005

Project Checklist

Sustainable Sites

14 Possible Points

Prereq 1	Construction Activity Pollution Prevention	Required
Credit 1	Site Selection	1
Credit 2	Development Density & Community Connectivity	1
Credit 3	Brownfield Redevelopment	1
Credit 4.1	Alternative Transportation , Public Transportation Access	1
Credit 4.2	Alternative Transportation , Bicycle Storage & Changing Rooms	1
Credit 4.3	Alternative Transportation , Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	Alternative Transportation , Parking Capacity	1
Credit 5.1	Site Development , Protect or Restore Habitat	1
Credit 5.2	Site Development , Maximize Open Space	1
Credit 6.1	Stormwater Design , Quantity Control	1
Credit 6.2	Stormwater Design , Quality Control	1
Credit 7.1	Heat Island Effect , Non-Roof	1
Credit 7.2	Heat Island Effect , Roof	1
Credit 8	Light Pollution Reduction	1

Water Efficiency

5 Possible Points

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

Energy & Atmosphere

17 Possible Points

Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Fundamental Refrigerant Management	Required
Credit 1	Optimize Energy Performance	1–10
Credit 2	On-Site Renewable Energy	1–3
Credit 3	Enhanced Commissioning	1
Credit 4	Enhanced Refrigerant Management	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1

Materials & Resources

13 Possible Points

Prereq 1	Storage & Collection of Recyclables	Required
Credit 1.1	Building Reuse , Maintain 75% of Existing Walls, Floors & Roof	1
Credit 1.2	Building Reuse , Maintain 95% of Existing Walls, Floors & Roof	1

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Credit 1.3	Building Reuse , Maintain 50% of Interior Non-Structural Elements	1
Credit 2.1	Construction Waste Management , Divert 50% from Disposal	1
Credit 2.2	Construction Waste Management , Divert 75% from Disposal	1
Credit 3.1	Materials Reuse , 5%	1
Credit 3.2	Materials Reuse , 10%	1
Credit 4.1	Recycled Content , 10% (post-consumer + 1/2 pre-consumer)	1
Credit 4.2	Recycled Content , 20% (post-consumer + 1/2 pre-consumer)	1
Credit 5.1	Regional Materials , 10% Extracted, Processed & Manufactured Regionally	1
Credit 5.2	Regional Materials , 20% Extracted, Processed & Manufactured Regionally	1
Credit 6	Rapidly Renewable Materials	1
Credit 7	Certified Wood	1

Indoor Environmental Quality 15 Possible Points

Prereq 1	Minimum IAQ Performance	Required
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
Credit 1	Outdoor Air Delivery Monitoring	1
Credit 2	Increased Ventilation	1
Credit 3.1	Construction IAQ Management Plan , During Construction	1
Credit 3.2	Construction IAQ Management Plan , Before Occupancy	1
Credit 4.1	Low-Emitting Materials , Adhesives & Sealants	1
Credit 4.2	Low-Emitting Materials , Paints & Coatings	1
Credit 4.3	Low-Emitting Materials , Carpet Systems	1
Credit 4.4	Low-Emitting Materials , Composite Wood & Agrifiber Products	1
Credit 5	Indoor Chemical & Pollutant Source Control	1
Credit 6.1	Controllability of Systems , Lighting	1
Credit 6.2	Controllability of Systems , Thermal Comfort	1
Credit 7.1	Thermal Comfort , Design	1
Credit 7.2	Thermal Comfort , Verification	1
Credit 8.1	Daylight & Views , Daylight 75% of Spaces	1
Credit 8.2	Daylight & Views , Views for 90% of Spaces	1

Innovation & Design Process 5 Possible Points

Credit 1.1	Innovation in Design	1
Credit 1.2	Innovation in Design	1
Credit 1.3	Innovation in Design	1
Credit 1.4	Innovation in Design	1
Credit 2	LEED Accredited Professional	1

Project Totals 69 Possible Points

Certified 26–32 points Silver 33–38 points Gold 39–51 points Platinum 52–69 points

Project Name	Owner	City	State	Rating	CertDate	Version	Project SF	Project Type	Owner Type
Phillip Merrill Environmental Center	Chesapeake Bay Foundation	Annapolis	MD	Platinum	30-Mar-00	NC v1	30,600	COMMERCIAL OFFICE	NONPROFIT CORPORATION
Social Security Annex Building Renovation	U.S. General Services Administration	Baltimore	MD	Certified	19-Nov-02	NC v2	440,108	COMMERCIAL OFFICE	FEDERAL GOVERNMENT
Social Security Administration Child Care Center	U.S. General Services Administration	Baltimore	MD	Certified	27-Feb-03	NC v2	32,000	DAYCARE	FEDERAL GOVERNMENT
Blair Towns	Blair-Towers LLC	Silver Spring	MD	Certified	21-Jan-04	NC v2	86,000	MULTI-UNIT RESIDENTIAL (APARTMENTS, DORMITORIES)	PROFIT CORPORATION
The Stewart's Building	The Harry and Jeanette Weinberg Foundation	Baltimore	MD	Certified	28-Jan-05	NC v2	242,000	MULTI USE	NONPROFIT CORPORATION
Inn & Conference Center Addition	University of Maryland University College	Adelphi	MD	Certified	9-Jun-05	NC v2	104,000	MULTI USE	STATE GOVERNMENT
Urbana Technology Center	Fannie Mae	Urbana	MD	Certified	30-Jun-05	NC v2	220,000	FINANCIAL & COMMUNICATIONS (BANK, POST OFFICE, DATA CENTER)	PROFIT CORPORATION
Eastern Village Cohousing Condominium	Eastern Village Cohousing, LLC	Silver Spring	MD	Silver	26-Sep-05	NC v2	92,582	MULTI USE	NONPROFIT CORPORATION
318 Sentinel Drive	Corporate Office Properties Trust	Annapolis Junction	MD	Gold	25-Oct-05	CS v1	125,000	COMMERCIAL OFFICE	PROFIT CORPORATION
304 Sentinel Drive	Corporate Office Properties Trust	Annapolis Junction	MD	Silver	1-Nov-05	CS v1	160,000	COMMERCIAL OFFICE	PROFIT CORPORATION
Third Creek Elementary School	Iredell-Statesville Schools	Statesville	NC	Gold	6-Nov-02	NC v2	92,000	K-12 EDUCATION	LOCAL GOVERNMENT
Kilgo Dormitory Renovation II	Duke University	Durham	NC	Certified	21-Jun-04	NC v2	46,000	MULTI-UNIT RESIDENTIAL (APARTMENTS, DORMITORIES)	OTHER
Duke University - Smith Warehouse	Duke University	Durham	NC	Certified	20-Dec-04	EB v1	50,000		NONPROFIT CORPORATION
EPA National Computer Center	US Environmental Protection Agency	Research Triangle Park	NC	Silver	25-Jan-05	NC v2	100,000	COMMERCIAL OFFICE	FEDERAL GOVERNMENT
Center for Interdisciplinary Engineering, Medicine, & Applied Science	Duke University	Durham	NC	Silver	12-Apr-05	NC v2	324,000	HIGHER EDUCATION	PROFIT CORPORATION
Kilgo Dormitory Renovation III	Duke University Housing	Durham	NC	Certified	29-Aug-05	NC v2	26,949	MULTI-UNIT RESIDENTIAL (APARTMENTS, DORMITORIES)	OTHER

Project Name	Owner	City	State	Rating	Cert Date	Version	Project SF	Project Type	Owner Type
Triangle Wastewater Treatment Plant	County of Durham	Durham	NC	Certified	26-Oct-05	NC v2	13,564	INDUSTRIAL (MANUFACTURING, WAREHOUSE, PUB. WORKS)	LOCAL GOVERNMENT
J.J. Audobon Lodge at the Sanctuary	Crescent Resources, LLC	Charlotte	NC	Certified	19-Apr-06	NC v2	8,472	ASSEMBLY (CONV. CENTER, PLACE OF WORSHIP, THEATER)	NONPROFIT CORPORATION
ImaginOn: The Joe & Joan Martin Center	Public Library of Charlotte & Mecklenburg County	Charlotte	NC	Silver	1-Jun-06	NC v2	142,000	MULTI USE	OTHER
Butner FCI-3	Federal Bureau of Prisons	Butner	NC	Certified	13-Jun-06	NC v2	529,000	PUBLIC ORDER & SAFETY (POLICE, JAIL, COURTHOUSE)	FEDERAL GOVERNMENT
Doug and Darcy Orr Cottage	Warren Wilson College	Asheville	NC	Gold	29-Jun-06	NC v2	6,800	HIGHER EDUCATION	NONPROFIT CORPORATION
John M. Langston High School Continuation & Langston-Brown Community Center	Arlington Public Schools, Arlington County	Arlington	VA	Silver	3-Sep-03	NC v2	50,000	MULTI USE	LOCAL GOVERNMENT
Pentagon Metro Entrance Facility	Pentagon Renovation Office	Arlington	VA	Certified	23-Sep-03	NC v2	25,000	TRANSPORTATION (AIRPORT, TRAIN STATION, BUS STATION)	FEDERAL GOVERNMENT
Engineering & Computational Sciences Building	Old Dominion University	Norfolk	VA	Certified	25-Aug-04	NC v2	83,000	HIGHER EDUCATION	STATE GOVERNMENT
Pentagon Athletic Center	Pentagon Renovation Program	Arlington	VA	Certified	31-Aug-04	NC v2	248,000	RECREATION	FEDERAL GOVERNMENT
Weinstein Hall	University of Richmond	Richmond	VA	Certified	13-Sep-04	NC v2	52,082	HIGHER EDUCATION	NONPROFIT CORPORATION
Personnel Support Facility	Naval Facilities Engineering Command	Virginia Beach	VA	Silver	25-Oct-05	NC v2	37,750	MULTI USE	FEDERAL GOVERNMENT
Hermitage Elementary School	Virginia Beach City Public Schools	Virginia Beach	VA	Certified	27-Oct-05	NC v2	84,357	K-12 EDUCATION	STATE GOVERNMENT
Remote Delivery Facility	Pentagon Renovation & Construction Program Office and the Defense Facilities Directorate	Arlington	VA	Certified	29-Nov-05	NC v2	250,000	MULTI USE	FEDERAL GOVERNMENT
Wilderness Road State Park Visitor Center	Virginia Department of Conservation and Recreation	Ewing	VA	Certified	23-Jan-06	NC v2	5,683	MULTI USE	STATE GOVERNMENT
Wetland Studies and Solutions, Inc.	Wetland Studies and Solutions, Inc.	Gainesville	VA	Gold	2-Mar-06	CI v2	53,614	COMMERCIAL OFFICE	PROFIT CORPORATION

Project Name	Owner	City	State	Rating	Cert Date	Version	Project SF	Project Type	Owner Type
P-526, Aircraft Maintenance Hangar	U. S. Navy	Norfolk	VA	Certified	9-May-06	NC v2	54,148	MILITARY BASE	FEDERAL GOVERNMENT
One Potomac Yard	Crescent Resources, LLC	Arlington	VA	Gold	19-Jun-06	NC v2	323,995	MULTI USE	PROFIT CORPORATION
Two Potomac Yard	Crescent Resources, LLC	Arlington	VA	Gold	19-Jun-06	NC v2	309,270	MULTI USE	PROFIT CORPORATION



design brief

OPTIONS AND OPPORTUNITIES

Summary

When focus is placed on the largest energy uses in a particular type of building, incorporating pertinent enhancements in a standard design can readily improve energy efficiency. This Design Brief summarizes the energy-efficiency design strategies that offer the greatest potential benefit in 11 building types.

Although some of the measures discussed in this brief are frequently employed, others are seldom considered during the design process. This quick overview of energy-efficiency strategies appropriate to different types of buildings will allow designers to place a range of potentially useful options on the table early in the decision-making process.

Energy intensity is presented as an indicator of the potential for cost-effective, energy-efficient design strategies in a particular building type.

Not all energy-efficiency measures are appropriate for all building types, but some are especially useful for particular buildings. This Design Brief reminds designers and builders of opportunities they should consider in each of their projects.

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Laboratories	22
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Warehouses	26

energy cost per square foot in different building types. The figure shows that, in general, energy-efficient designs are especially cost-effective in laboratories, hospitals, and grocery stores.

Energy use intensity is the amount of energy per square foot a building uses annually from all metered sources. Energy use intensity is useful in comparing energy use in buildings of different sizes and occupancies. The pie charts presented with each building type show energy use intensity. The charts (which are discussed in the introduction to each section) can be used to compare energy use in different building types.

Table 1 summarizes many of the most cost-effective energy design strategies according to their energy use intensity. Cells in Table 1 that are completely filled in represent strategies that will target the most energy-intensive uses in a given building type. Implementing these strategies has the most potential for minimizing unnecessary energy use in the building type.

On the other hand, cells that are completely clear indicate that this strategy will probably not significantly affect overall energy use in the finished building.

Table 1: Energy-efficiency measures for specific building types

For each building type, energy-efficiency measures are categorized according to their ability to minimize energy use.

Measures	Schools	Large offices	Small offices	Single-story, tilt-up retail	Department, mall, and free-standing retail stores	High-rise residential buildings	Grocery stores	Hotels and motels	Laboratories	Hospitals	Warehouses
High-efficiency lighting	●	●	●	●	●	●	●	●	●	●	●
Occupancy sensors	●	●	●	●	●	●	●	●	●	●	●
Efficient parking lot lighting	●	●	●	●	●	●	●	●	●	●	●
Automatic lighting controls	●	●	●	●	●	●	●	●	●	●	●
Skylights and photocell controls	●	●	●	●	●	●	●	●	●	●	●
Exterior shading	●	●	●	●	●	●	●	●	●	●	●
Cool roof	●	●	●	●	●	●	●	●	●	●	●
High-efficiency HVAC	●	●	●	●	●	●	●	●	●	●	●
Direct digital controls	●	●	●	●	●	●	●	●	●	●	●
Variable-speed drives	●	●	●	●	●	●	●	●	●	●	●
Demand-controlled ventilation	●	●	●	●	●	●	●	●	●	●	●
Direct/indirect evaporative cooling	●	●	●	●	●	●	●	●	●	●	●
Water-heating heat recovery	●	●	●	●	●	●	●	●	●	●	●

● = Highest potential
 ● = Some potential
 ○ = Least potential

Source: CTG Energetics Inc.

Energy-Efficiency Design Strategies for New Construction

Table 1 lists many of the energy-efficient design strategies that are discussed throughout this Design Brief. The following sections give brief descriptions of these strategies. Specific applications of these strategies are discussed under the building types where they are most applicable.

Building envelope measures. The skin of a building should provide an appropriate barrier between interior and exterior environments. *Reflective surfaces*, especially on roofs and walls, will minimize the amount of solar heat that penetrates a building. In particular, Energy Star-compliant “cool roofs” reflect a large portion of the sun’s heat energy back into the atmosphere. *Optimized thermal insulation* is essential to buffer the interior of the building from the fluctuating temperature outside. In general, Title 24 insulation requirements provide this optimization.

Exterior shading, such as horizontal overhangs and vertical fins, is a good way to decrease the amount of solar gain into a building and can also enhance the exterior design of the structure. In particular, shading fenestration from direct solar radiation has great potential to lower the cooling requirements of a building.

Two energy-efficiency strategies can be accomplished through glazing selection. *Lower solar heat gain coefficient (SHGC)* glazing reduces the amount of solar heat that is allowed into a building by reflecting or absorbing the heat that strikes it. Selecting glazing with low SHGC and high visible transmittance will allow light to enter the building and simultaneously reflect heat away from the interior. *Daylighting glazing* is a glazing specification strategy that allows the daylight entering the space to provide interior illumination without adding eyestrain or glare. Daylighting glazing is most often used in conjunction with the design of toplighting (that is, skylights and roof monitors) and sidelighting (windows and clerestories). This design strategy should be combined with *daylighting controls* to maximize energy efficiency.

Lighting measures. *High-efficiency lamps*, such as high-intensity T5 fluorescent lamps, T8 fluorescent lamps, and compact fluorescent lamps provide the same illumination as higher wattage counterparts. When these lamps

are coupled with *electronic ballasts* and *efficient fixtures*, they form a lighting system that can provide superior lighting quality at higher operating efficiencies (**Figure 2**). *Efficient parking lot lighting fixtures* can reduce the energy use on the site without compromising safety or illumination. “Hockey puck” fixtures require fewer poles, cut down on light pollution, and use 70 percent less electricity than “cobra head” fixtures.

A task/ambient lighting design strategy that provides an appropriate level of general light and provides task-level light where it is needed reduces the overall electricity required for lighting. Good designs also enhance working environments.

HVAC measures. *High-efficiency packaged units* and *high-efficiency heat pumps* provide the same cooling and heating capabilities as their standard counterparts while consuming less energy by integrating high-efficiency components and controls within their systems. The higher-quality components and controls found in *premium-efficiency motors on fans and pumps* and *high-efficiency, water-cooled chillers* allow these components of a central plant to perform more efficiently than standard equipment.

Indirect/direct evaporative cooling uses the physics of water evaporation to cool with reduced levels of compressor cooling, which is an energy-intensive process.

Two-speed cooling tower fans and *variable-speed drives on fans and pumps* and *energy management systems* (or direct digital control systems) will modulate HVAC equipment so that it is not working at full output capacity at all times, but working only according to the requirements of the building spaces. *Demand-controlled ventilation* modulates ventilated air to keep CO₂ levels below a set point (for example, 800 parts per million), thereby matching ventilation rates to the number of people occupying the space. When occupancy is below peak design conditions, reducing building ventilation saves energy without compromising indoor air quality.

Figure 2: Compact fluorescent lamp ballast systems

Integral, modular, and dedicated are the three types of CFL lamp ballast systems.

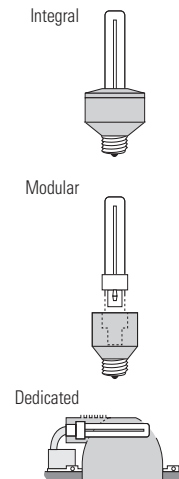
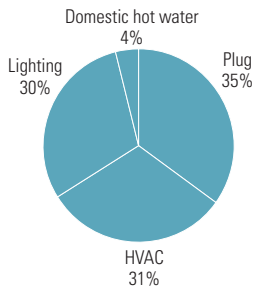


Figure 7: Small office energy use

Data is shown for climate zone 9 (the Los Angeles area). Energy use varies with occupancy, usage, location, and building.



Source: CTG Energetics Inc.

Small Offices

Small office buildings often have simple packaged HVAC units rather than central plants. In spec buildings, energy-efficient tenant improvements can be promoted both by specifying high-efficiency standards for the improvements and by passing the energy costs on to tenants.

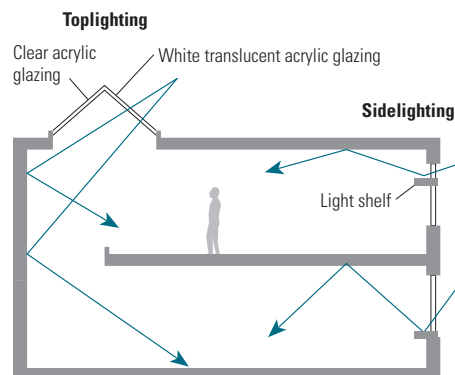
Options and Opportunities

Incorporate daylight into the design. Small office buildings should take advantage of the daylight available through sidelighting and skylights installed on upper floors (**Figure 8**). Specify continuously dimming ballasts in all spaces penetrable by daylight. Put these fixtures on their own circuit and control the electric lighting levels using a photosensor. Daylighting design is especially apt in single-story office buildings. Make sure that the photosensors are carefully calibrated after installation.

Shade office glass. The cooling load created by windows can be reduced or even eliminated by using overhangs and side fins to shade office windows, especially on south, east, and west facades. Increasing the width of overhangs to create covered walkways outdoors can reduce the need for hall-

Figure 8: Simple daylighting techniques

This schematic shows a mix of toplighting and sidelighting, light shelves, high-reflectance ceilings, and wall diffusion to provide fairly uniform deep-plan daylighting without the glare of direct sunlight. Selecting specularly selective glazing with an appropriate visual transmittance will reduce the contrast between indoor and outdoor lighting. If the glazing also has a relatively low solar heat gain coefficient, daylighting can be enjoyed while air-conditioning energy use is substantially decreased.



ways inside. First-cost savings from eliminated hallways can far outweigh the cost of increased shading devices.

Use high-efficiency HVAC units. A highly efficient, packaged air-conditioning unit can reduce cooling needs by 10 percent or more over a standard-efficiency, commercial packaged unit. Select equipment that has multiple levels of capacity (compressor stages) with good part-load efficiency, because equipment will usually run at less than maximum load. Consider specifying an airside economizer to take advantage of desirable outdoor air conditions. Specify durable components such as direct-drive actuators to avoid economizer failure.

