PROJECT PLANNING REPORT

FOR THE

CHEMISTRY

RESEARCH AND INSTRUCTIONAL LABORATORY

REVITALIZATION

IN THE LASH MILLER BUILDING

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I EXECUTIVE SUMMARY

This project will renovate existing laboratory space in the Lash Miller Chemical Laboratories to create a suite of laboratories in Materials and Catalytic Chemistry. The facilities are required to accommodate increased numbers of graduate students and postdoctoral fellows and their research and will also include a molecular imaging facility with clean room and related laboratories.

The Catalytic and Materials Chemistry project will involve major renovation of 1 543 nasm of existing laboratory space in the Lash Miller Chemical Laboratories to create a suite of labs that will substantially enhance the department's discovery, training and innovation capacity. Features of the revitalized chemistry labs include:

- Creation of 3 Spin-off Initiator labs
- Renovation of multiple materials chemistry research and technology development laboratories, including:
    - Addition of helium recovery systems to the NMR Facility;
    - Addition of technology and safety enhancements to the machine and glass support shops;
- Upgrade of electrical/mechanical systems to enhance function and sustainability;
- Renovation and consolidation of cluster/unix facility for enhanced efficiency of operations;
- Winterization of chilled water lines to increase for enhanced year-round energy utilization;
- Removal of all remaining asbestos;
- Renovation of research, financial, and student support facilities;
- Upgrade of existing air handling systems to more energy efficient and sustainable units

Improvements will also be made to upgrade and repair facilities for air handling, climate, and electrical systems in the Lash Miller building which is now over 45 years old. The renovations will be designed to create laboratories that respond to research initiatives in the 21st century and will address basic infrastructure improvements to systems which are currently overloaded and inefficient.

The total projected cost of the renovation is $8.0 million

This project is being submitted under the Federal Knowledge Infrastructure Program, identified as the St George Laboratory Revitalization for Physics and Chemistry. The Ontario government, in its budget of March 26, 2009, affirmed commitment to matching federal capital infrastructure investments in the Knowledge Infrastructure Program.

II PROJECT BACKGROUND

a) Membership:

Prof. Scott Mabury, Chair, Department of Chemistry
Mike Dymarski, Chief Technical/Administration Officer, Department of Chemistry
Leo Mui, Graduate Student, Department of Chemistry
Alex Tevlin, Undergraduate Student, Department of Chemistry
Adrienne De Francesco, Assistant Dean & Director of Infrastructure Planning, Faculty of Arts & Science
George Phelps, Manager, Design and Engineering, Real Estate Operations
Bruce Dodds, Director of Utilities, Facilities and Services
Christine Harvey-Kane, Planner, Campus and Facilities Planning

b) Terms of Reference:

1. Make recommendations for a detailed space program and functional layout for the suite of facilities and related support in the Lash Miller Building addressing the research requirements of Materials and Catalytic Chemistry.

2. Demonstrate that the proposed space program is consistent with the Council of Ontario Universities' and the University's own space standards.

3. Identify items of deferred maintenance that should be addressed concurrently with this renovation.

4. Identify all secondary effects, including space reallocations from the existing site, impact on the delivery of academic programs during construction and the possible required relocation of existing units if required.

5. Identify equipment and moveable furnishings necessary to the project and their estimated cost.

6 Identify all data, networking and communication requirements and related costs.

7. Identify all security, occupational health and safety and accessibility requirements and related costs.

8. Determine a total project cost estimate (TPC) for the capital project including costs of implementation in phases if required, and also identifying all resource costs to the University.

9. Identify all sources of funding for capital and operating costs.

10. Complete report by May, 2009.

c) Background Information:

The Department of Chemistry is located in the Lash Miller Building at 80 St. George Street, on the St. George campus.

The space identified for this project includes research space, common support facilities, graduate research lab space, and office/meeting areas. There is also a demand to upgrade and repair air handling, climate, and electrical systems which, original to the building, are now over 45 years old.

The Molecular Imaging Facility will take advantage of the early lead the Miller group has in atomic level imaging, using unsurpassed electron source brightness to put Canada in a world leading position in the newly emerging field of atomically resolved structural dynamics. The prospects for significant technological spinoffs from this facility are high both in terms of instrumentation to drive the revolution in atomic level imaging, and new insights into structure-function correlations at the atomic level of inspection - the fundamental limit to nanotechnology.

The Molecular Imaging Facility, once built, will be dedicated to advancing a major technological breakthrough in high brightness electron sources (10,000,000x) made at the University of Toronto that now makes it possible to directly watch atoms move in real time. The Facility will make use of innovative electron microscope and laser technology under development.

The Chemistry Spinoff Initiator labs will provide three strategically designed labs to “pre-incubate” spinoff companies generated by discoveries originating in faculty research labs. These labs will provide a bridge between start-up company and full-fledged, viable competitor in the research field.

The Chemistry Department will renovate existing laboratory space (1,543 nasm) in the Lash Miller Chemical Laboratories (circa 1963) in order to create a suite of Research Lab Facilities and labs that will substantially enhance the department’s discovery, training, and innovation capacity. Specifically, Chemistry will create state-of-the-art research labs in Materials and Catalytic chemistry, to leverage the significant expansion in these areas. Recent success in high-level faculty recruitment has yielded substantial increases in industry support for this critical area of research. This has resulted in a burgeoning graduate student and postdoctoral fellow hiring necessitating renovation of “old labs” to house these personnel and their research.

The renovations include the removal of asbestos and new electrical and mechanical services for new fume hoods. Energy efficient engineering and initiatives will be undertaken where possible.

Finally, the Department will renovate and repair facilities directed at enhancing research operations, student training and support.

The Chemistry Department will renovate and re-allocate existing space assigned to laboratory support. The Glass Blowing shop will be renovated to increase safety and create better space utilization. The Lab Services Machine Shop will be renovated in much the same way as the Glass Blowing shop, with the objective of increasing safety and space utilization. Both these areas will enjoy better traffic flow and thus more efficient operations once the renovation is complete.

New graduate and PDF research desks/offices (within the research labs) will be created to house a growing complement of graduate students, and to allow for active and easy collaboration between students.

d) Statement of Academic Plan:

In brief, Chemistry's academic plan over the past five years has been geared towards optimizing the learning, teaching, and discovery mission of the department.

