The Hydrogen Education Foundation's
Hydrogen Student Design Contest
2008/2009: A Green Building with Hydrogen
www.HydrogenContest.org

2008-2009 Hydrogen Design Contest: Green Buildings with Hydrogen

Official Rules and Design Guidelines

Last updated: 11 November 2008

Presented by the National Hydrogen Association's Hydrogen Education Foundation, the U.S. Department of Energy, Chevron, Fuel Cell Energy, NYSERDA, American Wind Power and Hydrogen, and the State University of New York - Farmingdale

Introduction

The Hydrogen Education Foundation's Hydrogen Design Contest challenges teams of university-level students from around the world to develop and design hydrogen applications for real-world use.

The 2008-09 Challenge: A Green Building with Hydrogen

"*The commercial and residential building sector accounts for 39% of carbon dioxide (CO2) emissions in the United States per year, more than any other sector. U.S. buildings alone are responsible for more CO2 emissions annually than those of any other country except China. Most of these emissions come from the combustion of fossil fuels to provide heating, cooling and lighting, and to power appliances and electrical equipment. By transforming the built environment to be more energy-efficient and climate-friendly, the building sector can play a major role in reducing the threat of climate change."* U.S. Green Building Council

Today, technologies and more intelligent ways of using energy must be employed in order to reduce our dependence on imported oil and decrease the widespread use of polluting energy technologies. In the U.S. alone, over 70% of all electricity consumption and over 39% of all energy is used to provide power, light, heat, etc. for buildings. Hydrogen has a unique role to play in our move to a more energy efficient and environmentally sustainable future by providing 100% clean energy when produced from renewable sources, including waste products. Additionally, it can help increase the effectiveness of renewable energy by storing excess energy for use when the resources are not available.

Challenge

Universities and other institutions for higher education are key to educating our nation about the importance of developing clean energy technologies and green buildings. Imagine your team has $28 Million USD to design a new green Student Center powered by hydrogen for the State

University of New York – Farmingdale Campus on Long Island, NY. Teams are challenged to design an energy efficient building that utilizes hydrogen produced from renewable sources for as much of its energy needs as feasible. Although your design should aim to address the needs of SUNY-Farmingdale, a great design will have key elements that are applicable to other buildings around the world. The hydrogen technologies and systems you select for your project plan must be commercially available and possible to implement for practical, real-world use by June 2009.

Background

New York State has long been a large user of energy in to the United States, but in recent years it also has become a leader in the areas of clean and renewable energy. With a large population base, vast energy needs, and dense urban business and residential areas, New York is a perfect location for the utilization of energy efficient technologies. These technologies have the ability to not only revolutionize cities and the way they function, but also the lives of its citizens through the benefits of a clean environment, reduced costs from lower energy consumption and economic growth generated by new industries.

Green buildings and renewable energy are among the short and long term applications with the greatest opportunity for practical implementation of hydrogen technologies. Given New York's commitment to hydrogen technologies and public education, the State University of New York - Farmingdale Campus offers an excellent opportunity to highlight the benefits of hydrogen in a near-term application.

Since 2004, the NHA Hydrogen Student Design Contest has challenged multi-disciplinary teams of university students to apply their creativity and academic skills in the areas of design, engineering, economics, environmental science, business and marketing to the hydrogen industry. Although the Contest designs are concepts when submitted, the Grand Prize winning teams from 2004 and 2005 each attracted the funding necessary for actual development and implementation: a new hydrogen fueling station and power park, respectively. The station designed in 2004 had its grand opening at Humboldt State University on September 9, 2008. Last year's Contest winner which designed a back-up and portable power system powered by hydrogen for airports has generated a great deal of interest for implementation at the Columbia International Airport in Columbia, South Carolina.

