Pre-design Submittal for the

Mariucci Arena - Rink, Weight Room & Team Area Remodels

University of Minnesota
Minneapolis, Minnesota
Submitted: March, 13 2015
University Project Number : 01-176-14-1963

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1.0 Overview

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Mr. Trevor Dickie
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Capital Planning and Project Management
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400 Donhowe Building, 319 – 15th Avenue S.E., Minneapolis, MN 55455

RE: Pre-design Submittal for Mariucci Arena at the U of M Campus

Dear Mr. Dickie,

JLG Architects is pleased to submit the 100% submittal for the renovations to Mariucci Arena at the University of Minnesota campus. The report has been reviewed and approved by the U of M representatives, and has been prepared in accordance to the U of M Capital Planning and Project Management regulations for Predesign for Capital Budget Projects. Direction from the University of Minnesota Athletics Administration and focus groups consisting (as identified within this document) was also used in its preparation.

The basis of our work has been to provide professional analysis of the existing conditions, the goals and objects identified during our design process, and synthesis into a document that confirm your project rationale and space requirements and provide the level of documentation to allow for final planning, design, and construction.

Please extend our thanks to the Athletic Department staff, various members of the U of M project team, and other individuals and organizations that contributed their time and energy to contribute to this document.

Sincerely,

Jeffrey Hysjulien, AIA
Director of Sports & Recreation - **JLG Architects**
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Summary

Mariucci Arena opened in 1993 and at the time was the premier collegiate hockey facility in the country. Since then other facilities have been built that exceed the quality level of team support areas that Mariucci Arena once led the nation in. Examples within the Big Ten conference include Penn St., Ohio St., and Wisconsin. Currently the team support areas within Mariucci Arena are outdated and in need of renovation to provide the spaces required to recruit the elite student athletes. In addition, reducing the size of the ice sheet will aid in recruitment of student athletes. Rinks in the NHL are 85 feet by 200 feet so the student athletes can practice and compete on an ice sheet at the University of Minnesota similar in size to the ice sheet they all strive to compete on. The athletic department also strives to retain student athlete loyalty post-graduation, thus the need for an M Club Letter Winners Clubroom in Mariucci Arena.

The objective of this project is to provide the hockey student athletes and the coaching staff with the tools they need to continue to be successful. The hockey locker room and offices will provide the coaches with state of the art technology and finishes to aid in recruiting. Recruitment and development of those recruits is the lifeblood of any Division I hockey program. A remodeled/expanded strength and conditioning space will allow the student athletes to maximize their potential through strength training, skill development and proper nutrition. Providing the M Club Room will allow the department to cultivate donors to the hockey program. The refrigerant used in the arena to make ice is being phased out by international regulations and must be replaced. At the same time, the piping and equipment used to provide cooling in the ice slab is reaching the end of its useful life and must be replaced. Additional revenues are expected with the size reduction of the ice sheet and approximately 200-250 additional seats added to the facility, generating additional revenue for the athletic department.

These renovations will require implementation of several phases of construction in order to align with funding and to be able to work around the necessary schedules of building users and athletic seasons.

Project Team

University of Minnesota

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2.0 Statement of Need

Historical Background

Mariucci Arena opened in 1993 and at the time was the premier collegiate hockey facility in the country. Since then other facilities have been built that exceed the quality level of team support areas that Mariucci Arena once led the nation in. Examples within the Big Ten conference include Penn St., Ohio St., and Wisconsin. Currently the team support areas within Mariucci Arena are outdated and in need of renovation to provide the spaces required to recruit the elite student athletes. In addition, reducing the size of the ice sheet will aid in recruitment of student athletes. Rinks in the NHL are 85 feet by 200 feet so the student athletes can practice and compete on an ice sheet at the University of Minnesota similar in size to the ice sheet they all strive to compete professionally on. The athletic department also strives to retain student athlete loyalty post-graduation, thus the need for an M Club Letter Winners Clubroom in Mariucci Arena.

Mission and Objectives

The objective of this project is to provide the hockey student athletes and the coaching staff with the tools they need to continue to be successful. The hockey locker room and offices will provide the coaches with state of the art technology and finishes to aid in recruiting. Recruitment and development of those recruits is the lifeblood of any Division I hockey program. A remodeled/expanded strength and conditioning space will allow the student athletes to maximize their potential through strength training, skill development and proper nutrition. Providing the M Club Room will allow the department to cultivate donors to the hockey program. The refrigerant used in the arena to make ice is being phased out by international regulations and must be replaced. At the same time, the piping and equipment used to provide cooling in the ice slab is reaching the end of its useful life and must be replaced. Additional revenues are expected with the size reduction of the ice sheet and approximately 200-250 additional seats added to the facility, generating additional revenue for the athletic department.

Instructional, Research, Public Service, and Continuing Education Functions

This project will provide the athletic department with outreach opportunities with youth hockey camps and donor outreach. Due to the specific nature of the athletic needs and uses, the majority of the project does not contribute to instructional, research, or public use. Staff and student athletes will continue to use the facility and spaces in the same manner that they do at this time, with the exception of any specialized pieces of training equipment, such as the Rapid Shot shooting stations. On a University Program level, there are not anticipated to be any changes.

Statutory Requirements and/or Other Mandates

Statutory requirements for this project include some minor building code updates and the international 2020 phase out of Freon used to make ice in Mariucci Arena. No infrastructure changes will be required for building code updates – all will be accommodated by the renovations and space planning. Increase in seating in the main arena bowl can be accommodated by the current exiting capacity of the building. As noted in the design narratives for the ice systems elsewhere in this document, the R-22 (trade name Freon) refrigerant has recommended replacement with an ammonia refrigerant system.

The proposed use of ammonia in the renovated ice refrigeration system will introduce the need for containment and mitigation in final design (refer to Section 10.59 - Ice Systems, Appendix 5 - Ammonia Safety Planning Reporting Training, Appendix 6 - Ammonia Code Review Outline for additional clarification). Part of this will require a wind study during future design phases for Mariucci and surrounding areas on campus to understand and plan for emergency procedures in the event of accidental fume discharge.

Relationship to Strategic Academic Plan

The vast majority of the proposed spaces affected by the project are direct support for athletic functions, both training and competition. The academic, and therefore Strategic Academic Plan benefits fall mostly under the umbrella of President Kaler's initiative to Champion the University by improving the ability to recruit top student athletes and provide top notch entertainment experience for fans. Providing lounge space within the team locker room suite will allow student athletes to study at the rink before practice.

Current Facility Deficiencies/Inadequacies

In 1993, the Gopher Men's Hockey Program moved from the old Williams and Mariucci Arena to the newly constructed Mariucci Arena, a dedicated men's hockey facility The original capacity of 9,700 spectators was increased to 10,000 in 2002 by adding 18 luxury suites. The latest upgrades to the facility came in 2012 with a new center-hung scoreboard and updated audio/visual infrastructure. Mariucci Arena also includes locker rooms for the men's hockey team, strength training space, and sports medicine and team administration offices. In addition to the men's hockey program, athletics, central ticketing, athletics marketing, kinesiology classrooms and recreational/public locker rooms are housed at Mariucci Arena.

When Mariucci Arena was built, it was intended to be used solely for men's hockey, but due to the increased demands from varsity athletics, several other sports utilize parts of the facility. Addressing the buildings inadequacies through a series of phased construction projects will alleviate the issues confronting the building users. The initial phase should address the Gopher Men's Hockey Team Locker Suite, which consists of the players locker room, lounges and other support spaces that need to be added/increased in size. Locker rooms on the lower level will require renovation to accommodate the Hockey team suite changes. Basic finishes and amenities are acceptable but physical space will interfere with new design for the main locker spaces.

One of the spaces which is over-utilized is the strength training room, which should be increased in size and updated to accommodate the increased use demand and the planned training program spaces. Administrative offices should also be expanded and updated. As part of this Pre Design process, the U of M Athletic Department directed the design team to include program space for the Women's Hockey program. While this program operates out of Ridder Arena for practice and all other activities, its administration offices are located in the Bierman Field Athletic Building and are recommended to move to Mariucci. Program space suggest that several operational requirements be shared between Women's and Men's Hockey - support areas such as staff break space and toilet facilities. Otherwise each administrative area is connected but intended to remain independent.

Incorporating a space for M-Club activities during games, which can double as a conference room within the arena is also an item which should be pursued. This item also raises the question of utilizing space within the building for storage, existing volume adjacent to the loading dock under the seating stadia's should pursued to utilize for building storage.

The coaching staff would like to reduce the current Olympic sized ice sheet to 90-92 feet wide with NHL corner radii. When this modification takes place, there will be additional space which will allow for one row of seats around most of the sheet. The arena's infrastructure is in great condition and has been well-maintained, but due to recent international regulatory changes that will take place in 2020, the ice sheet needs to be converted from R22 to ammonia (R-717). This change will require minor building and system updates due to the chemical properties of the ammonia.

3.0 Program Analysis

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Program Overview

The University of Minnesota Athletics Master Plan, completed in 2013 was used as the basis of program needs. The deficiencies and program needs were developed through initial meetings with stakeholders and CPPM representatives, among other building and environmental services representatives to verify and update the program of spaces from the Master Plan. Some changes were made to the program, including additions and deletions of necessary spaces.

Program spaces within Mariucci consist of administrative offices, locker and support areas, strength training space, event meeting space, building storage, and building systems updates to mechanical, electrical, and ice refrigeration. Main goals for project success were identified as:

PHASE I

- Renovate existing Gopher and Visitor locker rooms. Gopher locker area is to include athlete lounge, film room and sports medicine (include new hot and cold plunge tubs).
- Provide renovated public restrooms on Level 0.

PHASE II

- Renovate and expand the existing Strength Training Room (expansion into the south exterior building overhang).
- Add new Shooting and Puck Handling Stations.
- New office suite for Men's Hockey.

PHASE III

- Expand the south side of Level 3 to include a new "M-Club" (alumni suite / seating), considerations to stair and elevator access. Identify and complete additional structural work in lower levels for this option.
- Renovate area to accommodate additional large storage.

PHASE IV

- Renovate ice rink to include a reduced sheet size (approx. 92'-6" x 200'-0"), lower sheet height to accommodate sight lines, and provide additional seating around the rink.
- Convert the existing ice refrigerant system (the current R-22 system is being phased out per EPA), review additional facility needs associated with a system change such as utilities, HVAC and future expansion to Ridder Arena.

The final program of spaces differs from this list slightly in the following ways:

- Ridder Arena refrigeration is being relegated to future development and is more fully described in the ice systems replacement design narratives and options.
- No expansion to building footprint is in the final design concept recommendations.
- Public restrooms on Level 0 were not included in this Pre-Design.
- M-Club design does not include seating/ice view as part of the final recommendation, but is provided for in an add-alternate option.
- Elevator updates are included as possible cost add-alternate options

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	SPACE TYPE	ROOM DESCRIPTION	EXISTING EXISTING NSF	EXISTING COMMENTS	RECOMMENDED PROGRAM SF	TOTAL NSF	TOTAL GSF (X 1.15)	COMMENTS
PHASE I	HOME TEAM LOCKER SUITE	Locker Room	1,749		1,335	1,339	1,540	• 28 player lockers, including 4 goalies. Min. 30" wide, 36" for goalies. • Entire locker suite no access from public. Needs to be able to be shut down and secure. • Direct access to and from ice • Locker room acts as central hub for entire locker suite • Close proximity to athletic trainer and equipment rooms • Maintain existing stair access to upper level (Stair J) for team and staff use only. No public access to lower ice level. • Locker to have hooks for game day jerseys • Need excellent ventilation system to prevent bacteria growth and to control smell • Locker connection to player lounge desired • Coach lecture space at front of room with visual connection to all locker stalls. Smart TV with ability to draw on screen or communicate with other application • High end graphics and spatial design to empasize U of M and Golden Gopher branding. Audience will be players, staff, recruits (not public). • Skate-friendly flooring • Good lighting - ability to dim and control • High quality video and sound throughout • Game clock connected to scoreboard/arena system
		Restroom	109	3 WC; 1 urinal trough	123	123	141	• University standards for fixtures • (3) urinals; (2) WC; (4-5) lavatories
		Shower	145	6 shower heads; no specific drying area	355	355	408	• 8-10 shower heads desirable • Can be combined/gang style. Consult with coaching for final selection. • Space for towels to be hung + drying space
		Sauna	125	Re-use existing	160	160	184	• Relocate door if possible • Arrange to not have to go through toilet room or other spaces to access
		Grooming	127	4 sinks; toobrush rack on wall	113	113	130	• New area for sinks and toothbrushing. Other grooming space within changing area
		Changing	266	small wood locking cubbies and narrow open lockers for street clothes. Shared sapce with equipment room access. Not directly adjacent to team suite entrance.	345	345	397	• Immediately accessible upon entering locker suite • Direct access to/from locker room and toilet areas • 28 - 18" x 30" lockers • Benches for changing • Lockers large enough for street clothes and a coat • Securable lockers • Mirrored grooming counter within space • High quality in materials and feel - similar to country club
		Team Lounge	501	On separate level from team suite	815	815	937	• Room for entire team to gather • Comfortable seating in some areas • High quality video and sound • Adjacent to serving kitchen • Connections and outlets for player devices (phones, tablets, etc.)
		Kitchen	0	None	419	419	482	• Serving kitchen - not for preparation or cooking • Adjacent to lounge and dining spaces • Able to access from service or main corridor without entering team suite •To be set up to receive prepared meals from TCF stadium kitchens • Simple menu items and foods requiring only fridges, warmers, microwave, etc. • Other appliances: sink, coffee maker, hot water, fridge for individual player food storage, milk dispenser, beverage cooler, cereal dispenser • Stocked snack bar with some food and beverage options at all times • Juice Machine • Storage for dry goods and some beverages • High end design
		Dining	0	None	728	728	837	• Tables for up to 30 to eat a meal. Doesn't have to be all one table - can be smaller settings spread throughout space • Some fixed seating, some high top tables, some low seating
		Stick Rack	10		13	13	15	• Immediately adjacent to locker room en route to/from ice • Adjacent to equipment work area for player/equipment manager access • Wall mounted rack for holding up to 4-5 players sticks for each player. • Larger storage elsewhere within equipment storage areas
		Team Video Review	0	Existing is included in coach locker space below	615	615	707	• Theater style seating on raised platforms • Seating for minimum of 30-35 • Video and media access, connections to main video review and media storage system • Adjacent to locker and lounge spaces • Skate-friendly flooring (carpet OK) • Smart technology to enable writing on screen (or similar communication) • Sound proofing acoustics if located under weights areas to eliminate transfer from weights to video spaces
		Storage	875	Located under seating - only about 30% effective due to low/sloping head room	653	653	751	• Use existing storage spaces under arena seating
		Other	0				0	• Create easily accessible "interview" space where the players and staff can be pulled aside and media can have access. Within securable are and easy to set up media equipment so it's not in the way • Should be very close to locker or lounge to keep media separated and not infringing on private team spaces • Provide space in shower or toilet areas for (2) rolling laundry carts
		SUB-TOTAL - HOME TEAM LOCKER SUITE	3,907			5,678	6,530	
	ATHLETIC TRAINING	Training & Taping Room	912	Currently 4 taping tables, only need 3	589	589	677	• Space for three taping tables (same design as TCF Stadium) • Needs ice machine and water supply/drainage • Storage for supplies • Direct access to home team bench/ice and home locker room • Access path for gurney through corridor from this space to emergency personnel at ice resurfacer tunnel and ramp to loading dock
		Exam Room	192	(2) rooms - only need one	85	85	98	
		Athletic Trainer Office	194		100	100	115	• Desk and reference books storage • View of rest of training spaces