Specify a cool roof in single-story offices. Because cooling energy is usually more than 20 percent of a small office building's energy use, a roof that reflects large amounts of infrared lighting can save energy. Consider specifying the conventional built-up roof with an Energy Star-compliant cool roof (see www.energystar.gov for more information and a list of products). The Energy Star program is an independent rating system supported by the Environmental Protection Agency and the Department of Energy.

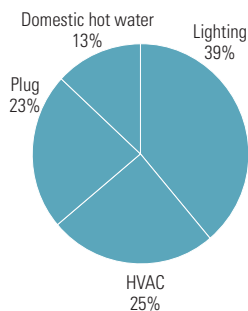
MORE SMALL OFFICE OPTIONS

In addition to those outlined, consider the following proven measures:

- Use a task/ambient lighting strategy.
- Utilize occupancy sensors in intermittently occupied spaces.
- Specify efficient parking lot lights.

Figure 3: School energy use

Data is shown for climate zone 9 (the Los Angeles area) with nine months of occupancy. Energy use varies with usage, location, and building.



Source: CTG Energetics Inc.

Schools

Because school buildings are often occupied for 50 years or more, designing the facilities with respect to their life-cycle costs helps minimize operating expense and maximize energy efficiency. However, school budget processes can make life-cycle costing challenging. After reducing such internal loads as lighting, it may be possible to install smaller HVAC equipment.

Options and Opportunities

Incorporate daylight into the design. Consider using skylights in classrooms, gymnasiums, and media centers. Design supplemental electric lighting systems to optimize daylighting by specifying dimmable ballasts, photosensors, and daylighting controls. When installed, photocell daylighting controls should be carefully calibrated and tested. School building personnel should be trained in the use of this technology.

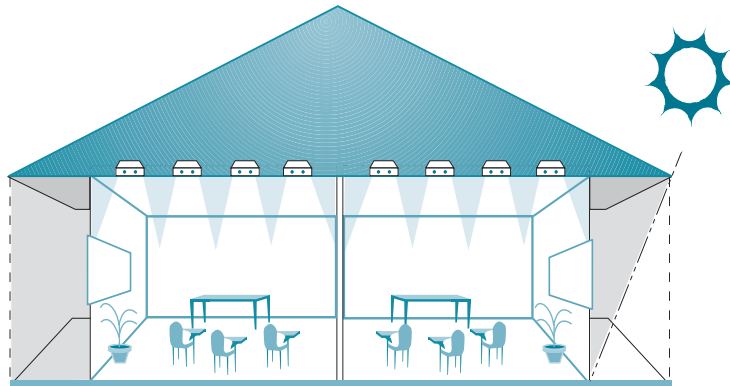
The ability to control the daylight entering a school is critical to the daylighting design's success. Although studies show that a classroom skylight design with manually operated internal louvers results in a dramatic increase in student performance, a skylight with no control is associated with a drop in math and reading scores. Daylight tends to penetrate from a window into an interior space about 1.5 times the head height of the window. Put the light fixtures in areas penetrable by sunlight on their own circuit and install daylighting controls.

Utilize occupancy sensors in intermittently used spaces. Occupancy sensors are recommended for intermittently used spaces such as conference rooms, restrooms, lounges, and storage areas. Lighting energy savings of 10 to 20 percent are often reported when schools are outfitted with these devices.

Shade classroom glass. The cooling load created by windows can be reduced or even eliminated by using overhangs to shade large windows in classrooms and other areas (**Figure 4**). Increasing the width of overhangs to create covered walkways can reduce or eliminate the need for internal hallways. First-cost savings can be realized by increasing the use of internal space; operational costs can be realized through lower HVAC energy use. These savings can more than offset the first cost of the overhang/walkway.

Figure 4: Shading classroom glass

Shading glass reduces the cooling load in classrooms and creates perimeter walkways. Reduced energy cost and the elimination of interior hallways can more than offset the cost of the overhangs.



Consider evaporative coolers in hot, dry climates. In hot, dry areas, specify small direct or indirect evaporative coolers instead of vapor-compression units. Evaporative coolers can save 60 to 80 percent of the cooling energy for spaces such as portable classrooms. In addition to saving energy, the direct evaporative coolers also add needed moisture to the conditioned air.

MORE SCHOOL OPTIONS

In addition to those outlined, consider the following proven measures:

- Utilize compact fluorescent and other high-efficiency lighting.
- Include direct/indirect lighting in media centers.
- In hot climates, specify a cool roof (a light-colored roof that reflects large amounts of infrared light).
- Design efficient parking lot lighting.
- Specify high-efficiency HVAC systems.
- Use direct digital controls to link schools to one another.
- Consider demand-controlled ventilation in auditoriums and gymnasiums.



**BUY PRODUCTS THAT MAKE
A DIFFERENCE**

What is an ENERGY STAR qualified roof product?

It is a reflective roof product that lowers roof surface temperature by up to 100°F, thereby decreasing the amount of heat transferred into a building's interior. ENERGY STAR qualified roof products save money and energy by reducing the amount of air conditioning needed to keep a building comfortable.

What does the ENERGY STAR label signify?

Products bearing the ENERGY STAR labels are more energy efficient than standard products, thereby saving energy and money. In general, ENERGY STAR qualified products including: appliances, HVAC equipment, office equipment, residential lighting, and even homes, reduce energy costs by at least 30%.

How does a roof product qualify for the ENERGY STAR label?

Roof products that meet or exceed solar reflectance, without compromising product quality and performance, qualify for the ENERGY STAR label. Manufacturers voluntarily sign an agreement with ENERGY STAR called a Partnership Agreement (PA) allowing them to place the ENERGY STAR label on the packaging of qualifying roof products. They can also use the label in product promotions and advertising for qualified products.

What types of roof products will carry the ENERGY STAR label?

ENERGY STAR roof specifications are not restricted to any particular type of roof product. However, ENERGY STAR expects that, at least initially, metal, single-ply membrane, and roof coating products will be most widely represented.

Why is ENERGY STAR interested in increasing the reflective roofing market?

Ninety percent of the energy in the United States is generated by burning fossil fuels, which creates the air pollution associated with smog, acid rain, and global climate change. By reducing the amount of energy needed to cool buildings, ENERGY STAR qualified roof products help to reduce the production of these air pollutants. Additionally, reflective roof products can help reduce the "heat island effect," a phenomenon in which cities can be 2 to 8° F warmer than the surrounding countryside. Such heat islands occur, in large part, because many buildings and paved surfaces are designed with dark materials that absorb heat from the sun. This heat is released at night, causing the air temperature to remain high. The resulting elevated temperature leads to an increased demand for air conditioning in buildings, increased fuel use for vehicle air conditioning, increased levels of smog, and associated increased levels of heat-related and smog-related health problems. Installing reflective roofs helps reduce the heat island effect, decreasing the amount of smog in the air and benefiting the entire community.

What are the benefits of ENERGY STAR qualified roof products?

Benefits of ENERGY STAR qualified roof products include:

- *Saves Money and Energy.* According to EPA, about \$40 billion is spent annually in the US to air condition buildings — one-sixth of all electricity generated in a year! ENERGY STAR qualified roof products reduce the amount of air conditioning needed in buildings, and can reduce energy bills by up to 50%.
- *Downsizes Cooling Equipment.* A reflective roof can reduce peak cooling demand by 10-15%. As a result, the home or building owner may be able to purchase a smaller, more efficient, and less expensive cooling system.
- *Decreases Pollution in Urban Areas.* Reduced energy demand means less burning of fossil fuels, which results in less pollution from power plants. Also, ENERGY STAR qualified roof products help to reduce the “heat island effect,” in which dark, heat-absorbing buildings and paved areas make the air in urban areas hotter, and more smoggy.
- *Increases Roof Product Life.* ENERGY STAR qualified roof products maintain a more constant temperature and reduce thermal shock, which occurs when cool rain hits a hot roof, causing a sharp drop in temperature. During temperature changes, a roof expands and contracts, causing stress and degrading the roof.

How much can businesses expect to save by installing ENERGY STAR qualified roof products?

Energy savings from installing ENERGY STAR qualified roof products will depend on the geographic location and climate where it is installed, existing insulation levels in the building, the type of roof it replaces, the type of roof installed, and how well it is kept clean and maintained. In general, cooling energy savings can be as high as 50%. Additionally, a reflective roof can reduce peak cooling demand by 10 to 15%. As a result, building owners may be able to purchase smaller, less expensive HVAC systems.

Will installing an ENERGY STAR qualified roof product save me money no matter where I live?

Homes and buildings located in hot and sunny climates will realize the greatest energy and cost savings. So, people living in southern geographic areas that use more air conditioning will see greater reductions in their energy bills than people living elsewhere in the country.

Under which circumstances will ENERGY STAR qualified roof products generate the greatest savings?

In general, building owners will save the most money on energy bills by installing an ENERGY STAR qualified roof product if their building has the following characteristics: high air-conditioning bills, a large roof surface as compared to the building’s overall size, lower levels of insulation, and/or a location in a hot, sunny climate. The most cost-effective time to install an ENERGY STAR qualified roof product is when re-roofing, constructing new buildings, or maintaining a roof by applying a coating.

Will I save money by using reflective roof products if my home or building already has a high level of insulation?

An energy-efficient home or building has both reflective roof surfaces and adequate insulation. But, you will notice greater savings on your cooling bills if you install ENERGY STAR qualified roof products on a building with a lower level of roof insulation. However, when installing a reflective roof while constructing a new building, doing a major renovation, or replacing your whole roof system, you should consult with your contractor to maximize savings by making sure an optimum level of insulation is installed.

Can I expect the same level of savings over the entire lifetime of my roof?

Due to normal wear and tear, some degradation of roof reflectivity can be expected, particularly within the first few years after installation. Flat roofs may accumulate more dirt and debris because their slope is not great enough to allow washing by rain. Following maintenance procedures minimizes degradation and maximizes energy savings. Consult your roofing contractor or [product manufacturer](#) to learn more about recommended maintenance procedures and schedules.

How do ENERGY STAR qualified roof products compare with standard roof products in terms of durability?

ENERGY STAR understands that the water tightness, durability, and longevity of a roof are the primary concerns of building and homeowners. These participating manufacturers must back their compliant roof products with warranties that are comparable to their other roof products.

How can I find ENERGY STAR qualified roof products?

The ENERGY STAR label will appear on roof product packaging and advertisements. If you are installing or replacing a roof on a commercial or residential building, be sure to ask your roofing contractor or manufacturer about ENERGY STAR. Find a [list of ENERGY STAR qualified roof product manufacturers](#) .

http://www.energystar.gov/index.cfm?c=roof_prods.pr_roof_faqs



About Green Roofs
Tuesday, 31 May 2005

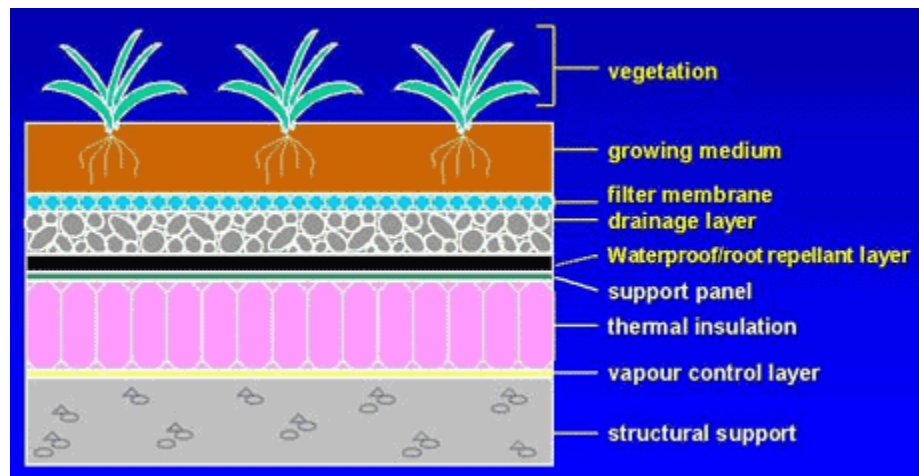
About Green Roofs

A green roof system is an extension of the existing roof which involves a high quality water proofing and root repellent system, a drainage system, filter cloth, a lightweight growing medium and plants.

Green roof systems may be modular, with drainage layers, filter cloth, growing media and plants already prepared in movable, interlocking grids, or, each component of the system may be installed separately. Green roof development involves the creation of "contained" green space on top of a human-made structure. This green space could be below, at or above grade, but in all cases the plants are not planted in the "ground". Green roofs can provide a wide range of public and private benefits.

Principal Green Roof Technology Components

Source: National Research Council, Institute for Research in Construction



In North America, the benefits of green roof technologies are poorly understood and the market remains immature, despite the efforts of several industry leaders. In Europe however, these technologies have become very well established. This has been the direct result of government legislative and financial support, at both the state and municipal level. Such support recognizes the many tangible and intangible public benefits of green roofs. This support has led to the creation of a vibrant, multi-million dollar market for green roof products and services in Germany, France, Austria and Switzerland among others. In Germany for instance, the industry made 700 million DM in sales in 1997, up from 500 million DM in sales in 1994. The industry continues to experience growth with 13.5 million square metres of green roofs constructed in 2001, up from 9 million square metres built in 1994.

Green roof technologies not only provide the owners of buildings with a proven return on investment, but also represent opportunities for significant social, economic and environmental benefits, particularly in cities. Find out more about the private and public benefits of green roof technologies below.

Frequently Asked Questions about Green Roofs

Why a green roof?

There are generic private benefits for virtually all projects, benefits, specific to the design and type of green roof, and benefits/incentives related to public policy, which have proven to be critical to developing the market in Europe:

Private Benefits

*Please Note: while there are similarities among green roofs, each installation is unique. Hence, all technical performance details provided will vary by region, climate, building and green roof type and design. These figures are provided as generic examples only and should not be used for designing projects without **expert advice and opinion**.*

The following benefits can be achieved with virtually all green roof infrastructure systems.

Economic Benefits - cost savings opportunities for the building owner include:

- Protection of roof membrane resulting in a longer material lifespan (it is estimated that green roofs will last up to twice as long as conventional roofs), resulting in decreased maintenance and savings in replacement costs;
- Savings on energy heating and cooling costs, depending on the size of the building, climate and type of green roof. Using a Micro Axxess Simulation model, Environment Canada found that a typical one storey building with a grass roof and 10 cm (3.9 inches) of growing medium would result in a 25% reduction in summer cooling needs. Field experiments by Karen Liu in Ottawa Canada, found that a 6 inch extensive green roof reduced heat gains by 95% and heat losses by 26% compared to a reference roof.

Sound Insulation

- Soil, plants and the trapped layer of air can be used to insulate for sound. Sound waves that are produced by machinery, traffic or airplanes can be absorbed, reflected or deflected. The substrate tends to block lower sound frequencies and the plants block higher frequencies.
- A green roof with a 12 cm (4.7 inches) substrate layer can reduce sound by 40 decibels; a 20 cm (7.9 inches) substrate layer can reduce sound by 46-50 decibels.

The following benefits may be achieved, depending on the type and design of the green roof system (i.e., accessible/inaccessible, intensive/extensive, integrated with other building systems or not).

Economic Benefits

- Potential to reduce the size of HVAC equipment on new or retrofitted buildings (capital and operational savings).
- Potential to reduce the amount of standard insulation used.
- Potential to incorporate cooling and/or water treatment functions.
- Potential for local, regional, and national market exposure, depending on the uniqueness of the project.
- Potential to reduce or eliminate roof drains.
- Potential to meet regulatory requirements for stormwater management.
- Potential to reduce community resistance to new developments.

Amenity Space and Aesthetics

- Provision of amenity space for day care, meetings, and recreation;
- Aesthetic appeal, increasing the value of the property and the marketability of the building as a whole, particularly for accessible green roofs. For example, American and British studies show that "good tree cover" adds between 6 to 15 per cent to the value of a home. Green roofs offer the same visual and environmental benefits.
- Satisfying the aesthetic needs of people looking down upon the roof from adjacent buildings.
- Potential to improve employee productivity.

Food Production

- The Fairmount Waterfront Hotel in Vancouver used to grow herbs, flowers, and vegetables on its accessible roof, saving its kitchen an estimated \$30,000 a year in food costs.



Herb Garden on Vancouver's Fairmount Waterfront Hotel (courtesy David Walker)

The following benefits may be achieved, depending on the type of public policy support for green roof installations in your area.

- Potential for faster approval process for new projects, as is the case in Chicago
- Potential for reduced stormwater/wastewater charges from your municipality or utility.
- Potential to reduce the size of stormwater management ponds or cisterns, resulting in cost savings.
- Potential for grants related to energy efficiency and/or green roofs.
- Potential for density bonusing / larger floor area ratio.
- Potential to satisfy regulatory requirements for green roofs.
- Potential to score more than 7 credits under the US and Canadian Green Building Council LEED certification system.
- Potential for satisfying minimum parkland / green space set aside, requirements.
- Potential for greenhouse gas emissions trading credits, stemming from energy savings.

Public Benefits

*Please note: All technical details provided will vary by region, building type and materials used. These figures are provided as generic examples only and **should not** be used for projects without **expert advice and opinion**.*

Economic Benefits

Public policies that support green roof installations will create jobs for the following:

- Suppliers and manufacturers of roofing membranes and root repellent layers;
- Suppliers and manufacturers of drainage layers, landscaping cloth, curbs, irrigation systems and other specialty products;
- Suppliers and manufacturers of substrate, light-weight soils and amendments;
- Garden nurseries specializing in plants specifically for green roofs;
- Design and engineering professionals;
- Contractors and landscapers; and,
- Companies supplying maintenance contracts.

Although no exact figures exist, it is estimated that the roofing industry in Germany employs approximately 12,000 people, and if all flat roofs were to be greened, this figure would increase to approximately 100, 000.

Community cost savings opportunities include:

- Cost savings from increased stormwater retention and decreased need to expand or rebuild related infrastructure.
- Decreased cost of meeting greenhouse gas reductions and adapting to climate change by reducing the "Urban Heat Island Effect" and the need for interior building insulation.
- Decreased need for health care services from reductions in ground level ozone resulting from a reduction in the urban heat island.
- Increased worker productivity and creativity.
- Decreased need for health care services and medication due to the benefits of passive experiences with nature and vegetation.
- Extending the lifespan of landfill sites by reducing re-roofing material waste.
- Opportunities to recycle aggregate and compost.

Improved Air Quality

Filtration of Airborne Particulates:

- A green roof will not only absorb heat, decreasing the tendency towards thermal air movement, but will also filter the air moving across it.
- 1 m² (10.76 ft²) of grass roof can remove between 0.2 kg of airborne particulates from the air every year.

Carbon Dioxide/Oxygen Exchange:

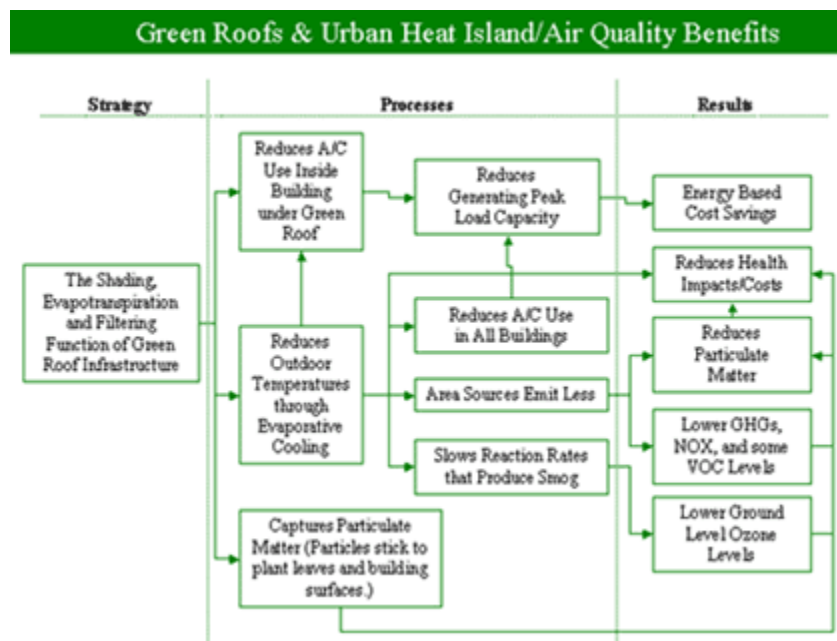
- Through the process of photosynthesis, plants convert carbon dioxide, water and sunlight/energy into oxygen and glucose. This cyclical process supplies animals and humans with oxygen and food.
- 1.5 m² (16.15 ft²) of uncut grass, produces enough oxygen per year to supply 1 human with their yearly oxygen intake requirement.