Winning teams, selected by a diverse panel of judges, will present their designs at the NHA Conference and Hydrogen Expo. The Hydrogen Conference is the largest hydrogen conference in the U.S. and the longest-running annual hydrogen conference in the world. In 2009, the NHA Conference and Hydrogen Expo will be held in Columbia, South Carolina.

1 Rules

1.1 Eligibility and Team Structure

- The Contest is open to current college and university undergraduate and graduate students in the U.S. or abroad. Team members must be enrolled in a college or university at the time of the Contest but do not have to be enrolled full-time.
- Teams are encouraged to include members from only one school. If collaboration between different schools is desired, the team leader and designated faculty advisor must request approval by submitting the team registration form with a cover email to

the address in Section 1.3 or by email to info@hydrogencontest.org. Teams with students from more than three schools are not allowed.

- Multiple teams from a single school are welcome, but each team must work independently to keep the competition fair to other teams.
- A team of about 10 students is recommended, although teams with fewer or more members are allowed.
- Undergraduate-only and graduate-only/mixed teams are allowed. If your team has one or more graduate students, you must register as a graduate-only/mixed team. All teams compete equally for the grand prize. However, some honorable mentions will be reserved for each category.
- Given the multi-disciplinary nature of this competition, teams are encouraged to include members with various expertises including architecture/planning, industrial design, engineering (all types), economics, business, environmental science, policy, chemistry, marketing, education, or any other field of study relevant to the team's design.
- Each team must have a faculty advisor. The faculty advisor must be a faculty member of a college or university with at least three students on the team. Adjunct and emeritus faculty are welcome to serve in this capacity. Faculty advisors may give guidance and suggestions but cannot perform actual design work. Faculty advisors can advise more than one team, but they must assist in making sure the teams work independently to keep competition fair to other schools with one team.

1.2 Citations and Questions

- Teams may use any source of data or materials: journals, computers, software, references, web sites, books, etc. All sources used **MUST** be cited.
- The website http://www.farmingdale.edu/ may be especially useful to the creation of your design. All technical questions specifically regarding SUNY-Farmingdale should be directed to Dr. Amit Bandyopadhyay at bandyoa@farmingdale.edu
- Teams may contact professionals in the hydrogen and fuel cell industry, as desired, and are encouraged to do so. If information from them is used to develop the design, teams **MUST** cite all sources.
- Teams may submit any questions about the contest by email (info@hydrogencontest.org); answers will be posted to an electronic public bulletin board on the contest web site www.HydrogenContest.org for the benefit of all competitors.

1.3 Report Format Submission and Scoring

- All entries must arrive at the location below **by 5 PM (ET), Friday, December 19, 2008.** Late entries will not be considered.
- Entries must be submitted in hardcopy (2 copies; see page requirements below) **and** on CD/DVD (see format requirements below) to the Hydrogen Education Foundation:

  2008-2009 Hydrogen Student Design Contest
  ATTN: Rex Hazelton
  Hydrogen Education Foundation
  1211 Connecticut Ave., NW

Suite 600
Washington, DC 20036

- Hardcopies (2): Pages should have 1" margins with single spacing and should use Times 12 point font. Bound hardcopies are appreciated but are not required and will not be judged differently.
- Electronic copy: The entire report, including graphics and citations, should appear on the CD as a single *.pdf file. ***Please write your school name on the CD.*** Reports submitted as multiple files will not be judged. Only the one electronic, *.pdf file will be sent to the judges and scored.
- The following page limits have been assigned to the following sections:

Section	**Page Limit**
Cover Page	1
Executive Summary	1
The Design	12 (including drawings)
Safety Analysis	3
Economic/Business Plan Analysis	4
Environmental Analysis	4
Marketing and Education Plan	3 (2+1 for the advertisement)
Appendix	5
References/citations	as necessary
Max. No. Pages	33 + references/citations

