



NEVER GET HOT DOWN



PURPOSE:

INSTALLATION OF GREEN ROOFS ON CAMPUS TO **INSPIRE** AND **EDUCATE** WESTERN STUDENTS AND FACULTY, ALONG WITH COMMUNITY MEMBERS ABOUT THE ENVIRONMENTAL AND ECONOMIC BENEFITS OF SUSTAINABLE GREEN CONSTRUCTION.





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INTRODUCTION

WESTERN WASHINGTON UNIVERSITY HAS BEEN AN ENVIRONMENTAL STEWARD FOR DECADES, AND HAS LED THE WAY FOR CAMPUS SUSTAINABILITY THROUGHOUT THE NATION. THE MILLER HALL RENOVATION HAS PRESENTED WESTERN AND HUXLEY COLLEGE OF THE ENVIRONMENT WITH A UNIQUE OPPORTUNITY TO INCORPORATE GREEN TECHNOLOGIES INTO EXISTING BUILDINGS, AND SERVE AS MODEL FOR ENVIRONMENTAL IMPACTS AND EDUCATION. THE PROPOSED LEED-EXISTING BUILDING (EB) RENOVATION IS A LARGE-SCALE REMODEL INCORPORATING SUSTAINABLE DESIGN CONCEPTS INTO THE EXISTING MILLER HALL STRUCTURE, SET TO BE COMPLETED IN FALL OF 2010.

WE PROPOSE THE INSTALLATION OF A GREEN ROOF – A ROOF IN WHICH VEGETATION IS GROWN ATOP (SEE RESEARCH AND ANALYSIS) – OVER THE EXISTING BICYCLE RACKS IN FRONT OF MILLER HALL. USING LOCAL AND REGIONAL SUPPLIERS. UTILIZING THE BEST TECHNOLOGY, WE PLAN TO CREATE A GREEN ROOF WHICH FOSTERS IMPORTANT ENVIRONMENTAL MANAGEMENT OPPORTUNITIES AND UNIQUE EDUCATIONAL BENEFITS TO THE STUDENTS AND FACULTY OF WESTERN WASHINGTON UNIVERSITY.

THE FOLLOWING SECTIONS OUTLINE THE METHODOLOGY TO OUR RESEARCH, CASE STUDIES IN GREEN ROOFS FROM AROUND THE NATION, OUR RESEARCH AND ANALYSIS AND PROJECT-SPECIFIC FINDINGS AND RECOMMENDATIONS, AND THE FUTURE IMPLICATIONS FOR GREEN TECHNOLOGIES, SUSTAINABLE PRACTICES, AND THIS PROJECT ON WESTERN WASHINGTON UNIVERSITY.





GREEN ROOFS: EDUCATIONAL AND ENVIRONMENTAL BENEFITS

THE BICYCLE RACK GREEN ROOF WILL PROVIDE ECONOMIC, ENVIRONMENTAL, AND EDUCATIONAL BENEFITS TO WWU STUDENTS AND FACULTY BODY, AND THE BELLINGHAM COMMUNITY AS A WHOLE. WHILE SIZE, CLIMATE, AND BUILDING MATERIALS CAN AFFECT WHICH BENEFITS ARE RECEIVED BY DIFFERENT GREEN ROOF SYSTEMS, THE FOLLOWING WILL BE A DIRECT RESULT OF THE MILLER HALL BICYCLE RACK COMPILED FROM A COMPLETE LIST AT GREENROOFS.COM

ECONOMIC:

- PROTECTION OF ROOF MEMBRANE RESULTING IN A LONGER MATERIAL LIFESPAN. GREEN ROOFS LAST AN ESTIMATED TWICE AS LONG AS CONVENTIONAL CONSTRUCTION.
- POTENTIAL FOR GRANTS RELATED TO ENERGY EFFICIENCY, AND TO SATISFY REGULATORY REQUIREMENTS SUCH AS LEED, LIVING BUILDING CHALLENGE AND OTHER RATINGS SYSTEMS.

ENVIRONMENTAL:

- STORM WATER RETENTION: WATER IS SLOWED AND STORED BY THE SOIL SUBSTRATE AND THEN TAKEN UP BY THE PLANTS FROM WHERE IT IS RETURNED TO THE ATMOSPHERE THROUGH TRANSPIRATION AND EVAPORATION. RATES OF EVAPORATION VARY ACCORDING TO SEASON, PLANT MEDIA, AND SOIL DEPTH.
- THROUGH THE PROCESS OF PHOTOSYNTHESIS, PLANTS CONVERT CARBON DIOXIDE, WATER AND SUNLIGHT/ENERGY INTO OXYGEN AND GLUCOSE REDUCING THE AMOUNT OF CO₂ IN THE ATMOSPHERE FROM ANTHROPOGENIC RISES IN GREEN HOUSE GAS EMISSIONS. GREEN ROOFS CAN REMOVE AIRBORNE PARTICULATES, AT A RATE OF 2 LBS. PER ONE SQUARE METER OF ROOF PER YEAR. AND THE URBAN HEAT ISLAND EFFECT.
- A GREEN ROOF WILL NOT ONLY ABSORB HEAT, DECREASING THE TENDENCY TOWARDS THERMAL AIR MOVEMENT, REDUCING THE URBAN HEAT ISLAND EFFECT; BUT WILL ALSO FILTER THE AIR MOVING ACROSS IT.
- GREEN ROOFS PROVIDE HABITAT INCREASING BIODIVERSITY AND ENCOURAGING WILDLIFE REFUGE FOR VARIOUS BUGS, BIRDS, AND INSECTS WITHIN THE URBAN ENVIRONMENT.
- SIGNAGE WILL EDUCATE STUDENTS ON MAJOR DESIGN PRINCIPLES, ILLUSTRATING ENVIRONMENTAL AND ECOLOGICAL BENEFITS, AND INCREASE STUDENT MORAL AND PRODUCTIVITY THROUGH CAMPUS BEAUTIFICATION.
- ROOF WILL DRAW AWARENESS TO FACULTY AND STAFF AND SERVE AS A CATALYST FOR SUPPORT FOR FUTURE GREEN ROOF PROJECTS.





EDUCATIONAL AND EXPERIMENTAL:

- SIGNAGE WILL EDUCATE STUDENTS ON MAJOR DESIGN PRINCIPLES, ILLUSTRATING ENVIRONMENTAL AND ECOLOGICAL BENEFITS.
- INCREASE IN STUDENT MORAL AND PRODUCTIVITY THROUGH BEAUTIFICATION.
- ROOF WILL DRAW AWARENESS TO FACULTY AND STAFF AND SERVE AS A CATALYST FOR SUPPORT FOR FUTURE GREEN ROOF PROJECTS.



PURDUE UNIVERSITY SCHLEMAN HALL GREEN ROOF, INDIANA

1,750 SF





METHODOLOGY

RESEARCH AND SOURCES

OUR RESEARCH HAS BEEN THROUGH A MIX OF USES, INCLUDING INTERNET SOURCES, BOOKS, AND ARTICLES. THE BOOK “PLANTING GREEN ROOFS AND LIVING WALLS” BY NIGEL DUNNET AND NOEL KINGSBURY, HAS BEEN CRITICAL TO OUR BACKGROUND RESEARCH AND HAS PROVIDED US THE PRACTICAL TECHNIQUES USED TO DESIGN, IMPLEMENT, AND MAINTAIN A GREEN ROOF. WE ALSO UTILIZED THE ASSOCIATION OF SUSTAINABILITY IN HIGHER EDUCATION (ASSHE) WEBSITE AND GREENROOFS.COM TO DEVELOP OUR CASE STUDIES AND UNDERSTAND THE LATEST TRENDS IN GREEN ROOF TECHNOLOGIES. ADDITIONALLY, GREENROOFS.COM HAS AN ACCESSIBLE DATABASE TO LOCATE LOCAL AND NATIONAL GREENROOF SUPPLIERS. THROUGH THIS LIST, WE HAVE PULLED UP THE PERSONAL SITES OF THE ARCHITECTS AND COMPANIES THAT HAVE INSTALLED MANY OF THE GREEN ROOFS IN BELLINGHAM.