Over the past five years, there have been eleven new faculty hires covering all the major sub disciplines in Chemistry including five Canada Research Chairs. Significant resources were directed towards supporting these faculty in launching their research and teaching careers. The function and support for all faculty was improved through directed enhancement of the support infrastructure (for example 929 nasm of renovations for new NMR and Mass Spec facilities) with strategic hiring of technical staff. Chemistry has also specifically supported a number of faculty spin-off companies to provide the necessary "pre-incubation" period necessary for successful technology transfer into the market place. During the same period Chemistry has managed the double cohort bulge while simultaneously enhancing overall quality of learning through the renovation of our teaching labs and directed improvements to our undergrad curriculum (new courses created and tired courses deleted). The teaching faculty (Lecturers and Senior Lecturers) have been supported via start-up packages (new hires), access to annual Request for Proposals for teaching equipment, expansion of participation in undergraduate research, and a concerted move to enhance collaboration and expertise exchange with tenure stream faculty. The technical and administrative staff have been given ever increasing responsibilities and opportunities to direct their area of activities.

The success of these endeavours is captured in the output metrics best correlated with positive impacts including: research faculty garnering more external awards and research funding than ever before; teaching faculty publishing more chemical education articles than the entire department did in the previous 100 years; multiple faculty spin-off companies successfully moving out into the commercial world. Chemistry has achieved an all-time high in the number of chemistry majors/specialists; exceeding earlier projections of numbers and quality of graduate students; and an ever increasing quality of service provided by support staff despite budget challenges.

The current challenge is to ensure that the physical infrastructure (the Lash Miller building) is working as efficiently and effectively as students, staff, and faculty. However, much of the building remains underutilized and in need of renovation. This project will yield substantial, sustained, and direct benefits to enhancing the mission of learning, teaching, and discovery within the Department of Chemistry.

Undergraduate Student Growth:

Phase I and II (recently completed) of the teaching lab renovations (total 3,344 nasm @ $10M) provides spectacular lab teaching space that would be required for any future growth in the Chemistry program. Chemistry is currently making efforts to increase enrolment in the undergraduate chemistry courses to take advantage of the capacity in both teaching complement and lab infrastructure. The lab teaching space is currently utilized by Engineering to teach a number of their courses. In the future, it may be the case that chemistry labs taught in the Faculty of Engineering will migrate to being offered in the Faculty of Arts and Science (FAS) through the Department of Chemistry; this would be consistent with the usual practice of chemistry being taught in most Faculties of Engineering. Chemistry has the capacity, in both human and lab infrastructure, to handle a significant increase in student numbers.

Graduate and Postdoctoral Students Growth:

Since the base year of 2004/05, Chemistry has grown its graduate program more than any other department in FAS with 72 additional BIU funded cohort students. The total of approximately 250 graduate students overall, currently in the program, is heavily weighted towards PhD students (~80%) over MSc. Future growth will be more modest but success of recent hires in garnering

external grants/contracts support is substantially more significant than earlier generations of faculty. This has lead to aggressive recruitment with the current yield of acceptances running over 90% for the cohort of early admissions, compared with 80% last year at this time. In short, Chemistry expects the graduate student population to continue to rise in lock-step with faculty success at raising the necessary support funds.

Chemistry currently has ~100 PDFs and Research Associates, a number that has stayed fairly consistent even while the graduate student numbers rose by ~50%. It is likely these numbers will stay relatively constant unless the supply of quality graduate students is compromised.

Faculty Growth:

Chemistry has added 11 new faculty to the St. George complement over the past five years, putting the department at near full complement, with most future hires likely to be linked to formal retirements. An emeritus suite completed last year will facilitate the transition of these into a reduced activity state while vacated lab space will be allocated to new hires. The building currently utilizes all available and usable lab space to full capacity. The challenge is that nine of the new faculty hires are all young assistant professors who have career trajectories that are expected to involve significant success in external grant and contract activities. These financial resources will result in ever more growth in graduate and post-doctoral student numbers and thereby more pressure on the available lab space as well as support facilities such as the Glass and Machine Shops. Thus, the need for more and better space will largely be driven by success and efficiency of the existing faculty complement, rather than by any effort to substantially increase faculty numbers. This is the model followed by Chemistry for at least the last three planning cycles.

e) Space Requirements

The Department of Chemistry currently occupies 15,898 nasm within the Lash Miller building. The planned renovations of 1,543 nasm do not increase the overall inventory of the Department, but rather provide upgraded, functional space. The project proposes significant renovations within the existing facility that will re-assign the spaces to better serve current and future needs.

III PROJECT DESCRIPTION

a) Vision Statement

This project will upgrade old and poorly functioning labs, administrative and technical support facilities, and building-wide mechanical and electrical systems. Creation of upgraded research and technology development labs and support facilities will contribute to a more efficient and productive use of space as well as provide room to expand student enrolments. Creation of "pre-incubator" labs for faculty spin-off companies will facilitate transfer of discoveries to the market-place. Upgrades focused on sustainability and enhanced energy efficiency will optimize operational expenditures.

The space program is presented below by floor, however individual components have been costed separately. There are three broad groupings; Research and Incubator Lab renovations, Departmental Research Services Renovations, and Building Infrastructure Renovations. These are separately indentified in Section IV, Resource Implications

b) Space Programme

Basement – 632 nasm

The facilities to be renovated in the basement of the Lash Miller Building, covering 632 nasm, are in many cases original to the building, and inadequate to support the research needs of modern chemistry research.

Renovations in the basement of Lash Miller include the creation of one of three incubator labs (63 nasm), which will provide designated space to ‘pre-incubate’ spinoff companies which have been generated by discoveries originating in faculty research labs. These incubator labs will provide the space required for small start-up companies to grow into full fledged, viable competitors in the research field.

Portions of the basement provide support to research and teaching labs alike. These spaces include the Machine Shop (248 nasm) and Glass Blowing Shop (79 nasm). These areas will be upgraded to increase traffic flow and safety for those who work within these areas. Connections will be made in order to create contiguous space, and to provide dedicated traffic flow between rooms.

The existing server room (78nasm) will be relocated to the basement into space deemed unsuitable for lab use. The server room will be provided with adequate cooling, and space to support not only the Chemistry servers, but possibly the servers of other FAS departments as the need arises.