- Entries that exceed the stated page limits will be deducted **3 POINTS** for each page that exceeds the limit.
- Teams must register online at www.HydrogenContest.org as an "undergraduate-only" or "graduate-only/hybrid" team before submitting your design.
- Each team must submit an abstract of less than 300 words to info@hydrogencontest.org by **Friday October 24th, 2008.** Please include "**Hydrogen Contest Abstract – [Your school name]**" in the subject line of the email. The abstract should provide an overview of the team's project, highlighting the main features and goals of its design. The abstract does not need to be included in the final submission. This information will assist the contest organizers in planning for the rest of the contest.
- The final submission must include an executive summary that reviews the main features of the project plan in language that a general audience can understand. For the other sections, as you describe your design, keep in mind that the judging panel will include both technical and non-technical experts.
- Each section of the final project plan should concisely and completely fulfill the specific requirements in the design guidelines (Section 2) and provide any other relevant information.
- The marketing ad should appear in the body of the project plan so judges may evaluate it. Teams are encouraged, however, to include additional high-resolution versions of the ad and any other pertinent graphics (design drawings, site plot, etc.) as separate files in a folder on the same submitted CD/DVD for Contest marketing purposes at the NHA Conference and Hydrogen Expo.

- The final submission can include an appendix of up to 5 additional pages (within the 33 page limit) for additional information, calculations, and background material if needed.
- Judging criteria:
  Points:
  20 Technical accuracy
  20 Realism, ability to be effectively installed
  20 Effective uses of renewable resources
  20 Practicality/usefulness
  20 Value per dollar spent
  20 Overall impact on university operations and surrounding community
  20 Originality
  20 Educational value
  20 Comprehensive nature of the design
  20 Clarity of writing
  200 Total
- Teams are encouraged to copyright their designs. By submitting a design in this contest, however, teams agree to have their papers professionally published in the proceedings for the NHA Conference. The Hydrogen Education Foundation and Contest sponsors assert the right to publicize the design concepts for their own purposes. All work will be given due credit to its authors.

1.4 Prizes

- One grand prize winning team and four honorable mention teams are expected to be selected. Two of the four honorable mentions are expected to be given to undergraduate-only teams and two honorable mentions to graduate-only/hybrid teams.
- On **February 1, 2009**, the Hydrogen Education Foundation will notify winning teams (teams are expected to refrain from publicly announcing their achievements until the public announcement date on April 1, 2009).
- Contest winners will be announced publicly at the NHA Annual Conference and Hydrogen Expo US in Columbia, South Carolina March 30-April 3, 2009 (for more information on the conference, visit: www.HydrogenConference.org). All five winning teams (one grand prize team plus four honorable mentions) will receive awards at the conference.
- Winning designs will be published in the conference proceedings and online at www.HydrogenContest.org. Up to five members from all winning teams are expected to be given complimentary registrations to the conference, in addition to complimentary hotel accommodations. For conference registration and hotel information, please see www.HydrogenConference.org.
- The grand prize winning team:
  - will receive a stipend of up to $5,000 to cover airfare, meals, and incidental trip expenses (must be documented), as well as complimentary hotel rooms (double occupancy) and conference registration for eight team members and their faculty representative;
  - will have the opportunity to present their design at a general session of the conference. The team must send at least 1 representative to present the team's

design; however, the team is **strongly** encouraged to use the stipend to allow the maximum number of team members to attend and participate; and
    - must send a 20-minute PowerPoint presentation (20 slides max) with highlights of the project plan (presentation will be given by the team representative(s) referenced above during a keynote session of the 1,000+ person conference); presentations are due via email to info@hydrogencontest.org by **March 6, 2009**.
- The four honorable mention teams:
    - Are expected to be invited to give poster presentations at the NHA Conference and Hydrogen Expo; and
    - are expected receive complimentary hotel rooms (double occupancy) and conference registration for up to four team members and their faculty representative.