CONTACTS & MEETINGS

PART OF THE DEVELOPMENT PROCESS HAS BEEN TO GARNER WESTERN FACULTY AND STAFF SUPPORT DURING THE EARLY STAGES OF DEVELOPMENT. WE BELIEVE THAT A MULTI-DISCIPLINARY AND COLLABORATIVE PROCESS CAN PRESENT A CHANCE FOR STUDENTS, CLASSES, CLUBS AND ADMINISTRATION TO TAKE PART AND FEEL A SENSE OF OWNERSHIP OVER THE PROPOSED GREEN ROOFS. WE CONTACTED TWO OF THE CAMPUS ARCHITECTS, DAVID WILLET AND KING CHOI, BOTH OF WHOM EXPRESSED A STRONG INTEREST IN THE GREEN ROOFS. DAVID WILLETT WAS ABLE TO PROVIDE US WITH DETAILS ON THE MILLER HALL GREEN ROOF PROJECT, AND OUTLINE THE POLITICAL PROCESSES THAT TOOK PLACE FOR THE COURT YARD GREEN ROOF TO GET APPROVED (CURRENTLY UNDER CONSTRUCTION). KING CHOI MENTIONED TO US THE IMPORTANCE OF WATER PROOFING AS A PRIORITY.

WE ALSO MADE CONTACT WITH WENDY WALKER, THROUGH THE ENVIRONMENTAL EDUCATION DEPARTMENT. AS PART OF OUR EFFORTS TO EDUCATE STUDENTS ON THE BENEFITS OF GREEN ROOFS, WE PROPOSED TO HAVE A STUDENT-RUN DESIGN PROJECT FOR AN EDUCATIONAL SIGN THROUGH THE ENVIRONMENTAL EDUCATION DEPARTMENT. LASTLY, WE MADE CONTACT WITH CAROL BERRY, THE SUSTAINABLE TRANSPORTATION PROGRAM MANAGER, AND SHE WANTED TO LEARN MORE ABOUT THE PROJECT BENEFITS, DESIGN LOGISTICS AND BACKGROUND IN REGARDS TO OUR SITE CHOICE.

DALE KRAUSE OF FACILITIES MANAGEMENT LED US TO A LOCAL GREEN ROOF DISTRIBUTOR IN MT VERNON CALLED ETERA, A DIVISION OF NORTHWEST HORTICULTURE. LOCATED ONLY 25 MILES SOUTH OF BELLINGHAM, ETERA HAS SEVERAL PLANT MEDIA OPTIONS SUCH AS PLUGS, CUTTINGS AND SEDUM TRAYS FOR A VARIETY OF GROWING CONDITIONS FOR GREENROOF PROJECTS AT ANY SCALE. WHILE ETERA ONLY OFFERS PLANT MEDIA THEY CONTRACT WITH OTHER LOCAL SUPPLIERS FOR THE ADDITIONAL LAYERS OF THE GREEN ROOF.



PROGRAM DEVELOPMENT

COLLABORATION AND MULTI-DISCIPLINARY APPROACHES ARE THE FOUNDATION OF OUR PROJECT DEVELOPMENT. WE SEEK TO INCLUDE FACULTY AND STUDENTS IN AN EFFORT TO CREATE AN ENVIRONMENT OF INSPIRATION, EDUCATION, AND INCREASED AWARENESS THROUGHOUT THE ENTIRE DEVELOPMENT PROCESS. WE WANT TO INCLUDE OUR STAKEHOLDERS EARLY SO WE CAN ADDRESS THEIR INTERESTS AND NEEDS EARLY AND INCORPORATE THEM ACCORDINGLY, AND WORK TO DEVELOP THE MOST COST-EFFICIENT, ENVIRONMENTALLY FRIENDLY ROOF.

WINTER QUARTER, OUR DEVELOPMENT GOAL WAS TO ENGAGE ALL OF OUR STAKEHOLDERS IN A MEANINGFUL WAY. THIS INCLUDED, BUT WAS NOT LIMITED TO, INTERVIEWS AND MEETINGS, EMAIL EXCHANGES AND GROUP DISCUSSIONS ARRANGED TO IDENTIFY WHAT EACH STAKEHOLDER WANTS (SEE CONTACTS & MEETINGS ABOVE). SECOND, WE WANTED TO IDENTIFY THE KEY ENVIRONMENTAL BENEFITS THAT THE ROOF WILL OFFER – SUCH AS STORM WATER MANAGEMENT, RUN-OFF REDUCTION AND POLLUTION REDUCTION. AT THE END OF WINTER QUARTER, WE PRESENTED OUR KNOWLEDGE ON GREEN ROOFS TO INSPIRE FUTURE STUDENTS AND FACULTY TO MOVE FORWARD WITH CAMPUS SUSTAINABILITY PROJECTS, ESPECIALLY PROJECTS THAT WILL BEAUTIFY CAMPUS AND PROVIDE EDUCATIONAL OPPORTUNITIES.

OUR HOPE IS THAT OUR PROPOSAL AND FINDINGS WILL PROVIDE A FOUNDATION FOR THE PROJECT TO BE CARRIED ON THROUGH FUTURE CAMPUS PLANNING STUDIO PROJECTS WITH A MIXTURE NEW INTERESTED PARTIES AND OF OUR EXISTING MEMBERS AND STAKEHOLDERS.





UNIVERSITY OF WISCONSIN-MILWAUKEE GREAT LAKES WATER INSTITUTE

IN 2003 THE UNIVERSITY OF WISCONSIN GREAT LAKES WATER INSTITUTE INSTALLED A 6,480 SQ FT GREEN GRID™ MODULE SYSTEM EXTENSIVE AND INTENSIVE GREEN ROOF. INTENTIONS BEHIND THE PROJECT INCLUDE PRESENTING INNOVATIVE AND COST EFFECTIVE STORM WATER BEST MANAGEMENT PRACTICES (BMP) TO THE MILWAUKEE METROPOLITAN AREA BY PROVIDING A WORKING MITIGATION MODEL TO MANAGE STORM WATER IN URBAN AREAS. THE PURPOSE BEHIND THE ONGOING RESEARCH ASSOCIATED WITH THE CAMPUS GREEN ROOF IS TO DEMONSTRATE THE REDUCTION OF STORM-WATER RUNOFF VOLUME AND POLLUTANT LOADS LEAVING THE SITE, COLLECT DATA ON THE ENVIRONMENTAL AND ECONOMIC BENEFITS HELPING ESTABLISH GROUNDS FOR THE USE OF GREEN ROOF TECHNOLOGY, AND PROVIDE EDUCATIONAL OPPORTUNITIES FOR THE PUBLIC AND STUDENTS. BOTH INTENSIVE (8" DEPTH) AND EXTENSIVE (4" DEPTH) MODULES WERE USED IN THE INSTALLATION OF THE ROOF ALLOWING FOR THE GREATEST AMOUNT OF SPECIES DIVERSITY.