Chemistry will also create two of three state of the art research labs in Laser Based Chemistry in the basement of the Lash Miller building, as part of a suite of research lab facilities. There have been of late substantial increases in industry support for this type of research and the growth in research, funding and student interest has necessitated the growth in labs as well.

Rooms 40-43, 46-52

First Floor - 302 nasm

The first floor is home to the departments’ administrative offices. These areas are heavily utilized by students, staff, faculty and visitors to the Chemistry department, and should reflect the caliber

of research and teaching which occurs within the department. These spaces are mostly original to the building, and are woefully in need of both aesthetic and functional upgrades. Renovated spaces will include the Business Office Suite (82 nasm), Faculty Administrative Suite (144 nasm) and Faculty Meeting/Conference Room (76 nasm).

The Business Office suite houses the administrative staff of the department. The renovation seeks to provide open, modern space, which will encourage collaboration between members of the Business Office. The current office space will be completely renovated and re-worked to enhance the operational and aesthetic functionality of the spaces.

The Chair, Undergraduate and Graduate Chairs all reside within the Faculty Administrative Suite. Open, flexible space will be created to house these functions. Although privacy is required for some services provided to students, the visual aesthetic of the space will be one of openness and collaboration

In addition to these functions, a large meeting conference room will be created to be shared by the department. This space will provide enhanced meeting functions, audio-visual capabilities, and hospitality services.

Rooms 125-128, 150-154B

Second Floor – 162 nasm

The second floor provides another opportunity to renovate and upgrade one Laser Based Chemical Research Lab, described above, for a total area of 162 nasm. The department has a number of existing old, outdated laboratories which must be brought up to modern standards in order to provide the infrastructure and functionality which is demanded by high caliber researchers today.

This research laboratory will also include an environmental enclosure, regulated for temperature, humidity levels, and providing a 'clean' environment, required by this type of laser research.

Included in the renovations is sit-down work space for graduate students, which affords these students quiet desk space away from the laboratory benches for scholarly writing and thesis work.

Rooms 242, 244, 249

Fifth Floor – 103 nasm

An Inorganic Synthesis Lab (103 nasm) is planned for the fifth floor, to replace an antiquated lab. This lab, along with an associated instrument room, will provide much needed research space to young faculty members who are eager to get their research underway.

An area will be provided for graduate students to use for quiet study or computer-based work away form the lab benches, and a meeting room/group study room will be provided adjacent to the research lab.

A faculty office which will be designated to the researcher in charge of this lab is included in this suite.

Rooms 517-518

Sixth Floor – 344 nasm

The requirement for research lab space and incubator lab space continues to the sixth floor, where one fume hood heavy Polymer Synthesis lab (200 nasm) and two additional incubator labs (total 144 nasm) will be housed.

These labs will be designed to echo closely the same design as what has been described above, and will provide both state of the art research and incubation space for spin-off companies.

Rooms 607-608A, 615-616A, 619, 619A, 628, 632-633

Building Infrastructure Renovations

There are four areas of anticipated building infrastructure renovations.

Firstly, there are four different types of air extraction systems in the Lash Miller building ranging from original to the building (1963) to recent major renovations (2004). The building is a significant consumer of power and energy. The different mechanical systems are well suited to upgrades which would reduce overall energy consumption. These upgrades include: a setback system for the air distribution serving undergraduate teaching labs during off hours; the potential ganging of the exhaust system in research labs to exhaust through two to four strobic fans; and the redistribution of conditioned air from office areas to lab areas.

Additionally there are opportunities for heat recovery projects either separate from air distribution/handling projects or in combination.

These two types of renovations require feasibility assessment to make sure the projects will yield expected results and that funds needed are commensurate with outcome. Two of these projects are currently being assessed by independent mechanical engineers.

There are two other important areas of building infrastructure renovations.

Basic infrastructure improvements to systems which are at or beyond life span include: chilled water; transformers, switch board and high voltage switch gear; and compressed air.

Lastly, asbestos removal, repairs to stairwells and shipping/receiving areas, door replacement and general painting are areas which need to be addressed.

These infrastructure renovations will require a comprehensive building schedule identifying work and activities to be done.

Chemistry Research & Instructional Laboratory Revitalization
Space Program

Floor	# Rms	Room Use	Nasm Per Room	Total Nasm
Basement				
	1	Glass Blowing Shop	79	79
	1	Machine Shop	248	248
	1	Server Room	78	78
	3	Laser based Chemical Research Labs	varies	164
	1	Incubator Lab	63	63
				632
First Floor				
	1	Business Office Suite	82	82
	1	Faculty Meeting/Conference Room	76	76
	1	Faculty Administrative Office Suite	144	144
				302
Second Floor				
	2	Laser based Chemical Research Labs	81 (avg)	162
Fifth Floor				
	1	Inorganic Synthesis Research Lab	103	103
Sixth Floor				
	1	Polymer Synthesis research lab	200	200
	2	Incubator Labs	72 (avg)	144
				344
Total nasm				1,543

c) Building Considerations

Mechanical/Electrical and Data

To support the type of research that occurs in the Lash Miller building, the current aging and inefficient infrastructure needs to be repaired and upgraded to deliver a more sustainable foundation for operations, with reductions in operating costs (energy and maintenance) and Chemistry's carbon footprint. Currently under consideration is the feasibility of replacing 180 existing emissions stacks with four high-velocity air handlers combined with energy recovery technology.

Accessibility, Access and Security

The University of Toronto is fully committed to ensuring that its buildings and services are accessible to persons with disabilities. Although existing buildings regulations (Ontario Building Code) clearly define the minimally acceptable level of accommodating persons with disabilities, the design team must consider reasonable enhancements in their design wherever possible,

Because of the diverse nature of the Chemistry Departments activities, the design must be sensitive to the needs of each specific user; research laboratories and support areas will have hours of operation that not only restrict access by the general public but also limit access to specific building users, while the Incubator labs may require restricted access to all but those who are directly a part of the specific incubator lab.

Facility Condition and Assessment

The Lash Miller building is in the highest tier of energy usage per unit area of buildings on campus, and is also a major user of water. Any changes planned for this building should make reduction of these expensive resources a priority.

It is understood that the Faculty of Arts and Science's ambition is a number of laboratory renovations. There is also a desire to incorporate changes to the HVAC system that will result in significant improvements to the energy use in the building. A study of the feasibility of a number of possible schemes is currently underway by an engineering consultant.