1.5 Contest Schedule

• The Hydrogen Design Contest begins!*	**July 25, 2008**
• **DUE: Abstracts (info@hydrogencontest.org)**	**October 24, 2008**
• **DUE: Entries due (see Section 1.3)**	**December 19, 2008**
• Announcement of winners to winning teams	**February 2, 2009**
• **DUE: Grand Prize team submits presentation for NHA Annual Hydrogen Conference to HEF Staff**	**March 6, 2009**
• Announcement and presentation of all winning designs	**March 30 - April 2, 2009**

* - Students may begin forming teams and working on Contest designs

2 Design Guidelines

SUNY-Farmingdale is currently looking to design and build a new 45,000 square foot Student Center. The University has budgeted $28 Million for this project, scheduled to break ground in summer 2009. Student teams are challenged to design an energy efficient Student Center utilizing hydrogen produced from renewable resources for SUNY-Farmingdale campus. The hydrogen technologies and systems you select for your project plan must be commercially available and possible to implement for practical, real-world use by June 2009.

2.1 The Design

A building includes many systems that must be integrated to provide a variety of functions for its inhabitants. This section will give you the guidance you need to create a fully functional Student Center whose systems will be powered, to the maximum extent practicable, by hydrogen and renewable energy technologies. As you discover details that have not been prescribed (like building materials), your team should make (and document!) your assumptions based on the environmental, economical and functional impact they will have on your design.

To complete this section, you must clearly communicate your Student Center design including, at a minimum, the following elements: *

1) Design Documentation/Drawings
   (a) Site plan and floor plans
   (b) At least one exterior rendering (computer or hand sketched). Additional renderings are suggested, but not required.

2) Mechanical Design Documentation
   (a) Description of all energy supplies to the building
   (b) Description of all energy loads
   (c) Description of energy conservation attributes
   (d) Special mechanical systems
   (e) Account for general space requirements in floor and site plan

3) Electrical Plan Documentation
   (a) Basic description**

4) Plumbing Plan
   (a) Basic description**

5) Structural Design Documentation
   (a) Basic description**

6) Name of the Student Center

A note about page limits: Addressing every element above may require additional pages that exceed the limit for this section. To avoid a page-limit penalty, carefully consider how you choose to communicate your project plan and design. Remember that although visuals in the body of your design are highly encouraged for effective communication, additional visuals may be included in the Appendix and referenced in the text.

In your team's design, the $28 million available must cover the costs for demolition of current buildings and the marketing plan in addition to the obvious costs of new construction and equipment. To be complete, all designs must also include the components listed in Appendix 1.3 (i.e., bookstore, food service, etc.).

One of the major purposes in your design should be to showcase the use of hydrogen and renewable energy technologies. This is an opportunity to show the extent to which these technologies can be used together, realistically, to power a real building. While your design of the Student Center is not required to draw 100% of its power from renewables and hydrogen, teams which most effectively incorporate the use of hydrogen and renewable energy will score much higher than those who incorporate a very small amount into their design.

*Teams may include other elements useful to communicate the effectiveness of the design, as space allows.
**You will need to have a relatively detailed plan to obtain accurate estimates for the cost of your electrical, plumbing plan and structural design. Those details, things like number of toilets, light fixtures and materials, should be detailed in your supporting documents located in the

appendix of your design, but are not required to be in your description of the design in this section which is subject to page limitations.

2.2 Safety Analysis

Public safety is a paramount concern for any public building or space. In this section, teams must show how their designs will operate safely and maintain the safety of the surrounding environment. Teams must insure that safety is comprehensively addressed in the operation of all hydrogen systems. This is especially important as you document the energy supplies for the Student Center. If you have hydrogen tanks, where will they be sited? Will your design comply with basic code provisions?

Judges will score the design according to how well they think safety has been addressed. This includes safety equipment and operational safety, as well as public perception of safety. Teams must address the following minimum requirements:

- Teams should identify the most significant (at least four risks to public safety in their designs. In determining which failure modes should be addressed, teams should consider both the magnitude of potential damage and frequency.
- Teams should describe how their design mitigates the risk of any identified issues.
- Teams must document their sources as necessary.