A PATH OF GREENGRID PAVERS (MADE FROM RECYCLED TIRES) WERE ASSEMBLED IN ORDER TO GIVE THE APPEARANCE OF A STEP GARDEN. THE CAREFUL SELECTION AND PLACEMENT OF PLANT SPECIES IN THE MODULES DEPENDING OF THEIR MATURE HEIGHT, BLOOM-TIME, AND COLOR WAS ALSO TAKEN INTO CONSIDERATION. INTENSIVE MODULES COVER OVER 2500 SQ FT. OF THE GREEN ROOF WHICH HAS THE POTENTIAL TO ABSORB 75 GALLONS PER MINUTE OF RUNOFF. ULTIMATELY THE PROJECT CAN STRENGTHEN COMMUNICATION BETWEEN CIVIC OFFICIALS AND BUSINESSES INVOLVED IN GREEN BUILDING LEADING TO A GREATER UNDERSTANDING OF SUSTAINABLE DEVELOPMENT.





CASE STUDIES

MICHIGAN STATE UNIVERSITY

IN 2000 A GREEN ROOF RESEARCH PROGRAM AT MICHIGAN STATE UNIVERSITY WAS LAUNCHED IN COLLABORATION WITH FORD MOTOR COMPANY IN AN ATTEMPT TO ADVISE FORD ON INSTALLING A TEN ACRE EXTENSIVE GREEN ROOF ON AN ASSEMBLY PLANT IN DEARBORN, MICHIGAN. THE INTENT OF THE RESEARCH PROGRAM AT MSU IS TO EVALUATE PLANT SPECIES RATE OF ESTABLISHMENT AND, POTENTIAL CARBON SEQUESTRATION, WATER AND NUTRIENT REQUIREMENTS, QUANTITY AND QUALITY OF STORM-WATER RUNOFF, AND ENERGY CONSUMPTION BY EVALUATING 48 RAISED ROOF PLATFORMS MEASURING 4' X 4' AND 8'X8'. IN 2004 MSU ACQUIRED FINANCIAL SUPPORT TO INSTALL A 3500 SQ FT EXTENSIVE GREEN ROOF ON THE PLANT AND SOIL SCIENCES BUILDING. THE ROOF SERVES AS AN EXCELLENT DEMONSTRATION PROJECT AS THE PUBLIC CAN VIEW THE TEN SPECIES OF SEDUM THAT ADAPT TO CHANGING GROWING SEASONS AND DISPLAY VIBRANT COLORS OF REDS WHITE AND YELLOW FROM A SECOND STORY VIEWING ROOM.

THE GREEN ROOF ALSO SERVES AS A LEARNING TOOL FOR GRADUATE AND UNDERGRADUATE STUDENTS ON INSTALLATIONS, MONITORING AND MAINTENANCE. ON CAMPUS THERE ARE SCIENTIFIC INSTRUMENTS MEASURING DIFFERENCES IN GRAVEL SURFACES VS. VEGETATED, CURRENT RAINFALL AND WEATHER CONDITIONS, HEAT TRANSFER IN AND OUT OF THE BUILDING, SOIL MOISTURE AND TEMPERATURE, AND WATER RUNOFF. FORTUNATELY THE GREEN ROOF WEIGHS HALF THE WEIGHT OF THE PRE-EXISTING GRAVEL BALLAST, WEIGHING APPROXIMATELY 10 LBS PER SQ FOOT SO THERE WAS NO NEED TO RETROFIT THE EXISTING STRUCTURE. AFTER THE REMOVAL OF THE GRAVEL BALLAST THE BASE LAYERS CONSISTING OF ROOT BARRIER MEMBRANE, DRAINAGE LAYER, FILTER FABRIC, AND WATER RETENTION FLEECE WERE INSTALLED, FOLLOWED BY PRE-VEGETATED MATS GROWN OFF SITE, WHICH WERE UNROLLED OVER THE BASE LAYERS IN FIVE HOURS WITH THE HELP OF VOLUNTEER PROFESSORS AND STUDENTS. THE VEGETATED MATS WERE DONATED BY A COMPANY CALLED XEROFLOR AMERICA LLC, A COMPANY THAT BEGAN IN EUROPE AND IN 2002 OPENED A BRANCH HERE IN THE US.

THE ONGOING RESEARCH AND DATA COLLECTION CONDUCTED BY STUDENTS ON THE CAMPUS GREEN ROOFS SERVES AS A CAMPUS PLANNING TOOL FOR STORM-WATER MITIGATION, ENERGY CONSERVATION, AND FEASIBILITY OF FUTURE INSTALLATIONS ON EXISTING AND NEW CAMPUS STRUCTURES. RESEARCH RESULTS ARE AVAILABLE ON THE MICHIGAN STATE UNIVERSITY WEBSITE. IN 2005 A 14 MONTH STUDY AT MSU IN WHICH 15 PLATFORMS OF THREE ROOF TYPES WERE TESTED FOR WATER RETENTION: AN EXTENSIVE GREEN ROOF WITH VEGETATION, AN EXTENSIVE GREEN ROOF WITH SUBSTRATE ONLY, AND A CONVENTIONAL COMMERCIAL ROOF WITH A 2 CM (0.8 IN) DEEP GRAVEL BALLAST. THE RESULTS QUANTIFIED THE DIFFERENCES IN WATER RETENTION AMONG ROOF VEGETATION TYPES AND AMONG COMBINATIONS OF GREEN ROOF SLOPES AND SUBSTRATE DEPTHS. RESULTS INCLUDED THAT VEGETATED ROOF TREATMENTS RETAINED 60.6% OF RAINFALL COMPARED TO 50.4% AND 27.2% FOR THE MEDIA-ONLY AND CONVENTIONAL GRAVEL BALLAST ROOFS, RESPECTIVELY. VEGETATED GREEN ROOF SYSTEMS REDUCED THE AMOUNT OF STORMWATER RUNOFF OVER A PERIOD OF TIME BEYOND THE ACTUAL RAIN EVENT (VANWOERT ET AL., 2005).





MICHIGAN STATE UNIVERSITY

GREENROOF RESEARCH PROGRAM



48 RAISED ROOF PLATFORMS

4' x 4' AND 8' x 8'

3500 SF GREEN ROOF

USED XEROFLOR

GRADUATE AND UNDERGRADUATE EDUCATION

ONGOING RESEARCH

INSTALLATION

MONITORING

MAINTENANCE





GRAND RAPIDS COMMUNITY COLLEGE

IN AUGUST OF 2008 GRAND RAPIDS COMMUNITY COLLEGE IN MICHIGAN INSTALLED A TWO LEVEL 17450 SQ FT EXTENSIVE 4" GREEN ROOF. IN SPRING 2007 GRAND RAPIDS COMMUNITY COLLEGE (GRCC) APPLIED FOR A GRANT FROM THE STEELCASE FOUNDATION FOR FUNDING THEIR PROPOSED GREEN ROOF AND VEGETATED PLAZA, ATTAINING THE GRANT BY FALL 2007. THE GREEN ROOF TECHNOLOGY SELECTED FOR THE PROJECT WAS LIVEROOF, COMPOSED OF PRE-VEGETATED MODULES. THE 25,000 SQUARE FOOT GREEN ROOF CAN BE VIEWED FROM A RAISED VIEWING PLATFORM, AND ALSO INCLUDES AN HERB GARDEN WHICH IS ACCESSIBLE TO THE CULINARY PROGRAM HERITAGE RESTAURANT ON CAMPUS. THE VIEWING DECK IS AVAILABLE TO THE PUBLIC AND STUDENTS OF ALL AGES TO ENCOURAGE LEARNING ABOUT THE PLANTS, GREEN ROOF BENEFITS AND THE CONCEPT OF SUSTAINABILITY.