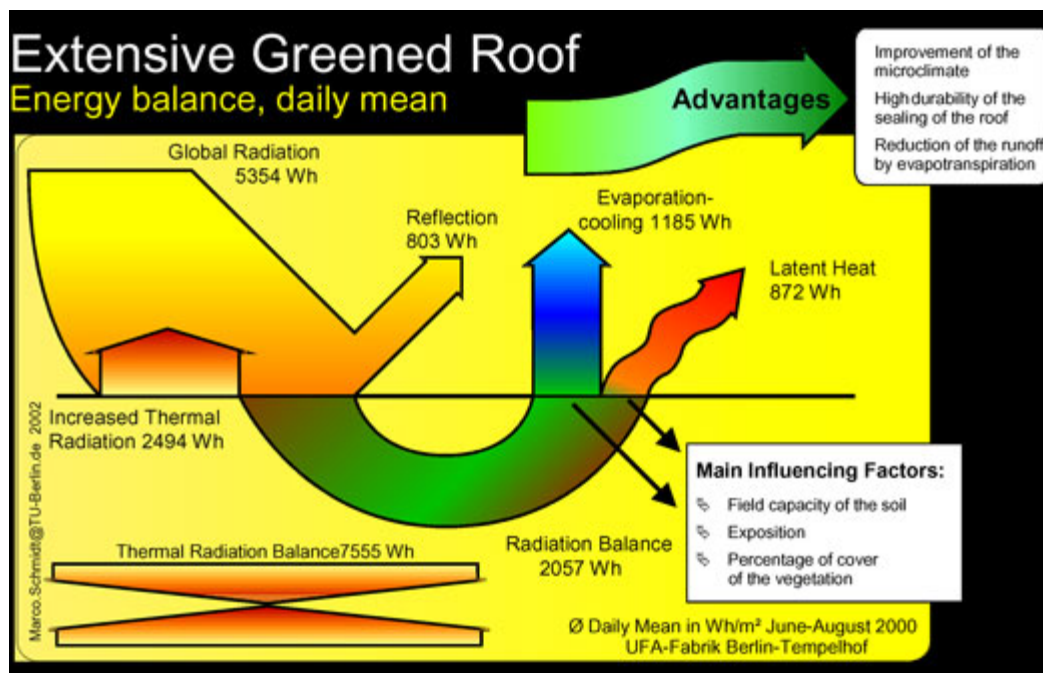
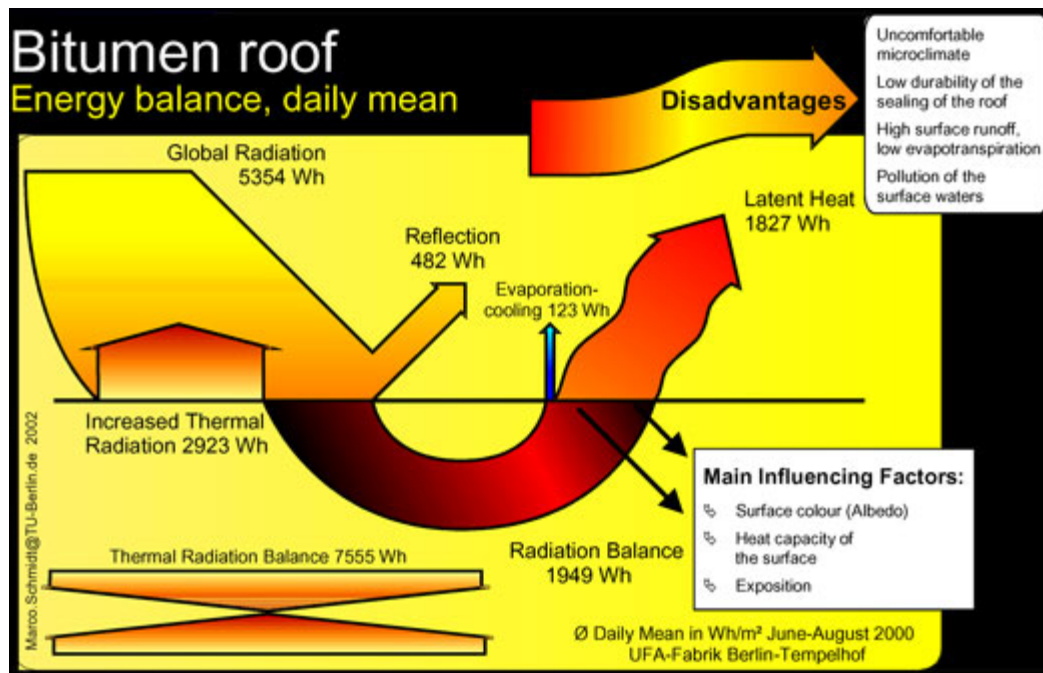
Temperature Regulation

Moderation of the Urban Heat Island Effect:

- Through the daily dew and evaporation cycle, plants on vertical and horizontal surfaces are able to cool cities during hot summer months. In the process of evapotranspiration, plants use heat energy from their surroundings (approximately 592 kcal per L of water) when evaporating water. One m² (10.76 ft²) of foliage can evaporate over 0.5 liters of water on a hot day and on an annual basis the same area can evaporate up to 700 liters of water.
- This process reduces the 'Urban Heat Island Effect' in the summer. The 'Urban Heat Island Effect' is the difference in temperature between a city and the surrounding countryside. It is mainly due to the expanse of hard and reflective surfaces, such as roofs, which absorb solar radiation and re-radiate it as heat. Reduction of the 'Urban Heat Island Effect' will also reduce the distribution of dust and particulate matter throughout the city and the production of smog. This can play a role in reducing greenhouse gas emissions and adapting urban areas to a future climate with warmer summers.
- Green roofs can play a role in reducing the urban heat island (UHI), augmenting the existing vegetation, but the precise amount of coverage is still uncertain. Dr. Brad Bass in collaboration with a modelling group at the University of British Columbia under the direction of Dr. Roland Stull, ran a mesoscale atmospheric simulation for the City of Toronto with green roofs. The city's vegetation reduced the UHI by up to 1 degree C over approximately 1/4 of the City. Using a green roof coverage of 50%, this cooling was extended to approximately 1/3 of the City and increased the maximum cooling to 2 degrees C. Although the green roof coverage was high, Dr. Bass estimated that only 6% of the roofs were fully irrigated as the model decreased irrigation to those parts of the city that were not fully urbanized, decreasing it to zero in totally natural areas of the city. This suggests that the actual green roof coverage to obtain these results could be much smaller than 50% although the exact requirement is difficult to determine due to a number of uncertainties that emerged in this modelling exercise.

The arrows in this diagram illustrate the nature of how green roofs reduce the urban heat island and improve air quality. For more information, see the Spring 2001 issue of the **Green Roof Infrastructure Monitor**.





The above images demonstrate the effect of a green roof on local heating - note the difference in energy radiated via evaporation-cooling vs.. latent heat between the two scenarios. (Used by permission of author: Marco Schmidt)

Building Insulation:

- Historically, green roofs have been used to insulate buildings. Shading the external surface of the building envelope has been shown to be more effective than internal insulation.
- Green roofs insulate buildings by preventing heat from moving through the roof. Their insulation properties can be maximized by using a growing medium with a low soil density and a high moisture content and by choosing plants with a high leaf area index (i.e. the bigger the leaves, the better). This could play a role in reducing greenhouse gas emissions and adapting urban areas to a future climate with greater incidences of drought and extreme heat.

Industrial Cooling:

- The Possman Cider Cooling and Storage Facility in Frankfurt, Germany yielded a 2-3 year payoff of their green roof system through savings in heating and cooling costs, as well as in equipment costs, since additional cooling towers had become unnecessary.

Creation of Microclimates:

- A green roof will have a noticeable impact on the heat gain and loss of a building, as well as the humidity, air quality and reflected heat in the surrounding neighbourhood. In conjunction with other green installations, green roofs can play a role in altering the climate of the city as a whole.
- On a summer day, the temperature of a gravel roof can increase by as much as 25 °C (77 °F), to between 60-80 °C (140 - 176 F). Covered with grass, the temperature of that roof would not rise above 25 °C (77 °F), thus resulting in energy cost savings.
- 20 cm (7.9 inches) of substrate with a 20-40 cm (7.9 - 15.7 inches) layer of thick grass has the combined insulation value of 15 cm (5.9 inches) of mineral wool.
- Rooms under a green roof are at least 3 - 4 °C (5.4 - 7.2°F) cooler than the air outside, when outdoor temperatures range between 25-30 °C (77 - 86 °F).

Water

Stormwater Retention:

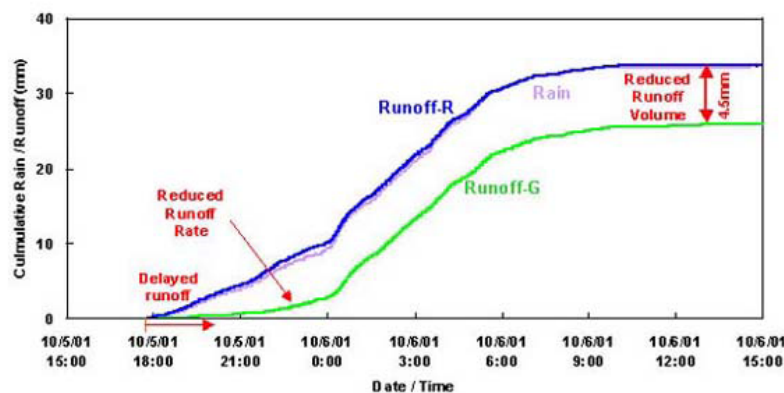
- Water is stored by the substrate and then taken up by the plants from where it is returned to the atmosphere through transpiration and evaporation.
- In summer, depending on the plants and depth of growing medium, green roofs retain 70-90% of the precipitation that falls on them; in winter they retain between 25-40%. For example, a grass roof with a 4-20 cm (1.6 - 7.9 inches) layer of growing medium can hold 10-15 cm (3.9 - 5.9 inches) of water.

Water Filtration:

- Green roofs not only retain the rainwater, but also moderate the temperature of the water and act as natural filters for any of the water that happens to run off.

Temporal Delay of Stormwater Runoff and Reduced Runoff Volume:

- Green roofs reduce the amount of stormwater runoff and also delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods.



The graph above records the cumulative rainfall and runoff from the Green Roof and the Reference Roof during a 34mm (1.3 inches) rain event over a 15h period in October 2001. The green roof delayed runoff and reduced the runoff rate and volume. For more details on this research conducted by the National Research Council's Institute for Research in Construction, see the article on page 7 of the Fall 2002 issue of the **Green Roof Infrastructure Monitor**. Source: National Research Council's Institute for Research in Construction.

Social Benefits

Aesthetics:

Urban greening has long been promoted as an easy and effective strategy for beautifying the built environment and increasing investment opportunity.

Health & Horticultural Therapy:

Psychological studies have shown that the restorative effect of a natural view holds the viewers' attention, diverts their awareness away from themselves and from worrisome thoughts thereby improving health.

People living in high-density developments are known to be less susceptible to illness if they have a balcony or terrace garden. This is partly due to the additional oxygen, air filtration and humidity control supplied by plants but also from the therapeutic benefits that result from caring for plants. The variety of sounds, smells, colors and movement provided by plants, although not quantifiable, can add significantly to human health and well being.

Patients in the same hospital, recovering from the same operation, were studied as to the restorative effects of views onto a landscaped courtyard versus a brick wall. The patients with the green view had shorter post-operative stays, took fewer moderate and stronger painkillers and had fewer negative evaluation comments from the nurses.

A green roof by **Garland** on a nursing home



Improved Safety:

A garden on the roof is often considered safer than a garden at grade. For example, because access to the roof is often restricted to building tenants or employees, there is less likelihood of assault or vandalism.

Recreation:

Green roofs can help to address the lack of green space in many urban areas. Studies show that leisure activities in natural settings such as gardens and parks, are important for helping people cope with stress and in meeting other non-stress-related needs.



Corporate Golf Course Green Roof

Community Building:

The creation of shared gardens, like the rooftop garden on top of the Mary Lambert-Swale housing project in Toronto, allows residents to feel ownership of their building and meet neighbors in a relaxed setting.

Preservation of Habitat & Biodiversity

Habitat:

Rooftop habitats can play one of two roles: a 'stepping stone' habitat connecting natural isolated habitat pockets with each other, or an 'island' habitat remaining isolated from other habitats at grade.

Green roofs can be specifically designed to mimic endangered ecosystems/habitats, including the prairie grasslands of the midwest US, the rocky alvars of Manitoulin Island and the Great Lakes Region in Canada.

The Toronto City Hall Demonstration Project features a black oak prairie ecosystem and native plant butterfly plot.

Flora & Fauna:

Green roofs designed for minimal maintenance are very protected and can become home to plants easily damaged by walking and to birds that nest on the ground. Since the soil on these green roofs is also less likely to be disturbed, it becomes a safer habitat for insects, and the deeper the soil the more diversity the roof can support.

In Germany, for instance, research has shown that green roofs can support anywhere from 10 to 40 different insect species and have even been found to harbour nesting bird species.

The Toronto City Hall Demonstration Project features two urban agriculture plots that are growing a variety of annuals and perennials.

Local Food Production

Green roofs can provide new opportunities for urban agriculture. There are many benefits to growing and distributing food locally including:

- Support of the local economy in growing, processing and distributing;
- Increased access to food by everyone;
- Fresher produce;
- Decreased travel time to market and related environmental costs; and
- Control of soil, fertilizer and pesticides.

What do I need to know about my building before I initiate a green roof installation?

You will need to know the slope, the structural loading capacity, and existing materials of the roof, as well as the nature of any drainage systems, waterproofing, and electrical and water supply in place. You should also consider who would have access to it, who will do maintenance, and what kind of sun and wind exposure the roof gets.

What kinds of landscape design should I use and what plants can I grow on my roof?

Plant selection depends on a variety of factors, including climate, type and depth of growing medium, loading capacity, height and slope of the roof, maintenance expectations, and the presence or absence of an irrigation system. A landscape architect would be able to advise you on suitable plants and design of the plantings.

How much does a green roof cost?

The cost of a green roof varies considerably depending on the type and factors such as the depth of growing medium, selected plants, size of installation, use of irrigation, and whether they are to be accessible on inaccessible - intensive, semi-extensive or extensive. Intensive green roofs typically require greater investment but confer the benefits of accessibility. An installed extensive green roof with root repellent/waterproof membranes may be installed for \$10-\$24 US per square foot. While green roofs typically require a greater initial investment, it is important to keep in mind that they can extend the life of the roof membrane and reduce the heating and cooling costs of your building. Speak to a qualified green roof professional about the range of costs and benefits for different green roof systems and designs.

How can I purchase a green roof system for my home or building?

You should contact green roof manufacturers directly and speak to a sales representative.

Green Roof System



Hamilton Building in Portland, OR
Green Roof System



Mountain Equipment Co-op
in Toronto, ON



Modular Green Roof System
Low lying shrubs

Who can design and install a green roof?

Landscape architects and contractors frequently design green roofs and can install the living components (i.e., growing medium and plants).

Because green roof systems include materials not found on conventional roofs, we recommend that you choose a qualified roofing contractor with experience in green roof installation to install the non-living components (e.g., vapor barrier, waterproof membrane). Contractors can be found in our **Corporate Members** section.

You can also contact a roofing consultant, who will assess your roofing design needs, ensure quality control and recommend a suitable green roof system.

How many LEED™ credits can I receive?

Green roofs can facilitate a significant improvement in the LEED™ rating of a building, contributing as many as 15 credits under the system, depending on design and level of integration with other building systems. In some instances, while green roofs may not contribute directly to achieving points under the system, they contribute to earning LEED™ credits when used with other sustainable building elements. For example, green roofs can earn direct credits under the following:

- Reduced Site Disturbance, Protect or Restore Open Space
- Landscape Design That Reduces Urban Heat Islands, Roof
- Storm Water Management
- Water Efficient Landscaping
- Innovative Wastewater Technologies
- Innovation in Design

(the above is an excerpt from Green Roofs and Maximizing Credits under the LEED™ Green Building System, by Richard Kula in The Green Roof Infrastructure Monitor, Spring 2005)

What sort of research is being done on green roofs?

A considerable amount of research on the public and private benefits of green roof infrastructure in different climate zones, different built environments, and at different scales needs to be conducted in order to forge a new industry through the development of supportive public policy.

Contact your local or county government for possible incentives.

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http://www.greenroofs.net/index.php?option=com_content&task=view&id=26&Itemid=40

GREENGRID®
The Natural Choice for Your Roof



The PREMIER Green Roof System

The GreenGrid® Green Roof System

offers distinct advantages over more complex systems with its simplicity in design, pre-planted modules, and movable modular features.



WESTON
SOLUTIONS

Introducing the GreenGrid® Modular Green Roof System

Simplicity in design and flexibility are the hallmarks of the GreenGrid® System. The system was designed by engineering, roofing, and horticultural experts to produce an efficient, integrated green roof product. GreenGrid® offers a modular design that arrives at your site pre-planted and ready for installation. The modules contain recycled plastics and the components can be hoisted to the roof via elevator, forklift, or crane, and quickly installed in accordance with the design. The modules can be placed directly on the roof membrane or on any other surface with adequate structural capacity.

GreenGrid® Green Roof System modules are lightweight compared to many other green roof systems. The Ultra-Extensive (2.5-inch depth) modules—supporting only sedum species—weigh approximately 10 pounds per square foot (wet). The Extensive (4-inch depth) modules—supporting shallow rooting grass, sedum, and wildflower species—weigh approximately 15 pounds per square foot (wet). The Intensive (8-inch depth) modules—supporting a large variety of ornamental perennials and shrubs—weigh approximately 28 pounds per square foot (wet). They can be easily arranged or rearranged to suit the needs and desires of the client. Most importantly, roof maintenance and repair is simple—modules can just be moved should roof repair/maintenance be required, then put back in place.



About Green Roofs



Green roofs are not a new phenomenon. Due to their excellent insulation and storm-water retention properties, these roofs have been a standard construction practice in many countries for years. Since the 1970s, green roofs increasingly have become part of the landscape in Europe, where there are over 100 million square feet of planted roofs today. Due to the complexity of some of these systems, green roofs have been somewhat slow to catch on in North America. These “European” systems are constructed in layers, starting with a waterproof membrane and drainage layer, then insulation, root barriers, soil layers, and a wind erosion blanket are put in place. The landscape is then installed, which can take considerable time to mature.

The GreenGrid® System offers distinct advantages over these complex systems with its straightforward design, pre-planted modules, and movable modular features.

System Options

Ultra-Extensive Modules

The 2.5-inch Extensive GreenGrid® System is an extremely lightweight green roofing system of modules, composed of 2.5 inches of soil media and drought-tolerant vegetation. The vegetation is composed of colorful sedums requiring little or no irrigation, fertilization, or maintenance. This 2.5-inch green roofing system is appropriate for building where structural capacity is limited. The approximate weight of a fully saturated 2.5-inch GreenGrid® Extensive roof system is 10 pounds per square foot, which is similar to the weight of gravel ballast placed on many conventional roofs.

Extensive Modules

The 4-inch Extensive GreenGrid® System is a lightweight green roofing modular system composed of a 4-inch layer of soil media and drought-tolerant vegetation. The drought-tolerant vegetation is composed of colorful sedums, grasses, and meadow flowers requiring little or no irrigation, fertilization, or maintenance. The types of plants suitable for this system are those native mainly to locations with dry and semi-dry conditions or with rocky outcrops, such as an Alpine environment. The approximate weight of a fully saturated 4-inch GreenGrid® Extensive roof system is 15 pounds per square foot.

Intensive Modules

The 8-inch Intensive GreenGrid® System is designed for more elaborate roof landscapes. These rooftop gardens are generally intended for human use and thus must have the structural capacity for the live loads associated therewith. The 8-inch depth system allows for a larger selection of plants, including ornamental perennials, annuals, and small flowering shrubs. GreenGrid® pavers pathways, terraces, water features, edge treatments, and other architectural features result in beautiful and dramatic new usable spaces. Depending on the plant selection, drip irrigation systems, fertilization, and/or maintenance may be necessary, just as they would be for a traditional garden. Although a more refined application and, therefore, generally more expensive, the ecological benefits of Intensive green roofs are wide-ranging due to the utilization of larger and greater plant species diversity. The average weight of a fully saturated 8-inch GreenGrid® Intensive roof system starts around 28 pounds per square foot.



The Advantages a GreenGrid® System Brings to Your Building

Easy Roof Maintenance and Repair: Since the GreenGrid® system is modular, roof surfaces are always accessible for maintenance and repair. “No matter the type or age of a roof, eventually it will leak. The question is, when” said Larry Flynn, Senior Editor, *Building Design & Construction*, (1 Sept. 2003, vol. 44, no. 9, p. 66). When the roof requires maintenance or repair, the GreenGrid® modules are simply removed, then put back in place when repair is complete, without disturbing growing media or plants.

Engineered, Integrated System: All components of the GreenGrid® Green Roof System are designed and engineered to work together. This results in installation efficiencies, thereby lowering costs, and assures an integrated design.

Lightweight for Existing/New Roofs: The GreenGrid® system can be installed on any roof in good condition where structural capacity is present. The choice of lightweight modules make a green roof feasible for almost any building without requiring upgrades to its structural capacity.