		Hydrotherapy	123		546	546	628	• Room for (2) 10'x10' Hydroworx or similar flush hot/cold therapy tubs • Consider raised platform to allow minimal excavation in renovated space • Small room for pumps and necessary mechanical (approx. 25-30 s.f.), included in total room s.f. • View to other taping areas
		Storage	418	specific storage part of overall team storage under arena seating	403	403	463	• Directly adjacent to training space • Use existing storage space below arena seating - approximately 30% of space is full height. Remaining is low or zero head height.
		SUB-TOTAL - ATHLETIC TRAINING	1,839			1,723	1,981	
	COACHES LOCKER SUITE	Locker Room	161		116	116	133	• (5) coaching staff lockers • Nice finishes, open design - similar to main locker room • Same ventilation needs for lockers as main locker room • Privacy from anyone using video review space in next room
		Toilet Room	170		63	63	72	• (1) urinal; (1) WC • (2) lavatories
		Shower	20	included in toilet room total above	49	49	56	• Included in toilet room total above
		Video Review/Meeting Space	160		212	212	244	• Located as part of coaching locker (or adjacent) • Comfortable seating for 4-6 players plus 1-2 staff • Video and media access, connections to main video review and media storage system • No player access without coaching present
		SUB-TOTAL - COACHES LOCKER SUITE	511			440	506	
	HOME TEAM EQUIPMENT	Stick and Skate Work Area	246		396	396	455	• Location directly off of ice and near bench/locker room • Work bench for general use • Sewing station for 1 or 2 machines • Skate sharpening bench • Rivet station on workbench - room for 3 machines • Dedicated tool locations • Bins for small parts • Casework storage for smaller items • Minor immediate storage for short term work and emergency items • Ability to roll laundry carts and jersey racks into room • Vented airflow • Lockable room
		Equipment Room	938		663	663	762	• Sewing station for 1 or 2 machines • Work bench for equipment manager • Stick rack for bulk stick storage (lockable) • Ability to roll laundry carts and jersey racks into room • Lockable room • Space Saver - type integrated storage system. 10' wide by 4' deep sections • Ability to access laundry and main locker room with minimal disturbance to distribute clean uniforms and collect soiled laundry
		Equipment Manager Office	119		0	0	0	• Dual desks • Shelving for incoming/outgoing samples & equipment (helmet, skate, sticks, etc.) • Within or adjacent to main equipment storage room
		Laundry	348		370	370	426	• (2) each industrial washers and dryers • Dedicated venting and power for machines
		Storage	331		334	334	384	• Use existing storage under arena seating for additional storage
		SUB-TOTAL - HOME TEAM EQUIPMENT	1,982			1,763	2,027	
	VISITING TEAM LOCKER	Locker Room	693		568	568	653	• Visting team will not enter home team locker suite or area • Relocate and reuse existing open metal lockers (approx. 22) • Visiting team will use main corridor and enter ice from service tunnel/resurfacer gate at west end of rink • Can use existing/renovated public lockers connected by common existing shared toilet and chower room for visiting team. Relocated lockers in one existing room, benches and shelf/hook rail above in the other.
		Taping	82		527	527	606	• Provide space for portable taping table & athletic trainer equipment cases
		Coach	82		54	54	62	• Can be included with taping space
		Equipment	94	Carts in corridor as required	0	0	0	• Corridor space for portable skate sharpening, flight cases, equipment cases and jersey racks • Must not interfere with code required egress requirements in corridor if applicable
		Toilet and Shower	339		210	210	242	
		SUB-TOTAL - VISITING TEAM LOCKER	1,290			1,359	1,563	
TOTAL - PHASE I			9,529			10,963	12,607	
PHASE II	MENS HOCKEY OFFICES	General Requirements						• Needs to remain on Level 1 • Access from street, elevator, and stair to all levels • Will act as starting and ending point for recruiting tours
		Entry Vestibule	52		50	350	403	• Combine hockey offices vestibule and public vestibule in this location to allow public access to Stair L and Elevator C • Signage to clearly discourage public from entering hockey offices instead of public areas of arena • Finishes and appearance to reflect general arena rather than Gopher Men's
		Lobby/ Waiting	59		400	400	460	• Includes administrative assistant space and reception desk • High end finishes and materials/graphics • Adjacent to conference room and restrooms for visitors • First impression of visitors and recruits - must exude Gopher Hockey and history,
		Conference Room	0	No conf room in team admin., must use conference room in building admin. space				• Immediately adjacent to reception • Room for 12-15 people at conference table • Full technology for presentations - video review, sound, lighting control, conference calling, etc.
		Administrative Assistant	922		0	0	0	• Can be combined with reception and lobby • Workspace for up to (2) persons • Direct view of lobby. Main entry, and ability to screen and coordinate visitors • Access to work area • Close adjacency to head coach office and supplementary access to other coaching staff offices

	Director of Operations Office	102		160	160	184	
	Head Coach Office	194		240	240	276	• Exterior window if possible • Room for 3-4 visitors (recruits) • Adjacent to reception, conference room, assistant and associate coaches offices • Large TV monitor with HDMI hookup • Connected to recruiting room
	Recruiting Room/Lounge	0		150	150	173	• Comfortable furniture for 5-8 family members and staff • Video connections/sound for presentations and recruiting • Direct connection to head coach office • High end graphics and Gopher Men's Hockey history • High end finishes
	Assistant Coach Office (2)	102	Only (1) existing	150	150	173	• Natural light if possible • Seating for 4 to review video or adjacent to space that works for this • Large screen video monitor and video review capability
	Associate Head Coach Office	160		150	150	173	• Adjacent to head coach office
	Volunteer Coach Office	0		115	115	132	• Set up for volunteer coach or other temporary/seasonal staff use
	Mail Room	223		0	0	0	• Included with break room • Space for intake of mail, counter for sorting, recycling, mailboxes for staff
	Men's Toilet Room	0		75	75	86	• Shared with Women's Hockey administration • Single user
	Women's Toilet Room	0		75	75	86	• Shared with Women's Hockey administration • Single user
	Break Room/Kitchenette	112		350	350	403	• Sink • Microwave • Full size fridge • Coffee pot/maker • Dishwasher • Cabinet storage • Sitting/table space for staff • Shared with Women's Hockey administration
	Storage	67		80	80	92	• General storage for office use
	Existing Ticket Area Work Room (123A-3)	67	• To be used for new Strength area	0	0	0	
	SUB-TOTAL - MENS HOCKEY OFFICES	2,060			2,295	2,639	
WOMENS HOCKEY OFFICES	General Requirements		• Women's hockey program does not currently have any space within Mariucci Arena. There are offices elsewhere on campus, primarily located in Bierman Field Athletic Building and would be relocated to Mariucci Arena per discussions with Athletics during this PreDesign process				• Provide Women's Hockey program with administrative space equal to that of the Men's Hockey program. • Appropriate common use spaces can be shared as noted
	Entry Vestibule	0		125	125	144	• Weather-resistant space for visitors to enter building • Separate from public building access
	Lobby/ Waiting	0		450	450	518	• Includes administrative assistant space and reception desk • High end finishes and materials/graphics • Adjacent to conference room and restrooms for visitors • First impression of visitors and recruits - must exude Gopher Hockey and history, accomplishments
	Administrative Assistant	0		0	0	0	• Can be combined with reception and lobby • Workspace for up to (2) persons • Direct view of lobby. Main entry, and ability to screen and coordinate visitors • Access to work area • Close adjacency to head coach office and supplementary access to other coaching staff offices
	Director of Operations Office	0		200	200	230	
	Head Coach Office	0		240	240	276	• Room for 3-4 visitors (recruits) • Adjacent to reception, conference room, assistant and associate coaches offices • Large TV monitor with HDMI hookup • Connected to recruiting room
	Recruiting Room/Lounge	0		180	180	207	• Comfortable furniture for 5-8 family members and staff • Video connections/sound for presentations and recruiting • Direct connection to head coach office • High end graphics and Gopher Women's Hockey history • High end finishes
	Assistant Coach Office (2)	0		150	150	173	
	Associate Head Coach Office	0		150	150	173	• Adjacent to head coach office
	Mail Room	0		0	0	0	• Shared space with Men's Program
	Men's Toilet Room	0		0	0	0	• Shared space with Men's Program
	Women's Toilet Room	0		0	0	0	• Shared space with Men's Program
	Break Room/Kitchenette	0		0	0	0	• Shared space with Men's Program
	SUB-TOTAL - WOMENS HOCKEY OFFICES	0			1,495	1,719	
BUILDING ADMINISTRATION	Entry Vestibule	439		0	0	0	• Existing entry vestibule for building to remain & used by/inconjunction with Men's Hockey Lobby. See that section for more information. • Access to Building Administraiton through West Lobby 154-4 • Existing ticket booth to remain
	Administrative Assistant	80		120	120	138	• View of access and entry from West Lobby • Adjacent to Building Manager office
	Building Manager Office	165		150	150	173	• Typical office furnishings
	Office	153		150	150	173	• Typical office furnishings
	Conference Room	185		0	0	0	• Building Administration to use Women's Hockey conference room when necessary
	Mens Toilet Room	175		0	0	0	• Replaced by single user toilet room
	Womens Toilet Room	182		0	0	0	• Replaced by single user toilet room
	Open Office (for 3)	243		300	300	345	• Space for three office cubicles • Small supply closet included within space
	Supply/Storage	69		80	80	92	• Combine with janitor space • Mop bucket and storage rack for janitorial
	Electrical Closet	99		99	99	114	• To remain in existing location
	Skate Rental	211	• Currently on Level 1 adjacent to public lobby. Consider moving to lower level.	150	150	173	• Wall of skate cubbies for rental storage • Counter for servicing skates • Dutch door - top half is service window • Secure storage • Tie into network for transactions • Cash drawer • Adjacent to public corridor and accessible route • Adjacent or path to ice access through resurfacer tunnel & gate
	Janitor	109		0	0	0	• Combine with storage