RESEARCH AND ANALYSIS

GREEN ROOFS HAVE FUNCTIONED AS EFFECTIVE ROOF SYSTEMS FOR HUNDREDS OF YEARS, AND STEM FROM TRADITIONAL NORWEGIAN AND SCANDINAVIAN DESIGNS. EVOLVING WITH NEW MATERIAL TECHNOLOGIES, GREEN ROOFS HAVE BEEN APPLIED TO VARIOUS TYPES OF CONSTRUCTION RANGING FROM INDIVIDUAL HOMES, APARTMENTS, SCHOOLS AND EVEN LARGE SCALE MANUFACTURING FACILITIES. GREEN ROOFS, ALONG WITH THE GREEN BUILDING INDUSTRY, HAVE ENCOUNTERED NEW ENTHUSIASM, DEVELOPMENT, AND IMPLEMENTATION OVER THE LAST TWENTY YEARS. SUCH ENTHUSIASM HAS CREATED A LARGE INDUSTRY FOR NEW TECHNOLOGIES IN CREATING AND APPLYING GREEN ROOFS. THIS NEW AND EVOLVING INDUSTRY OFFERS A WIDE VARIETY OF SYSTEMS AND STYLES AND FOR GREEN ROOFS THAT COULD BE IMPLEMENTED ON WESTERN'S CAMPUS.

THERE ARE TWO MAIN TYPES OF GREEN ROOFS: EXTENSIVE AND INTENSIVE. EXTENSIVE ROOFS ARE THE MOST COMMONLY USED, AND USUALLY INVOLVE A SHALLOW TRAY SYSTEM WHICH HOLD PLANT MEDIA AND FACILITATE DRAINAGE. THE TRAYS SIT ON TOP OF A WATER PROOF MEMBRANE WHICH FUNCTIONS AS THE ACTIVE BARRIER TO MOISTURE. EXTENSIVE GREEN ROOFS ARE TYPICALLY THE CHEAPEST, MOST EASILY IMPLEMENTED AND REQUIRE THE LOWEST MAINTENANCE VERSUS OTHER SYSTEMS. THE VARIETY OF PLANTS GROWN WITH EXTENSIVE SYSTEMS IS LIMITED TO SHALLOW ROOTING PLANTS SUCH AS SEDUMS AND USUALLY MAINTAIN A LOW PROFILE. INTENSIVE ROOFS TYPICALLY REQUIRE AT LEAST 8-12" OF SOIL AND INCLUDE A WIDE VARIETY OF PLANT TYPES. INTENSIVE ROOFS ARE MOST OFTEN INCORPORATED INTO THE STRUCTURE OF THE ROOF OR AS THE ROOF, RATHER THAN ON IT.



EXTENSIVE GREEN ROOF

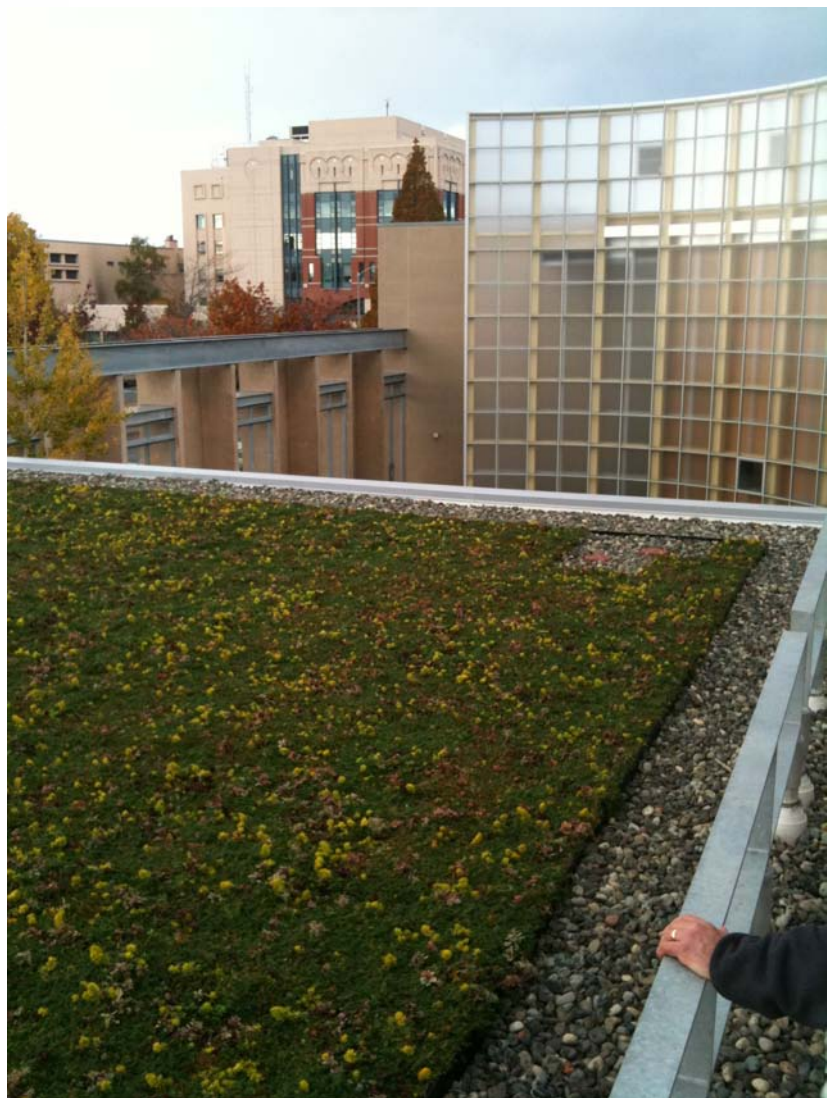


INTENSIVE GREEN ROOF

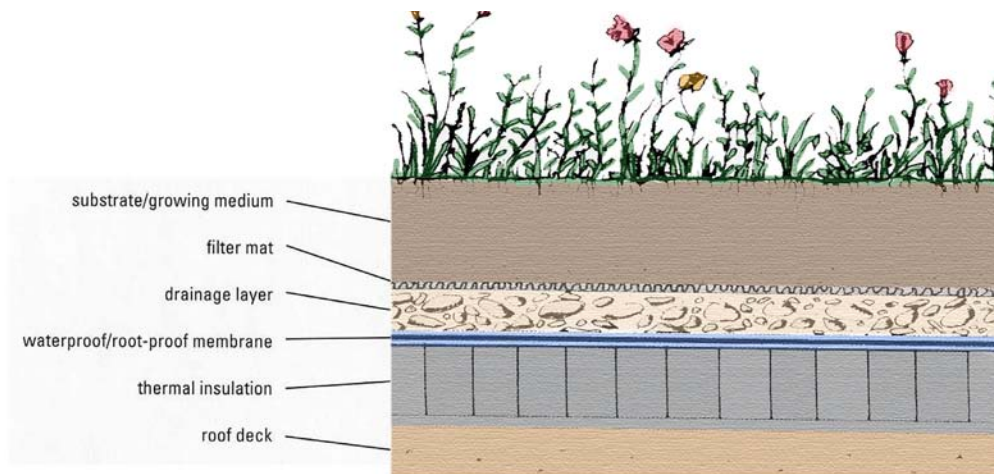




GREEN ROOF PROJECTS CAN VARY IN SIZE, CURRENTLY SMALLER PROJECTS ARE BECOMING MORE APPARENT SUCH AS THIS BUS STOP IN THE UK (BELOW).