Pre-planted System: The GreenGrid® modules are planted in advance at the nursery. This means modules arrive at the job site already planted and ready for installation. Pre-planting also allows plants to be pre-grown at the nursery in the modules until they reach the desired maturity. Finally, if there are construction delays, the planted modules can simply wait at the nursery, growing, until it's time for the GreenGrid® installation.



See the table below for additional GreenGrid® advantages.

GreenGrid® Advantages	GreenGrid® Green Roof System Solution	Traditional (Built-in-Place) Systems
Easy Roof Maintenance & Repair	Modules can easily be moved then put back in place without disturbing growing media or plantings	Layers need to be cut and rolled back until repair location found: plants and layers damaged
Engineered, Integrated System	Components engineered to work together, optimizing installation and integration	Generally customized by project, multiple sourcing, limited production speed
Competitive Installed Cost	Competitive installed cost versus leading built-in-place systems	New roof surface plus mat, drainage, root barrier, moisture retention layers often costly
Quick Installation	Delivered pre-planted, ready to set in place, reduced downtime due to inclement weather	Multi-layer, built-in-place, vegetation planted at job site, time-consuming
Pre-planted	Pre-planted in advance at the nursery. Speeds installation time and can be pre-grown to desired plant coverage	Roofs generally require about 2 years to be “green”
Lightweight for Existing/ New Roofs	Lightweight—installs on any existing roof surface in good condition and with structural capacity	Systems often heavy and roof surface replacement often required despite condition
Easy Rooftop Placement	All modular system components quickly put in place on roof in accordance with design	Components delivered to rooftop by multiple sources can present scheduling difficulties
LEED® Recycling Credits	All GreenGrid modules contain recycled material contributing to LEED® recycling credits	Components generally do not contain recycled material
Built-in Water Retention	Module design provides built-in water retention	Water retention layers must be added
Pre-determined Water Retention Option	Ecoballast® modules augment stormwater retention without plants and growing media	Not available
Easy System Alteration/Additions	Option of installing green roof in sections offers opportunity for future add-ons	Often difficult and expensive to change/add-on due to edge design requirements
Wrap-Around Warranty	GreenGrid® installed as part of a Mule-Hide Green Roof offers a NDL Wrap-Around Warranty	Limited Warranty – Removal and re-installation of plants/vegetation generally not included

Reduced energy costs: When the outside air temperature reaches 95° F, traditional black rooftop surface temperatures can be as high as 175° F. The heat load of a roof impacts the amount of energy necessary to cool the building to the desired temperature. Due to its insulating properties, GreenGrid® green roofs can significantly reduce the heat load of the roof in warm seasons.

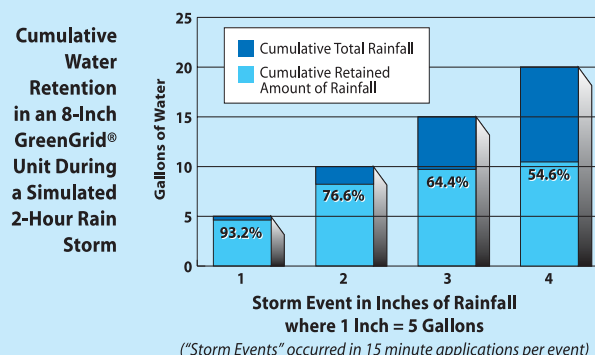
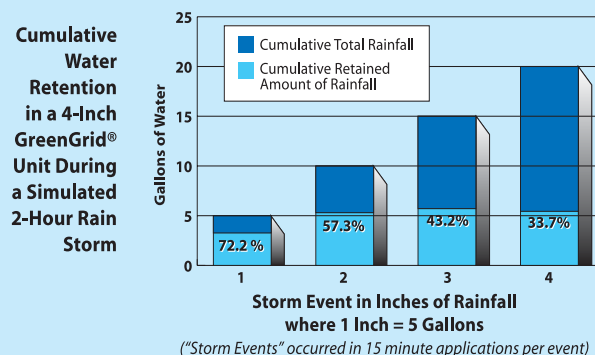
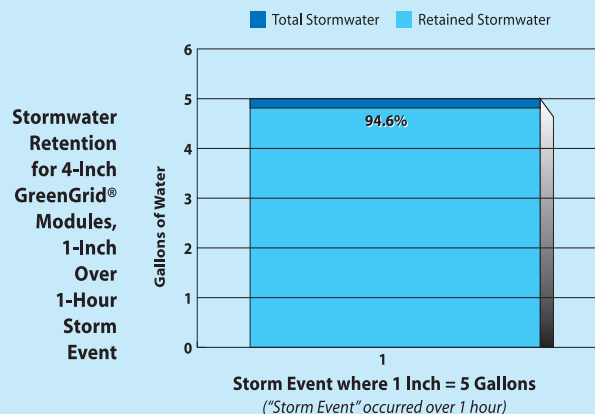
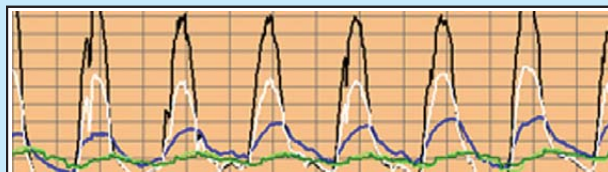
Reduced urban heat island effect: The urban heat island effect occurs in most of the large cities of the world and has actually been shown to change weather patterns in some. Roads and building rooftops absorb a significant amount of heat during the day, which, in turn, is radiated back into the atmosphere, causing further warming. GreenGrid® green roofs help insulate and shade buildings, and the plants on green roofs transpire, thereby cooling the atmosphere around them.

Stormwater management: Green roofs help alleviate stormwater runoff through retention and detention of rainfall and detention of runoff from roofs. This benefit can cut costs associated with required municipal on-site stormwater retention.

Sound insulation: The growth media, plants, and layers of trapped air in a green roof system serve as excellent sound insulators. Tests have shown that green roofs can reduce the indoor noise pollution from outdoor contributors by as much as 10 decibels per every 3 inches of soil media.

Extended roof life: GreenGrid® green roofs can protect roof membranes from ultraviolet radiation, extreme temperature fluctuations, and puncture or other physical damage.

Creation of added value and aesthetics: Green roofs can provide an oasis of green in the urban environment by creating visually pleasing vistas, serene rooftop gardens, and functional gathering areas.



GreenGrid® Projects



APPLE COMPUTER STORE - NORTH MICHIGAN AVENUE

Client: Apple Computer, Inc.
Location: Chicago, IL
GreenGrid® Size: 2,400 Square Feet
Installation Contractor: WESTON
Landscape Design: Douglas Hoerr Landscape Architecture
Rooftop System: Extensive
Status: Completed Summer 2003



CHICAGO TARGET RETAIL STORE

Client: Target Corporation
Location: 2939 W Addison St., Chicago, IL
GreenGrid® Size: 9,664 Square Feet
Installation Contractor: WESTON
Landscape Design: Hayden Bulin Larson Design Group Ltd., Landscape Architects
Rooftop System: Extensive
Status: Completed Summer 2003



AMERICAN RED CROSS OF GREATER CHICAGO - RAUNER CENTER

Client: American Red Cross of Greater Chicago
Location: Chicago, IL
GreenGrid® Size: 2,800 Square Feet
Installation Contractor: WESTON
Landscape Design: Douglas Hoerr Landscape Architecture
Rooftop System: Extensive
Status: Completed Summer 2004



MILWAUKEE HOUSING AUTHORITY - HIGHLAND GARDENS

Client: Milwaukee Housing Authority
Location: Milwaukee, WI
GreenGrid® Size: 20,032 Square Feet
Installation Contractor: WESTON
Landscape Design: WESTON
Rooftop System: Extensive
Status: Completed Fall 2004



UWM GREAT LAKES WATER INSTITUTE

Client: University of Wisconsin-Milwaukee – Great Lakes Water Institute
Location: 600 E. Greenfield Ave., Milwaukee, WI
GreenGrid® Size: 6,480 Square Feet
Installation Contractor: WESTON
Landscape Design: WESTON
Rooftop System: Extensive/Intensive
Status: Completed Summer 2003



OGDEN RESOURCE CENTER - SUSTAINABLE BUILDING

Client: Washington State School for the Blind Ogden Resource Center
Architect: Terra Architecture
Location: Vancouver, WA
GreenGrid® Size: 6,640 Square Feet
Installation Contractor: Landgraphics, Inc.
Landscape Design: Terra Architecture
Rooftop System: Intensive
Status: Completed Spring 2003



HASTINGS-KEITH FEDERAL OFFICE BUILDING

Building Owner: United States General Services Administration
Client: J & J Contractors, Inc.
Location: Hastings-Keith Federal Office Building, 56 North 6th Street, New Bedford, MA
GreenGrid® Size: 3,400 Square Feet
Installation Contractor: WESTON and J & J Contractors, Inc.
Landscape Design: Oak Point Associates
Rooftop System: Extensive
Status: Completed Spring 2004



HOME DEPOT STORE

Client: Glenn Johnson Construction
Location: Chicago, IL
GreenGrid® Size: 48,800 Square Feet
Installation Contractor: Christy Webber Landscapes
Landscape Design: WESTON
Rooftop System: Extensive
Status: Completed Fall 2005



BARBER PARK GREEN BUILDING

Client: Ada County Parks & Recreation
Location: Boise, ID
GreenGrid® Size: 3,660 Square Feet
Installation Contractor: WESTON
Landscape Design: WESTON
Rooftop System: Ultra-Extensive
Status: Completed Summer 2005



HOLY REDEEMER CATHOLIC CHURCH

Client: Holy Redeemer Catholic Church
Location: Portland, OR
GreenGrid® Size: 4,464 Square Feet
Installation Contractor: WESTON
Landscape Design: WESTON
Rooftop System: Extensive
Status: Completed Summer 2005



IKEA STORE

Client: IKEA US
Location: Stoughton, MA
GreenGrid® Size: 21,376 Square Feet
Installation Contractor: WESTON
Landscape Design: WESTON
Rooftop System: Extensive
Status: Completed Summer 2005



CENTER FOR URBAN ECOLOGY

Client: National Parks Service
Location: Washington, DC
GreenGrid® Size: 6,500 Square Feet
Installation Contractor: WESTON/Platinum One Contracting
Landscape Design: U.S. Department of the Interior
Rooftop System: Extensive
Status: Completed Summer 2004



ABC SUPPLY COMPANY - HEADQUARTERS

Client: ABC Supply Co., Inc.
Location: Beloit, WI
GreenGrid® Size: 10,370 Square Feet
Installation Contractor: WESTON/Corporate Contractors, Inc.
Landscape Design: WESTON
Rooftop System: Intensive/Extensive
Status: Completed Summer 2001



NATTY BOH BREWERY REDEVELOPMENT

Client: Natty Boh Brewery
Location: Baltimore, MD
GreenGrid® Size: 12,000 Square Feet
Installation Contractor: WESTON/Cole Roofing, Inc.
Landscape Design: Cho Benn Holback & Associates
Rooftop System: Extensive
Status: Completed Fall 2004

Optional Features

Additional features are available to enhance the benefits and aesthetic appeal of your green roof. Whether your goal is to create a pleasing and enjoyable space, or optimize the beneficial use of your building's roof space, there are many options available to make the most of your GreenGrid® Green Roof System.



Beneficial Enhancements

- Ecoballast®—These modules can be added to augment stormwater retention.
- Drip Irrigation Systems—Drip irrigation systems can be added as an effective way to irrigate plants requiring maintenance such as ornamental grasses, perennials, and native plants.



Ecoballast®



Drip Irrigation System

Aesthetic Enhancements

- Pavers
- Water Features
- Edge Treatment
- Outdoor Furniture and Planter Boxes



Pavers



Water Features and Edge Treatment



Outdoor Furniture and Planter Boxes



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B-D066 11/16/05

GREENGRID®
The Natural Choice for Your Roof



The PREMIER Green Roof System

The GreenGrid® Green Roof System

offers distinct advantages over more complex systems with its simplicity in design, pre-planted modules, and movable modular features.



WESTON
SOLUTIONS

Introducing the GreenGrid® Modular Green Roof System

Simplicity in design and flexibility are the hallmarks of the GreenGrid® System. The system was designed by engineering, roofing, and horticultural experts to produce an efficient, integrated green roof product. GreenGrid® offers a modular design that arrives at your site pre-planted and ready for installation. The modules contain recycled plastics and the components can be hoisted to the roof via elevator, forklift, or crane, and quickly installed in accordance with the design. The modules can be placed directly on the roof membrane or on any other surface with adequate structural capacity.

GreenGrid® Green Roof System modules are lightweight compared to many other green roof systems. The Ultra-Extensive (2.5-inch depth) modules—supporting only sedum species—weigh approximately 10 pounds per square foot (wet). The Extensive (4-inch depth) modules—supporting shallow rooting grass, sedum, and wildflower species—weigh approximately 15 pounds per square foot (wet). The Intensive (8-inch depth) modules—supporting a large variety of ornamental perennials and shrubs—weigh approximately 28 pounds per square foot (wet). They can be easily arranged or rearranged to suit the needs and desires of the client. Most importantly, roof maintenance and repair is simple—modules can just be moved should roof repair/maintenance be required, then put back in place.



About Green Roofs



Green roofs are not a new phenomenon. Due to their excellent insulation and storm-water retention properties, these roofs have been a standard construction practice in many countries for years. Since the 1970s, green roofs increasingly have become part of the landscape in Europe, where there are over 100 million square feet of planted roofs today. Due to the complexity of some of these systems, green roofs have been somewhat slow to catch on in North America. These “European” systems are constructed in layers, starting with a waterproof membrane and drainage layer, then insulation, root barriers, soil layers, and a wind erosion blanket are put in place. The landscape is then installed, which can take considerable time to mature.

The GreenGrid® System offers distinct advantages over these complex systems with its straightforward design, pre-planted modules, and movable modular features.

design brief

BUILDING INTEGRATED PHOTOVOLTAICS

<http://www.energydesignresources.com/resource/23>

Summary

A sustainable technology that provides the opportunity for generating electricity and replacing conventional construction materials is building integrated photovoltaics (BIPVs). BIPV systems generate electricity by converting solar energy into useable power to supply building electrical loads. As a leading renewable technology, it is poised for widespread use by design teams in the non-residential construction industry in California and across the United States.

With an abundance of accessible solar energy, California is a prime location for photovoltaic technology and BIPV applications. This technology has the potential to generate substantial electricity capacity for the state. Currently, it is estimated that only about 0.3 percent of California's total electricity generation is produced using solar energy. However, photovoltaic technology has the potential to take a much larger role in supplementing or replacing nonrenewable generation sources for electricity in the future.

California's commercial building owners and designers who integrate BIPV in new and existing buildings may reap numerous economic and environmental benefits. However, designing with BIPVs requires a "whole building" approach that focuses on the interaction of all the energy systems in a building. By evaluating the interoperability of all systems, energy savings may be compounded, and full economic and environmental advantages may be realized.

Using building integrated photovoltaic technology, design teams may supply solar energy to building systems, integrate the technology seamlessly into the building design, and provide an economical renewable energy source for building owners.

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Minimize Electric Loads

The first consideration in BIPV applications is to maximize efficiency in the building's energy demand or load. Designers should minimize the electricity load by utilizing integrated energy design strategies such as building envelope improvements, daylighting techniques, and natural ventilation applications (refer to various Energy Design Resources design briefs). Additionally, installing energy-efficient lighting and cooling equipment throughout a building minimizes energy loads. In BIPV applications, the goal is to minimize the building's energy needs and then supplement the remaining loads supplied by the local utility grid with PV-generated electricity. By minimizing the electricity needs and utilizing BIPV, the designer maximizes the potential energy cost savings.

The Visitor Center at Mt. Zion National Park is an example of a building where energy-saving and sustainable features were integrated throughout the design (**Figure 3**). Electric loads were first minimized. Then, utility electricity demand was further reduced using supplemental electricity generated by PV technology.

Optimize the Generation of Electricity

Just as a building should be designed to maximize energy efficiency, a BIPV system should be designed to optimize electrical output. It is important to note that the availability of solar radiation generally matches commercial building electric loads throughout the day and throughout the year. For example, typical energy use for office buildings peaks near midday and during the summer season, the time when there is the greatest solar potential.

For maximum energy output, it is important to determine the orientation, tilt angle, size and location of the BIPV system in relation to the building site and design. Flexibility exists in the placement (tilt and orientation) of BIPV, so it is best to match the time of day, month, and season when peak solar generation occurs with the peak electrical needs of the building.

Figure 3: Zion Canyon Visitor Center, Zion National Park, Springdale, Utah

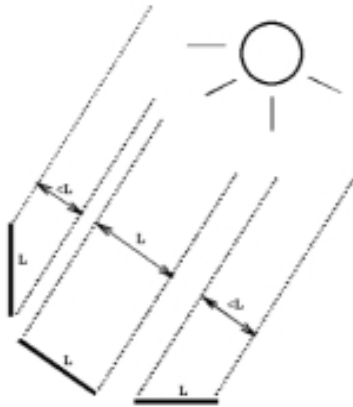
The 7,600 ft² (706 m²) Visitor Center at Mt. Zion National Park is one of the National Park Service's (NPS) most efficient buildings. Building features include daylighting, Trombe walls for passive solar heating, downdraft cooling towers for natural ventilation cooling, energy-efficient lighting, and advanced building controls. The center estimates these features result in approximately 10 kW reduction in the building's electrical demand.

A roof-mounted photovoltaic system provides approximately 30 percent of the remaining electricity needed. Since battery storage was already part of the uninterrupted power system design, by adding a converter it was easy to integrate a PV system into the building's design.



Source: National Renewable Energy Laboratory

Figure 4: Amount of solar radiation striking surfaces of different tilts



SEASONAL ADJUSTMENTS FOR BIPVS

Optimal performance is related to the electric load shape of the building. Optimal tilt may vary plus or minus approximately 15 degrees of the site latitude depending on when the peak load occurs. In general, if peak performance is desired in the summer, mount PV panels at a lower tilt angle to collect greater amounts of the high altitude summer sun.

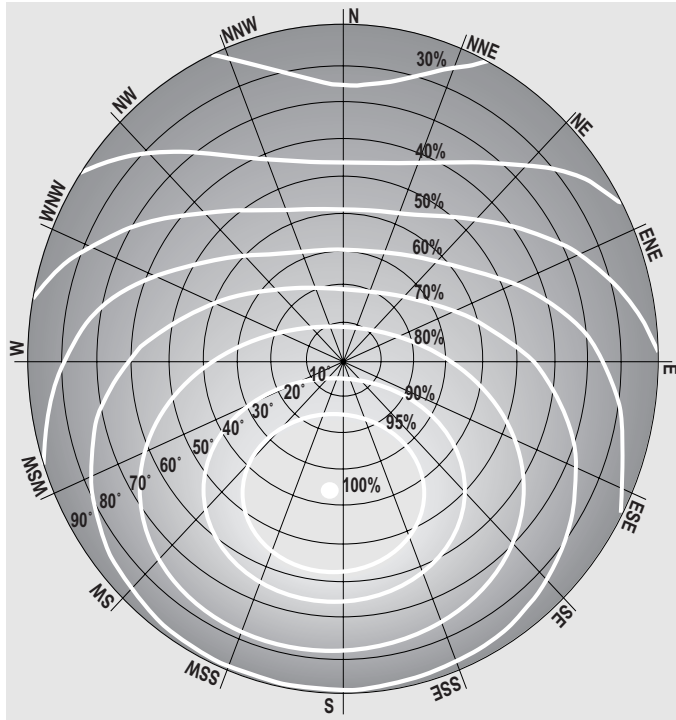
- **Tilt.** Maximum solar intensity occurs on a flat surface perpendicular to the sun's rays (**Figure 4**). Inclining the panels toward the sun increases the amount of sunlight striking the surface and will increase the output. The sun's path sweeps a daily arc that changes seasonally throughout the year. In this way, the sun follows a prescribed solar position described by an altitude angle (vertical) and azimuth angle (horizontal). By orienting the BIPV panels to be perpendicular to the sun at certain times of day and year, it is possible to optimize solar exposure to match loads. Studies have shown that, because of the relationship between tilt and output, the tilt of the installation directly affects the economics associated with energy savings.

As a general rule of thumb in the Northern Hemisphere, BIPV installations produce the most energy over the course of a year when oriented true south and tilted at an angle equivalent to the site latitude. However, instantaneous output varies depending on cloud cover and the sun's position. As a panel gets farther from a tilt equivalent to the site latitude, the total annual output decreases. A vertical surface orientation may produce approximately 30 percent less electricity, while a horizontal surface orientation may produce approximately 10 percent less electricity than an optimally inclined installation.