Hazardous Materials

A summary of the presence of asbestos containing materials is included as an Appendix ( ). Detailed information can be obtained from the University's asbestos inventory system upon request. Prior to planning any renovation or demolition project, a pre-construction survey must be carried out.

Heating, Ventilation and Air Conditioning Systems

Depending on the outcome of the engineering studies for energy conservation proposals now in progress, and the extent to which the HVAC systems will need to be re-worked as a recommendation for those reports, additional deferred renewal items should also be included in the work of the main project:

- Replace all of the chilled water coils in the main air handlers
- Replace the fume hood fans affecting the areas under renovation
- Overhaul the pneumatic controls affecting those same areas

Plumbing

It is assumed in the course of the laboratory renovations, that local plumbing will be replaced or modified. No other plumbing issues have been noted requiring re-work.

Electrical Power

Within the last two years, the source of the chilled water used for air conditioning the building was changed from a plant inside the Lash Miller Building to the central plant at the Bahen Centre. The old chillers were removed, freeing up additional power capacity.

The transformers, switchboard and high voltage switchgear as well as the distribution panels are original equipment. While there may be a few years of service left before replacement becomes

a priority, the extent of the renovations planned may require replacement of some or all of these components at this time.

Fire Prevention

Sprinkler protection will be required by Building Code for any areas undergoing major renovation. Currently, sprinkler protection is limited to the sub-grade areas, and the new floors of the Davenport wing.

Elevators

No elevator issues will impact this renovation

Building Fabric/Envelope

The roof should be replaced in conjunction with the work of the renovation project, along with the installation of roof anchors. It is assumed that the laboratory renovations will include interior painting.

d) Environmental Impacts

The University of Toronto is strongly committed to the development and maintenance of exemplary strategies that are aimed at enhancing not only the campus but also the global environment. This commitment is set out in the University's *Environmental Protection Policy*, dated 7 March 1994 (Appendix C).

On campus, buildings represent the single most important element that affects the environment; they give it a recognizable form and are major consumers of natural resources in their construction and operation. Building design professionals have an inherent responsibility to foster good environmental practices as do building users and University administrators.

In order to encourage building designs that meets the University's environmental policy, an environmental section has been incorporated into the University's *Design Standards Manual*. This section obligates the design team to adhere to a set of environmental design principles which will be followed as each component part is completed.

e) Schedule

This project will proceed with implementation once funding commitments are in place. The project will be materially complete by December 31, 2010.

IV RESOURCE IMPLICATIONS

a) Total Project Cost Estimate

The total project cost estimate (TPC) for the project is $8.0 M, which includes estimates or allowances for:

- Construction costs (assuming lump sum type of tender to qualified general contractors in the month of May/09)
- Contingencies
- Taxes
- Hazardous waste removal
- Demolition
- Decommission of labs being vacated
- Permits and insurance
- Professional fees, architect, engineer, misc. consultants (LEED, etc.), project management
- Computer and telephone terminations
- Furniture and equipment
- Miscellaneous costs (signage, security, other)
- Commissioning
- Escalation

Excluded:

- Moving and staging,

The total project cost has been identified as follows:

1. Research and Incubator Laboratories Renovations	
Inorganic Synthesis Research	$331,750.00
Polymer Synthesis Research	$495,100.00
Laser Based Chemical Research - 1	$481,100.00
Laser Based Chemical Research - 2	$284,500.00
Laser Based Chemical Research - 3	$141,000.00
Incubator Laboratory A,B,C	$715,000.00
Total	**$2,448,450.00**

2. Department /Research Services Renovations	
Department Offices	$408,600.00
Machine and Glassblowing Shops	$386,000.00
Faculty Meeting/Conference Room	$292,680.00
Department Computer Server Room	$126,600.00
Miscellaneous labs & rooms in Lash Miller (loading dock, LM 30, stairwells, and some labs needing minor refinishing upgrades, etc)	
L.S.	$175,000.00
Total	**$1,388,880.00**

3. Building Infrastructure Renovations	
Extend Chilled Water Cooling; Laboratory Heat Load Rejection	
Remove Remaining Asbestos; Corridor Ceiling and Floors	
Upgrade Building Electrical Transformer	
Replace Building Air Handling Systems; Feasibility/Costing Study	
Upgrade Building Compressed Air System to Support Research Labs	
Renovate Degraded Steps and Paint Walls in All Stairwells	
Replace Degraded Doors and Paint All Room Doorframes	
Renovate and Upgrade Shipping/Receiving Area.	
Allowance for Three	**$4,162,670.00**
Lecture Hall Upgrade	TBA*

*Under spending from the projects will be directed to classroom improvements. The classroom improvements will be determined together with the Office of Space Management, once available funding has been identified.

Total Estimated Project Cost	**$8,000,000.00**

b) Operating Cost

The project incorporates energy saving initiatives with increased usage. It is anticipated therefore, that the operating costs will remain the same, i.e. that the increased usage will be offset by energy saving measures.

c) Funding Sources

This project is being submitted under the Federal Knowledge Infrastructure Program, identified as the St George Laboratory Revitalization for Physics and Chemistry. The Ontario government, in its budget of March 26, 2009, affirmed commitment to matching federal capital infrastructure investments in the Knowledge Infrastructure Program.

V RECOMMENDATIONS

It is recommended that the Planning and Budget Committee recommend to the Academic Board:

1. THAT the Project Planning Report for the Chemistry Research and Laboratory Revitalization Lash Miller Building be approved in principle.

2. THAT the project scope of 1,540 nasm of renovations be approved in principle at a cost of $8 million, subject to the receipt of funding.

APPENDIX A

TOTAL PROJECT COST ESTIMATE

(On Request to Limited Distribution)

APPENDIX B

DETAILED PROJECT SCOPE AND DESCRIPTION

1.0 Research and Incubator Laboratories Renovations

1.1 Rooms LM 517/517A/518; Inorganic Synthesis Research

Scope of Project

The purpose of this Project is to provide renovated laboratory space and offices for inorganic synthesis research using existing laboratory space in Lash Miller.

- Room LM 518 is an 82.2 nasm room that will be renovated for research lab use.
- Room LM 517 is a 10.6 nasm entry office that will be used for research group meetings.
- Room LM 517A is a 10.2 nasm inner room that will be used as a faculty office.