2.3 Economic/Business Plan Analysis

Capital, Installation, Transitional and Marketing Costs

The $28 Million USD available for this project must cover capital, installation, transitional (including demolition), and marketing costs. That is, the cost of all equipment, the cost to install the system(s), and the cost of any other work that may be required for a transition from an incumbent system to a new one using hydrogen technologies. For example, if a fuel cell is designed to replace an electric generator and the generator must be removed and thrown away, the removal/disposal costs must be included in the project budget. Teams must clearly document all project costs and show that the total is less than or equal to $28 million. In the end, if SUNY-Farmingdale chooses to implement your design, it should be able to do so within the allotted budget.

Teams are encouraged to request professional estimates for major systems such as electrical and plumbing. To get an accurate estimate, a professional rule of thumb is that it takes a minimum of three quotes to get an accurate idea of how much your system will actually cost. Your team is not required to obtain three quotes, but doing so will enhance the accuracy of your documentation and increase the realism of your design. It will also allow you to make smarter decisions on how you allocate the available funds.

Operational Costs

Operational costs should be documented separately from those described above and are the only costs that don't need to be included in the $28 million USD budget. One of the purposes for designing an efficient building that is powered by clean energy technologies is to reduce operating costs after it's built. Teams should clearly document the annual operating costs of the system(s) for the first year. If operating costs will change significantly in the next 4 years after

the first full year, those changes should also be documented. If you believe the energy efficiencies of the hydrogen systems you choose provide lifecycle cost savings compared to the technologies they replace, those savings should be clearly documented. If your design produces revenue, that revenue should be included in this part of the Economic Analysis. After reading this subsection, the judges should have a clear idea of what it will cost to operate and maintain your Student Center for five years.

Overall
In addition to the costs addressed above, teams should show the value of their design in realistic terms. For example, a design that costs $800,000 but has a value of $800,000 (it might save $300,000 in other energy/maintenance costs) might be perceived very differently from one that costs $500,000 and has a value $500,000.

Teams are encouraged to address any other issues that may affect the economic viability of the project plan (within the page limitations of this section).

In all cases above, teams may use tables and figures to illustrate key points.

2.4 Environmental Analysis
In this section, teams must document the project's environmental impact.

Energy Efficiency
Teams must show the overall balance of energy use for the major system(s) in the design operation (i.e., energy in = energy out, in kWh). Teams should include detail for major subsystems where appropriate. A visual representation of the energy balance, including tables and/or figures, is encouraged.

Emissions
If any emissions will be produced from the energy systems designed, they must be documented (in grams of CO2).

Other
Teams should clearly communicate the environmental impact (positive and negative) of other elements of the design. This could include variable volume toilets, water filtration and other elements.

2.5 Marketing and Education Plan
By design, universities are densely populated facilities. Even when equipment is operated by trained staff and not in direct contact with the public, students and local residents need to be educated about new technologies and may express concerns about safety and efficiency. Public acceptance of hydrogen can be a particular challenge in some communities. A logical, well-placed education and outreach effort, however, can mitigate any concerns, facilitate public acceptance, educate and even generate support for its use.