		Break/Kitchen	255		169	169	194	• Room for small table & chairs • Counter space • Fridge • Sink • Coffee • Microwave
		Unisex Toilet Room	0		70	70	81	• Single user
		SUB-TOTAL - BUILDING ADMINISTRATION	2,365			1,288	1,481	
	STRENGTH & CONDITIONING	Strength and Conditioning Training Space	5,831	• Existing is 2 separate spaces	6,113	6,113	7,030	• NOTE: SEE FULL EQUIPMENT LIST IN APPENDIX • Upgraded and renovated space • Secure space during open hours - only staff and student athletes (hockey). Controlled hours of operation. • Card access or biometrics for access
		Nutrition Bar	0		100	100	115	• More like an alcove or other smaller space • Not an area to sit down • Space for coolers and beverage dispensers • Coaching staff will prepare supplements and disperse from this location
		Strength Coach Office	116		160	160	184	• Room for coach, files, and office furniture • Ability to meet with 1-2 student athletes • Some small equipment storage • View to strength and conditioning areas from office if possible • Adjacent to student entry for security and monitoring if possible
		Assistant Strength Coach Office	0		150	150	173	• Shared space for 2 staff
		Shooting Station (2)	0		400	800	920	• Specific shooting stations by Rapid Shot • Enclosed rooms, one left and right handed shooter • Raised floor - choose which end is target end • Consider sound and interference with adjacent spaces
		Men's Toilet Room	147	• Only one restroom existing	135	135	155	• Single user toilet space • Single user shower with bench and drying area
		Women's Toilet Room	0		135	135	155	• Single user toilet space • Single user shower with bench and drying area
		Student Entry	0		130	130	150	• Direct door access to exterior of building • Space for coats and student athletes personal items (bags) to keep them out of training space • Acts as weather vestibule for rest of room • Intended as access to strength and conditioning spaces for non-hockey student athletes after hockey hours
		Storage	269		200	200	230	• Located on lower (ice) level for major items storage
		SUB-TOTAL - STRENGTH TRAINING	6,363			7,923	9,111	
	OTHER	Kinesiology	3,896		0	0	0	• Existing space to be relocated
TOTAL - PHASE II			10,788			13,001	14,951	
PHASE III	M-CLUB	Main Club Space	1,537	• This space is not currently finished space within Marriuci Arena.	1,368	1,189	1,367	• Access from secure circulation areas, able to handle checkpoint • Privacy from general public • Gathering space for up to 150 • Can share access and vertical circulation with other club level areas • Space must be enclosed for HVAC/sound • Lounge/bar atmosphere - portable serving counters or bars will be used • General furnishings, budget, similar to TFC Stadium alumni club spaces • High top tables, lots of televisions/monitors, casual lighting, U of M branding apparent in finishes and decor • Consider glazing or other methods of views to/from concourse below • Code required numbers of exits based on occupancy • Separation from media areas - no cross mingling of patrons and media
		Restroom	0		74	65	75	• Single user
		Host Station	0		95	83	95	• Included in Main Club space s.f.
		SUB-TOTAL - M CLUB	1,537			1,337	1,538	
	OTHER	Press Area Restroom(s)	225	demo existing to make room for new	75	75	86	
	NW STORAGE	NW Storage Space	4,247	• This space is technically used for light storage but is not finished space.	4,247	4,247	4,247	• Enclosed storage space under seating stadia • Provide new double access doors at tunnel ramp • Provide new Overhead Door for loading in • Edge of slab will end before edges of enclosure walls in order not to require structural shoring of existing walls • Ventilation will be required • Lighting for new space
		SUB-TOTAL - NW STORAGE	4,247			4,247	4,247	
TOTAL - PHASE III			5,784			5,584	5,785	
PHASE IV	SPECTATOR SEATING	Added arena bowl seating	0	n/a for s.f. calculations		0	0	• Add approximately 200-250 seats when rink size is reduced. Added seats will be along the rink sides, but not on ends. Does not affect any other spaces in terms of square footage.
		Ice Equipment Room	885		885	885	885	
		Refrigerated Ice Slab	21,115		21,115	21,115	21,115	
TOTAL - PHASE IV			22,000			22000	22000	
	OTHER	Public Locker Rooms						• Maintain at least three public locker rooms for rentals and tournaments and clinics/camps. Can be used for visiting team suite on game nights as noted in Visiting Team Locker descriptions above
		SUB-TOTAL - OTHER				0	0	
		TOTAL EXISTING SPACES	48,101	Differences in square footages is attributed to converting some of the bulding space into these purposes as they were used for other purposes prior to project.		50,876	54,570	TOTAL RECOMMENDED PROGRAM SPACES ***note "Other" spaces not include in total except for NW Storage***

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- Women’s Hockey administrative offices are moved into Mariucci and share minor support areas with Men’s Hockey administration.

The renovations will require Fixtures, Finishes, and Equipment (FF&E). These final needs are to be determined in the schematic and design development phases of project design. The weights and strength training room will require exact layout and planning for power, data, and other utility needs via communication with coaching staff, however space planning and programming for Pre Design was based on a specific list of equipment provided by strength and conditioning staff. Special equipment that requires specific infrastructure within the renovated spaces is relatively limited. The hydrotherapy spaces in the athletic training area of the main locker suite will require two tubs with exterior dimensions of 10’x10’ in plan. Design was based on Hydroworx brand hot/cold plunge tubs. Also provided are a pair of Pro model Rapid Shot puck shooting training stations, with plan size of 32’-8” long by 12’-6” wide and a height of 9’. These are specialized and customized models and details for final design are to be coordinated with the manufacturer and coaching staff.

Weight Training Equipment List (Phase 2)

Equipment Description	Size(W”xL”xH”)	Quantity
Double Sided Half Racks	49x76x94	4
Rack Platforms	73x97x_	8
Weight Benches	24x55x_	8
Bikes	20x49x_	13
Keiser Functional Trainer	64x48x93	3
Keiser Performance Trainer	24x12x87	6
Revers Hypers	52.5x40x_	3
Glute. Ham Raise	36x60x_x	4
Medicine Ball Storage	76x20.125x_	2
Lateral Pull Downs	24x53x96	3
Dips Machine	38x52x64	3
Physio Ball Storage	18x54x82	1
Dumbbells and Racks	27x90.5x42.5	3
Dumbbell Benches	24x55x_	6
Kettlebell Rack	26x90x29	1
Vibrator –Power Plates	38x46x60	3
Scale	24x19x_	1
Leg Sled	68x107x66	2
Pit Sharks	62x66x60	3
Treadmills	48x77x_	3
Elliptical	27x71x58	2
Rowers	24x94x_	3
Versa Climbers	43x46x_	3
Arc Trainer	37x76x62.5	1

Stepper Mill	31.25x53x88	1
Storage Closet	12’3.5x7’5”	1
Storage Closet	14’4x9’4”	1
Skating Treadmill	115x131x96	1
Storage Locker	22x8.5x28.25	1
Muscle Milk Cooler	2’6”x2’8”x6’7”	2
Russian Plyos	25x18x23	6
Plyo Box Sets	22x22x12	2
Plyo Box Sets	25x25x18	2
Plyo Box Sets	28x28x24	2
Plyo Box Sets	32x32x30	2
Inversion Tables	29x84x86	2
Standing Calf Raise	33x45x63	1
Soft Plyo Box Set	22x22x12	1
Soft Plyo Box Set	25x25x18	1
Soft Plyo Box Set	28x28x24	1
Soft Plyo Box Set	32x32x30	1
Bar Holders	32.5x26x_	2
Bumper Plate Holders	49x15.5x_	7
Foam Roller Storage	20x27x_	1
Chalk Holders	26x26x24	3
Landmine	18x24x6	1
Lat Pulldown Storage	29x32x60	1
Weight Belt Rack	26x26x59	1
40 Yard Turf Area	25’x120’x0	1
Open Exercise Area	18’6”x23’x0	1

4.0 Facility Program Development

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Facility Program Development

Only one University Program is directly affected by the proposed renovation at Mariucci Arena. The School of Kinesiology, part of CEHD, currently occupies approximately 3,700 square feet of space at the far north end of Level 1, SW quadrant. During the second Phase (Phase II) the University will coordinate with the Kineosology Department, inconjuction with Intercollegiate Athletics, to review alternate space opportunities in advance of the renovation to Mariucci Arena. The resultant square footage in Mariucci will be used to house the new program space for Men's & Women's Hockey Offices and Building Administration Offices in addition to the expansion of the Strength Training Facility as indicated in this document.

5.0 Financial Analysis

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Financial Analysis

The project is expected to be financed through donations to the athletic department and other Hockey Program fundraising efforts. State funds are not expected to be requested for this project. Revenue generation is not expected to change for the building with the exception of the fact that additional revenues will be realized with the size reduction of the ice sheet as an additional 200 to 250 seats will be added, to the facility during Phase IV, generating approximately $200,000-$250,000/year.

No new building envelope square footage is being developed as a part of this project, and general use of spaces is remaining the same. Building operating cost will be changed through efficiencies in the refrigeration system, re-allocated HVAC controls and systems, and enclosure of the NW storage space under the seating structure. The addition of 200-250 persons, as a result of the additional seating installed during Phase IV, for events is negligible on the heating and cooling systems.

6.0 Site Analysis

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Site Analysis

No new space is being constructed that will increase or change the building envelope at Mariucci Arena as part of this project. A new entry door is planned for the Strength Training Room(Phase II) as indicated in the design plans. This exterior space is currently compacted earth under and existing overhang and is adjacent to existing exterior concrete slab and stair access to sidewalk level from the building. New frost-protected stoop and concrete slab will be needed at the new door to accommodate, but will not affect landscape or pedestrian traffic patterns to and from the building. All other access points are from existing door locations and have existing paving to remain.

7.0 Environmental/Code/Hazardous Materials

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Overview

Existing interior conditions are all enclosed and environmentally controlled spaces, serviced by building HVAC and occupant comfort controls. Some code-related improvements will be required as part of the renovations.

Occupied spaces – all renovated team suite, administration, strength training, and M-Club spaces will be designed to meet or exceed building code and accessibility requirements.

Building Egress and Life Safety – this project affects life safety in the following ways:

- Seating bowl(Phase IV) – total added seats is to be approximately 200-250 additional persons in the seating bowl for an event. Current exit paths and egress points can accommodate this increase without changes.
- Ice/Floor area (Phase IV) – initial building designs have 220 person exiting the ice surface via the home team bench, corridors, and exist stairs up to grade. The home team suite design in this project package maintains this path via existing corridor to allow emergency egress from the ice surface via existing designated route. Final design must show this path and identify life safety plans for this area.
- Administration (Phase II) – egress from administration is intended to be via central office suite corridor and exit doors at lobbies of each of the two hockey administration offices. Building administration will exit through the existing west lobby.
- Weight and Strength Training (Phase II) – these spaces will continue to exit via current access directly to exit stair enclosures and direct to the outside. One new door is being provided which increases the available egress more than what is currently there.
- M-Club (Phase III) – the M-Club occupancy is anticipated and programmed to be 50 or less persons. However, 2 exit points leading directly to stair enclosures are provided.

The ice systems narrative describes requirements for the use of proposed ammonia within the facility. Measures will have to be taken for HVAC and emergency fume release, as well as daily operation required by code for the use of ammonia refrigeration systems.

Security for the building does not change compared to existing conditions, however final design phases must address specific operational needs for individual access and control within the team suites, administration, and weights areas. The M-Club security is handled the same way as the existing club and suite spaces.

Codes

- 2012 International Building Code adopted with state amendments, chapter 1305, effective (anticipated to be adopted Nov. 2013).
- 2000 Guidelines for the Rehabiliation of Existing Buildings adopted with state amendments, chapter 1311, effective March 31, 2003.
- 2014 National Electrical Code, chapter 1315, effective July 1, 2014.
- Minnesota Energy Code chapters 1322 & 1323, effective June 1, 2009.
- Minnesota Acessibility Code (2006 IBC, 2003 ICC/ANSI 117.1) aopted with state amendments, chapter 1341,effective July 10 2007.
- 2006 International Mechanical & Fuel Gas Codes adopted with state amendments, chapter 1346, effective October 26, 2009.
- Minnesota State Plumbing Code, chapter 4715, effective October 23, 2009.

2007 MN State Fire Code:

- 2006 International Fire Code adopted with sate amendments, chapter 7511, effective July 10, 2007.

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Hazardous Materials Survey

Summary: An asbestos and lead hazard assessment was conducted on June 5, 2014. The purpose of the hazard assessment was to determine if any asbestos containing material or lead paint was present in the areas where the rink and team areas are being remodeled in Mariucci Arena.

Project Description: Facilities Management Hazardous Materials Program surveyed the areas to be remodeled and took bulk samples of suspected asbestos containing materials and performed an XRF Spectrum Analyzer test for lead based paint on the painted surfaces in question.

Conclusions: The bulk samples of suspect asbestos containing material (ACM) were analyzed via polarized light microscopy (PLM) for asbestos content. Any material that is greater than 1% asbestos is considered to be ACM.

The following suspect materials tested none detected (ND) as ACM in the building:

- <4" fiberglass pipe insulation
- 4"-8" fiberglass pipe insulation
- spray-on fireproofing
- concrete block mortar
- sheetrock and taping compound
- baseboard adhesive
- 2'x4' ceiling tile, crater pinhole
- grey sink undercoating
- fiberglass duct insulation

Analysis of Lead Results: The following represents the features which contain lead based paint in the particular areas tested.

There was no lead based paint on the surfaces tested

Observations and Recommendations: FMHMP recommends that throughout the general demolition activities associated with this building that the contractor needs to follow OSHA regulations (1926.62 Interim Lead Standard) and the 1.0 mg/cm2 with a .2 mg/cm2 variation standard for the XRF prescribed by Minnesota OSHA.

8.0 Cost Analysis

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Budget/Funding Source

PHASE I- Locker Room Renovations

o Construction:	$ 2,969,041
o Construction Costs by Owner:	$ 381,709
o Non-Construction:	$ 572,000
o FF&E	$ 227,250
o Total	$ 4,150,000

PHASE II- Men's & Womens Hockey Offices, Building Administration Offices, Strength Training & Offices

o Construction:	$ 2,936,124
o Construction Costs by Owner:	$ 1,003,671
o Non-Construction:	$ 687,605
o FF&E	$ 1,447,600
o Total	$ 6,075,000

PHASE III- M-Club & NW Storage

o Construction:	$ 926,580
o Construction Costs by Owner:	$ 172,300
o Non-Construction:	$ 237,160
o FF&E	$ 63,960
o Total	$ 1,400,000

PHASE IV- Ice Replacement (Refrigerant System, Reduce Ice Size, Lower Ice, Add Seats)

o Construction:	$ 3,408,348
o Construction Costs by Owner:	$ 495,822
o Non-Construction:	$ 720,830
o FF&E	$ 0
o Total	$ 4,625,000

Total Project

o Construction:	$ 10,240,093
o Construction Costs by Owner:	$ 2,053,502
o Non-Construction:	$ 2,217,595
o FF&E	$ 1,738,810
o Total	$ 16,250,000

Funding: The identified projects will be fully funded through Intercollegiate Athletics.