WHATCOM MUSEUM GREEN ROOF





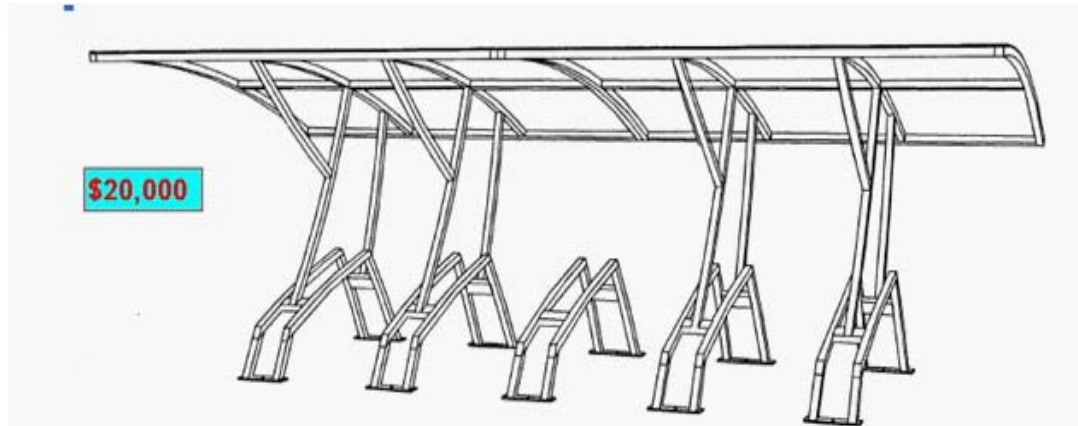
XERO FLOR IS THE GREEN ROOF DISTRIBUTER THAT IS BEING USED FOR THE CURRENT MILLER HALL RENOVATION PROJECT. THE NEAREST LOCATION IS IN NORTH OREGON WHERE THE SEDUM IS GROWN IN THE FIELD AND THEN TRANSPORTED AND INSTALLED LIKE SOD.

ETERA LOCATED IN MT VERNON AND IS ANOTHER POTENTIAL DISTRIBUTOR FOR THE PROPOSED GREEN ROOF PROJECT. SEVERAL MIXES OF SEDUM FOR A VARIETY OF CONIDITIONS ARE GROWN IN THE FIELD AND TRAYS. DAVID GILMORE, ETERA GREEN ROOF SPECIALIST, EXPRESSED GREAT INTEREST IN OVERSEEING STUDENT AND FACULTY VOLUNTEERS ON THE INSTALLATION OF THE PLANT MEDIA TO REDUCE INSTALLATION COSTS.

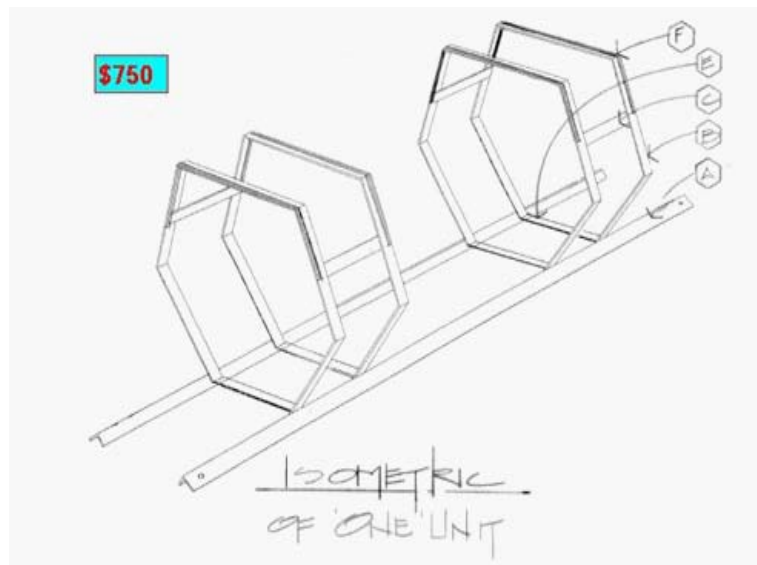
SEDUM MAT 2"
WATER RETENTION
FLEECE 1/2"
DRAINAGE LAYER 1/2"