This renovation will include asbestos removal, chemical decontamination and removal of existing fume hoods, and demolition of laboratory benches and aged electrical and mechanical support utilities.

The renovation will include new electrical and mechanical services for six energy efficient fume hoods and two benches with inert gas supply lines and tie-ins to existing exhaust ducts. In addition, study and work space is required for six graduate students. This lab renovation will incorporate energy efficiency by using a cascading air supply from the office space one floor below as well as energy efficient lighting and air distribution.

Phasing Plans & Staging of Work

Space is currently empty having been vacated last year upon retirement of a faculty member, and has been demolished

1.2 Rooms LM 607/608/608A/616/616A/628; Polymer Synthesis Research

Scope of Project

The purpose of this Project is to provide renovated laboratory space and offices for Polymer Synthesis Research.

- Room LM 607 is a 33.8 nasm cold room facility that will be de-commissioned and combined with LM 608 to form a 58.3 nasm research laboratory.
- Room LM 608A is a 19.2 nasm office that will be used for study space for six graduate students.
- Room LM 616 is a 21.1 nasm entry office that will be used for group meetings.
- Room LM 616A is a 19.1 nasm inner room that will be used as a faculty office.
- Room LM 628 is an 82.2 nasm laboratory that will be used as research and analytical instrument space as well as study space for four graduate students.

This renovation includes asbestos removal, the chemical decontamination of the existing cold room exhaust and fume hood, removal of fume hoods and the demolition of cinder

block non support walls, laboratory benches and aged electrical and mechanical support utilities.

The renovation will include new electrical and mechanical services for 10 energy efficient fume hoods, two glove boxes and four laboratory benches, including inert gas supply, vacuum lines and tie-ins to existing exhaust ducts. In addition, study and work space is required for 10 graduate students in LM 608A and LM 628. This lab renovation will incorporate energy efficiency by using a cascading air supply from the office space to the east as well as energy efficient lightening and air distribution. The de-commissioning of the cold room has been calculated to save the Faculty $8,000 - $10,000 per annum in electrical utility costs.

Phasing Plans & Staging of Work

Rooms 607, 608, 608A are currently empty. In preparing for the arrival of a new faculty member in polymer chemistry, occupants were moved to other lab space on the sixth floor. The space is being disassembled. LM 616, 616A are the inner and outer office/lab of an emeritus faculty member who will be allocated an office in the “emeritus suite” also located on the sixth floor. The 616/616A complex is included in the planning for this renovation.

Also included in Project 1.2 is lab LM 628, currently occupied by Opalux, a spin-off currently pre-incubating in this old lab. Opalux personnel will be moved by the end of April 2009 to an unused teaching lab for the summer months pending renovation of LM 49 (Project 1.6). If that lab is not completed in time then Opalux will need to move off-site pending completion. LM 628 will then be demolished, and the project combined with the construction taking place in 607, 608, 608A, 616, 616A.

Project Schedule

This Project is in the planning stage and will be completed within the next five months.

1.3 Rooms LM 46/46A/47/48; Laser Based Chemical Research

Scope of Project

The purpose of this Project is to provide renovated laboratory and graduate student study space for laser based chemical research using existing laboratories and office space in Lash Miller.

- Room LM 46 is a 23.9 nasm wet laboratory that will be renovated to provide support laboratory space to activities in LM 47/48.
- Room LM 46A is an 18.3 nasm office that will be used for graduate student study space.
- Room LM 47/48 is a combined 82.2 nasm space that will be renovated to contain a state-of the-art laser based research facility complete with a 50 nasm enclosure to house the laser under controlled conditions of temperature, humidity and particulate.

The renovation of these spaces will include asbestos removal, chemical decontamination and removal of two existing fume hoods, and the demolition of a cinder block non support wall, laboratory benches and aged electrical and mechanical support utilities.

The renovation work will include new electrical and mechanical services suitable for a small laboratory. LM 46 will contain one energy efficient fume hood and two laboratory benches with inert gas supply, vacuum lines and tie-ins to existing exhaust ducts. LM 46A will be

renovated as graduate student study and work space suitable for five graduate students. The lab renovation will incorporate energy efficiency in air distribution and lighting. .

Phasing Plans & Staging of Work

These labs (46, 46A, 47, 48) functioned as part of the "old NMR labs" and were vacated in Fall 2009, upon completion of the new NMR Lab. Minor demolition and asbestos removal will be required. This lab will need to be completed in summer 2009 as individuals located in LM 242, 244, 249 (Project 1.4) will move here in part, while that project is staged and completed.

Project Schedule

This Project will be completed within five months of the start date.

1.4 Rooms LM 242/244/249; Laser Based Chemical Research

Scope of Project

The purpose of this Project is to provide renovated laboratory and graduate student study space for laser based chemical research using existing laboratories and office space in Lash Miller.

- Room LM 242 is a 40.4 nasm room that will be used for student study space for 10 -12 graduate students.
- Room LM 244 is a 40.4 nasm room that will be renovated to contain developmental laser research facility.
- Room LM 249 is an 82.2 nasm space that will be renovated to contain a state-of the-art laser based research facility complete with an enclosure to house the laser under controlled conditions of temperature, humidity and particulate.

These renovations will include asbestos removal, the chemical decontamination and removal of two existing fume hoods, laboratory benches and aged electrical and mechanical support utilities.

Work will include new electrical and mechanical services, two energy efficient fume hood and laboratory benches with inert gas supply and vacuum lines and tie-in to existing exhaust ducts. LM 242 will be renovated to become graduate student study and work space suitable for 10-12 graduate students. The lab renovation will incorporate energy efficiency in air distribution and lighting.

Phasing Plans & Staging of Work

This space requires complete demolition and asbestos removal. Individuals (students, PDFs, research associates), currently in this space, will move to the Project 1.3 labs and/or to physics labs (Miller is jointly appointed to physics/chemistry). Project 1.4 will not be started until Project 1.3 is completed

Project Schedule

This Project will be undertaken in 2010 and will be completed within six months of the start date once Project 1.3 renovations have been completed.

1.5 Room LM 43; Laser Based Chemical Research

Scope of Project

The purpose of this Project is to provide renovated laboratory space for chemical laser based research using existing laboratory space in Lash Miller.

- Room LM 43 is a 40.8 nasm room that was part of the suite of rooms in the former Nuclear Magnetic Resonance facility.