Construction Cost Clarifications and Assumptions:

Documents used to prepare this budget estimate include the following (from JLG Architects):

1) Team Lockers Floor Plan (received January 15, 2015)
2) Building Administration / Women's Offices Floor Plan (received July 16, 2014)
3) Men's Offices / Weights Offices Floor Plan (received June 30, 2014)
4) Weights / Training Floor Plan (received June 30, 2014)
5) M-Club (Small) Option A Floor Plan (received July 16, 2014)
6) M-Club Option A Floor Plan (received June 30, 2014)
7) M-Club Option B Floor Plan (received June 30, 2014)
8) M-Club Option C Floor Plan (received June 30, 2014)
9) Pre-Design Draft Submittal Narrative (received June 30, 2014)
10) As-Built Drawings for Mariucci Arena provided by the U of M

Escalation

Current market condition is reflecting an escalation factor of 6% per year. Project budget pricing is based on midpoint of construction, June 2015 for a 5% escalation factor. June 2015 is the anticipated midpoint of construction for Phase 1 of the Project. Actual escalation is to be determined at time of project phase commencing.

Budget Pricing

This budget estimate was developed with cost opinions from a select group of subcontractors that have recently completed projects at the U of M. JE Dunn completed quantity takeoff for all construction systems with the preliminary plans from JLG Architects, and by referencing documents from other similar projects at the U of M. All budget estimates were compared to historical cost data for other projects of this type.

Project Cost Estimates with Alternates

Description	Quantity	Cost	Unit cost
PHASE I			
Locker Rooms	10,963 SF	2,969,041	270.82
PHASE II			
Men's & Women's Hockey Offices, Building Administration & Strength Training & Office	14,951 SF	2,936,124	196.38
PHASE III			
NW Storage Room M-Club Option A (Small)	5,784 SF	926,580	160.20
PHASE IV			
Ice Replacement: Option 5 Ice System & Option 1 Electrical	22,000 SF	3,408,348	154.92
Total Construction Cost	53,698 SF	$10,240,093	$190.70

Alternates	Pending	Accepted	Rejected
PHASE I			
1) In-fill Visitor Locker tunnel and add seating	$15,468		
PHASE I/II			
2) Provide new AHU's in lieu of re-using existing.	$ 297,163		
PHASE I/III			
3) Additional cost for soil modification work required for M-Club Option A (Large Version) to be completed during the Locker Room renovations.	$274,792		
4) Deduct if soil solidification for the M-Club option A is completed during the Locker Room Renovations in lieu of after Locker Room Renovations.	($94,863)		
PHASE II/III			
5)Passenger Elevator Renovation			$130,000
6)Service Elevator Renovation			$120,000
PHASE III			
7) M-Club Option A (Large) (In addition to M-Club A(small) cost)	$776,965		
8) M-Club Option B			$887,521
9) M-Club Option C			$1,117,388
PHASE IV			
10) Upgrade refrigeration system to accommodate ice systems in both Mariucci and Ridder Arenas.			$942,052
2) Add an ammonia scrubber system for the new ice refrigeration system.	$304,660		

****See appendix for full cost breakdown.****

Clarifications

1.) Pricing based on construction during summer of 2015.

2.) pricing includes construction contingency of 8% and escalation of 5% (escalated to mid-point contruction June 2015.

3.) Locker Room renovation cost does not include soil solidification under footings required for M-Club Option A.

4.) Rough-in and cabling for A/V and voice/data is included. Equipment and devices by U of M.

9.0 Project Schedule

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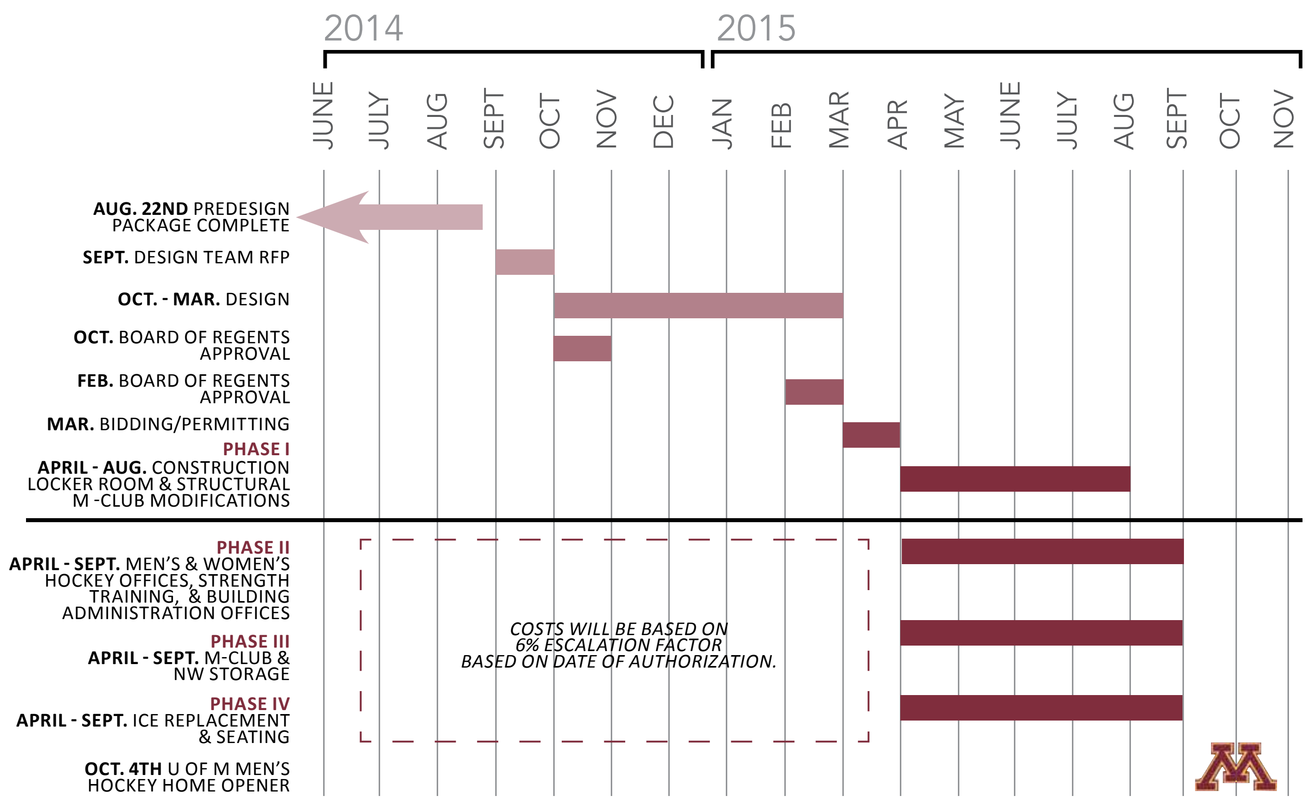
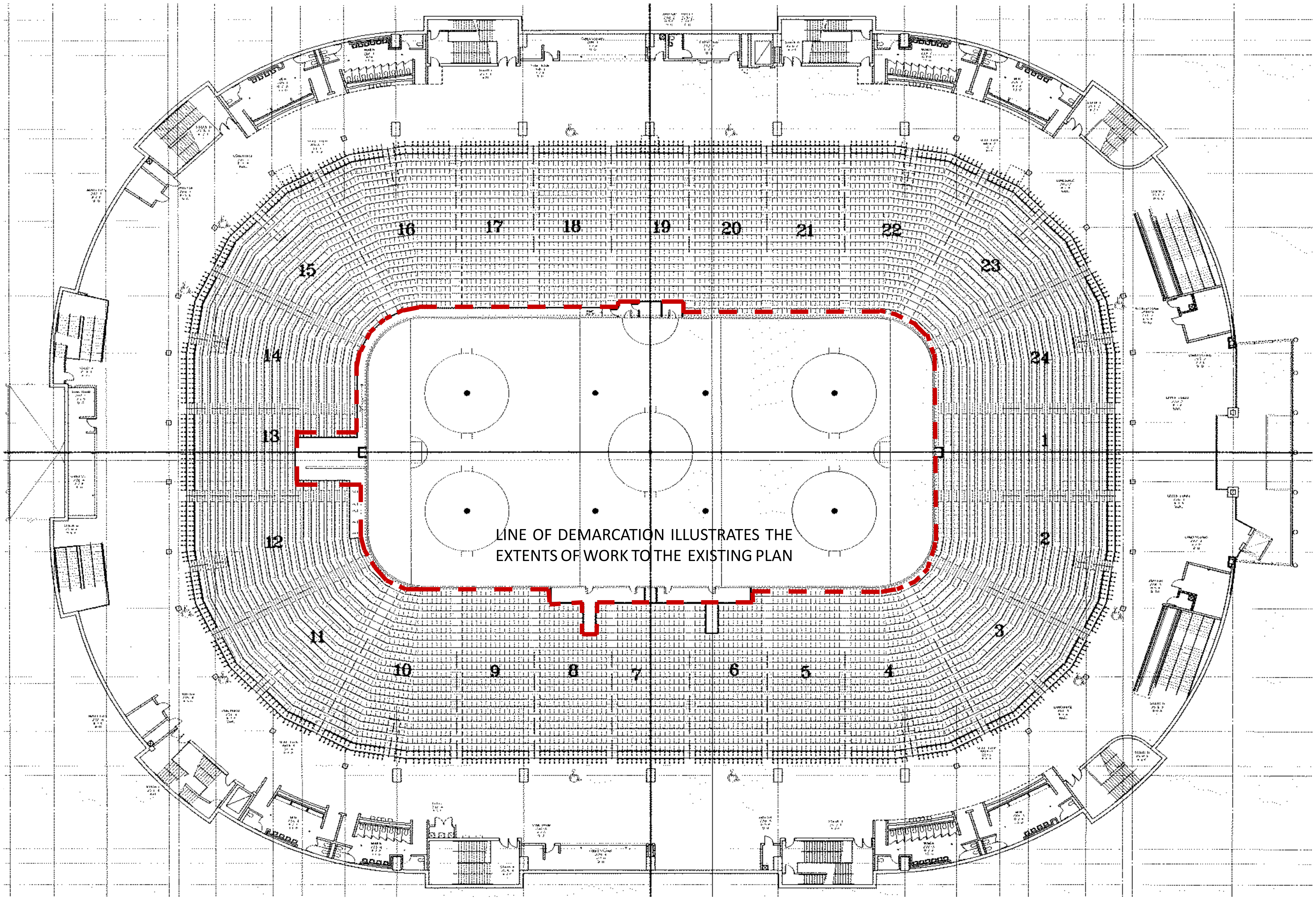
Project Schedule



10.0 Design & Narratives

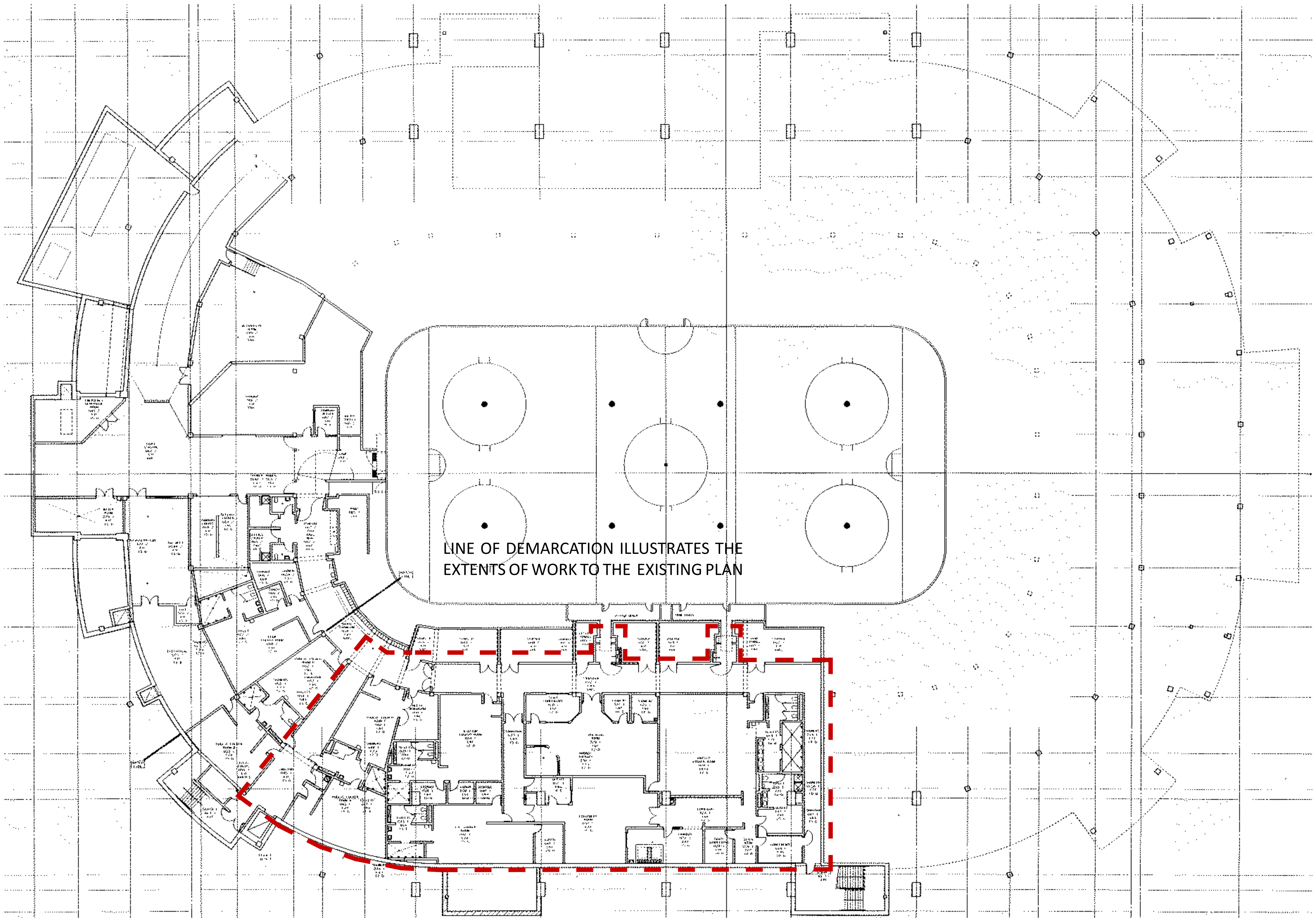


Area of Work

Ice Level - Ice Sheet

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963



Area of Work
Ice Level - Team Locker Area (Phase I)