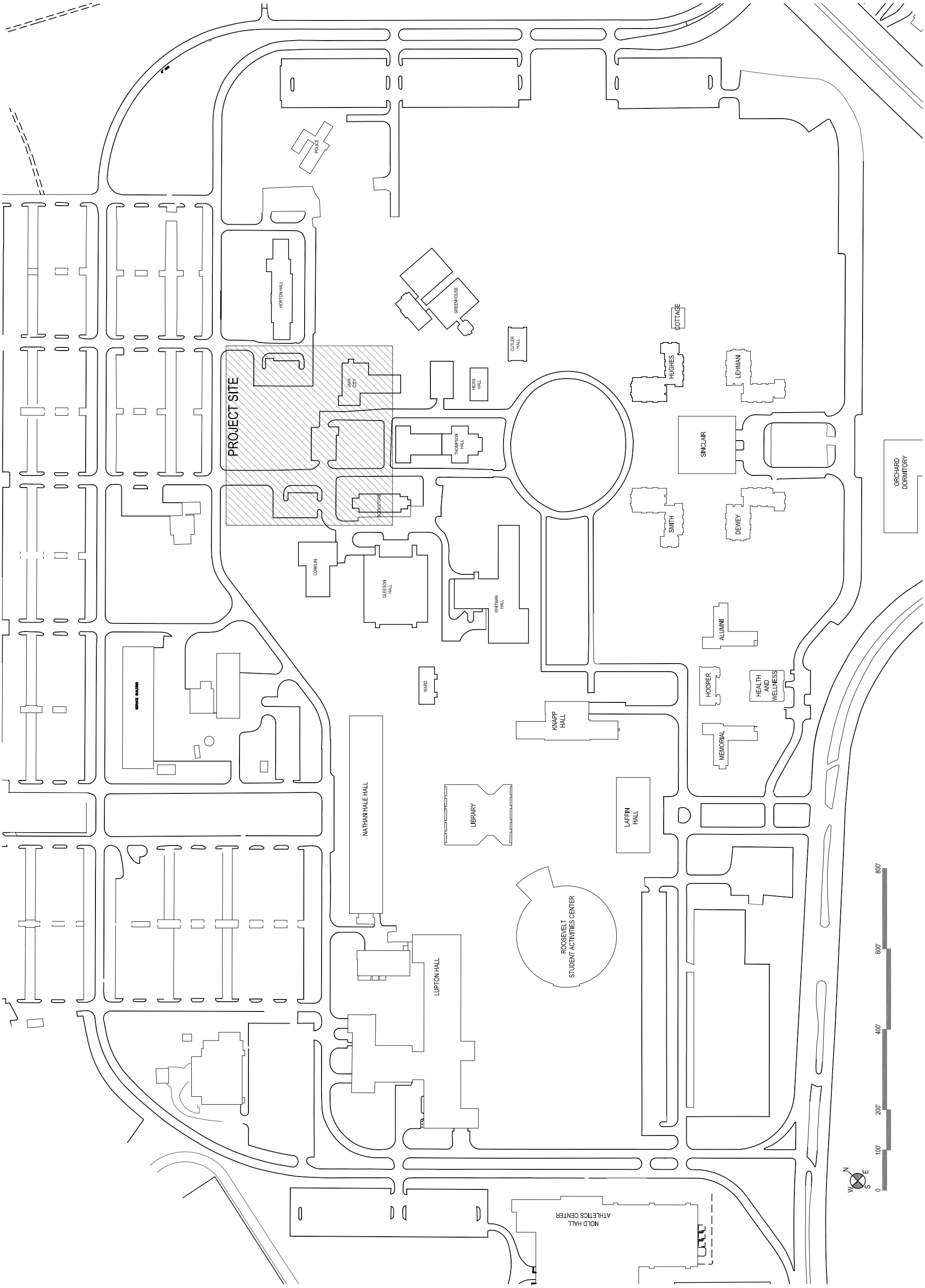
To address the issue of public acceptance and build local support for the university's use of hydrogen technologies, teams must create a realistic marketing plan and a one-page ad (scaled to

fit on a 8.5” x 11” page) for inclusion in a local publication or as a poster on-site at the airport. The cost of implementing this plan must be included in the allowable overall project budget. The plan should:

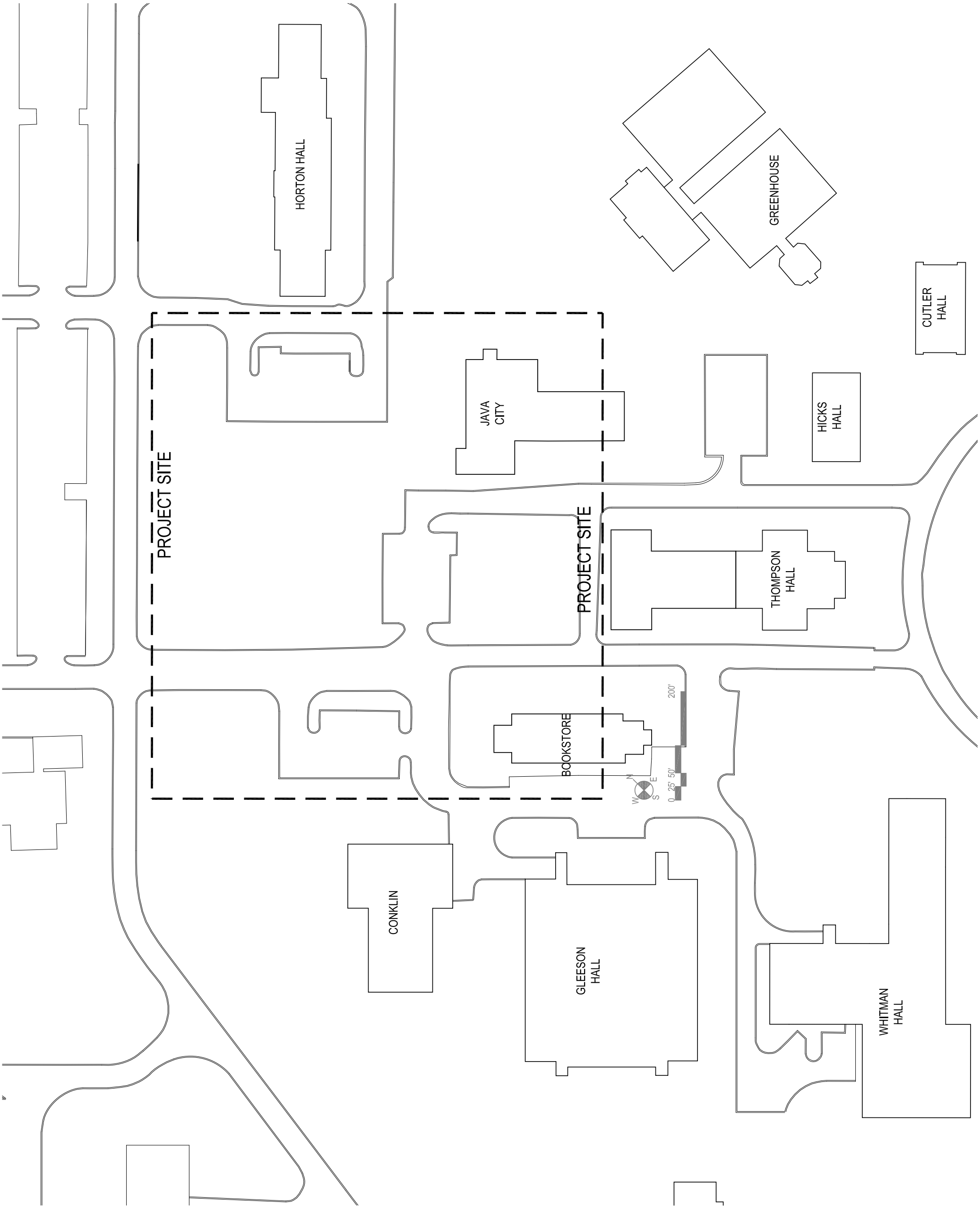
- build support for your design and understanding of hydrogen technologies;
- allay public safety fears or reduce potential resistance; and
- raise local awareness of the benefits of hydrogen technologies so your design can be built and installed with maximum acceptance of the new design.