EXISTING BIKE RACKS & COST



CURRENT COVERED STANDARD	
TOTAL COST	\$20,000
BIKE CAPACITY	10
COST PER BIKE	\$2,000



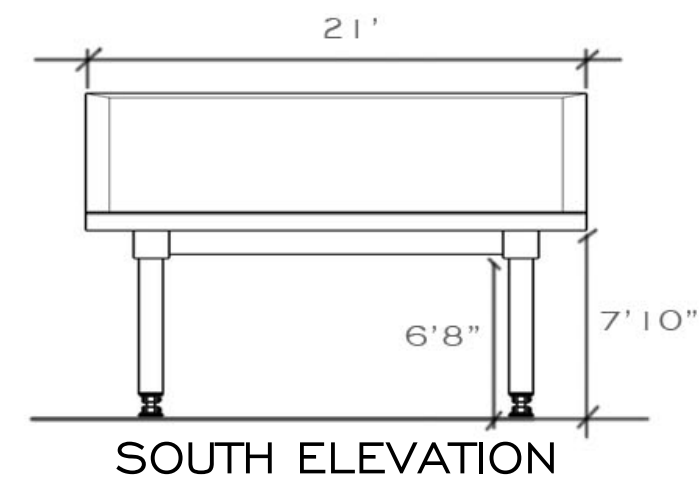
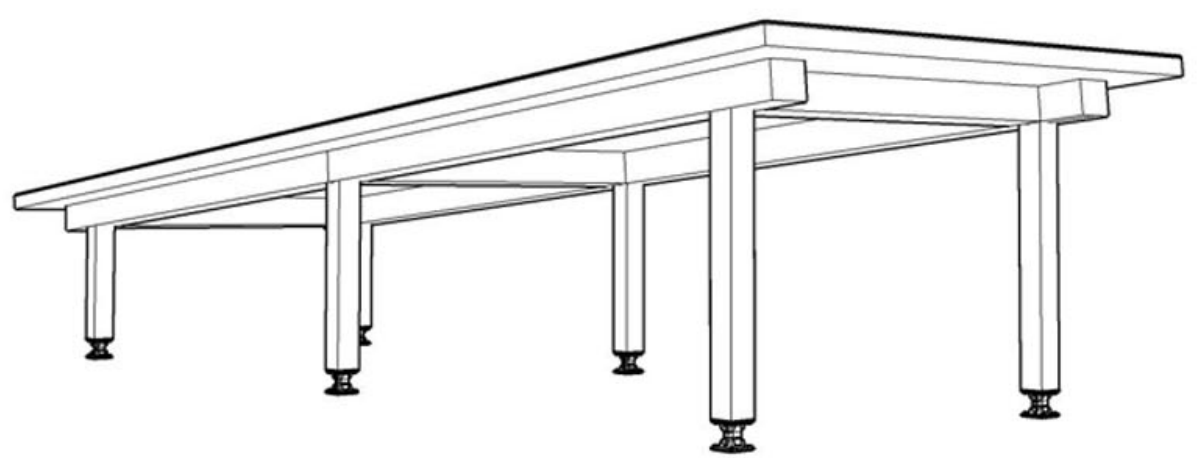
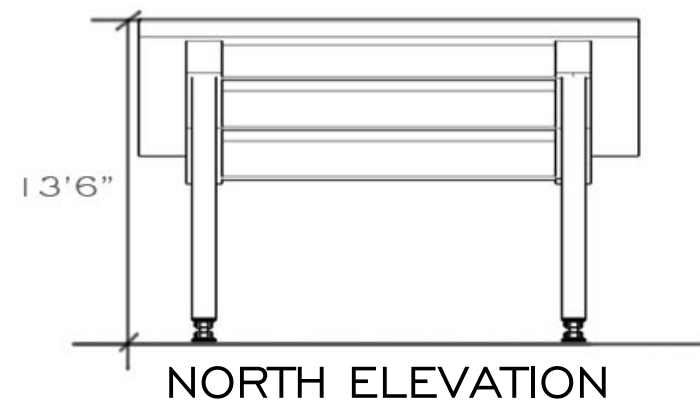
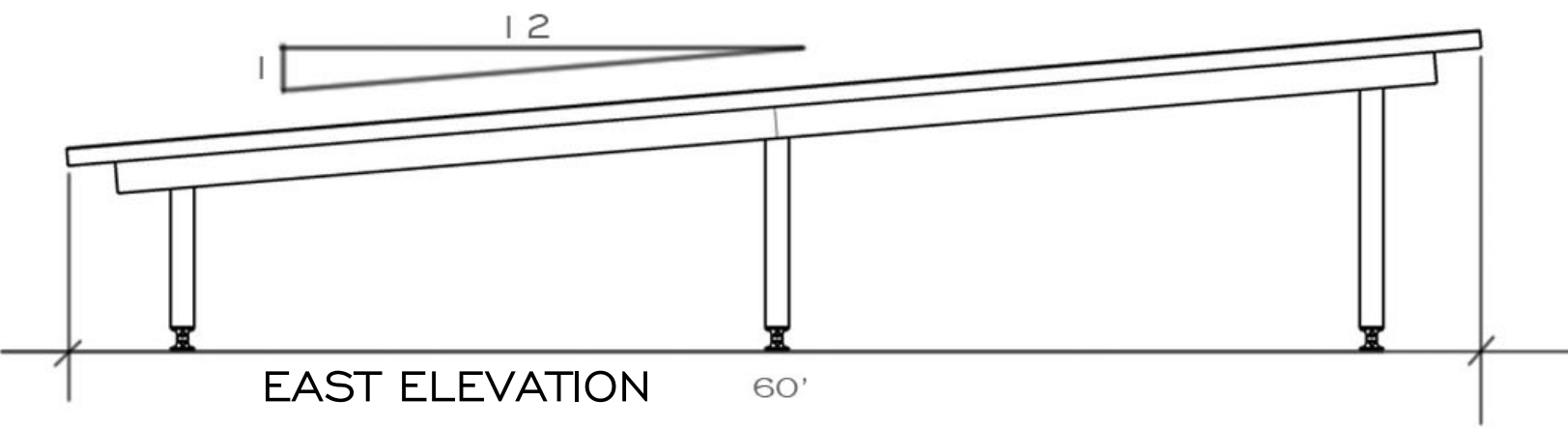
PREVIOUS UNCOVERED STANDARD	
TOTAL COST	\$750
BIKE CAPACITY	4
COST PER BIKE	\$188

PURPOSED BIKE ROOF COST

MILLER AND COMMUNICATIONS LABOR AND MATERIALS		\$ 1 00,000
FOOTINGS, POSTS, BEAMS,		
CONCRETE, AND ALL OTHER MATERIALS		
WATERPROOF MEMBRANE		\$ 75,000
ETERA GREEN ROOF MATERIALS		
\$ 8.00 SF (W/ VOLUNTEER STUDENT LABOR)		\$ 2 1,600
\$ 1 1 .00 SF (INSTALLED BY ETERA)		
TOTAL PROJECT COST ESTIMATE		\$ 1 96,600
BUS STOP GREEN ROOF INSTALLATION		\$ 1 1 ,800
MILLER HALL DESIGN	1 200 SQF	
TOTAL COST		\$ 92,400
CURRENT BIKE CAPACITY	56	
COST PER BIKE		\$ 1 650
POTENTIAL BIKE CAPACITY	80	
COST POTENTIAL PER BIKE		\$ 1 1 55
COMMUNICATIONS DESIGN	900 SQF	
TOTAL COST		\$ 92,400
CURRENT BIKE CAPACITY	48	
COST PER BIKE		\$ 1 925
POTENTIAL BIKE CAPACITY	64	
COST POTENTIAL PER BIKE		\$ 1 440