- **Orientation.** The total amount of energy that strikes a surface is a function of both tilt and orientation. On east- and west-facing façades, BIPV systems are less efficient than systems oriented south. Nevertheless, vertically mounted BIPVs with east/west orientation can yield up to 60 percent of the optimally inclined southern orientation. For these east/west orientations, low sun angles at the beginning and end of the day account for the majority of the power generated. **Figure 5** shows the distribution of annual incident energy striking a surface in Southern California. In general, largely horizontal southern or vertical western

Figure 5: Distribution of annual incident energy typically striking a surface in Southern California

Efficiency relative to tilt and orientation at 35° latitude indicates that a large number of tilt and orientation combinations provide 90 percent of maximum generation, demonstrating significant flexibility in BIPV siting. Since BIPV can be used in a variety of configurations, it can be viewed as a widely applicable building material.



installations are best to supply typical commercial daytime applications.

- **Sizing.** Even with supplemental on-site PV generation, commercial buildings generally remain net importers of electricity because of their significant energy requirements. Design constraints (space availability, efficiency of placement, building envelope requirements, and costs) typically determine the capacity of BIPV systems rather than electric load requirements. For this reason, commercial BIPV systems are often designed to serve a dedicated (frequently DC) load, such as landscape lighting or irrigation control, to more directly link output to demand.

Figure 6: Locations with optimum tilt and associated solar energy output

Location	Orientation (Longitude, Latitude)	Optimum Tilt Angle °	Energy Output kWh/m ² /y
Berlin	13, 52	35	121
London	0, 52	35	111
Madrid	4, 40	35	201
Lisbon	9, 39	30	201
Rome	13, 42	35	191
Amsterdam	5, 62	40	129
Geneva	6, 46	30	143
Krakow	20, 50	35	124
Oslo	11, 60	45	130
Athens	23, 38	30	183
Budapest	19, 47	35	143
Vienna	16, 48	35	132
Istanbul	29, 41	30	176
Abu Dhabi	55, 25	25	223
Perth	116, -32	30	227
Melbourne	145, -38	30	182
Brisbane	153, -28	25	189
Mexico City	-99, 19	20	205
Miami	-30, 26	25	220
Los Angeles	-117, 33	30	233
New York	-74, 41	35	169
Seattle	-122, 47	35	147
Tucson	-111, 32	30	253
Buenos Aires	-58, -34	30	201
Cape Town	18, -35	30	232
Nairobi	36, -1	5	203
Bangalore	77, 13	15	217
Delhi	77, 28	30	233
Tokyo	140, 35	30	149
Singapore	104, 1	0	171
Hong Kong	114, 22	20	156
Moscow	56, 37	40	119

Source: BP Solarex

Seasonal climatic conditions (temperature and solar radiation) and available surface areas also affect the sizing of BIPV systems. For initial estimates, 10W/sqft (100W/sqm) may be used to roughly estimate BIPV capacity based on size. Designers may want to consult with a PV specialist, system integrator, or consultant to provide array sizing according to desired output, or use one of numerous software tools, worksheets, and charts currently available. Additional reference information is available in the Appendix of this document.

- **Location.** BIPVs should be placed where they have secured long-term solar access. It is critical not to locate BIPV panels where neighboring landscapes or structures that may shadow the system are present or anticipated in the future. Full or partial shading of the panels inhibits the production of electricity. The system performs best if there is homogeneous solar access because the solar cell with the lowest illumination level determines the operating current for all of the cells wired in that series.

Figure 6 indicates the optimum tilt and the associated solar energy output for various geographic locations. Clearly, Los Angeles is a location particularly well suited for the generation of electricity from solar energy with a potential annual energy output of 22 kWh/ft²/y (233 kWh/m²/y). An optimally placed, 1,000 sqft PV array on a 10,000 sqft office building in Southern California may potentially provide up to 20 percent of the annual energy load.

Maximize Efficiency of Energy Storage

Since BIPVs only generate electricity while the sun is shining, proper energy storage is critical. In most commercial applications, integration with the electric grid is advisable. Hybrid systems, which are battery plus grid-connected configurations, provide the added benefit of protection from power interruptions. Additionally, battery-stored energy may provide peak shaving opportunities by offsetting grid-power needs during periods of

high-energy costs. The following considerations are important when sizing a battery for proper PV energy storage:

- 1) Assess the anticipated time period when the system is expected to provide power without receiving an input charge from the solar array.
- 2) Multiply the time period by the daily power requirement (amp-hours).
- 3) Add a safety factor to the battery sizing equation for the depth of discharge. This is a safety factor to avoid over-draining of the battery bank.
- 4) In certain climates, a multiplier may be necessary to account for reduced performance due to extreme ambient temperature conditions.

Meet Aesthetic Goals

Most importantly, BIPV products on the market today make visual statements by adding patterns, textures, colors, and visual notoriety to the roof or façade of a building. Whether it is the shiny exterior of a BIPV curtain wall or the inscribed patterns of semitransparent BIPV glazing products, architects may design visually distinctive applications.

Additionally, buildings that employ new and emerging technologies like BIPV tend to have a higher profile than standard designs and may be distinguished as “green.” Several prominent architectural firms have used BIPV designs to achieve a dual image of being aesthetically appealing and environmentally responsive. Consequently, BIPV integrated designs have brought added value and recognition to both designers and owners of numerous public and private buildings across the United States.

To maximize the aesthetic benefit, BIPVs should be fully integrated into the design, rather than appliquéd. By using a “whole building” approach, it is possible for the BIPV elements

to complement rather than compete with other attributes of the building. For designers that wish to create an aesthetically appealing building with distinctive “architectural features,” BIPV may be an appropriate and welcome addition to any architectural program.

BIPV Applications

Applications of BIPV systems are designed to effectively displace traditional construction materials. Due to the cross-functional roles of BIPV systems, applications typically require a multi-disciplinary approach. For example, a BIPV skylight is considered a part of the building envelope, a solar generator of electricity, and a daylighting element. All three of these functions impact various design aspects of a project and should involve interaction among the architect, mechanical engineer, electrical engineer or lighting designer, electrician, and building contractor.

There are three main architectural applications for BIPV systems: wall and façade elements, roof and large coverings, and light filtration and screening elements. Each application is discussed in greater detail below.

Wall and Façade Elements

Opaque façade systems for BIPV include curtain-wall products and spandrel panels. As a façade system, BIPVs are designed to be part of the building envelope and act as an outer skin and weather barrier. BIPV curtain-wall applications may require complex detailing to coordinate framing and wiring, minimize any shading from the mullions, and minimize sealing problems. In some instances, BIPVs are installed as a second (nonsealed) outer layer to avoid some of the inherent complexities. However, such a solution reduces the associated savings of construction material, a displacement that may be critical to project economics.

BIPV products are also fabricated as spandrel panels. Spandrel panels are opaque glass panels frequently used between floors or at the bottom three feet of wall in curtain-wall systems. These

Figure 7: Example of wall façade



Source: National Renewable Energy Laboratory

panels can be made in standard or custom sizes for all commercial wall applications. Either crystalline or thin-film technology may be used. Spacing between the solar cells determines the power output, and in some cases mock cells may be used to maintain uniform appearance while reducing costs.

Roof and Large Coverings

Roofs and large coverings are frequently the most attractive opportunity for BIPV installations because of their substantial solar access. Roofs require little compromise regarding placement and solar orientation of the solar cells, and transform the roof into valuable and productive space. On the other hand, issues may arise regarding proper weatherproofing and structural load considerations for BIPV-integrated rooftop systems. For these reasons, some designers may choose standoff framed PV modules or other BIPV applications. By doing so, the designers lose the cost-savings opportunity of replacing standard construction roofing material with the BIPV system.

BIPV roof products such as standing-seam metal roof or a PV roof shingle replace standard roofing materials like the ever-present asphalt shingle. Also available is a tile-like module, developed as a direct-mount product for sloped roofs, that replaces and/or complements roof tiles. Large-area glass PV modules may also be integrated into the roof.

Light Filtration and Screening Elements

Both crystalline and thin-film materials have been incorporated into insulated glass products. These glazing products can be specified with a range of transmissivity, while providing the same thermal characteristics as conventional architectural glazing products. For the opaque crystalline cells, the amount (and translucency) of space between the cells determines the overall transmissivity and appearance of the panel. In thin-film products, the modules can be laser-etched. Laser etching can produce an infinite variety of patterns, from company logos to cartoons,

Figure 8: Example of standing seam roof



Source: National Renewable Energy Laboratory

Figure 9: Cross-section of BIPV roofing product

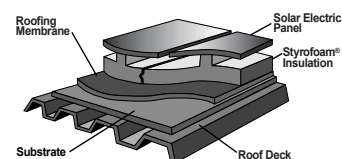
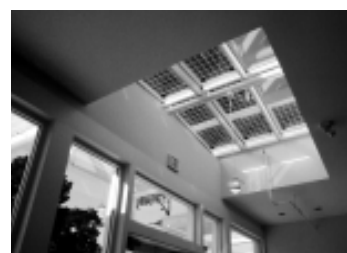


Figure 10: Example of PV skylight



Source: National Renewable Energy Laboratory

**Figure 11: Example of
BIPV atrium**



Source: National Renewable Energy Laboratory

resulting in a wide range of light transmission levels. Some thin-film PV materials themselves are inherently semi-transparent. In general, as the transmissivity of a BIPV glass element increases, the solar performance decreases (a result of reduced solar cell area). The designer should consider acceptable trade-offs between desired outside views, typical glazing characteristics, and electricity generation requirements when specifying BIPV glazing products.

Additionally, awnings and shading systems are a rapidly growing application of BIPVs and may be designed with varying degrees of thermal and transmissive characteristics. Integrating photovoltaic technology into sun shading systems adds electricity generation to the traditional benefits of reducing heat gain and glare control.

BIPV Systems

BIPV systems capture sunlight and convert it into electricity and heat. The electricity generated is direct current (DC) and is able to power appliances that use direct current. The BIPV-generated current may be stored in (DC) batteries, or converted to alternating current (AC) electricity for general application or connection to the utility grid.

The basic building block of BIPV technology is a PV module. Solar cells are assembled to form a module, and modules are wired together to form a site-specific array. Since PV systems produce direct current, they are usually connected to batteries and/or inverters. Additional components and wiring are referred to as “balance-of-system” components.

PV cells consist of a thin layer of semiconductive material. In most cases this layer is made of silicon that is “doped” with a small amount of impurities. The silicon creates an interface between a layer with excess electrons (n-type) and a layer with excess protons or “holes” (p-types). It is because of this junction between the n- and p-type layers that current is generated when solar radiation strikes the cell. The current

unit more frequently used to calculate traditional material costs. In some cases, the marginal cost increase of installing BIPV may be as little as two to five percent over the total construction cost. As the production of PV modules continues to increase around the United States and the world, it is likely that the unit cost will continue to decrease.

Additional Project Savings

Other factors, both tangible and intangible, may also contribute to the economic viability of BIPV applications. On a project-by-project basis, construction factors such as site, climate, specific design requirements, and electrical needs may provide more opportunities for savings. Additionally, BIPV materials are visible symbols of sustainable architecture and, as such, may provide value by providing architectural distinction, recognition for innovative thinking, and an image of environmental responsibility. In turn, these intangible benefits may translate into marketing advantages and increased employee/customer loyalty for design teams and building owners.

Tangible benefits of BIPV technology may include:

- Suitability in densely populated areas.
- Usability where grid connection is not available.
- Ability to generate electricity during peak usage times, thus reducing the utility's peak delivery requirements.
- Integration with the maintenance, control, and operation of other installations and systems in the building.
- Increased reliability, particularly where uninterrupted power supply is at a premium.

The best way to assess the economic attractiveness of a building strategy like BIPV is to evaluate the total cost of the system over time. This is accomplished by performing a life-cycle cost (LCC) analysis. LCC analysis gives the total cost accounting for

Figure 16: Case Study

Discovery Science Center Santa Ana, California

PV system: 20 kWp, 50° tilt, thin-film photovoltaic system
Size: 4,334 ft²
Number of Inverters: four,
utility grid connected

There are 464 photovoltaic panels integrated into the southwest side of the Discovery Science Center's 10-story-tall Cube. Altogether, these panels form one of the largest building integrated thin-film applications to date.

They provide the Science Center with up to 20 kiloWatts of DC power at midday (30,000 kWh of electricity per year), or about 10 percent of the electricity needs of the Science Center. In comparison, one house uses about 2 kiloWatts of power. The solar energy system is connected to the Discovery Science Center's main utility line.

Figure 17: Case study

**Thoreau Center for Sustainability
Presidio National Park
Building 1060
San Francisco, California**

PV system: 1.25 kWp
Size: 215 ft²
Number of Inverters: one (four kW),
utility grid connected

The exterior and interior skylights over the entry to Building 1016 are laminated with 24 photovoltaic panels. The BIPV system produces electricity and serves as shading and daylight design elements. The energy generated by the panels is converted into AC electricity and fed into the building's power grid. At peak capacity the system can generate enough electricity to power 65 energy-efficient light fixtures.

The spacing of square polycrystalline cells allows 17 percent of the light striking the surface to enter the space providing additional daylighting benefits. The PV modules do not serve, however, as the weathering skin of the building. Due to seismic considerations, the PV panels are stacked above traditional skylights.



Source: National Renewable Energy Laboratory

all expenses incurred and cost savings gained over the life of the system. It allows the designer to compare the economics of different power options as well as determine the most cost-effective system design for the PV array. Most LCC analysis includes capital costs, maintenance costs, energy costs, replacement costs, energy cost savings, and salvage value. When using LCC to compare different systems, it is important that each system configuration performs the same work with the same reliability.

Project cost savings is achieved by replacing construction material with BIPV products and displacing grid-generated electricity. It is important to have a full understanding of building material characteristics and utility rate structures regarding energy demand and time-of-use charges when evaluating potential BIPV projects.

Economic Externalities

Several benefits of BIPV applications are classified as economic externalities or costs that do not enter into conventional economics. However, economic externalities such as environmental or social issues may contribute significantly to the overall well-being of the country and should not be discounted.

PV technology is a renewable energy source that is reliant on the sun for power. Generation of electricity using PV technology is recognized as being renewable, sustainable, energy-efficient, and “green,” and has additional benefits not typically accounted for in life-cycle cost or simple payback analysis. These economic externalities benefit the consumer indirectly and are difficult to assign a dollar value. They include the following:

- Offsets of fossil fuel depletion.
- Reduction of environmental degradation with no associated CO₂ emissions.
- Promotion of energy-efficient buildings.
- Ability to help meet peak demand needs.
- Mitigation of utility substation and distribution limitations.

FOR MORE INFORMATION

National Renewable Energy Laboratory (NREL)–

National Center for Photovoltaics:

www.nrel.gov/ncpv/

Department of Energy–Photovoltaics Program:

www.eren.doe.gov/pv

NREL–Center for Basic Sciences:

www.nrel.gov/basic_sciences

Measurement and Characterization:

www.nrel.gov/measurements

Million Solar Roofs:

www.eren.doe.gov/millionroofs

Photovoltaic Manufacturing Technology:

www.nrel.gov/pvmat

PV Silicon Materials Research:

www.nrel.gov/silicon

Surviving Disaster with Renewables:

www.nrel.gov/surviving_disaster

PV Power:

www.pvpower.com

Department of Architecture and Urban Design,

University of California at Los Angeles:

www.aud.ucla.edu/energy-design-tools

Building Energy Tools Directory:

This is a directory of more than 125 computer software programs for the analysis of energy efficiency, renewable energy, and sustainability in buildings.

www.eren.doe.gov/buildings/tools_directory/

Energy Efficiency and Renewable Energy Clearinghouse (EREC)

P.O. Box 3048

Merrifield, VA 22116

Phone: (800) DOE-EREC

E-mail: doe.erec@nciinc.com

Energy Center of Wisconsin

595 Science Drive

Madison, WI 53711

Phone: (608) 238-4601

Fax: (608) 238-8733

www.ecw.org/projects/bipv.html

APPENDIX E

STORMWATER MANAGEMENT

The Kessler Mill site has documented stormwater management issues during heavy rains. Its location at the bottom of a hillside across the road from a creek coupled with poor drainage and extensive asphalt surfaces cause ponding during heavy rains and severe flooding during torrential rains.

Stormwater management is a part of sustainable design and a LEED construction point. Information about rainfall yields and rain gardens are included in this Appendix. Information about porous pavement is included here as well though applications may be limited to just a portion of the site due to the weight of the fire apparatus and possibilities for contamination from fire academy training. Appendix D contains information about green roofs which are another form of stormwater management. Any specific product discussions in this section are meant to be informational and are not endorsements of any particular product or supplier. Opportunities for stormwater management are not limited to the technologies presented here.



Rain pooling in the parking lot of the Recreation Department building on the Kessler Mill site.



Poor drainage at the loading dock of the existing Kessler Mill building.



Rain gardens, such as this one in Blacksburg, VA, slow the flow of water and use it for the plants within.



Porous pavement is a hard surface for parking, but water flows through. (www.tececo.com/images/photographs/porous_pavement/PorousPavement.JPG)



Table 1.0: Annual Rainfall Yield in Gallons for Various Roof Sizes and Rainfall Amounts

ROOF SIZE IN SQUARE FEET	RAINFALL IN INCHES								
	20	24	28	32	36	40	44	48	52
1000	11236	13483	15730	17978	20225	22472	24719	26966	29214
1100	12360	14832	17303	19775	22247	24719	27191	29663	32135
1200	13483	16180	18876	21573	24270	26966	29663	32360	35056
1300	14607	17528	20450	23371	26292	29214	32135	35056	37978
1400	15730	18876	22023	25169	28315	31461	34607	37753	40899
1500	16854	20225	23596	26966	30337	33708	37079	40450	43820
1600	17978	21573	25169	28764	32360	35955	39551	43146	46742
1700	19101	22921	26742	30562	34382	38202	42023	45843	49663
1800	20225	24270	28315	32360	36405	40450	44495	48540	52584
1900	21348	25618	29888	34157	38427	42697	46966	51236	55506
2000	22472	26966	31461	35955	40450	44944	49438	53933	58427
2100	23596	28315	33034	37753	42472	47191	51910	56629	61349
2200	24719	29663	34607	39551	44495	49438	54382	59326	64270
2300	25843	31011	36180	41348	46517	51686	56854	62023	67191
2400	26966	32360	37753	43146	48540	53933	59326	64719	70113
2500	28090	33708	39326	44944	50562	56180	61798	67416	73034

<http://www.greenbuilder.com/sourcebook/RainwaterGuide1.html>

Table 3.0: Rainfall Yield in Gallons for Various Roof Sizes or Landscapes and Rainfall Amounts

LANDSCAPE / ROOF SIZE IN SQUARE FEET	RAINFALL IN INCHES								
	0.25	0.50	0.75	1.00	2.00	3.00	4.00	5.00	6.00
1000	140	281	421	562	1124	1685	2247	2809	3371
1100	154	309	463	618	1236	1854	2472	3090	3708
1200	169	337	506	674	1348	2022	2697	3371	4045
1300	183	365	548	730	1461	2191	2921	3652	4382
1400	197	393	590	787	1573	2360	3146	3933	4719
1500	211	421	632	843	1685	2528	3371	4214	5056
1600	225	449	674	899	1798	2697	3596	4494	5393
1700	239	478	716	955	1910	2865	3820	4775	5730
1800	253	506	758	1011	2022	3034	4045	5056	6067
1900	267	534	801	1067	2135	3202	4270	5337	6405
2000	281	562	843	1124	2247	3371	4494	5618	6742
2100	295	590	885	1180	2360	3539	4719	5899	7079
2200	309	618	927	1236	2472	3708	4944	6180	7416
2300	323	646	969	1292	2584	3876	5169	6461	7753
2400	337	674	1011	1348	2697	4045	5393	6742	8090
2500	351	702	1053	1405	2809	4214	5618	7023	8427

<http://www.greenbuilder.com/sourcebook/RainwaterGuide2.html>

What happens to rain water around your home or commercial property? Ever have problems with excess drainage? Trouble with soil erosion? Want to improve water quality?

A "Rain Garden" may be your answer.

Find Solutions That Work

Why not put nature to work for you? Create a "rain garden" to manage stormwater in many land use settings, especially around homes and commercial properties. It's simple, beautiful and functional. Let's take a closer look.

This bioretention area is much like a forest habitat. Just as a forest soaks up water and allows it to slowly penetrate the soil, a rain garden stores and filters rainwater.

It works like this. The rain garden intercepts stormwater runoff, full of pollutants from roofs, sidewalks, roads and parking lots. This excess drainage ponds in the depression of the garden. As the water soaks in, chemicals are available to the plant roots and attach to the garden's soil and mulch.

The end result – improved water quality and less surface sheet flow during rain events.