High resolution or large format images can be included on the team’s CD. See Section 1.3.

APPENDIX 1


POLICE
HORTON HALL
GREENHOUSE
CUTLER HALL
PROJECT SITE
JAVA CITY
HICKS HALL
THOMPSON HALL
BOOKSTORE
CONKLIN
GLEESON HALL
WHITMAN HALL
WARD
SERVICE BUILDING
KNAPP HALL
LIBRARY
NATHAN HALE HALL
LAFFIN HALL
LUPTON HALL
ROOSEVELT STUDENT ACTIVITIES CENTER
NOLD HALL ATHLETICS CENTER
COTTAGE
HUGHES
LEHMAN
SINCLAIR
SMITH
DEWEY
ORCHARD DORMITORY
ALUMNI
HOOPER
HEALTH AND WELLNESS
MEMORIAL
0
100'
200'
400'
600'
800'
N
E
S
W

APPENDIX 2


HORTON HALL
GREENHOUSE
CUTLER HALL
PROJECT SITE
JAVA CITY
HICKS HALL
PROJECT SITE
THOMPSON HALL
BOOKSTORE
200'
0 25' 50'
N
W
E
S
CONKLIN
GLEESON HALL
WHITMAN HALL

APPENDIX 3

2/8/2008

Revised 3/6/08

Program - New Student Union

Target Phase 1 Program

	Name	Capacity/Comments	Number	Aprox. SF	Subtotal	Total
1.00	**Food Service - Commuters**					
1.01	Dining For Commuters	280 seats	1	4,000	4,000	
1.02	Servery		1	2,800	2,800	
1.03	Kitchen Components	One Kitchen serving entire facility	1	4,100	4,100	
	Subtotal					**10,900**
1.50	**Food Service - Residents**					
1.51	Dining For Residents	235 seats	1	3,000	3,000	
1.52	Servery		1	1,600	1,600	
	Subtotal					**4,600**
3.00	**Lounges**					
3.01	Commuter Lounge	Commuter computer stations	1	800	800	
3.02	Study Lounge	Quiet space, no cell phones, etc.	1	0	0	
3.03	Study Rooms	Study space for small groups			0	
	Subtotal					**800**
4.00	**Student Organization Offices**					
4.01	Student Government		1	300	300	
4.02	Radio Station			800	0	
	Funded Organizations		2	250	500	
4.03	Newspaper					
4.04	Yearbook					
4.05	Student Activities Board					
4.06	Dormitory Council					
4.07	Other Student Organizations		6	125	750	
4.08	Temporary Student Office Space		0		0	
4.09	Student Org. Meeting Room	Shared meeting space for all student org.	0	200	0	
4.11	Art Gallery		0		0	
	Subtotal					**1,550**
5.00	**Meeting Rooms**					
5.01	Meeting Rooms	50 seats each	0	500	0	
5.02	Small Meeting Rooms	25 seats each	3	250	750	
5.03	Large Meeting Space	Conference Space	0	1,000	0	
	Subtotal					**750**
6.00	**Large Multi Purpose**					
6.01	Large Multi Purpose	330 Dining or 650 Lecture	1	5,700	5,700	
6.02	Stage	With A/V equipment	1			
6.03	Storage	storage	1	400	400	
	Subtotal					**6,100**
12.00	**Bookstore**					
12.01	Bookstore		1		3,400	
	Subtotal					**3,400**
13.00	**Admin. Offices**					
13.01	Director / Ast. Director		1		0	
13.02	Student Affairs Administration	Building manager	1	120	120	
	Reception/Secretarial Area		1		0	
	Subtotal					**120**
14.00	**Support Space**					
14.01	Maintenance		As Required			
14.02	Building Storage		As Required			
14.03	Truck Docks		As Required			
					0	**0**
	Total Net SF Building					**28,220**
	Gross SF Building	**Factor of 1.6**				**45,152**