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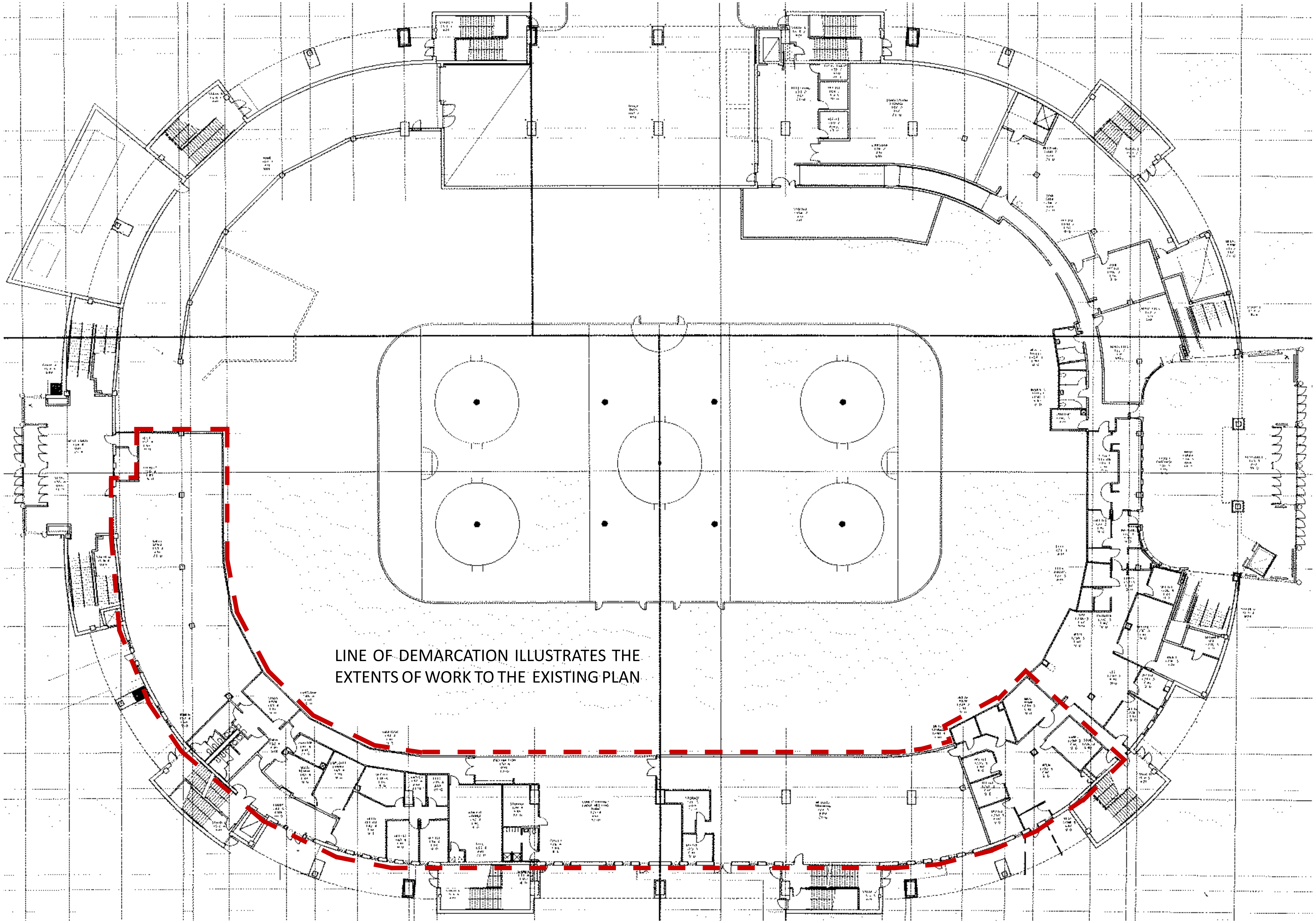

Area of Work
Main Level (Phase 2)

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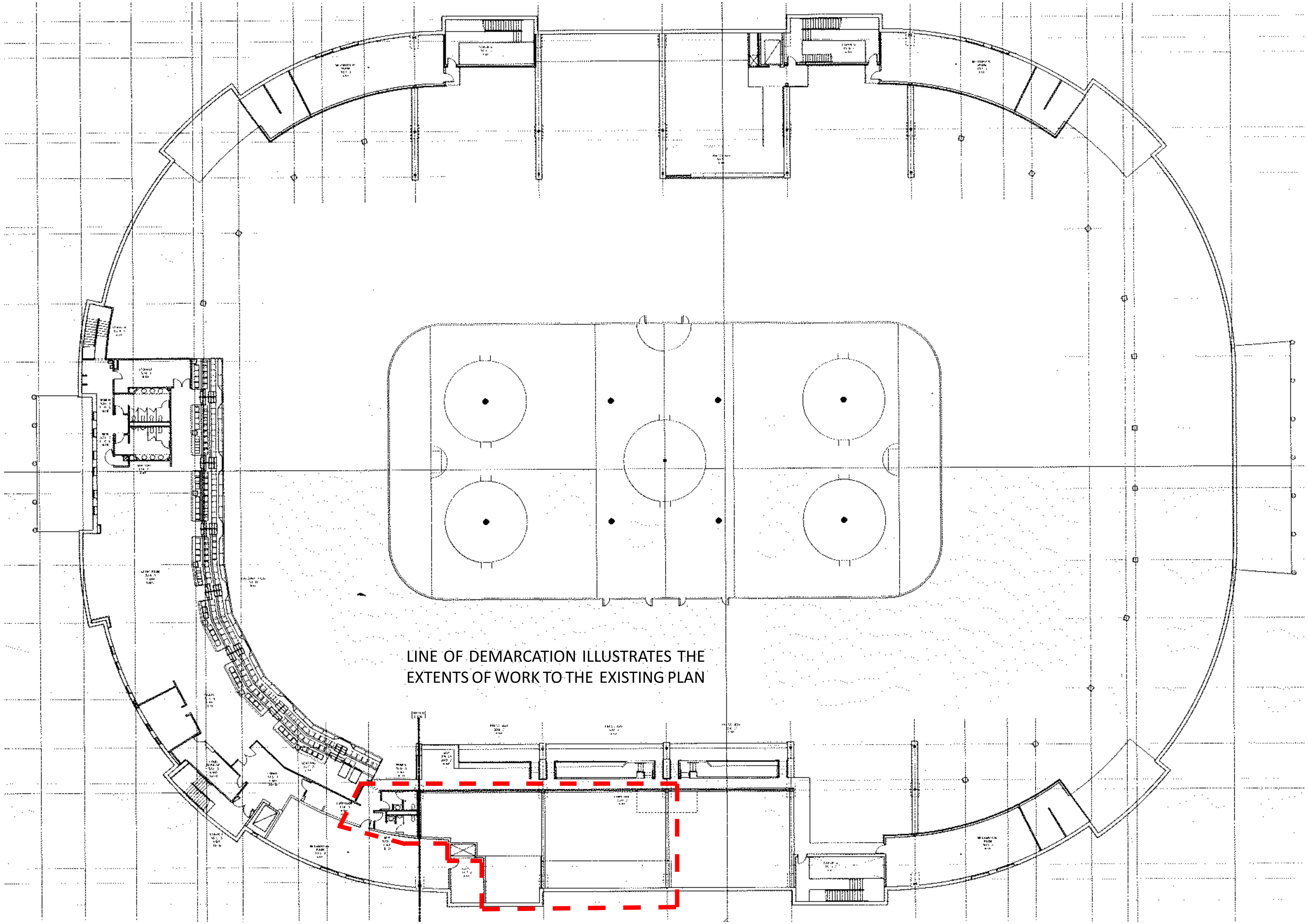

Area of Work
Club Level (Phase 3)

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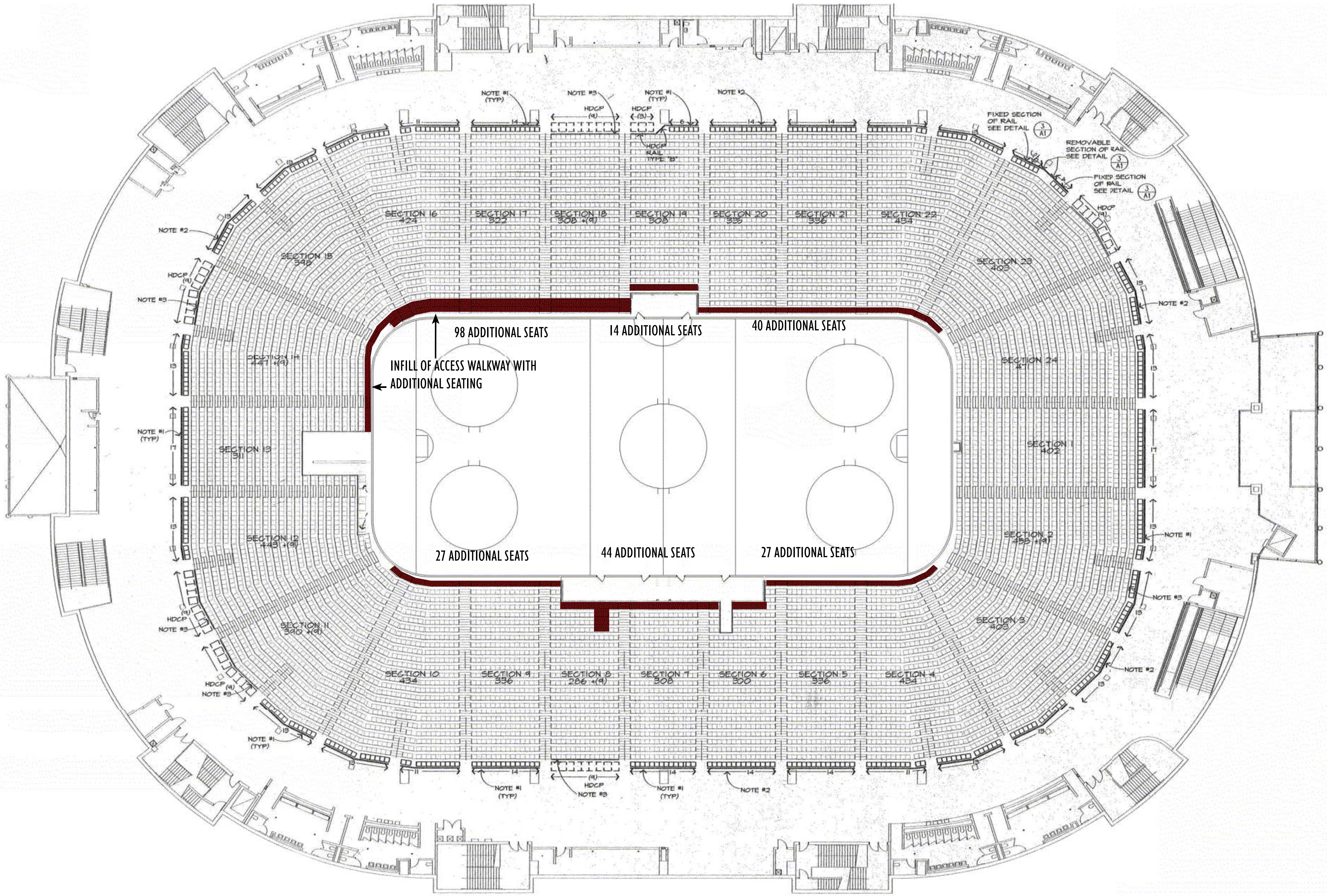

Additional Seating
Revised Ice Sheet (Phase 4)