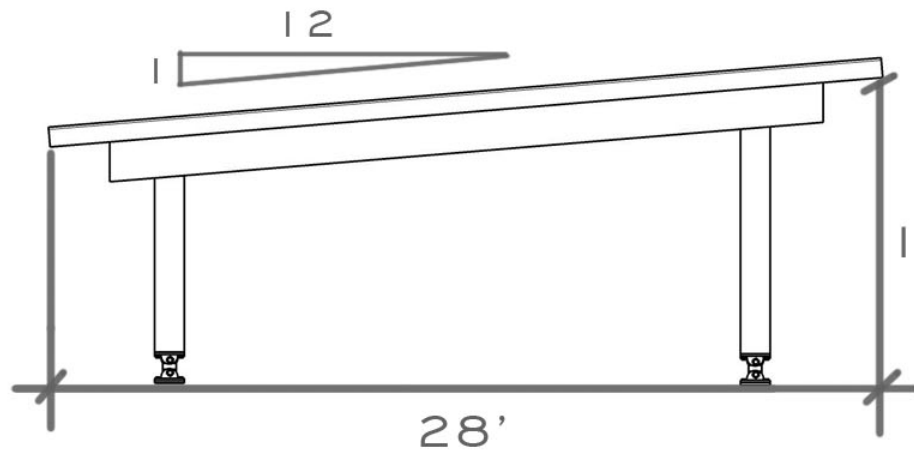
MILLER HALL DESIGN



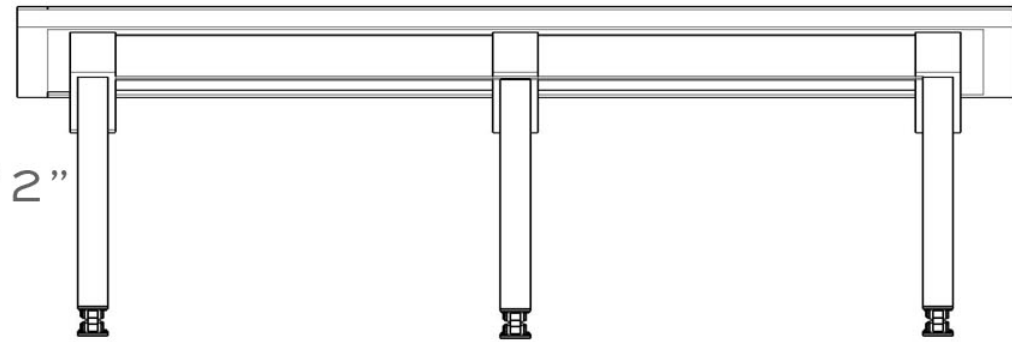
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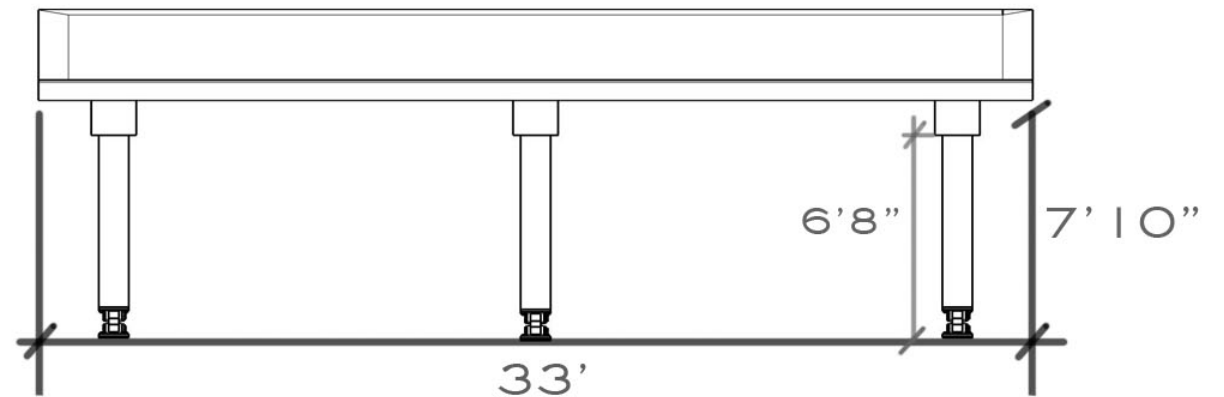
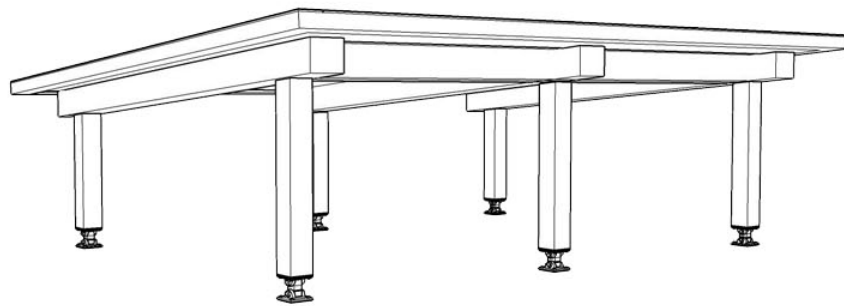
COMMUNICATIONS DESIGN