CONTACT INFORMATION

Abingdon Region Office:

Phone: (276) 676-5488 ; FAX: (276) 676-5581
Bland, Buchanan, Carroll, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise and Wythe counties

Salem Region Office:

Phone: (540) 387-5461 ; FAX: (540) 387-5445
Alleghany, Bath, Bedford, Botetourt, Craig, Floyd, Franklin, Giles, Henry, Highland, Montgomery, Patrick, Pittsylvania, Pulaski, Roanoke and Rockbridge counties

Farmville Region Office:

Phone: (434) 392-4159 ; FAX: (434) 392-1550
Amelia, Appomattox, Buckingham, Campbell, Charlotte, Cumberland, Halifax, Lunenburg, Mecklenburg, Nottoway, Powhatan and Prince Edward counties

Charlottesville Region Office:

Phone: (434) 977-5193 ; FAX: (434) 296-3290
Albemarle, Amherst, Arlington, Augusta, Clarke, Culpeper, Fairfax, Fauquier, Fluvanna, Frederick, Goochland, Greene, Loudoun, Louisa, Madison, Nelson, Orange, Page, Prince William, Rappahannock, Rockingham, Shenandoah and Warren counties

Tappahannock Region Office:

Phone: (804) 443-2211 ; FAX: (804) 443-3164
Caroline, Charles City, Chesterfield, Essex, Gloucester, Hanover, Henrico, James City, King & Queen, King George, King William, Lancaster, Mathews, Middlesex, New Kent, Northumberland, Richmond, Spotsylvania, Stafford, Westmoreland and York counties

Waverly Region Office:

Phone: (804) 834-2300 ; FAX: (804) 834-3232
Accomack, Brunswick, Dinwiddie, Greensville, Isle of Wight, Northampton, Prince George, Southampton, Surry and Sussex counties, and cities of Chesapeake, Suffolk and Virginia Beach



Virginia
Department of Forestry
Central Office
900 Natural Resources Drive, Suite 800
Charlottesville, Virginia 22903
www.dof.virginia.gov
Phone: (434) 977-6555
Fax: (434) 296-2369

VDOF P00124; 02/2005

This institution is an equal opportunity provider.

Rain Gardens

*A landscape tool
to improve water quality*



Virginia Department of Forestry
www.dof.virginia.gov

Experience the Benefits Each Day

Thanks to a strategically placed rain garden that is designed well, excess drainage from roofs, gutters and pavement is captured, eliminating soil erosion.

The garden also allows the water to pond and percolate through the soil mixture, entering the water cycle through "groundwater recharge," which is much better than entering as sheet flow.

Through the rain garden process, plants receive nutrients from ponding storm water. This keeps them healthy.

Vegetation tolerant of flooding and drought help capture the stormwater and also create an attractive setting.

Another advantage of the garden's plants is that they help provide a habitat for wildlife.

Plus, the volume and quality of water is better than when it enters the garden – whether it is absorbed in or leaves a rain garden.



Plan Your Garden Carefully

Each rain garden site is unique. Keep in mind the topography, soil permeability, drainage basin, volume and velocity of water flow.

When determining the size of your garden and which plants to select, consider the light, temperature, moisture or water requirements, and size of the drainage area. The shape of the garden is not as important as the area available for water retention. So plan your garden carefully and consider all the variables when choosing your rain garden site.

What's Involved

Grass Buffer Strip

The surface of the grass buffer strip slows water as it enters the rain garden. Avoid a steep grade on the slope of the grass buffer/swale.

Ponding Area

This is a depressional area where the water is stored, allowing it to evaporate or soak into the soil. The ponding depth of six inches provides for adequate surface storage of water, and must not pond in excess of four days (to avoid mosquito and other insect breeding).

Mulch/Organic Layer

The mulch plays a very important role in removing harmful chemicals. Shredded hardwood mulch is recommended because it allows for a greater surface area for absorption and resists flotation/washout.

Planting Soil

A good soil mixture is leaf mulch (20%) blended into a sandy soil (50%) and topsoil (30%). The soil area of the rain garden provides a source of water and nutrients for the plants to grow. Clay particles adsorb heavy metals, hydrocarbons and other pollutants.

Plant Selection

Make sure your planting design includes species that tolerate extremes, as there will be very wet and very dry periods. Most riparian plant species will do well in rain gardens. Include plants that mimic forest habitat and have an aesthetic landscape value such as flowers, berries, interesting leaves or bark. Groundcovers, perennial shrubs and trees are also key in your planting design.

Two Natural Answers

Rain gardens perform many of the functions that forested riparian buffers perform to improve water quality. The following chart highlights the similarities of these systems.

Function	Riparian Buffer	Rain Garden
Absorb excess water	Spongy leaf litter layer	Mulch layer
Groundwater recharge	Water percolates through organic soils	Water ponds and percolates through porous soil mixture
Nutrient uptake	Plants remove nutrients from ponding storm water	Plants remove nutrients from ponding storm water
Vegetation	Species tolerant of frequent flooding	Species tolerant of flooding and drought
Water level zones	Stream edge to floodplain	Bottom of garden to edge of berm
Habitat opportunities	A diverse wildlife habitat corridor	Plants selected for wildlife habitat values



Storm Water Technology Fact Sheet Porous Pavement

DESCRIPTION

Porous pavement is a special type of pavement that allows rain and snowmelt to pass through it, thereby reducing the runoff from a site and surrounding areas. In addition, porous pavement filters some pollutants from the runoff if maintained.

There are two types of porous pavement: porous asphalt and pervious concrete. Porous asphalt pavement consists of an open-graded coarse aggregate, bonded together by asphalt cement, with sufficient interconnected voids to make it highly permeable to water. Pervious concrete consists of specially formulated mixtures of Portland cement, uniform, open-graded coarse aggregate, and water. Pervious concrete has enough void space to allow rapid percolation of liquids through the pavement.

The porous pavement surface is typically placed over a highly permeable layer of open-graded gravel and crushed stone. The void spaces in the aggregate layers act as a storage reservoir for runoff. A filter fabric is placed beneath the gravel and stone layers to screen out fine soil particles. Figure 1 illustrates a common porous asphalt pavement installation.

Two common modifications made in designing porous pavement systems are (1) varying the amount of storage in the stone reservoir beneath the pavement and (2) adding perforated pipes near the top of the reservoir to discharge excess storm water after the reservoir has been filled.

Some municipalities have also added storm water reservoirs (in addition to stone reservoirs) beneath the

pavement. These reservoirs should be designed to accommodate runoff from a design storm and should provide for infiltration through the underlying subsoil.

APPLICABILITY

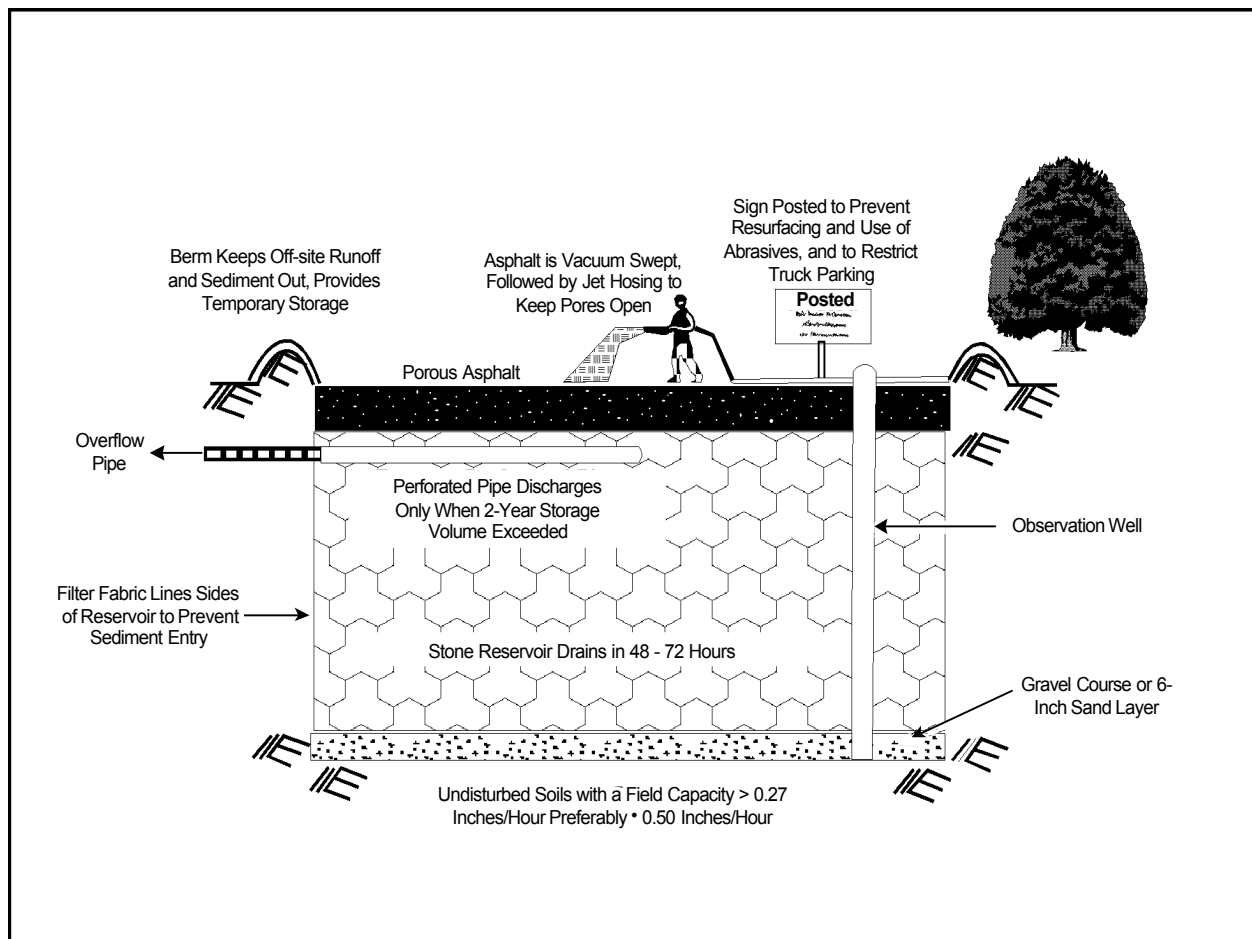
Porous pavement may substitute for conventional pavement on parking areas, areas with light traffic, and the shoulders of airport taxiways and runways, provided that the grades, subsoils, drainage characteristics, and groundwater conditions are suitable. Slopes should be flat or very gentle. Soils should have field-verified permeability rates of greater than 1.3 centimeters (0.5 inches) per hour, and there should be a 1.2 meter (4-foot) minimum clearance from the bottom of the system to bedrock or the water table.

ADVANTAGES AND DISADVANTAGES

The advantages of using porous pavement include:

- Water treatment by pollutant removal.
- Less need for curbing and storm sewers.
- Improved road safety because of better skid resistance.
- Recharge to local aquifers.

The use of porous pavement may be restricted in cold regions, arid regions or regions with high wind erosion rates, and areas of sole-source aquifers. The use of porous pavement is highly constrained, requiring deep permeable soils, restricted traffic, and adjacent land



Source: Modified from MWCOG, 1987.

FIGURE 1 TYPICAL POROUS PAVEMENT INSTALLATION

uses. Some specific disadvantages of porous pavement include the following:

- Many pavement engineers and contractors lack expertise with this technology.
- Porous pavement has a tendency to become clogged if improperly installed or maintained.
- Porous pavement has a high rate of failure.
- There is some risk of contaminating groundwater, depending on soil conditions and aquifer susceptibility.
- Fuel may leak from vehicles and toxic chemicals may leach from asphalt and/or binder surface. Porous pavement systems are not designed to treat these pollutants.
- Some building codes may not allow for its installation.
- Anaerobic conditions may develop in underlying soils if the soils are unable to dry out between storm events. This may impede microbiological decomposition.

As noted above, the use of porous pavement does create risk of groundwater contamination. Pollutants that are not easily trapped, adsorbed, or reduced, such as nitrates and chlorides, may continue to move through the soil profile and into the groundwater, possibly contaminating drinking water supplies. Therefore, until more scientific data is available, it is not advisable to construct porous pavement near groundwater drinking supplies.

In addition to these documented pros and cons of porous pavements, several questions remain regarding their use. These include:

- Whether porous pavement can maintain its porosity over a long period of time, particularly with resurfacing needs and snow removal.
- Whether porous pavement remains capable of removing pollutants after subfreezing weather and snow removal.
- The cost of maintenance and rehabilitation options for restoration of porosity.

DESIGN CRITERIA

Porous pavement - along with other infiltration technologies like infiltration basins and trenches - have demonstrated a short life span. Failures generally have been attributed to poor design, poor construction techniques, subsoils with low permeability, and lack of adequate preventive maintenance. Key design factors that can increase the performance and reduce the risk of failure of porous pavements (and other infiltration technologies) include:

- Site conditions;
- Construction materials; and
- Installation methods.

These factors are discussed further in Table 1.

PERFORMANCE

Porous pavement pollutant removal mechanisms include absorption, straining, and microbiological decomposition in the soil. An estimate of porous pavement pollutant removal efficiency is provided by two long-term monitoring studies conducted in Rockville, MD, and Prince William, VA. These studies indicate removal efficiencies of between 82 and 95 percent for sediment, 65 percent for total phosphorus, and between 80 and 85 percent of total nitrogen. The Rockville, MD, site also indicated high removal rates for zinc, lead, and chemical oxygen

demand. Some key factors to increase pollutant removal include:

- Routine vacuum sweeping and high pressure washing (with proper disposal of removed material).
- Drainage time of at least 24 hours.
- Highly permeable soils.
- Pretreatment of runoff from site.
- Organic matter in subsoils.
- Clean-washed aggregate.

Traditionally, porous pavement sites have had a high failure rate - approximately 75 percent. Failure has been attributed to poor design, inadequate construction techniques, soils with low permeability, heavy vehicular traffic, and resurfacing with nonporous pavement materials. Factors enhancing longevity include:

- Vacuum sweeping and high-pressure washing.
- Use in low-intensity parking areas.
- Restrictions on use by heavy vehicles.
- Limited use of de-icing chemicals and sand.
- Resurfacing.
- Inspection and enforcement of specifications during construction.
- Pretreatment of runoff from offsite.
- Implementation of a stringent sediment control plan.

OPERATION AND MAINTENANCE

Porous pavements need to be maintained. Maintenance should include vacuum sweeping at least four times a year (with proper disposal of

TABLE 1 DESIGN CRITERIA FOR POROUS PAVEMENTS

Design Criterion	Guidelines
Site Evaluation	<ul style="list-style-type: none"> Take soil boring to a depth of at least 1.2 meters (4 feet) below bottom of stone reservoir to check for soil permeability, porosity, depth of seasonally high water table, and depth to bedrock. Not recommended on slopes greater than 5 percent and best with slopes as flat as possible. Minimum infiltration rate 0.9 meters (3 feet) below bottom of stone reservoir: 1.3 centimeters (0.5 inches) per hour. Minimum depth to bedrock and seasonally high water table: 1.2 meters (4 feet). Minimum setback from water supply wells: 30 meters (100 feet). Minimum setback from building foundations: 3 meters (10 feet) downgradient, 30 meters (100 feet) upgradient. Not recommended in areas where wind erosion supplies significant amounts of windblown sediment. Drainage area should be less than 6.1 hectares (15 acres).
Traffic conditions	<ul style="list-style-type: none"> Use for low-volume automobile parking areas and lightly used access roads. Avoid moderate to high traffic areas and significant truck traffic. Avoid snow removal operations; post with signs to restrict the use of sand, salt, and other deicing chemicals typically associated with snow cleaning activities.
Design Storm Storage Volume	<ul style="list-style-type: none"> Highly variable; depends upon regulatory requirements. Typically design for storm water runoff volume produced in the tributary watershed by the 6-month, 24-hour duration storm event.
Drainage Time for Design Storm	<ul style="list-style-type: none"> Minimum: 12 hours. Maximum: 72 hours. Recommended: 24 hours.
Construction	<ul style="list-style-type: none"> Excavate and grade with light equipment with tracks or oversized tires to prevent soil compaction. As needed, divert storm water runoff away from planned pavement area before and during construction. A typical porous pavement cross-section consists of the following layers: 1) porous asphalt course, 5-10 centimeters (2-4 inches) thick; 2) filter aggregate course; 3) reservoir course of 4-8 centimeters (1.5-3-inch) diameter stone; and 4) filter fabric.
Porous Pavement Placement	<ul style="list-style-type: none"> Paving temperature: 240° - 260° F. Minimum air temperature: 50° F. Compact with one or two passes of a 10,000-kilogram (10-ton) roller. Prevent any vehicular traffic on pavement for at least two days.
Pretreatment	<ul style="list-style-type: none"> Pretreatment recommended to treat runoff from off-site areas. For example, place a 7.6-meter (25-foot) wide vegetative filter strip around the perimeter of the porous pavement where drainage flows onto the pavement surface.

removed material), followed by high-pressure hosing to free pores in the top layer from clogging. Potholes and cracks can be filled with patching mixes unless more than 10 percent of the surface area needs repair. Spot-clogging may be fixed by drilling 1.3 centimeter (half-inch) holes through the porous pavement layer every few feet.

The pavement should be inspected several times during the first few months following installation and annually thereafter. Annual inspections should take place after large storms, when puddles will make any clogging obvious. The condition of adjacent pretreatment devices should also be inspected.

COSTS

The costs associated with developing a porous pavement system are illustrated in Table 2.

Estimated costs for an average annual maintenance program of a porous pavement parking lot are approximately \$4,942 per hectare per year (\$200 per acre per year). This cost assumes four inspections each year with appropriate jet hosing and vacuum sweeping treatments.

REFERENCES

1. Field, R., et al., 1982. "An Overview of Porous Pavement Research." *Water Resources Bulletin*, Volume 18, No. 2, pp. 265-267.
2. Metropolitan Washington Council of Governments, 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*.
3. Metropolitan Washington Council of Governments, 1992. *A Current Assessment of Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in a Coastal Zone*.
4. Southeastern Wisconsin Regional Planning Commission, 1991. *Costs of Urban Nonpoint Source Water Pollution Control Measures*, Technical Report No. 31.
5. U.S. EPA, 1981. *Best Management Practices Implementation Manual*.

TABLE 2 ESTIMATED COSTS FOR A POROUS PAVEMENT SYSTEM

Component	Unit Cost	Total
Excavation Costs	740 cy X \$5.00/cy	\$3,700
Filter Aggregate/Stone Fill	740 cy X \$20.00/cy	\$14,800
Filter Fabric	760 sy X \$3.00/cy	\$2,280
Porous Pavement	556 sy X \$13.00/sy	\$7,228
Overflow Pipes	200 ft X \$12.00/ft	\$2,400
Observation Well	1 at \$200 each	\$200
Grass Buffer	822 sy X \$1.50/sy	\$1,250
Erosion Control	\$1000	\$1,000
Subtotal		\$32,858
Contingencies (Engineering, Administration, etc.)	25%	\$8,215
Total		\$41,073

6. U.S. EPA, 1992. *Stormwater Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices*. EPA 833-R-92-006.
7. Washington State Department of Ecology, 1992. *Stormwater Management Manual for the Puget Sound Basin*.

ADDITIONAL INFORMATION

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Water Management Administration
Maryland Department of the Environment
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Fort Necessity National Battlefield
National Park Service
1 Washington Parkway
Farmington, PA 15437

Massachusetts Highway Department
Clem Fung
Research and Materials Group
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Morris Arboretum
Robert Anderson

9414 Meadowbrook Avenue
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Washington Department of Ecology
Linda Matlock
Stormwater Unit
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Olympia, WA 98504-7696

The mention of trade names or commercial products does not constitute endorsement or recommendation for the use by the U.S. Environmental Protection Agency.

<http://www.epa.gov/owm/mtb/porouspa.pdf>

For more information contact:

Municipal Technology Branch
U.S. EPA
Mail Code 4204
401 M St., S.W.
Washington, DC, 20460



APPENDIX F

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

CPTED principles use the built environment to deter criminal activity. Roanoke County has the opportunity to create living, real world examples of CPTED principles at the new Public Safety Training Academy that the public and other agencies can use in their own homes, businesses, and communities. Information about CPTED is included in this appendix.



Thorny plants are one method of natural access control. (www1.brcc.edu/murray/research/cpted/access_control/images/close-up.jpg)



Landscaping can be used to claim territoriality. (www1.brcc.edu/murray/research/cpted/territoriality/images/VCPA_apartment_territoriality.png)



SAFETY BY DESIGN: CREATING A SAFER ENVIRONMENT IN VIRGINIA

VIRGINIA DEPARTMENT OF CRIMINAL JUSTICE SERVICES
CRIME PREVENTION CENTER

<http://www.vcpa.org/CPTED/CPTED Web Brochure.pdf>

§ 15.2-2283

PURPOSE OF ZONING ORDINANCES

"Zoning ordinances shall be for the general purpose of promoting the health, safety or general welfare of the public and of further accomplishing the objectives of § 15.2-2200. To these ends, such ordinances shall be designed to give reasonable consideration to each of the following purposes, where applicable: (i) to provide for adequate light, air, convenience of access, and safety from fire, flood, crime and other dangers; (ii) to reduce or prevent congestion in the public streets; (iii) to facilitate the creation of a convenient, attractive and harmonious community; (iv) to facilitate the provision of adequate police and fire protection, disaster evacuation, civil defense, transportation, water, sewerage, flood protection, schools, parks, forests, playgrounds, recreational facilities, airports and other public requirements;..."