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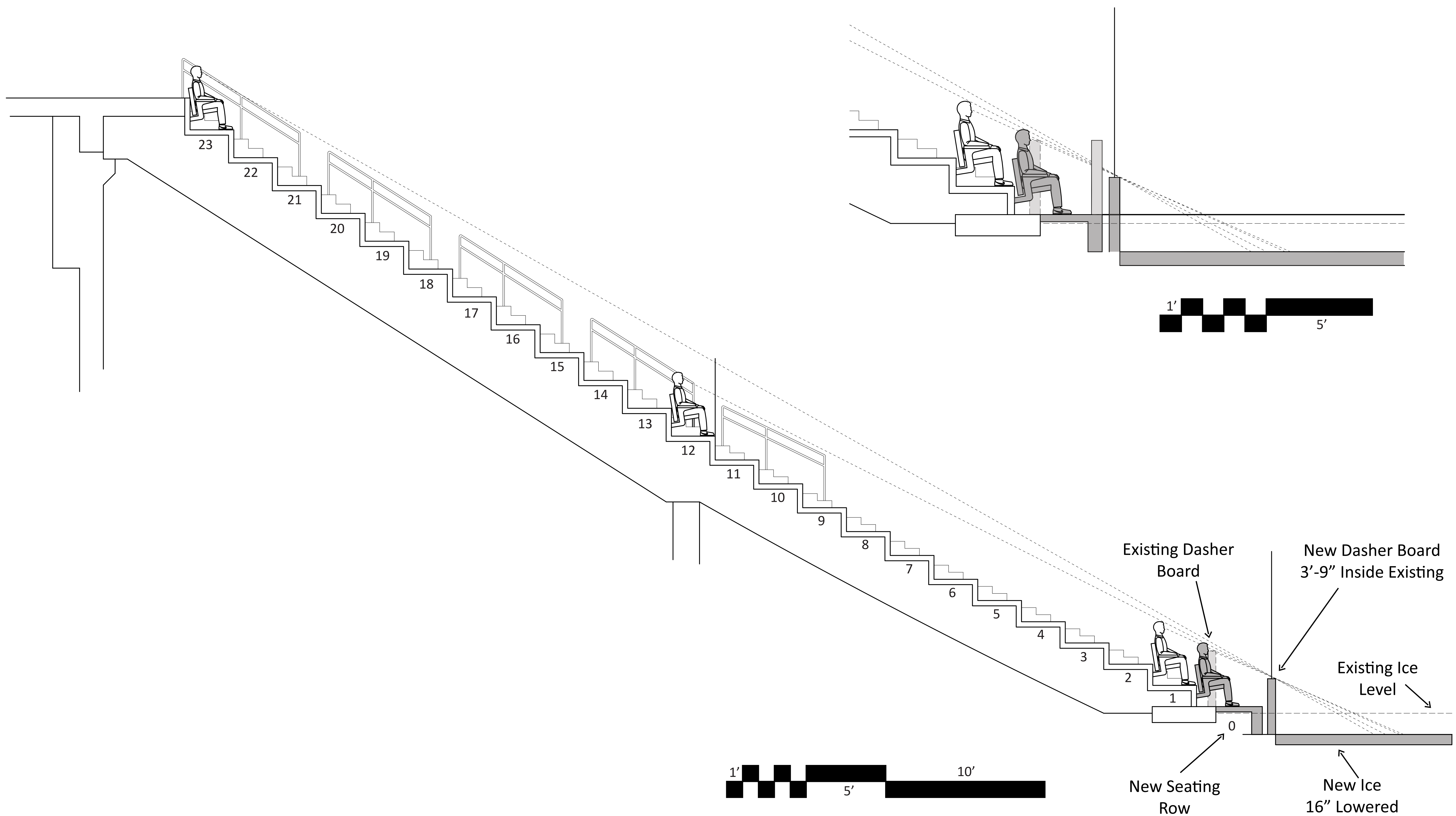

Sight Line Study (Phase 4)

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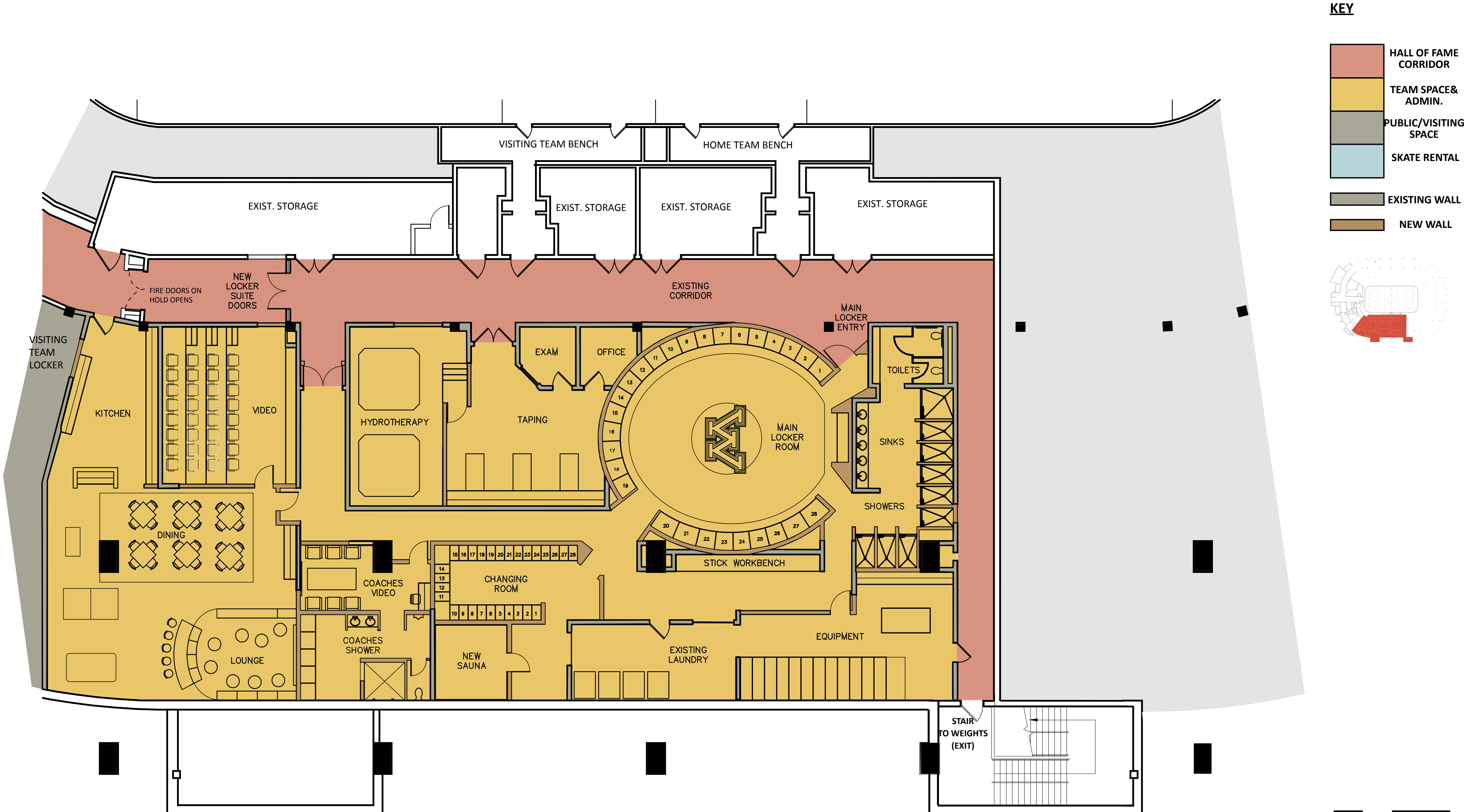

Team Lockers
Ice Level (Phase I)

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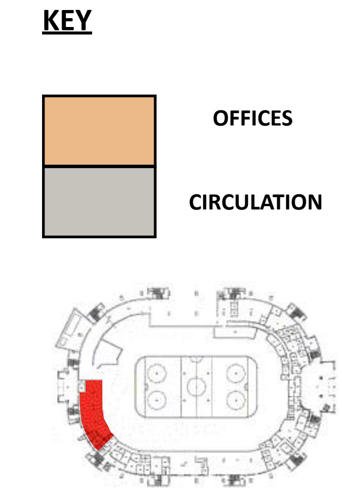
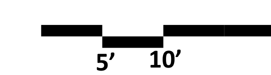
hive

JLG architects





Building Administration/Womens Offices
Main Level

(Phase 2)

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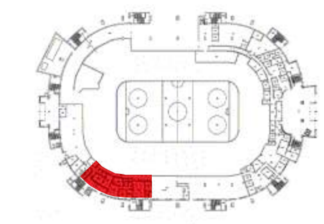
JULY 2014 PROJECT # 01-176-14-1963

KEY

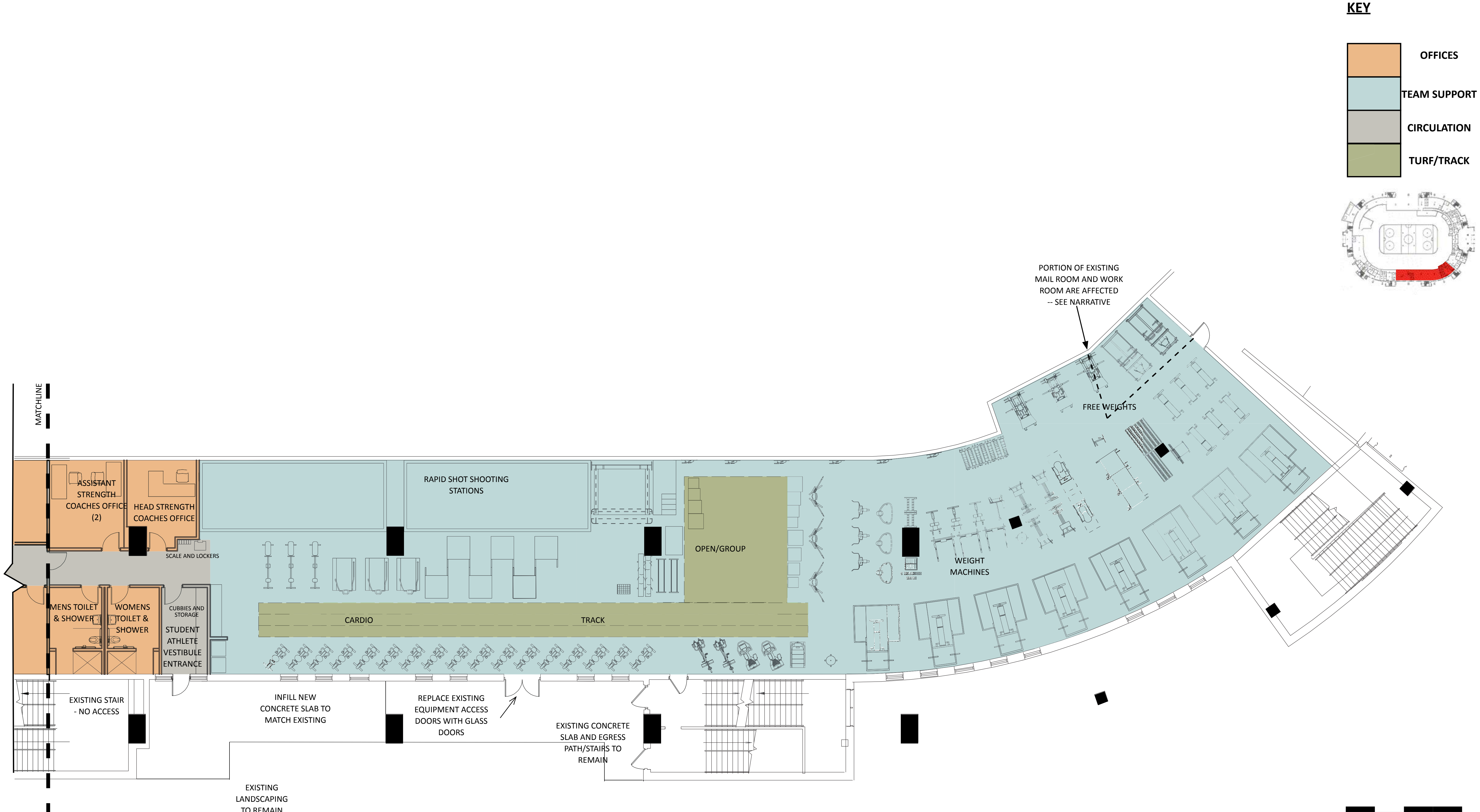
	OFFICES
	CIRCULATION
	WEIGHTS



Mens Offices/Weights Offices
Main Level (Phase 2)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963