The renovation of these spaces will include asbestos removal, chemical decontamination and removal of one existing fume hood, laboratory benches and aged electrical and mechanical support utilities.

The renovation work will include new electrical and mechanical services one energy efficient fume hood and one laboratory bench with inert gas supply, vacuum lines and tie-ins to existing exhaust ducts.

Phasing Plans & Staging of Work

This space (LM 43) is currently vacant since it was part of the NMR lab. It will be fitted out with instruments obtained through a Leader Opportunity Fund-CFI proposal.

Project Schedule

This Project will be undertaken in late 2009 and will be completed within six months of the start date.

1.6 Rooms LM 49/615/632/633/633A; Incubator Laboratory A,B,C

The purpose of this Project is to provide renovated laboratory space for Chemistry research groups and designated as Incubator Laboratories A, B and C. The renovation required for each space, the phasing and staging of work and the project schedule is as follows:

1 Incubator Laboratory A: LM 49
- Room LM 49 is a 63.3 nasm room. This renovation includes asbestos removal, removal of laboratory benches and aged electrical and mechanical support utilities. The renovation work will include new electrical and mechanical services contain three energy efficient fume hoods and two laboratory benches with inert gas supply, vacuum lines and tie-ins to existing exhaust ducts.
- LM 49 is currently vacant (previously the NMR lab) and thus can begin renovations immediately.
- The estimated time to complete the work is four months.

2 Incubator Laboratory B: LM 615
- Room LM 615 is a 63.2 nasm room. This renovation includes asbestos removal, chemical decontamination and removal of two fume hoods, laboratory benches and aged electrical and mechanical support utilities.
- The renovation work includes new electrical and mechanical services for two energy efficient fume hoods and two benches with inert gas supply lines and tie-ins to existing exhaust ducts. In addition study and work space is required for two to three researchers.

- LM 615 is currently occupied by Tidwell (emeritus) with a part-time senior research associate and a small spin-off company. The plan is for 1.6-2 to be completed ahead of 1.6-3 and thus current activities will move to LM 632/633/633A once it is completed to allow conversion of LM 615.
- This Project will be undertaken as a priority once funding has been secured. The estimated time to complete is six months.

3 Incubator Laboratory C: LM 632/633/633A

- Room LM 632,633 and 633A are 40.5 nasm, 21.2 nasm, and 19.2 nasm respectively.
- This renovation includes asbestos removal, chemical decontamination and removal of the existing fume hoods, laboratory benches and aged electrical and mechanical support utilities. The removal of the cinder block non-support walls will result in one single 82.3 nasm laboratory.
- The renovation work includes new electrical and mechanical services for three energy efficient fume hoods and two benches with gas supply lines and tie-ins to existing exhaust ducts. In addition study and work space is required for two to three researchers
- LM 632, 633, 633A are currently occupied. LM 632 is intermittently used partially as an instrument room. LM 633 and 633A currently house the departments' servers. The servers will be moved to LM 65 which will be renovated and upgraded as part of Project 2.4 and will need to be completed ahead of 1.6-2. Current activities in 632 will be move to 615 until 1.6-2 is completed
- This Project will begin after the Department computer servers presently located in LM 333 and 633A are moved to LM 65. This is defined as Project 2.4. The estimated time to complete is eight months.

Note: any activities currently in 615, 632 may be located elsewhere in the Lash Miller Building or suspended pending completion of renovations as required.

2.0 Department /Research Services Renovations

2.1 Rooms LM 150A/150B/151/151A/152/ 153/153A/LM154/154A/154B; Department Offices

Scope of Project

The purpose of this Project is to renovate and upgrade administrative office space in the Department to improve the services provided to Faculty, Staff and Students.

This renovation includes the offices of the Administrative Assistant to the Chair, the Undergraduate Chair and associated staff, the Graduate Chair and associated staff, the Chief Administrative Officer and Assistant, the Chief Financial Officer and associated staff and the Department reception area. In total, this renovation will provide office space for thirteen administrative faculty and staff and increase office space from eight to eleven rooms.

1: Business Offices: LM 154/154A/154B

- Combined, this space is 82.2 nasm.

- Reorientation of the offices along the windows and the incorporation of glass and energy efficient lightening allows for a brighter more inviting environment in which to work and conduct business.
- This project has started and will be completed within one month. Staff has been relocated in Temporary offices in LM 119 and LM 340.

2: Faculty Administrative Offices/Reception: LM 150/151/152/153

- Combined, this space is 144 nasm.
- Reorientation of the offices along the windows and the incorporation of glass is planned where practical.
- There is a need for privacy in providing services to students, and this concept will be incorporated into the design.
- Temporary office space will be used in LM 128 and LM119 during this renovation.

Phasing Plans & Staging of Work

The full suite of department offices is divided into two main groups: business office (154, 154A, 154B) and chair, undergrad, grad (150, 151, 153). The Business office is currently being renovated and will be completed by the end of April/early May 2009.
The staging of these office renovations will require office space be found, elsewhere in the building, to accommodate six staff, the chair and two associate chairs. It is possible (LM 149) will remain functional for much, and perhaps all of the renovations. Significant renovations are required for the rooms bounded by 153, 151, and 150) which encompass the two associate chairs. The office renovations should occur during the summer months to interference with departmental support functions during critical periods.

Project Schedule

tbd

2.2 Rooms LM 40/41/42/51/52/53; Machine and Glassblowing Shops

Scope of Project

The purpose of this Project is to renovate and upgrade the Department Machine and Glassblowing Shops to improve the safety for our staff, and provide better service to Faculty, Staff and Students.

1: Machine Shop: LM 52/53/54

- The present machine shop consists of rooms LM 52 and 53 and combined provides 208 nasm.
- Purchase of additional machinery and equipment over the past 5 years has led to a crowded condition that is somewhat inefficient and increases the risk for injury.
- The importance of this facility to both the chemistry department and other departments on campus has been demonstrated.
- The addition of LM 51, providing 40 nasm to this shop would allow for a better layout of the machinery and lower the risk potential.

2: Glassblowing Shop: LM 40/41/42

- This current Glassblowing Facility consists of rooms LM 40 and 41 and is 60.2 nasm.