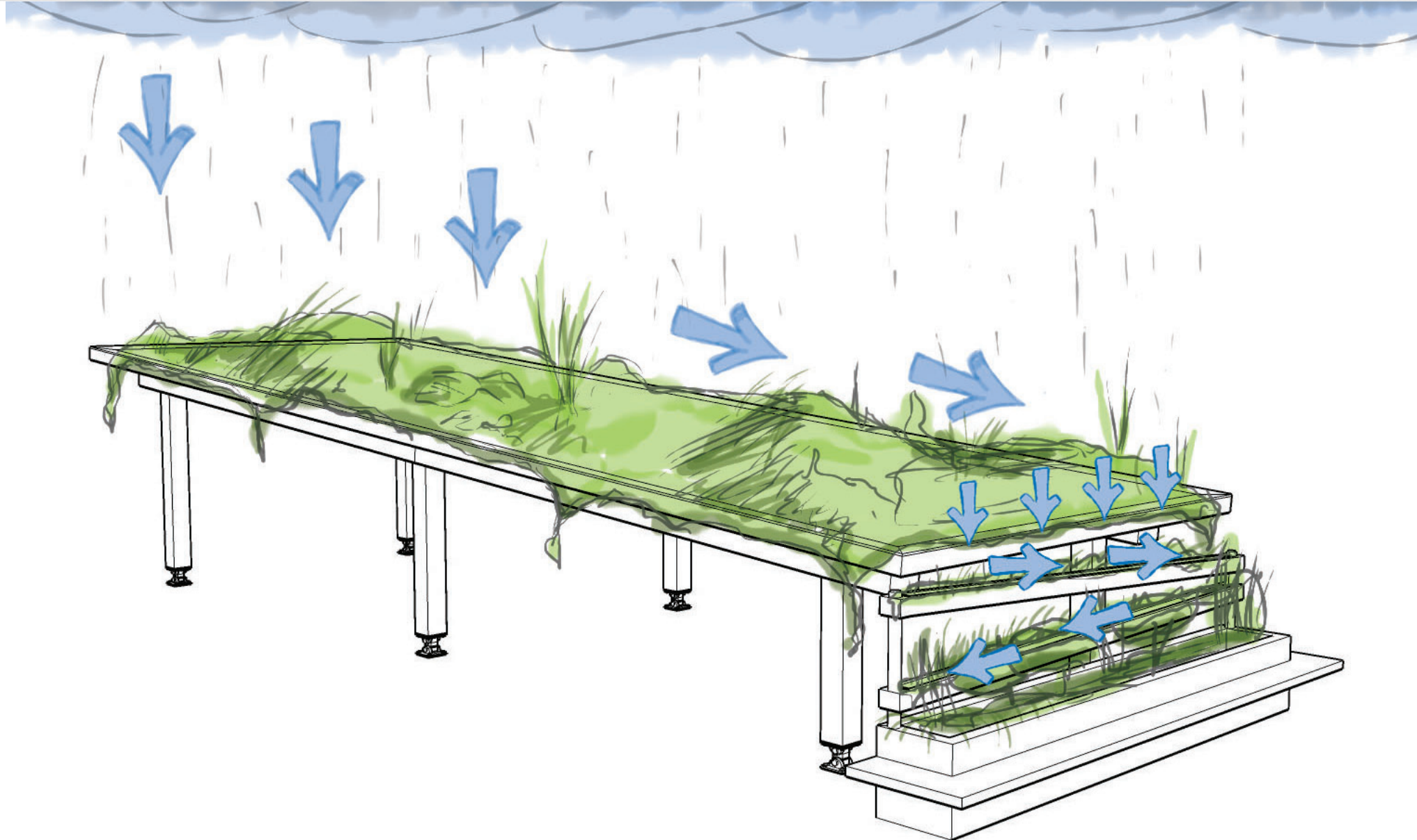
EAST ELEVATION



NORTH ELEVATION



SOUTH ELEVATION

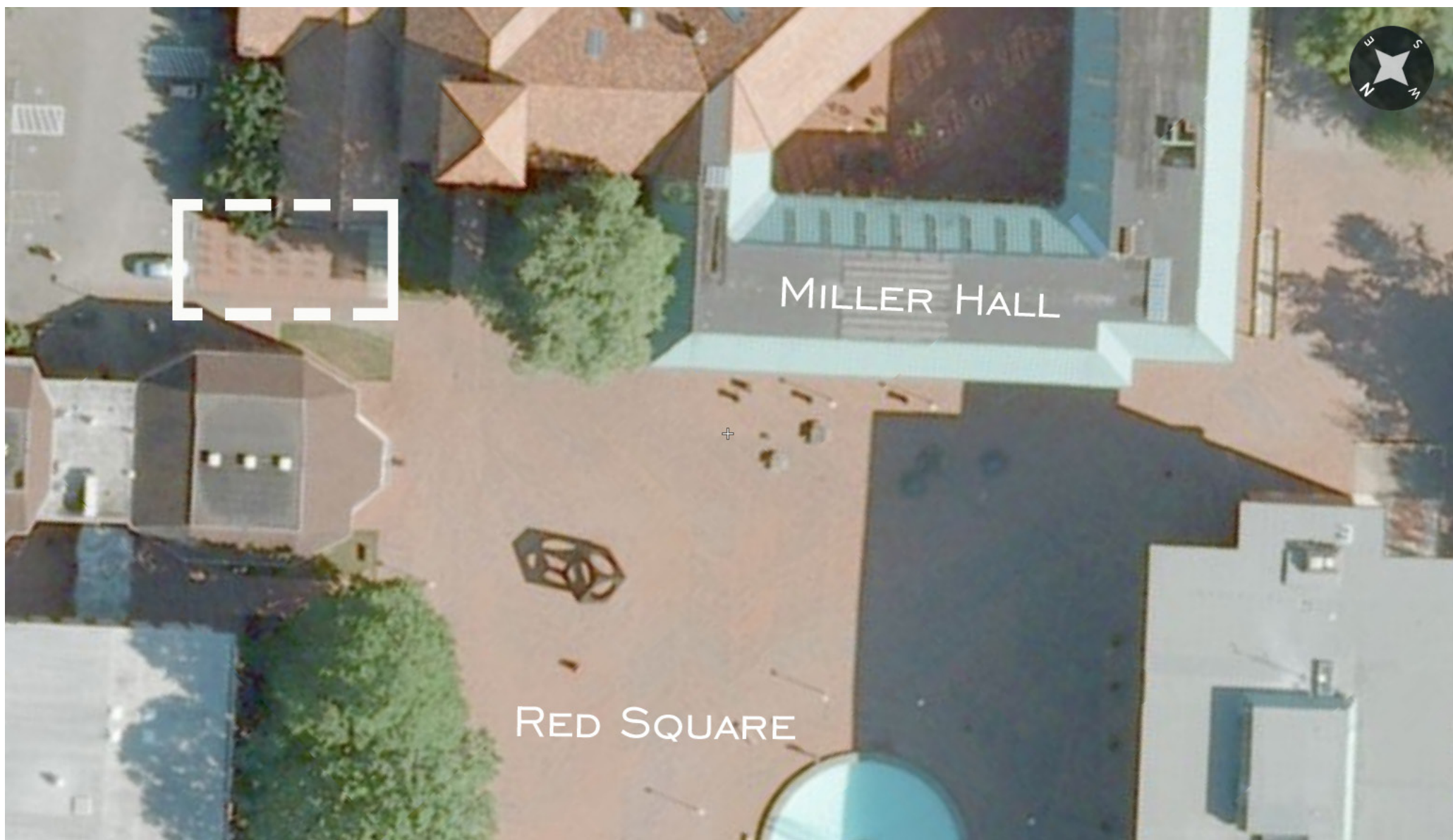












MILLER HALL

RED SQUARE













FUTURE WORKS

SUSTAINABLE BEAUTIFICATION PROJECTS ON CAMPUS WILL BECOME MORE IMPORTANT AS THE UNIVERSITY CONTINUES TO WORK TOWARDS A MORE SUSTAINABLE CAMPUS. THIS INCLUDES INSTALLATION OF MORE GREEN ROOFS AND LIVING WALLS AROUND CAMPUS. LIVING WALLS ARE ANOTHER FORM OF BEAUTIFICATION THAT CAN IMPROVE AIR QUALITY AND VENTILATION AS WELL AS SOLAR INSULATION. SOME OF THESE POTENTIAL INSTALLATIONS COULD BE A GREEN ROOF ON TOP OF THE BUS STOP ON HIGH STREET NEXT TO THE LIBRARY, THE BIKE RACKS BETWEEN CARVER GYM AND THE SMATE BUILDING, AS WELL AS THE WADE KING RECREATION CENTER. THESE THREE LOCATIONS REPRESENT EXAMPLES OF EXISTING STRUCTURES ON CAMPUS THAT CAN EASILY BE ADAPTED TO SUPPORT A GREEN ROOF. THE WADE KING RECREATION CENTER BUILDING WAS INITIALLY DESIGNED AND BUILT TO SUPPORT A GREEN ROOF THUS INSTALLATION WOULD TAKE MINIMAL ADAPTATION.

GREEN WALLS ARE ANOTHER FORM OF SUSTAINABLE BEAUTIFICATION THAT PROVIDE MANY OF THE SAME BENEFITS AS GREEN ROOFS DO. GREEN WALLS ARE ABLE TO INSULATE BUILDINGS, PROVIDE SHADE TO WINDOWS AND SIDEWALKS, SEQUESTER RAIN RUN-OFF, AS WELL AS IMPROVE THE VISUAL QUALITY TO THE CAMPUS. AS WITH GREEN ROOFS THE INSTALLATION CAN BE ADAPTED TO RENOVATIONS, INSTALLATIONS, AND NEW BUILD PROJECTS. MOST GREEN WALLS ARE DESIGNED IN MODULAR FORM FOR THE PURPOSE OF SIMPLE AND RELIABLE CONNECTION TO THE WALL. OTHER MORE INTENSIVE PROJECTS CAN HAVE SUBSTRATES ATTACHED DIRECTLY TO THE WALL CREATING A LIVING WALL. GREEN WALLS ARE AN EFFECTIVE CURRENT STRATEGY TO IMPROVING THE CAMPUS BEAUTY AND THE UNIVERSITIES STATURE AS AN ENVIRONMENTAL STEWARD.





GREEN WALL







CONCLUSION

A GREEN ROOF OVER THE MILLER HALL BICYCLE RACKS PROVIDES A COST-EFFECTIVE EDUCATION AND ENVIRONMENTAL TOOL FOR WESTERN WASHINGTON UNIVERSITY. IT WILL SERVE AS AN EDUCATIONAL BEACON WITH A SOUTH-FACING GARDEN THAT WILL INSPIRE STUDENTS AND STAFF CROSSING RED SQUARE, AND BECOME THE PILOT PROJECT FOR FUTURE CAMPUS-WIDE BEAUTIFICATION PROJECTS. THE DEVELOPMENT PROCESS WILL SERVE AS A MODEL FOR FUTURE CAMPUS PLANNING STUDIO STUDENTS AND STUDENTS ACROSS THE UNIVERSITY, TO BETTER INTER-AGENCY AND FACULTY COLLABORATION. THE ROOF WILL SERVE SEVERAL KEY ENVIRONMENTAL PURPOSES, INCLUDING WASTE WATER AND RUN-OFF MANAGEMENT, AIR FILTRATION, AND WATER SEQUESTRATION. THESE BENEFITS WILL BE BROADCASTED TO THE CAMPUS VIA EDUCATIONAL SIGNAGE, WHILE ENLIGHTENING STUDENTS AND INCREASING AWARENESS OF THE BENEFITS OF GREEN ROOFS.

OVER THE LONG TERM, OUR GREEN ROOF WILL BE THE FIRST OF MANY GREEN BEAUTIFICATION PROJECTS ON THE WESTERN WASHINGTON CAMPUS, AND ADVANCE OUR CAMPUS'S REPUTATION AS A PREMIER ENVIRONMENTAL STEWARD. THE RELATIONSHIPS AND COLLABORATIVE NETWORKS WE ESTABLISH WITH THIS PROJECT WILL BE THE SPRINGBOARD FROM WHICH OTHER PROGRAMS CAN BRANCH FROM, AND BE USED AS A FOUNDATION.





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