Strength and Conditioning
Main Level

(Phase 2)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963

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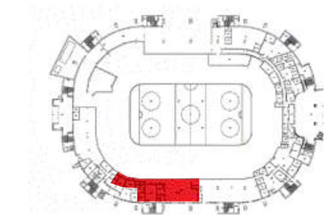
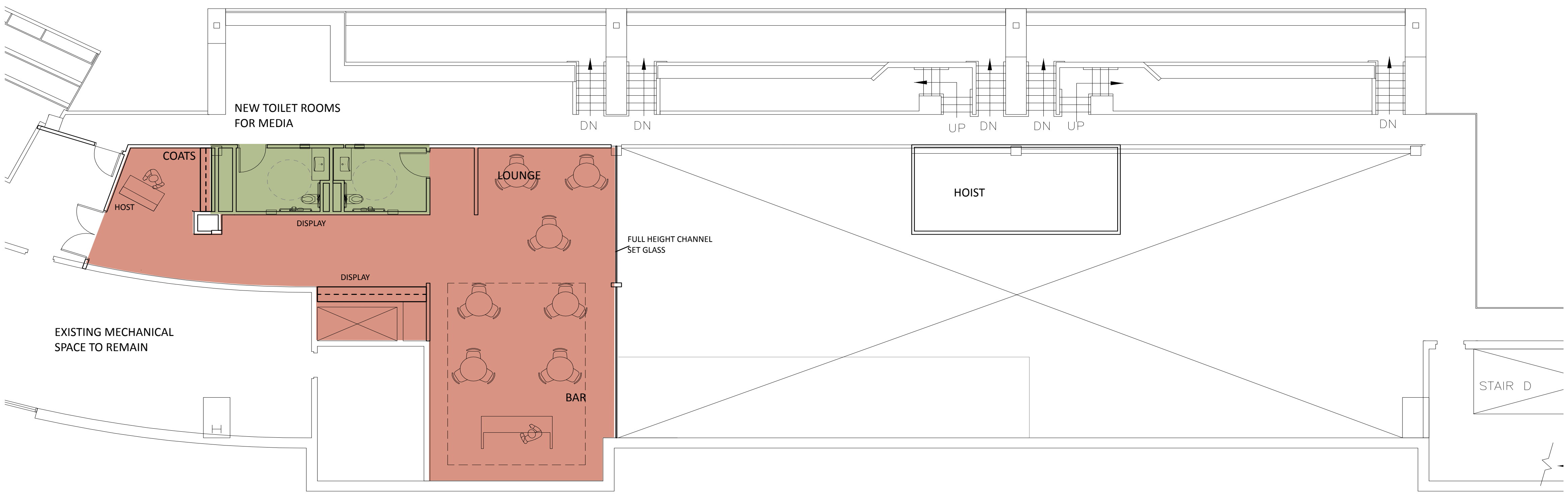
NEW M-CLUB SPACE

MEDIA TOILETS



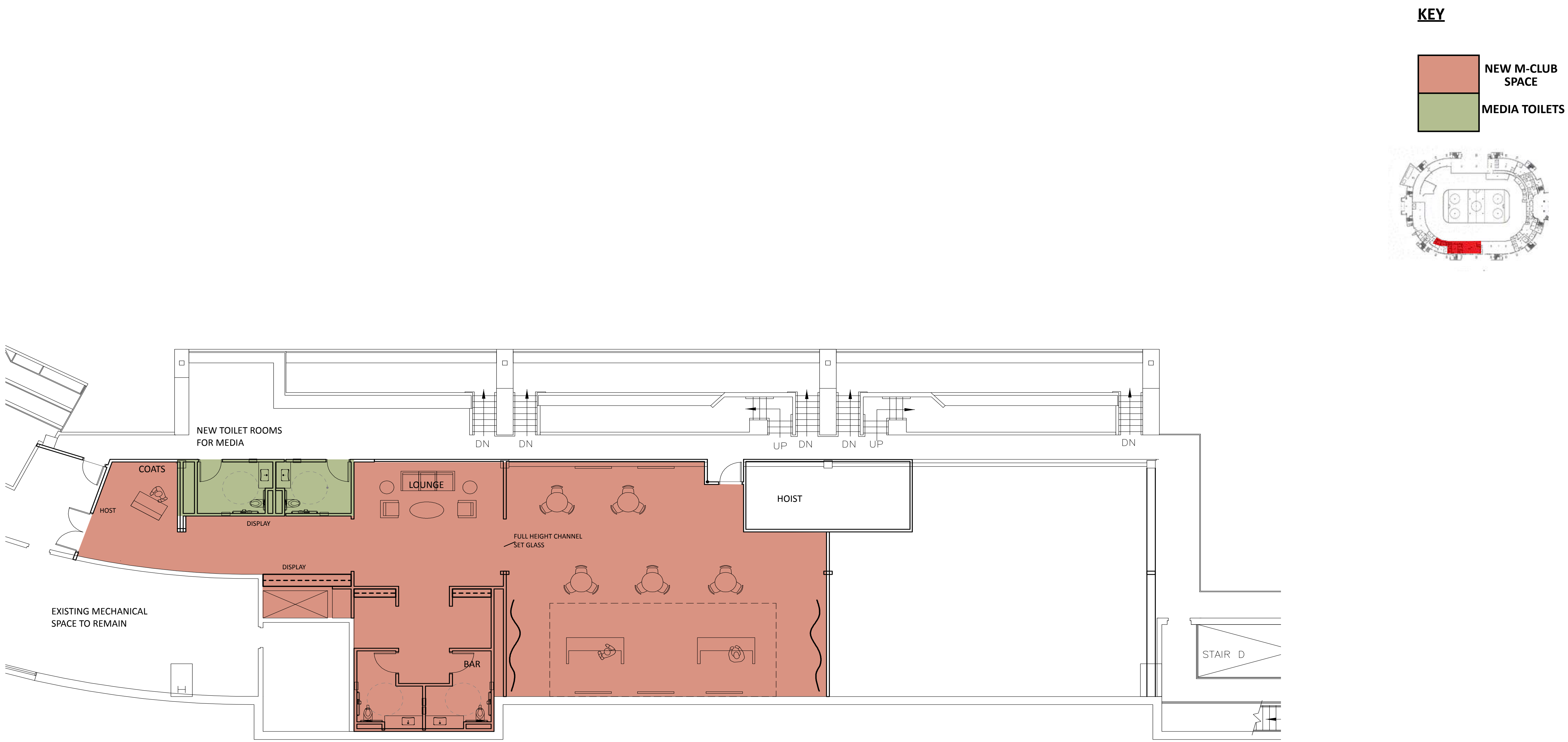


M-Club -Option A (Small)
Upper Level (Phase 3)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963

5' 10' 20'



M-Club -Option A (Large)
Upper Level

(Phase 3)

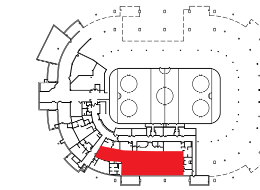
UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

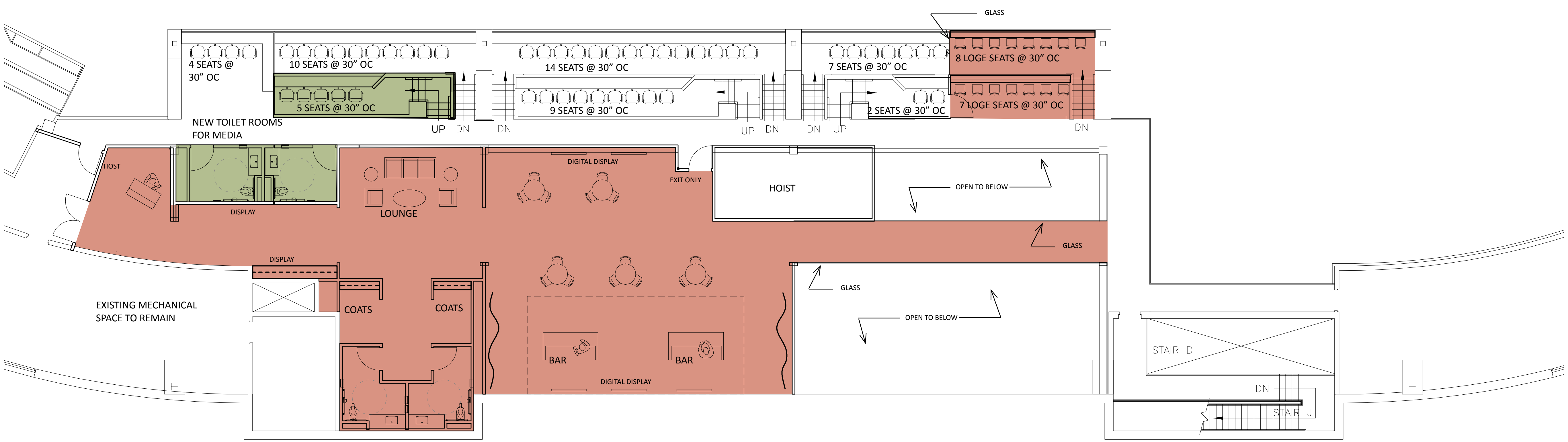
JULY 2014 PROJECT # 01-176-14-1963

KEY

NEW M-CLUB SPACE

REVISED MEDIA





M-Club Option B
Upper Level

(Phase 3)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963

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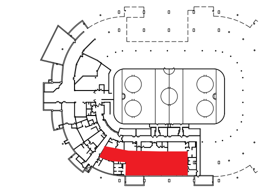
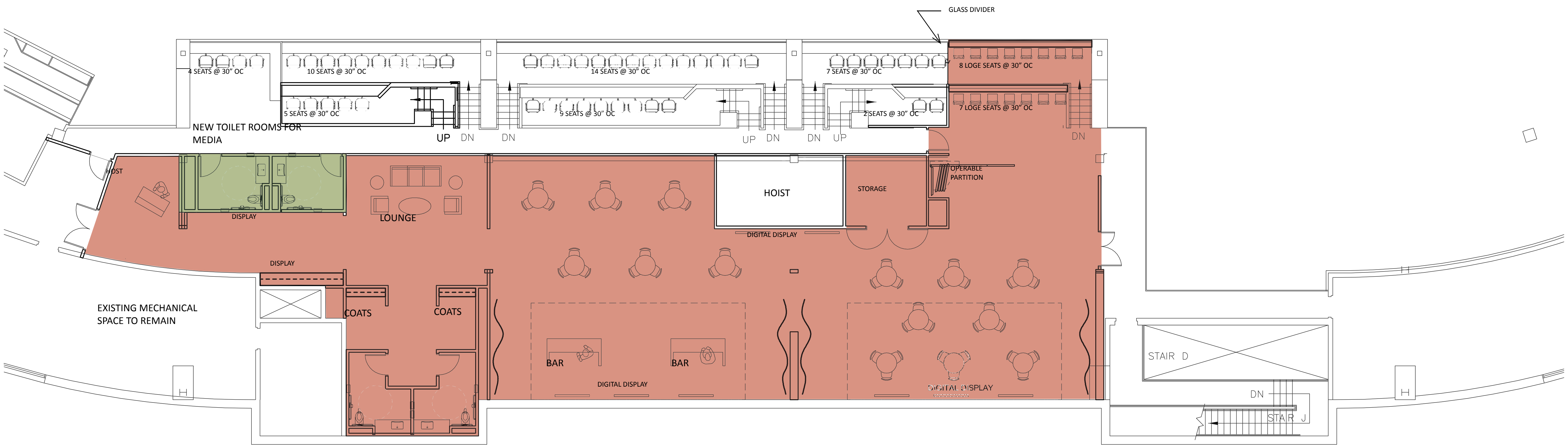
KEY

NEW M-CLUB SPACE

MEDIA TOILETS





5' 10' 20'

M-Club Option C
Upper Level

(Phase 3)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963

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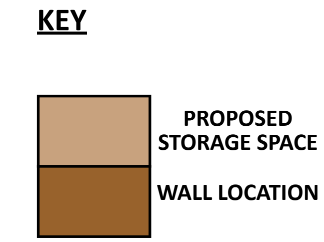