- Additional space is required to relocate equipment for more efficient operation and to improve staff worker safety.
- Additional storage space is planned in LM 42; 19.6 nasm to be able to store glass stock and supplies and space to relocate a liquid oxygen Dewar system away from the open flames associated with glassblowing operation in LM 40.
- An oxygen generator is being considered to replace the liquid oxygen system.
- An interior passageway connecting LM 40 to LM 42 would be added for access.

Phasing Plans and Staging of Work

Machine and Glass shops are currently occupied by five machinists and two glassblowers. The Machine Shop will expand into LM 50(currently vacant). Any renovations (e.g. removal of asbestos, painting, space upgrades) will require scheduled work stoppages to coincide with scheduled joint vacations since work and equipment are inherently difficult to relocate. The Glass Shop will expand into LM 42, currently vacant, and work in the Glass Shop will be scheduled to occur during vacation periods.

Project Schedule

tbd

2.3 Rooms LM 125/126/127/127A/127B/128; Faculty Meeting/Conference Room

Scope of Project

LM 128 is a 40.9 nasm room. The purpose of this Project is to renovate and expand LM 128 to a more functional Faculty meeting/seminar room to better serve the needs of a larger chemistry Department. The plan involves the removal of interior non-support cinder block walls to the east to increase the total area to 76.3 nasm, add a small kitchen and exterior access to the courtyard lobby area. This would require relocation of the mailroom; LM 127A; 6.8 nasm, the department photocopier room; LM 125; 16.5 nasm and several small achieve storage rooms; LM 126, LM127 and LM 127B; 12.8 nasm.

Phasing Plans and Staging of Work

The current meeting/seminar room (128) will be removed from use during the renovations. The meeting/seminar room will be expanded to include 125, 126, and 127 which currently function as the mailroom, one photo-copy machine, and departmental archive space. These three functions will be located elsewhere in the building in currently underutilized space. This space will be renovated during the summer months coinciding with other renovations to nearby offices.

Project Schedule
tbd

2.4 Room LM 65; Department Computer Server Room

Scope of Project

LM 65 is a 78.4 nasm room. This space is not considered suitable for laboratories or offices due to its location and inadequate support services. The purpose of this Project is to renovate this space to accommodate a move of the Department computer facilities which are presently located in LM 634/634A. This allows for better utilization of LM 634 as proposed in Project 1.6.

This renovation includes asbestos removal, removal of an old air conditioner, removal of laboratory benches and aged electrical and mechanical support utilities.

The renovation work will include new electrical and mechanical services for a cluster of computers, and adequate air cooling. This lab renovation will incorporate energy efficiency in engineering by using energy efficient lightening and air distribution.

Phasing Plans and Staging of Work

LM 65 is currently vacant having previously been the site of the mass spec laboratory, now in the new AIMS lab located in LM 18. The space requires demolition and minor asbestos removal.

Project Schedule
tbd

2.5 Miscellaneous labs and rooms in Lash Miller (loading dock, LM 30, 27, 28, stairwells, and some labs needing minor refinishing upgrades, etc)

Scope of Project

The purpose of this Project is to renovate laboratories in the Lash Miller building that are presently under-utilized for various reasons, including degraded conditions, requiring some minor upgrades to comply with safety concerns, or to improve research and teaching performance.

The following are examples of Projects of the type of work:

- Room LM 27/28 is a combined 67.1 nasm former radioisotope lab that has been decommissioned. Demolition is required to remove walls, fume hoods, benches and lead lined storage vaults in order to combine the space to make it useful for future research projects.
- Room LM 30 is a common area that is used for department storage of gas cylinders, receiving and storage, dry ice storage and liquid nitrogen storage and dispensing. An upgrade to this is space is required to make this area safer, and to provide a better supply service to department research groups.
- Room LM 206 and 211 are teaching labs that require refurbishment of the east wall shelves and cupboards.
- Room LM 217 requires an upgrade to the air supply diffuser to provide more evenly distributed ventilation to the lab. This is accomplished by the installation of cloth covers over the air diffusers. This retrofit was successful accomplished to 36 diffusers in teaching lab LM 113/117
- Rooms LM 709; 6.9 nasm, LM 710; 7.2 nasm and LM 711; 27.7 nasm are explosion proof labs on the 7th floor of Lash Miller that are no longer suitable as research space. This project would involve demolition of this space for use as a

Department faculty records storage facility. This is needed to remove this records accumulation and potential combustion source from PI group labs and this will provide additional research space in there group labs.

- LM 705; 20.4 nasm room that is used as a chemical waste disposal transfer facility. Upgrades are required to improve the movement of waste chemicals and the safety of this facility.
- Nine doors between laboratories in the Davenport Research wing need to be replaced with fire-rated doors in order to reduce the fire compartment size that currently defines each laboratory. At present, by Fire Code definition, there are 4 laboratories in Davenport that are recognized as fire compartments. This designation restricts the quantity of chemicals that can be stored in each compartment. A number of Fire Code violations have been observed due to this designation and correction could impact negatively on research efforts. Replacement of 9 internal non fire-rated doors with fire rated doors will increase the number of laboratories or fire compartments from 4 to 12 and provide more flexibility for chemical storage and research. These doors are located as follows:

    - Between LM 351 and LM 552
    - Between LM 354 and LM 355
    - Between LM 370 and LM 371
    - Between LM 372 and LM 373
    - Between LM 451 and LM 452
    - Between LM 454 and LM 455
    - Between LM 455 and LM 455B
    - Between LM 470 and LM 471
    - Between LM 472 and LM 473

Phasing Plans and Staging of Work

This project is a compilation of lab and common spaces that have not received any renovation or attention since the inception of the building. These include LM 30, which currently serves as the departments Nitrogen, dry-ice, and gas cylinder facility and requires a modest upgrade. The functions other than liquid nitrogen can be located elsewhere during the time required for renovations. Other areas (LM 27, 28 labs) are currently vacant allowing demolition and renovation to proceed as a small part of a larger project. Stairwells and other related common spaces need finish upgrades and painting and can be staged with other related building-wide renovations as part of Projects in 3.0.

Project Schedule
tbd

2.6 Rooms LM 158/159/161/162; Lecture Hall Upgrade

Scope of Project

The purpose of this project is to upgrade the four lecture theatres in Lash Miller that are controlled by the Office of Space Management but used extensively for undergraduate teaching of chemistry. The rooms are: LM 158; 126.1 nasm, LM 159; 228.2 nasm, LM 161; 176.5 nasm and LM 162; 170.9 nasm.