(Code 1950, §§ 15-821, 15-968.3; 1962, c. 407, § 15.1-489; 1966, c. 344; 1968, c. 407; 1975, c. 641; 1976, c. 642; 1980, c. 321; 1983, c. 439; 1988, c. 439; 1989, cc. 447, 449; 1990, cc. 19, 169, 384; 1992, c. 812; 1993, cc. 758, 884; 1997, c. 587.)



"The proper design and effective use of the built environment can lead to a reduction in the fear of crime, and to an improvement in the quality of life."

- Dr. C. Ray Jeffery

BROUGHT TO YOU BY:



Virginia Department of Criminal Justice Services



Virginia Crime Prevention Association



Virginia CPTED Committee



TIPS TO ENHANCE SECURITY

HOUSES

- ♦ Use walkways and landscaping to direct visitors to the main entrance and away from private areas
- ♦ Keep shrubs and trees trimmed from windows and doors to improve visibility
- ♦ Use lighting over entrances
- ♦ Use thorny plants along fence lines and under windows to deter access by intruders

APARTMENTS

- ♦ Ensure hallways are well lit
- ♦ Install good quality deadbolts locks and peepholes on unit doors
- ♦ Provide common space in central locations to encourage tenant interaction
- ♦ Join or start an Apartment Watch in your building

NEIGHBORHOODS

- ♦ Locate open spaces and recreational areas so they are visible from nearby homes and streets
- ♦ Avoid landscaping that might create blind spots or hiding places
- ♦ Make sure there is effective lighting
- ♦ Design streets to discourage cut through or high-speed traffic using “traffic calming” measures
- ♦ Join or start a Neighborhood Watch in your neighborhood

BUSINESSES

- ♦ Locate checkout counters near the front of the store, clearly visible from outside
- ♦ Window signs should cover no more than 15 percent of the windows to provide clear visibility into and out of the store
- ♦ Use shelving and displays no higher than 4’ to help see who is in the store
- ♦ Avoid creating outdoor spaces that encourage loitering
- ♦ Ensure lighting is consistent throughout the parking lot and into the store

NOTE: CPTED principles are site specific. Please be aware of the need to consider the type of use, the area, the demographics. etc., when applying CPTED principles.

NATURAL ACCESS CONTROL

(CONTROLS ACCESS)



Landscape material is used to control access into a parking deck, while also reinforcing territoriality and providing natural surveillance from the street and sidewalk.



Fencing along the units' patio area helps to control access, as well as provide a sense of ownership. The fencing material also allows for visibility to and from the area.



This is an example of access control that doesn't eliminate natural surveillance opportunities and is easy to maintain.

NATURAL SURVEILLANCE

(INCREASES VISIBILITY)



Designers of this garage have reduced areas to hide by opening up walls that are typically solid. Surveillance opportunities are created throughout and it feels more open.



The rear entrance into these apartment units has created natural surveillance opportunities to and from the walkway and street while showing territoriality.



The main entrance of this school is located adjacent to the principal's office and the design provides surveillance opportunities. This design is key for all business and office environments.

TERRITORIALITY

(PROMOTES A SENSE OF OWNERSHIP)



Fencing and landscaping material have been located along property lines which formally designate public and semi-public space as well as showing ownership, natural surveillance and access control.



The maintenance, landscaping, and decorative flags shown on this downtown street indicate ownership and pride.



Landscaping screens the parking lot from the roadway and identifies public and semi-public space while allowing for natural surveillance into the site.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

We constantly respond to our environment, whether we are aware of it or not. Our responses help us interact safely in our communities. Effective design of our environment helps us to feel safer and reduces opportunities for criminal acts to occur.

- ♦ Crime Prevention Through Environmental Design (CPTED), (pronounced sept-ed), is an initiative that helps us create healthy, safe communities through well planned design.
- ♦ CPTED is based on the premise that the design of our environment directly affects our behavior. It influences both the opportunities for crime to take place and our fear of crime. This has an important impact on our quality of life.
- ♦ CPTED enhances safety by altering physical design and encouraging positive social interaction.
- ♦ CPTED offers an alternative to creating fortress-like communities where we have to lock ourselves away to feel safe. CPTED complements the use of target hardening strategies like locks and bars, police and security personnel. It increases our freedom to use our community facilities.

HOW CPTED WORKS

CPTED promotes design principles in planned environments that encourage safe behavior and reduce the opportunities for crime to occur.

Three inter-related basic principles guide CPTED: natural access control, natural surveillance and territoriality.

NATURAL ACCESS CONTROL (controls access)

Guides people entering and leaving a space through the placement of entrances, exits, fences, landscaping and lighting. Access control can decrease opportunities for criminal activity by denying criminals access to potential targets and creating a perception of risk for would-be offenders.

NATURAL SURVEILLANCE (increases visibility)

The placement of physical features, activities and people in a way that maximizes visibility. A potential criminal is less likely to attempt a crime if he or she is at risk of being observed. At the same time, we are likely to feel safer when we can see and be seen.

TERRITORIALITY (promotes a sense of ownership)

The use of physical attributes that express ownership such as fences, signage, landscaping, lighting, pavement designs, etc. Defined property lines and clear distinctions between private and public spaces are examples of the application of territoriality. Territoriality can be seen in gateways into a community or neighborhood.

In addition to the three main principles described, two other ideas support CPTED; Activity Support and Maintenance.

ACTIVITY SUPPORT (fosters community interaction)

Encouraging activities in public spaces that are intended for use by residents and other legitimate users discourages criminal acts.

MAINTENANCE (deters offenders)

A well maintained home, building or community creates a sense of ownership. A well kept area tends to make someone feel like they will be observed by neighbors or business owners as it is obvious people care about the area.

PUTTING CPTED TO WORK

CPTED can be applied in both existing communities and during the planning stages of new development. Ideally, CPTED principles should be applied during the design phase to avoid potential costly changes later. NOTE: The application of CPTED principles is site specific.

IN EXISTING DEVELOPMENT:

- ♦ CPTED can be applied by identifying problem areas and creatively finding solutions to make those spaces safe. These solutions can also help the space better meet the needs of users.
- ♦ A CPTED assessment can be done for an existing community, home, building, school, playground, park, business, etc.

IN NEW DEVELOPMENT:

- ♦ Many problems can be avoided if the principles of CPTED are applied during the design and planning process.
- ♦ CPTED reviews are becoming standard practice in the planning process. Currently in Virginia, many localities review site plans for existing and new development with CPTED principles in mind.
- ♦ Design professionals can increase the quality of life for users of a space by incorporating CPTED principles into the design.



CPTED GUIDELINES

<http://www.vcpa.org/CPTED/VCPA CPTED Guidelines 04-26-05.pdf>



Safety by Design:
Creating a Safer
Environment In Virginia



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Understanding CPTED

CPTED and the concepts of safe design have had several significant influences over the years. As early as the 1960's, Jane Jacobs discussed the interaction of the physical environment with its inhabitants and how important this is in the life and vitality of a street or neighborhood in The Death and Life of Great American Cities. She wrote "the basis for community security is a strong sense of social cohesion and a feeling of control over one's home turf."

In 1969, architect and urban planner Oscar Newman coined the expression "defensible space" when he began his study on public housing and its layout, in association with residents' perception of safety and their victimization. His focus was on a person's feeling of ownership or lack thereof (territoriality), and this relationship with criminal activity. He also emphasized the need to consider the "context" of a use or building type. As referenced in his 1973 book, Defensible Space, page 102, on context he states, "The introduction of a large grouping of new buildings of distinctive height and texture into an existing urban fabric singles out these buildings for particular attention. If this distinctive image is also negative, the project will be stigmatized and its residents castigated and victimized." Some of his work since then has related to the design, layout and use of residential streets as a deterrent to crime.

C. Ray Jeffery, a criminologist from Florida State University, coined the term "CPTED" and studied the relationship between the physical environment and incidence of crime. In 1971, he authored Crime Prevention Through Environmental Design. Studies were undertaken where inmates were interviewed as to why they chose a certain location for the crime that was committed, and what the influencing factors, if any, were to that environment.

In 1982, James Wilson and George Kelling wrote "Broken Windows". The concept of broken windows is one where in no matter what type of neighborhood, if a building is left with a broken window, graffiti, trash, etc., long enough, disorder and decline of the building or area surrounding it will spread.

" The first thing to understand is that the public peace... is not kept primarily by the police, as necessary as police are. It is kept by an intricate, almost unconscious network of voluntary controls and standards among the people themselves.... No amount of police can enforce civilization where the normal, casual enforcement of it has broken down".
- Jane Jacobs, The Death and Life of Great American Cities

In 1994, the Commonwealth of Virginia took a step towards broadening the responsibility for addressing *crime* from just law enforcement agencies and amended the Zoning Enabling Legislation Zoning § 15.2-2283 to include the following:

"Zoning ordinances shall be for the general purpose of promoting the health, safety or general welfare of the public and of further accomplishing the objectives of such ordinances of § 15.2-2200. To these ends, such ordinances shall be designed to give reasonable consideration to each of the following purposes where applicable: (i.) to provide for adequate light, air, convenience of access, and safety from fire, flood, crime and other dangers; (ii) to reduce or prevent congestion in the public streets; (iii) to facilitate the creation of a convenient, attractive and harmonious community; ..."

CPTED Principles

Three **interrelated** principles make up the CPTED concepts and strategies: Natural Surveillance, Natural Access Control, and Territoriality.

NATURAL SURVEILLANCE

Natural Surveillance is the placement of physical features, activities and people in a way that maximizes visibility.

This design concept is directed towards keeping intruders under observation, and therefore less likely to commit criminal acts. This will have a reverse affect where most people feel safer when they can see and be seen.

Natural surveillance utilizes design features to increase the visibility of a property or a building. Features that maximize the visibility of people, parking areas and building entrances include unobstructed doors and windows, pedestrian-friendly sidewalks and streets, front porches and appropriate nighttime lighting.

NATURAL ACCESS CONTROL

Natural Access Control is the physical guidance of people coming and going from a space by the judicious placement of entrances, exits, fencing, landscaping and lighting.

This design concept is directed primarily at decreasing the opportunity for criminal activity by denying access to crime targets and creating a perception of risk for offenders. People are physically guided through a space by the strategic design of streets, sidewalks, building entrances, landscaping and gateways. Design elements are also useful tools to clearly indicate public routes and discourage access to private areas.

Natural access control also utilizes physical and mechanical means of controlling access through locks, alarm systems, signs, etc.

TERRITORIALTY

Territoriality is the use of physical attributes that express ownership such as fences, signage, landscaping, lighting, pavement designs, etc.

This design concept also creates or extends a sphere of influence. People take more interest in something they own or when they feel intrinsically involved. Therefore, the environment should be designed to clearly delineate private spaces.

Users are encouraged to develop a sense of territorial control, while potential offenders, perceiving this control, are discouraged. This concept includes features that define property lines and distinguish between private and public spaces. This can be accomplished by such measures as landscape plantings, pavement designs, gateway treatments, appropriate signage and "open" fences.



In addition to creating areas of *Activity Support*, properly designed and maintained spaces also establish *Territoriality*, as shown at these shops in Henrico County, Virginia.

CPTED Principles - continued

In addition to the three main principles described, two other ideas support CPTED:

ACTIVITY SUPPORT

Activity support encourages interaction by putting activities in public spaces that are intended for use by residents or customers and other legitimate users and, therefore, discourages criminal acts.

This is more effective when activities are planned for times when the use of a space is minimal.



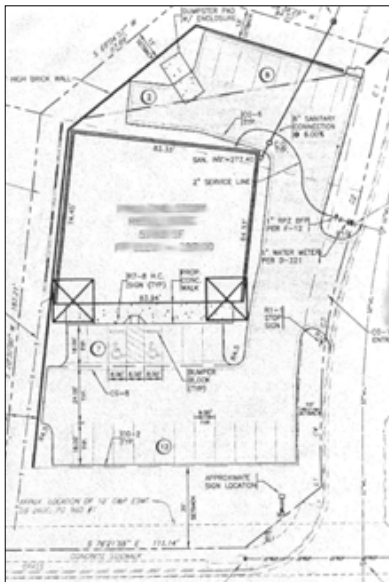
This farmers market in Staunton, VA offers *Activity Support* in the downtown area. Activities like this draw people downtown and encourage continued use of the area.

MAINTENANCE

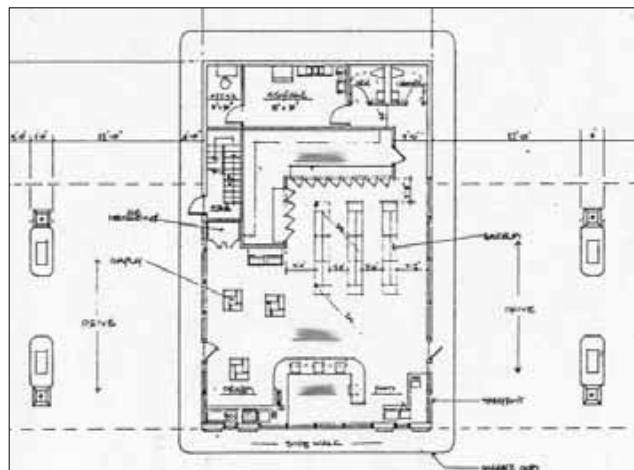
Care and maintenance enable continued use of a space for its intended purpose. It also serves as an additional expression of ownership.

Deterioration and blight indicate less concern and less control by the intended users of a site and can be a sign of a greater tolerance for disorder. Proper maintenance protects the public health, safety and welfare in all existing structures, residential and non-residential, and establishes minimum requirements and acceptable standards.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN



This is a site plan example. How a site is laid out and where parking, entrances, etc., are located are examples of a few items considered when applying CPTED strategies.



This is a floor plan example. The interior layout of businesses, offices, etc., is important when applying CPTED strategies.

CPTED Principles - continued



The above photo depicts a new community in Henrico County, VA, where many CPTED principles are in place. The landscaping in this photo is very young and should mature where *Natural Surveillance* opportunities will not be lost, and where *Territoriality* and ownership will be apparent.



Ownership and pride are apparent in this downtown street. A visitor to the area would know that this community takes pride in its city.

Other ways of involving CPTED principles in a project is by using a three-step review process:

- **Designation:** What is the intended use of the area? What behavior is allowed?
- **Definition:** Are there physical limitations to the area or site? Are borders between the area and public spaces defined? Is it clear which activities are allowed where?
- **Design:** Does the physical environment safely and efficiently support the intended use?

Other issues that should be addressed when considering a site design or use in an area include:



A bench has been placed in a corner of the building where the drop off area is for library books in Chesterfield County, VA. This is an example of unassigned space.

CONTEXT: All CPTED recommendations must be viewed in relation to how the built or natural environment is used. What cultural definitions do the users bring to the space? If we design a space that does not address the way the intended users will use the space the intended users may bypass security measures. Context (Image and Milieu) is every bit as important to CPTED as are the other core principles.

DESIGN CONFLICT: Occurs when two incompatible activities are located next to one another and are forced to compete for the same space. Example: Sidewalks for elderly housing that take residents past teenage recreation areas may cause elderly residents to feel intimidated by the rough play they see, even though no direct threat is intended.

UNASSIGNED SPACE: Occurs when a site is built with spaces that have no assigned purpose and no one to exercise control over them. Such space lacks environmental cues that suggest how the space is to be used or who should control it. Example: A vacant lot in a downtown area may become the territory for local youth and be used in an undesired way.

CPTED Principles – continued

CRIME GENERATORS: Locations that have a propensity to generate crime in the surrounding area. Example: Establishments that serve alcohol can be crime and public disorder generators if they lack strict controls for the sale and use of alcohol.



Example of a hollow core door and a keyed doorknob.

TARGET HARDENING: A basic tool for providing safety and security. It involves making targets resistant to criminal attack through the installation of locks, alarms or lighting. (see Appendix for Target Hardening Section)

Safety Checklist

- How well is an area maintained? Is it clean?
- Can you tell that people care about the area?
- Can you see into businesses, onto a property? Can they see you?
- Do you feel safe walking by yourself?
- What makes you feel safe or unsafe about the area?
- Is there lighting in the area? Are you able to identify someone from 50 feet?



Use of glass in the design of the workout room in an apartment complex in Virginia Beach, VA allows for visibility to and from the hallway and child playroom.



Outdoor café/dining areas provide Activity Support and additional 'eyes on the street' as shown on this street in Bristol, VA. Awnings and potted plants also show *Territoriality* and ownership.

PUBLIC BUILDINGS

Public facilities such as libraries, government buildings, churches, fire stations, etc., present a unique challenge. Safety and security are concerns at these locations, but few desire the installation of *visible* high security measures that would deter from a customer service oriented look or feel to the site.

DESIGN STRATEGIES:

NATURAL SURVEILLANCE

- Designate a main entrance point into the facility that is easily observable from both inside the building and the parking area or roadway.
- Designate a main area to secure bike racks that is easily observed from a normally occupied area of the building.
- Avoid landscaping that might create blind spots or hiding spaces.
- Secure all out buildings and locate them in areas that are easily observed.
- Provide uniform lighting without glare for scheduled nighttime activities and to permit good observation by neighbors and patrol units during non-business hours.
- Interior offices should offer surveillance opportunities into the corridors.
- SEE LANDSCAPING AND LIGHTING section.



A raised tree canopy, in combination with low growing landscaping and the placement of windows provide for clear sight lines from the building to the parking lot of this library in Henrico County, VA. This allows for *Natural Surveillance* of the site by customers and passing motorists.

NATURAL ACCESS CONTROL

- Locate the site so all areas can be observed during off-business hours to detect unauthorized activities whenever possible.
- Limit access to only one controlled entrance into the facility that is easily observable from inside and out.
- Lock unused areas off from the public. Employee only areas should be locked so that the public can't gain entry without assistance.
- Secure bike racks so they can't serve as a climbing aid.
- Define the property using fencing, landscaping or a type of open design barrier to control access.
- Provide signs indicating where a person is in relation to the rest of the property. Signs should also direct a visitor to the main entrance.

- SEE TARGET HARDENING section.

TERRIORTIALITY

- Locate the main entrance so it is easily identified when approaching the building.
- Locate the office near the main entrance with plenty of usable glass to allow observation of entrance doors as well as the visitor parking areas.
- Locate signs on and around the premises stating No Trespassing, etc.
- Use signage or pavement markings to identify traffic patterns, employee and visitor parking areas, entrances, etc.

PUBLIC BUILDINGS – Design Strategies continued

ACTIVITY SUPPORT

- Encourage the Neighborhood Watch in the surrounding neighborhoods to 'own' the public facility by reporting any suspicious activity to the Police or Sheriff's Department after hours.
- Use of buildings after hours by a civic group, neighborhood watch, etc. will offer additional activity support.

MAINTENANCE

- Maintain all lighting fixtures.
- Frequently empty trash receptacles.
- Keep the grounds clean and well maintained.
- Keep lines of sight open by maintaining landscaping.
- Eliminate graffiti as soon as it appears.



This security/receptionist desk at the entrance to the administration offices for Henrico County, VA offers an informal form of *Access Control*. Visitors to the complex can only enter the Administration Building at this point; all other entry doors have card readers in place.

Crime Prevention Through Environmental Design

The unique design of this fire station in Staunton, VA employs *Territoriality*. Pride and ownership are evident in its appearance.



SCHOOLS

Our schools have been the focus of a great deal of study and scrutiny the last few years. Add-ons such as cameras, metal detectors, auxiliary locks and assigned police personnel have done little to solve the long-term security issues. A poorly designed school will be hard to secure, no matter what devices are employed. On the other hand, simple design changes and modifications can serve to enhance security devices or limit the need for expensive and maintenance/manpower intensive measures.

DESIGN STRATEGIES:

NATURAL SURVEILLANCE

- Designate a main entrance point into the facility that is easily observable from both inside the building and the parking area or roadway.



The design of this school in Virginia Beach, VA makes it obvious where the main entrance is. *Natural Surveillance* opportunities are in place from the parking lot and adjacent residential street. The line of shrubs delineates *Territoriality* and along with the sidewalk, defines what is public space and what is semi-public space.

- Designate a main area to secure bike racks that is easily observed from a normally occupied area of the building.
- Avoid landscaping that might create blind spots or hiding spaces.
- Secure all out buildings and locate them in areas that are easily observed.
- Provide uniform lighting without glare for scheduled nighttime activities and to permit good observation by neighbors and patrol units during non-business hours.
- Interior offices should offer surveillance opportunities into the corridors.
- Design hallways to be easily observed with very few offsets.
- Locate visual panels in all

classrooms to allow teachers to observe the hallway with minimal visual distractions to the seated students.