Upgrades would include:

- Replace individual seating with theatre style seats
- Improve the projection system to make it unobtrusive to viewing

- Improve the acoustics for better sound projection
- Upgrade the lighting
- Upgrade the floor covering
- Paint the walls

Phasing Plans and Staging of Work

Chemistry lecture hall will require upgrades to seating, lighting, audio/visual and general appearance and function. Pending expected completion of Projects 1.1 to 1.6 and Projects 2.1 to 2.5, with anticipated savings in hand, should be directed to working with the Office of Space Management to address the shortcomings of these teaching spaces used by Chemistry, as well as by other departments.

Project Schedule
tbd

3.0: Building Infrastructure Renovations

3.1 Extend Chilled Water Cooling; Laboratory Heat Load Rejection

Scope of Project

There are a number of research labs in Lash Miller that require additional cooling beyond what is provided by the Building air handling system. These labs contain heat producing instruments that make the rooms uncomfortable to work in and jeopardize the operation and warranty of the instrumentation/equipment. Seasonal cooling is available in certain labs for summer air conditioning. It has been estimated that there is 75 tons of unused capacity available. This scope of this Project is to winterize the air chillers and extend chilled water lines to laboratories that require year round cooling to remove heat from identified lab.
The present rooms that require additional cooling are LM 3G, LM248, LM317, LM437, LM 440, LM 523 and LM 623.

Phasing Plans & Staging of Work

There are no phasing plans and staging of work required to complete this Project apart from intermittent shutdowns to complete tie-ins.

3.2 Remove Remaining Asbestos; Corridor Ceiling and Floors

Scope of Project

Asbestos containing materials are a legacy of the design and construction of Lash Miller carried out in the mid-sixties. As labs are renovated, this abatement has been carried out with a consequential financial burden to the renovation. This does not however address the common areas of the Building such as halls and stairwells.

The scope of this Project is to remove all asbestos containing ceiling and floor tiles from hallways and stairwells. It is estimated that this is an area of 28,000 sq ft. of ceiling tile and a similar area of floor tile. This project would also remove any asbestos insulation from pipes above the ceiling. A replacement ceiling and floor would then be installed.

3.3 Upgrade Building Electrical Transformer

Scope of Project

The electrical power consumption of Lash Miller Labs has been increasing steadily over the past 20 years. At present this is a 2 megawatt-hr peak load building. The primary feed to the building has a capacity of 2.4 megawatts. Steps have to be taken to prepare for the future. Energy conservation measures are a part of the solution with the eventual installation of a new building air handling system. However the 44 year old transformer should be replaced as well. An upgrade to a 13,8 kV transformer should be evaluated as part of this project. The secondary feed line is under the 2 megawatt load demand of this building and should be upgraded to provide adequate backup power; this will assist with maintenance activities and provides secure backup power for highly sensitive analytical instruments and computer servers.

Phasing Plans & Staging of work

Large phase plan and staging of work issues need to be addressed as part of the initial planning for this installation.

3.4 Replace Building Air Handling Systems; Feasibility/Costing Study

Scope of Work

The air handlers installed on each floor of the original research building are past their intended design life. There are signs of corrosion and inefficient operation and they have become costly to maintain. A feasibility study is required in this scope to review the options for the ventilation of this building to make it an energy efficient building that continues to meet the research mission of the University.

The study would review replacement of 7 air supply fans presently located on each floor with 3 energy efficient supply units that would be located on the roof or penthouse area. Along with this, 180 roof exhaust fans would be replaced with a manifolded system and 3 high velocity exhaust fans. A Heat Recovery System should be considered to recover heat from the exhaust air and transfer it to the supply air. This would save the energy required to heat and/or cool the air intake air.
The study should:

- Identify the equipment and control modifications required,
- Estimate the construction costs and schedule to implement this modification, including phasing plans and staging of work,
- Estimate the energy savings in implement of this modification operating

Phasing Plans & Staging of work

There are no phasing plans and staging of work required to conduct this feasibility study.

3.5 Upgrade Building Compressed Air System to Support Research Labs

Scope of Project

The demand for compressed air as a support gas to research labs has increased steadily over the years. A decision was made 15-20 years ago to not replace the Building air compressor. At present the supply is being delivered from 2 x 75 hp compressor in Earth Science. The scope of this project is to install 2 x 50 hp air compressors complete with

duel desiccant towers as a primary air supply for Lash Miller and a back-up air supply for Earth Sciences.

Phasing Plans & Staging of work

There are no phasing plans and staging of work requirements for this project. Once the air compressors are installed and commissioned, the equipment can be connected to existing delivery lines.

3.6 Renovate Degraded Steps and Paint Walls in All Stairwells
3.7 Replace Degraded Doors and Paint All Room Doorframes

Scope of Project

Lash Miller architectural is showing its age. This project will "Spruce-up" the interior component of the building that add to the character and comfort of the students, faculty and staff: These tasks include:

- Fixing steps that have worn over the 40 years of use.
- Re-painting walls and ceilings in stairwells
- Replacing and/or refurbishing office and lab doors
- Repainting all corridor doorframes

Phasing Plans & Staging of work

There are no phasing plans and staging of work required to conduct these tasks apart from local access restrictions during the work.

3.8 Renovate and Upgrade Shipping/Receiving Area.

Scope of Project

The shipping/receiving area for Lash Miller does not meet the present needs of the Department.

Renovations are required to better handle the numerous deliveries of chemicals and equipment that arrive daily during business hours. A better incorporation of the dock area with the stores receiving counters would assist in creating a more seamless system. Updated computer tracking of orders by barcodes from initial purchase through to delivery would result in a reduction in paperwork and related labour costs.
This Project would evaluate methods to improve the service based on a review of other Chemistry Department and external companies.

In addition, an incorporation of the Chemistry receiving area with the Physics receiving area which share the same underground delivering garage should be evaluated with the goal of reducing the duplication of services for the 2 Departments. An underground pathway for the movement of goods and services between the 2 Departments would open opportunities for cooperation in the future with a potential for operational savings.

Phasing Plans & Staging of work

Phase plan and staging of work issues need to be addressed as part of the evaluation for this renovation. The intent is to minimize the disruption of services to the faculty.

APPENDIX C

ROOM DATA SHEETS

(Under separate cover)