- Design open access to restrooms with no need for a hallway door or modify existing doors so they are locked in the open position.
- SEE LANDSCAPING AND LIGHTING section.

NATURAL ACCESS CONTROL

- Locate the site so all areas can be observed during off-school/business hours to detect unauthorized activities whenever possible.
- Limit access to only one controlled entrance into the school that is easily observable from the main office during the school day.
- Eliminate or design covered walkways to restrict access to the roof and avoid other structures (such as door overhangs, fences or landscaping) that may provide roof access.
- Arrange student lockers to allow casual observation, with plenty of room between rows and no dead ends.
- Provide two-way communication throughout the building.
- SEE TARGET HARDENING section.

SCHOOLS – Design Strategies continued

TERRITORIALITY

- Position the main entrance so it is easily identified when approaching the building.
- The office should be near the main entrance with plenty of usable glass to allow observation of entrance doors as well as the visitor parking areas.
- Secure the parking area when the school is not in use.
- Signs should be located in the parking lot and at all entrances stating all visitors must check in at the office. The signs should also direct visitors to the main entrance of the school.
- Locate signs on and around the premises stating Drug Free Zone and No Trespassing.
- Use pavement markings to identify traffic patterns and faculty, student and visitor parking areas.
- Require maintenance personnel, contract workers, etc. to wear uniforms and/or photo-id badges plainly visible.

MAINTENANCE

- Maintain all lighting fixtures.
- Frequently empty trash receptacles.
- Keep the grounds clean and well maintained.
- Keep lines of sight open by maintaining landscaping.



This is example of an older school in Henrico County, VA that is well maintained.

The bus loop in front of the school is clearly visible from the adjacent street and school office. Lighting has been installed under the canopy, as well as along the bus loop.

PARKS, TRAILS and OPEN SPACES

Parks, trails and open spaces provide a number of design challenges for personal safety, as they are typically large and used by a variety of people. Direct observation is not always possible or even desired in natural settings. Often, there is a conflict between safety principles and preserving the naturalness and desired seclusion of the resource.



Both walkers and pedestrians use this trail in Seattle, Washington. The yellow line is a symbolic barrier that separates pedestrian traffic from the cyclists.

Greenways are a key part of the green infrastructure that helps to assure a high quality of life for all communities. These areas are selected for protection and conservation because combined together in an integrated system these areas support natural systems that help keep the air and water clean.

An additional benefit of greenways is the opportunity for citizens to spend time outside and have alternative ways to go places within the community. The challenge for such systems is the perception of safety, both for potential users and for adjacent property owners. ***As more people use them, the safer they become.***

Some of the key ways to assure safety are through clear signage, hardened surfaces and proper delineation of the corridor. Several of the most successful greenways are rail to trail corridors in Virginia. The W & OD trail from Washington, DC to Purcellville, the Virginia Creeper Trail from Abington through Damascus to White Top and the New River Park that goes from the Galax and Fries area to Pulaski. The trails have been accepted and they have become key economic generators for the areas they go through.

When designing for safety in these areas, the focus should be on pathways, parking areas, trailheads, restrooms, areas of concentrated activity and most especially isolated areas.

DESIGN STRATEGIES:

NATURAL SURVEILLANCE

- Locate parking lots, picnic areas, trailheads and facilities used at night near streets and other activity centers so they are easily observable by police patrols and other park users. Cluster compatible activities to avoid conflict and to increase social observation.



Clear sight lines are in place to the path, shelter and play areas of this Henrico County, VA park.

- Locate children's areas and public restrooms near staffed areas to make observation of these areas easier.
- Positioning some bike trails and walking paths near areas of park activity or at places where parks meet commercial or residential uses, or pairing them with active streets can make users more observable by others.
- Recognize that some park areas cannot be observed or made safe during night hours.
- If parks are used at night, provide good lighting for areas that can be safely used at night.

PARKS, TRAILS and OPEN SPACES – Design Strategies continued

- Position benches in areas where intended users will be able to provide Natural Surveillance and demonstrate territoriality. Benches offer periodic resting for trail and open space users.
- Trees will make users feel more comfortable while watching the area around them.

NATURAL ACCESS CONTROL

- Gate off vehicular entrances when parks are closed.
- Provide clearly visible entries to park buildings. Light them if used at night.
- Provide a clear distance of at least 10 feet between the trails and wood-lines to offer sight lines and distance from potential attacks.
- Provide a clear separation between regional trails and private property. The separation should permit leaving the trail in an emergency.
- If a particularly attractive portion of the trail is isolated, making its users vulnerable, create and clearly mark an alternate, observable path that gives users a choice for safer mobility.
- Clearly mark the hours the park or trail is open to the public. Well-placed entrance signs or gates should be used to notify the public and to control access into the park or area.



This stretch along the oceanfront in Virginia Beach, VA has many uses. Pedestrians can use the boardwalk. Benches are positioned in landscaped areas, and a bike path runs parallel to the open green space and boardwalk. Pedestrian crosswalks are striped across the bike path throughout and are clearly marked. The yellow line separates opposing bicycle traffic.

TERRITORIALITY

- When people see certain facilities they receive certain cues as to which uses are appropriate. Providing children's play areas encourages family use of a park.
- Clearly define paths between parking lots and other facilities.
- Erect maps to provide a sense of where one is and where one can go. These maps should

clearly identify trail names, distances to facilities, emergency phones, and the characteristics of trails, e.g., "this is an isolated walking trail."

- Post park rules at access or gathering points in the park. Rules give the ability to designate acceptable uses and discourage unacceptable uses of the park.
- Trails should also have signs with trail names, directional signs to areas of public activity and even mile markers to help orient users. Trails need to be marked for use, such as biking or walking.



Open space areas will be used in a variety of ways, especially if located in central areas to parking and other activities within the park as in this example in Henrico County, VA.

ACTIVITY SUPPORT

- Encourage planned activities in passive recreation areas and parks, i.e. senior walking groups at specific times each day; elementary school trips, etc. Add programs in areas and at times when the

space is not busy or typically used.

PARKS, TRAILS and OPEN SPACES – Design Strategies continued

- Avoid conflicts in design and intended use. For example, illuminating a park that closes at sunset may encourage illegal and unintended use.

MAINTENANCE

- Prune trees and shrubs to keep paths open and to eliminate the potential for areas of entrapment and concealment.
- Design parks to make maintenance easier by locating an adequate number of trash receptacles in areas where people congregate and by using durable, vandal-resistant materials.
- Provide prompt removal of trash, graffiti and invasive landscaping species.
- If park benches are planned, choose benches that have seat dividers to discourage long-term usage, such as sleeping or skateboarding.



This is a bench style that eliminates or discourages sleeping.



This is a trail entrance at a park in Henrico County, VA. The entrance is off of a main road that runs through the park.



Photo of a trail at James River State Park in Gladstone, VA. Courtesy of the Virginia Department of Conservation and Recreation web page.

LIGHTING

Lighting and landscaping are important elements in any site design. Many localities require separate landscaping and lighting plans to be approved for new and existing development. It is important to compare the lighting and landscaping plans for conflicts.

Whether a single house, or an industrial complex, appropriate lighting techniques should be used. Good lighting will help people feel more comfortable with their surroundings. It should provide clear paths for movement and highlight entryways without creating harsh effects or shadowy hiding places.

Lighting is one of the most economical and effective forms of crime prevention available.



Alternate landscape and light islands within parking areas to prevent trees from growing up into the light fixtures. The above fixture is an example of a shoebox light fixture found in Chesterfield County, VA.

DESIGN STRATEGIES:

- Provide lighting systems that make pedestrians more visible to motorists and can illuminate other vehicles and objects that should be avoided.
- Locate lighting systems for homes and businesses along walkways to permit pedestrians to see risks involved with walking at night.
- Illumination should fall throughout the parking area, along the walkway, along the building edge and building entrances.
- Provide lighting systems that will enhance the ability to observe surroundings.
- Provide lighting systems that minimize glare, shadow, light pollution and light trespass.
- Provide lighting that is even, uniform and does not produce dark areas or sharp contrasts for concealment.
- When creating uniform lighting consider the type of fixture, the height of the poles, the direction the light needs to go and the spacing of the fixtures.
- The lamps used throughout the site should be the same. Whether Metal Halide, High Pressure Sodium or another type of light is used, the emphasis is to have the same color of light throughout the site. This will provide good color rendition, help with visibility and reduce contrasts.
- Routine maintenance of the lights is necessary. A program should be implemented to review the lights regularly to determine if any have burnt out or been broken and need replacing.
- A program should be established to relamp the complex, also known as group relamping. This will better ensure the proper use of the light bulb, as well as reducing cost when lights need to be replaced one at a time and each individual visit has to be paid for.
- Globes should be cleaned to ensure full illumination from the light.
- A program should be established for trimming and maintaining tree canopies and other plant materials at and around the light poles, wallpacks, etc.



Separate trees from light poles for effective lighting in a parking lot. In this example in Chesterfield County, VA, the light is only illuminating the tree canopy.

LIGHTING – Design Standards continued

Residential application:

- Keep your porch lights on at night!
- Install dusk to dawn sensors on porch lights.
- Install motion sensor lights along the sides of a home to illuminate areas with poor surveillance.

Multi-Family Residential application:

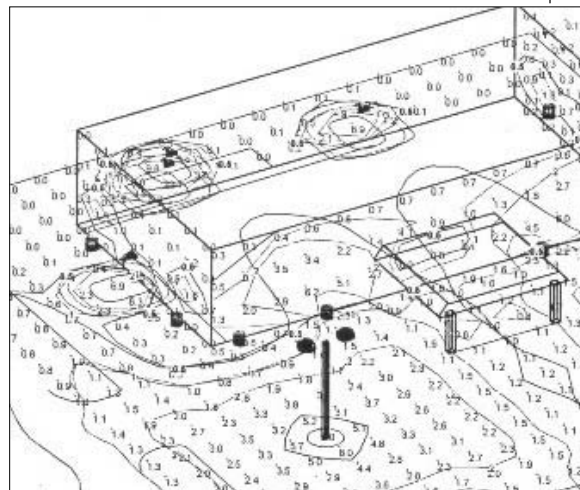
- Use the same type of lamp throughout the complex. Whether Metal Halide, High Pressure Sodium, incandescent or another type of light is used, the emphasis is to have the same color of light throughout the site. This will provide good color rendition, help with visibility and reduce contrasts.
- Note that most porch lights are incandescent bulbs, which are white in color. If High Pressure Sodium bulbs are installed in the other fixtures, which are yellow-orange in color, this will not provide good color rendition, but actually create contrasts.
- Parking lot lighting should be at a *minimum-maintained level* of 1.0 foot-candles or 10 lux. This lighting should also spill over to the front, side and rear yards of the units whenever applicable.
- Wire the porch lights to come on at dusk and turn off at dawn automatically. This will aid tremendously to the amount of light in the front and rear of the units.
- Using compact fluorescent lamps in small fixtures will help generate more light at lower electricity and maintenance costs.
- Install light poles versus attached light fixtures (i.e. wallpacks) to increase the light level.
- The light fixture should be one that puts the light down on the ground, versus horizontally and up in the air. Many of the decorative light fixtures put the light everywhere but where you want it, which is on the ground.
- If decorative fixtures are used, install the type of fixture where the bulb is in the top of the 'globe'. This will place the light down and avoid glare because you don't actually see the bulb. (see below left photo)



This post-top example has the bulb in the top of the fixture. The white bulb you see is for decorative purposes only. This design eliminates glare and directs the light towards the ground.



Another design of a post-top fixture is pictured here.



This is an example of a 3-D lighting plan with point-to-point foot-candle levels

LANDSCAPING

Landscapes can be particularly useful, as stated in the landscape ordinances of many communities, because properly designed and maintained, they "... facilitate the creation of a convenient, attractive and harmonious community; to conserve and protect natural resources, including air and water quality; to enhance property values; to preserve the unique character of an area; and to encourage the appropriate use of land."

Landscapes can work for CPTED by supporting the core components: Natural Surveillance, Natural Access Control and Territoriality. In order to create a landscape that aids in CPTED, it is critical to select appropriate plants and landscape materials, install them in fitting locations and stick to rigorous maintenance. Plants that "fit" in a landscape will be able to reach maturity and provide the maximum environmental benefits to the local community. Landscape materials, like stone, water, benches, gravel, fences, concrete, brick, bike racks, earth, lighting and plant materials, need to be selected to suit the space, the activities intended for the space and for the long term benefits each provides in creating a safe and aesthetically pleasing environment.

Landscaping is used to control the direction of movement both visually and physically. Landscaping and screening (to include walls, fences, etc.) is often required to buffer and protect the homeowner. Safety and security need to also be considered and addressed in every development. One goal may be to deny access to an area while providing opportunities for surveillance.

DESIGN STRATEGIES:

- Planting and selection of landscape materials should be such that sight lines remain open and clear and places of concealment are not fostered.
- Keep shrubs trimmed to a maximum of 3 feet, or at least below windowsills, when safety is an issue.
- Tree canopies should have a natural growth height of at least 4 feet from the ground when located around entrances, parking areas, walkways, etc.
- Elevate tree canopies to a height that provides adequate Natural Surveillance. If young trees



Above is an example in Henrico County, VA where an 'overlay district' requires a continuous hedge. What visibility to the business and parking lot is being allowed?

- are 'limbed up' too soon, it shortens their life and makes them more prone to failure.
- Choose plants that will naturally grow to the desired form or height to reduce maintenance, etc.
- If graffiti is a known problem in the area, specify thorny landscape plants as a natural barrier to deter unwanted entry.
- Specify vines or planted wall coverings to deter graffiti. Avoid blank spaces, which may be an invitation to graffiti vandals.
- Provide landscape and fencing that do not create hiding places for

criminals.

- Consider creative solutions to fencing schemes that work aesthetically and functionally, while providing visibility to and from a site.
- Use lighting in the landscaping, both for security and aesthetics.

3) City of Roanoke, Virginia Vision 2001-2020 www.roanokeva.gov/vision/policies

Policies and Actions. Public Services: Police, Fire/EMS, Solid Waste Management, Code Enforcement

Policies:

PS P1. Community Policing. Roanoke will continue its community policing approach to strengthen close interaction and mutual cooperation between police, residents, businesses and community groups.

PS P2. Public safety services.

PS P3. Fire and EMS services.

PS P4. Code administration. The City will continuously review development and building codes and their administration to ensure appropriate regulations and review processes that encourage quality development and protection of the public's health, welfare and safety.

Actions:

Public Safety

PS A1. Develop strategies that strengthen community-policing (i.e. COPE) efforts between the police department, residents, businesses and community groups.

PS A3. Revise zoning ordinance to integrate Crime Prevention Through Environmental Design in the development review process.

**4) Comprehensive Plan, Policy Document - Virginia Beach, Virginia
December 2, 2003** <http://www.vbgov.com/dept/planning/plans/complan/>

Introduction and General Strategy

Five Building Blocks –

5. Healthy Neighborhoods: All residents' want attractive, crime free neighborhoods, and we should strive in the design of them to promote safety and security as well as function and visual appeal. This includes access to neighborhood parks.

Strategic Growth Areas (suburban to urban transformation)

Detailed Human-scale Design, Fifth Principle of Five: Part of what is required for compact, mixed-use developments to become acceptable patterns of development within communities is the creation or recreations of well-designed urban areas that are safe, attractive and convenient. It is important for these areas to be built at a 'human scale,' especially as people experience activity along the streets, sidewalks and public spaces. For example, the sounds from outdoor cafes, people gathering around fountains in public plazas and aromas from local coffee shops and bakeries all combine to create a sense of interest, excitement and social interaction. Urban streetscapes are designed with special paving, landscaping, lighting and other features that create an interesting and inviting environment. When designed and built with quality in mind, these physical elements galvanize to foster a positive sense of urban place,

Other urban design considerations relate to massing of buildings, orientation of buildings to the street, on-street and structured parking, street furniture, presence of windows, doors, porches and other architectural elements and the effective use of landscape and signage.

Primary Residential Area Principle 3 – Neighborhood Traffic

Employ land use and roadway design techniques that discourage cut-through traffic within residential neighborhoods. Often called "traffic calming" strategies, these techniques include assessing the neighborhood traffic condition and, if warranted, providing greater police enforcement, limiting direct

CPTED RESOURCES:

CPTED Guidelines

General Guidelines for Designing Safer Communities

City of Virginia Beach
Municipal Center/Police Department
2509 Princess Anne Rd
Virginia Beach, VA 23456-9064
www.vbgov.com
(757) 563-1066 FAX (757) 563-1064 bjeaton@vbgov.com

Crime Prevention Through Environmental Design: A guide to creating safer environments in Chesterfield County, Virginia

Chesterfield County Police Department
Support Services Division/Crime Prevention Unit
Clover Hill Police Support Facility
2730 Hicks Road
Chesterfield, Virginia 23235
(804) 674-7006 eicherj@chesterfield.gov

Crime Prevention Through Environmental Design: General Guidelines for Designing Safer Communities, April 2001

City of Bristol Virginia
497 Cumberland Street
Bristol, Virginia 24201
(540) 642-2300 bvsocp@bristolva.org

North Trail Zoning Ordinance - Sarasota, Florida

Department of Planning and Development
1565 1st. Street
Sarasota, FL 34236
(813) 954-4195

A Working Guide for Planning and Designing Safer Urban Environments

Planning and Development Department 20th Fl, East Tower
City Hall
Toronto, Ontario M5H 2N2
(416) 392-0403

Design For Public Safety

Department of Planning and Economic Development
25 West Fourth Street
Saint Paul, MN 55102
(612) 266-6660 FAX (616) 228-3261

RESOURCES AND SUGGESTED READING

Bratiningham, P. J., & Bratiningham, P.L. (eds.) *Environmental Criminology*. Beverly Hills, CA: Sage, 1981.

Clarke, Ronald V. (ed.) *Situational Crime Prevention: Successful Case Studies*. Albany, NY: Harrow and Heston, 1992.

Crowe, Timothy. *Crime Prevention Through Environmental Design*. Stoneham, MA: Butterworth-Heinemann, 1991.

Fennelly, Lawrence. *Handbook of Loss Prevention and Crime Prevention*, 2nd ed. Stoneham, MA: Butterworth-Heinemann, 1988.

Governor's Commission on Crime Prevention and Control. *Crime in Minneapolis, 1977*

Jacobs, Jane. *The Death and Life of Great American Cities*. New York, NY: Random House, 1961.

Jeffrey, C. Ray. *Crime Prevention Through Environmental Design*. Beverly Hills, CA: Sage 1971.

National Crime Prevention Council. *Designing Safer Communities, 1997*

National Institute of Law Enforcement and Criminal Justice., *Street Lighting Projects*, 1979.

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Poyner, Barry. *Design Against Crime*. Stoneham, MA: Butterworth-Heinemann, 1983.

Werkerle, Gerda R & Carolyn Whitzman. *Safe Cities: Guidelines for Planning Design and Management*. New York, NY. Van Nostrand Reinhold, 1995.

Zelinka, Al & Brennan, Dean. *SafeScape: Creating Safer, More Livable Communities through Planning and Design*. Chicago, Ill: Planners Press, 2001.

AUDIO VISUAL

Virginia Department of Criminal Justice Services

Frank Johnstone
805 East Broad Street
Richmond, VA 23219
(804)786-8467 fax (804) 371- 8981

Safer Places: A Crime Prevention Through Environmental Design Tutorial
(CD ROM) A CD-ROM tutorial on CPTED. It takes 4 hours to complete the entire tutorial. Available for free in Windows 95 or Macintosh formats.

Department of Transportation

Greg Gilbert
Traffic Engineering
1401 East Broad St.
Richmond, VA 23219
804-786-4034

Traffic Calming (video)
5 minute video on traffic calming experiments in Virginia

Department of Planning

221 N. Figueroa St. , Room 1650 A
Los Angeles, CA 90012-2601
(213) 580-5249 FAX (213) 580-5261

Designing Out Crime in Homes and Small Businesses (video)
14 minutes for homes and small businesses.

Crime Prevention Through Environmental Design (video)
28 minutes for architects, law enforcement, developers and planners.

The MXD Collaborative, Inc.

1164 14th Place, NE, Suite 1A
Atlanta, GA 30309-3505
(404) 875-4027

CPTED Multimedia Presentation & Training CD ROM

The CD ROM can be both interactive and self-running. The presentation is complete with professional narration, music highlights and video news footage. The CD can be used as an introduction and training piece on the concepts and principles of CPTED. The view also has the option to let the entire presentation self run from beginning to end - approximately 30 minutes. The CD is available for \$15 each.

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(804) 231-3800 FAX (804) 231-3900
vaprevent@aol.com web: www.vcpa.org

National Crime Prevention Council

1000 Connecticut Avenue, NW, 13th floor
Washington, DC 20036
(202) 261-4126 FAX (202) 296-1356
www.ncpc.org

International CPTED Association

439 Queen Alexandra Way SE
Calgary, Alberta, Canada, T2J 3P2
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