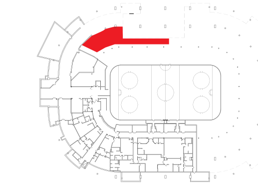

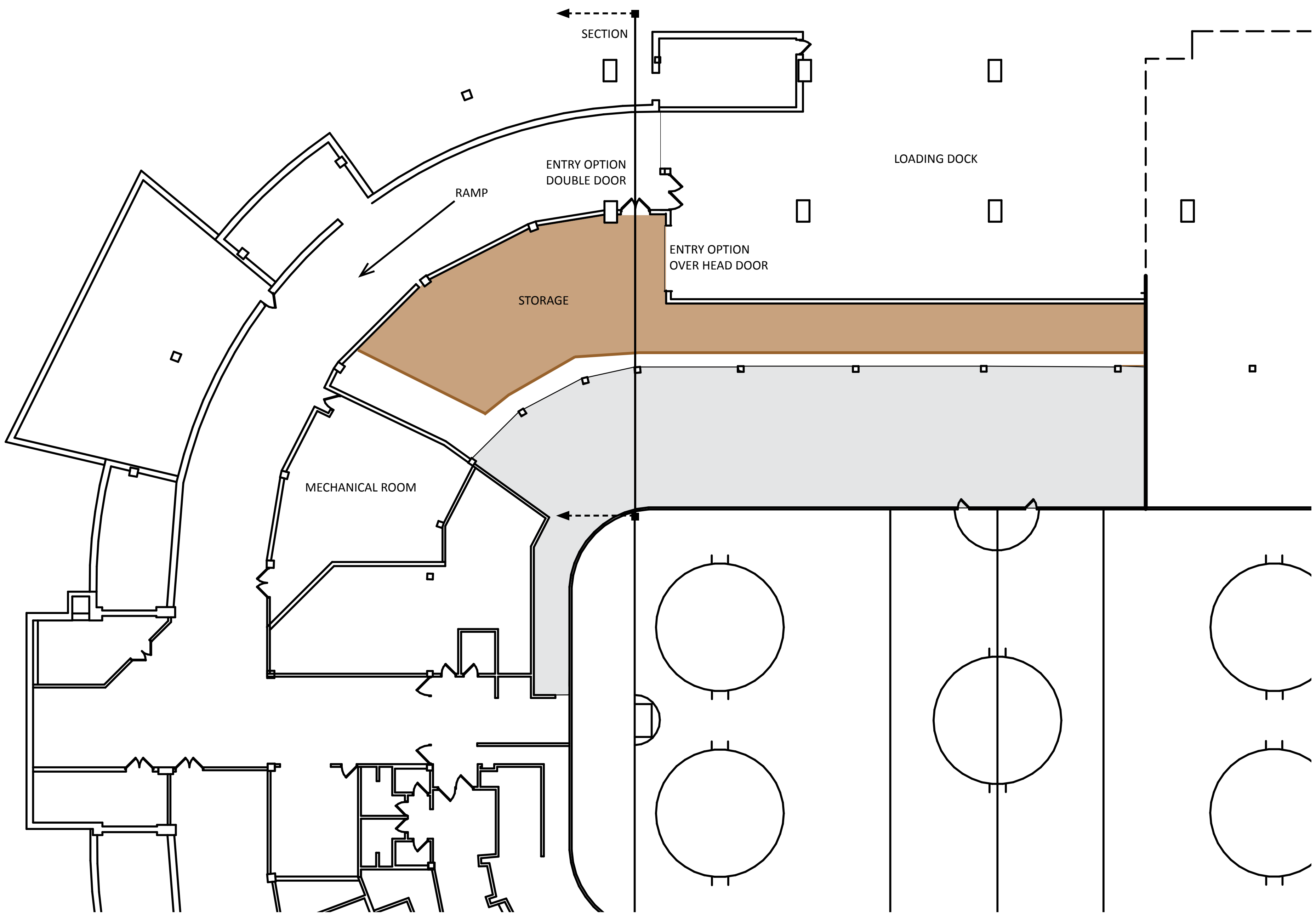

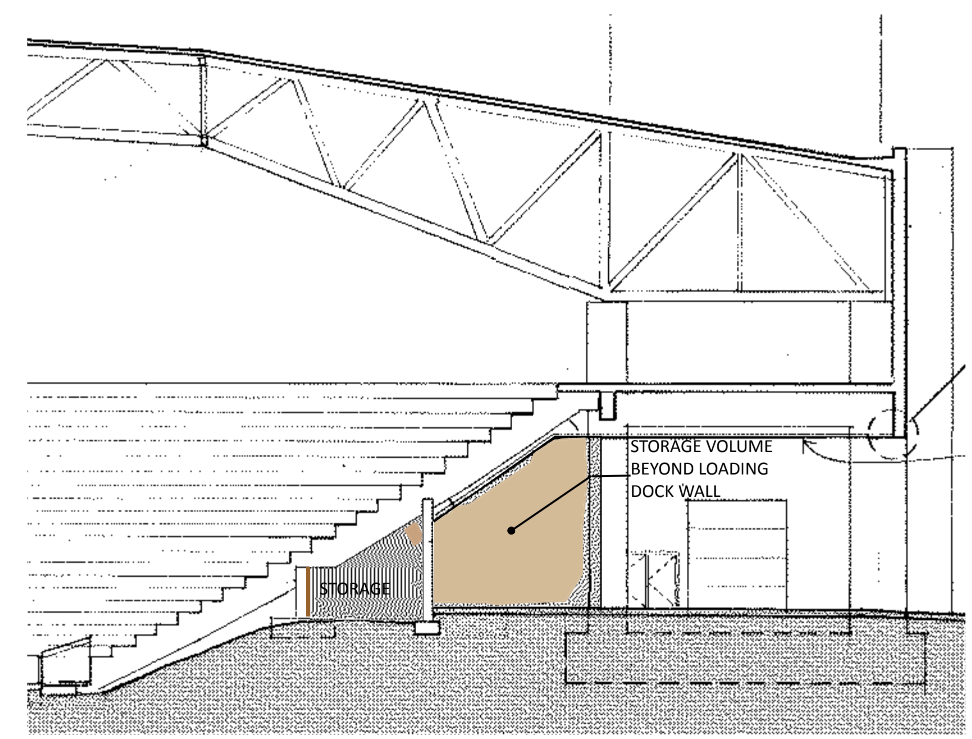

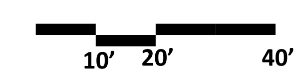

Storage Addition
@ Loading Dock

(Phase 3)

UNIVERSITY OF MINNESOTA - MARIUCCI ARENA

JULY 2014 PROJECT # 01-176-14-1963

Team Locker Room (Phase I)

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Strength and Conditioning Room (Phase 2)

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Strength and Conditioning Room (Phase 2)

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Strength and Conditioning Room (Phase 2)

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Strength and Conditioning Room (Phase 2)

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M-Club Option A-Small (Phase 3)

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M-Club Option A-Large (Phase 3)

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JULY 2014 PROJECT # 01-176-14-1963

Men's Hockey Locker Suite & Support Spaces
Renovated Public/Visiting Team Locker Room
Skate Rental/Hall of Fame/Corridor Graphic Branding (Phase 1)

General
Items Not Included: Furniture, Audiovisual equipment, Move Costs, Art and Plants, hazardous abatement, specialty graphics unless noted otherwise.

Scope of Work:
The extent of this portion of the project is located on the basement/ice level approximately from Stair L and Elevator C east to extent of excavated space and includes the areas bounded by the main corridors, and includes design descriptions for the following three areas:

1. Men's Hockey Locker Suite & Support Spaces
2. Renovated Public/ Visiting Team Locker Rooms and Skate Rental
3. Hall of Fame/Corridor Graphic Branding

See plans for demarcation lines.

Assumptions:

- Phone system and data activation to be provided by the owner.
- Provide in-wall fire treated blocking as required for all millwork and wall mounted accessories.
- Fire proof all penetrations as required.

Building Requirments
This portion of the Mariucci renovation project does not have an exterior component. All work is within existing building shell.

Demolition

- Refer to existing plans to identify extent of all walls being demolished.
- Collection, storage and disposal of all existing items to be removed are to be performed in accordance with University standards.
- Unless indicated otherwise, demolition is to include walls, doors, hardware, fixtures, ceilings, casework, millwork, and finish flooring as required to bring the space to a condition to recieve new work.

Materials & Finishes

- Unless noted otherwise, the following materials and finishes are to be used throughout locker and team spaces.
- Walls – 8" CMU, sealed & painted. Some walls may receive graphic paint schemes (by this package) and applied branding graphics (by FFE package). Walls full height to underside of structure above. Some 4" and 6" CMU walls in select applications- alcove returns, wing walls, etc.
- Floors – Resilient sport flooring (Mondo skate flooring); Ceramic floor tile; Antibacterial carpet; quarry tile, sealed concrete.
- Ceilings – ACT to be 2x2 moisture resistive tiles; moisture resistive gyp board;
- Wood accents – dark oak stained paneling and running trim.
- Laminate – used in various areas including soffits and graphics
- Glass – frosted and other decorative glass used in displays and accents.
- Plastic toilet compartments – solid plastic with stainless hardware. Ceiling hung & braced.

Men’s Hockey Locker Suite & Support Spaces
Renovated Public/Visiting Team Locker Room
Skate Rental/Hall of Fame/Corridor Graphic Branding (Phase 1)

General
Items Not Included: Furniture, Audiovisual equipment, Move Costs, Art and Plants, hazardous abatement, specialty graphics unless noted otherwise.

Scope of Work:
The extent of this portion of the project is located on the basement/ice level approximately from Stair L and Elevator C east to extent of excavated space and includes the areas bounded by the main corridors, and includes design descriptions for the following three areas:

1. Men’s Hockey Locker Suite & Support Spaces
2. Renovated Public/ Visiting Team Locker Rooms and Skate Rental
3. Hall of Fame/Corridor Graphic Branding

See plans for demarcation lines.

Assumptions:

- Phone system and data activation to be provided by the owner.
- Provide in-wall fire treated blocking as required for all millwork and wall mounted accessories.
- Fire proof all penetrations as required.

Building Requirments
This portion of the Mariucci renovation project does not have an exterior component. All work is within existing building shell.

Demolition

- Refer to existing plans to identify extent of all walls being demolished.
- Collection, storage and disposal of all existing items to be removed are to be performed in accordance with University standards.
- Unless indicated otherwise, demolition is to include walls, doors, hardware, fixtures, ceilings, casework, millwork, and finish flooring as required to bring the space to a condition to recieve new work.

Materials & Finishes

- Unless noted otherwise, the following materials and finishes are to be used throughout locker and team spaces.
- Walls – 8” CMU, sealed & painted. Some walls may receive graphic paint schemes (by this package) and applied branding graphics (by FFE package). Walls full height to underside of structure above. Some 4” and 6” CMU walls in select applications- alcove returns, wing walls, etc.
- Floors – Resilient sport flooring (Mondo skate flooring); Ceramic floor tile; Antibacterial carpet; quarry tile, sealed concrete.
- Ceilings – ACT to be 2x2 moisture resistive tiles; moisture resistive gyp board;
- Wood accents – dark oak stained paneling and running trim.
- Laminate – used in various areas including soffits and graphics
- Glass – frosted and other decorative glass used in displays and accents.
- Plastic toilet compartments – solid plastic with stainless hardware. Ceiling hung & braced.

- Solid surface counters – solid surface (Corian) or quartzite counters & backsplashes. Integrated sinks in kitchen areas, ceramic underset in lavs.

Description of Spaces (Phase 1)

- Changing Room – Wood full height lockers with doors. Skate flooring, vinyl base. Grooming counter with solid surface, full height mirrors. Small sink for toothbrushing.
- Main Locker Room – wood open lockers with custom finishes and accents. Flooring is skate flooring, center to have custom team logo carpet. Ceiling is custom gyp, laminate, and glass with multiple layers and large lighted plastic team logo in center. End wall is full wood casework with whiteboard and video smartboard.
- Showers/Toilets – ceramic tile walls, skate flooring. Gyp ceilings. Solid surface/quartzite counters with moderate ceramic lavs. Existing sauna to be moved and relocated within new CMU shell. Some wood millwork accents at entry transition to rest of team suite.
- Team Lounge – carpet flooring, portion of floor is recessed 12". Built in bar seating, end wall casework (full wall) with video and electronics. Team meal and dining area to have large format tile flooring. Walls painted CMU with wood wainscot throughout and some millwork accents. Serving counter at pass through at shared wall with kitchen.
- Kitchenette – quarry tile flooring, wood casework upper & lower cabs with solid surface/quartzite counters throughout. Gyp ceiling. Tile walls around casework. Space for warming carts, microwave, coffee and hot beverage machines, dishwasher, sink, etc.
- Team Video Room – painted CMU with wood wainscot walls. Video wall is wood casework with wood soffit on 1/3 of ceiling. 2/3 ceiling ACT. Carpet flooring throughout. Three rows of stadium seating (Irwin Signature), one on the ground, two on raised steps.
- Equipment Work Room – skate flooring, laminate casework, solid surface counters. Upper & lower cabs. Painted CMU walls. ACT ceiling.
- Team Storage – all spaces under arena seating risers to remain as is. New painted HM doors on existing frames.
- Athletic Trainer – skate flooring throughout. Wood casework and solid surface counters. Painted CMU walls. ACT ceilings. Taping tables are FFE. Walls along corridor and between taping area and office/exam are to be half height CMU and upper portion aluminum storefront windows.
- Hydrotherapy – ceramic tile walls and floors. Ceiling painted gyp. Raised floor with steps access, stainless steel handrail and guardrails. (2) 10'x10' tubs – Hydroworx Thermal and Polarplunge models. Shared walls with trainer space to be half height CMU and upper portion is aluminum storefront windows.
- Coaches locker (video review) – skate flooring perimeter, carpet under furniture and video area. Painted CMU walls, ACT ceiling. Wood casework upper cabs over solid surface/quartzite counter with knee space underneath.
- Coaches Locker – skate flooring in all but shower. Ceramic tile on walls in toilet, shower, and lavatory. Wood lockers and accents in locker area. Ceramic tile on shower floor. Ceiling painted gyp.
- Equipment Office – painted CMU walls. Wall with door, CMU half wall with aluminum storefront window above. Carpet floor, vinyl base. Wood casework and solid surface counter one wall. Act ceiling.
- Equipment Storage – wood casework and solid surface counters along entire north wall. Sealed concrete floor, vinyl base. Painted exposed ceiling. Painted CMU walls. 9' wide manually operated Space Saver storage system along entire south wall.
- Laundry – painted CMU walls. Sealed concrete floor, vinyl base. Exposed painted ceiling. Liquid retention curb poured into existing floor at machine spaces.
- Public Locker Room (south) – some existing CMU walls to remain. New paint on all, ceilings exposed painted to match existing. Plastic bench on wall brackets, single plastic shelf with hanging rod and hooks below. New skate flooring throughout.
- Public Locker Room (north) – to be used as visiting team locker. Some existing CMU walls to remain, new paint on all. Ceilings exposed painted to match existing. Painted open mesh dividers, open face individual lockers (25 total) 24" wide. New skate flooring throughout.
- Team suite corridor – painted CMU walls, edge soffit gyp, center high end ACT. Patterned skate flooring throughout. Elaborate custom built wood and laminate/glass entry "arch" at Main Corridor junction.
- Main corridor (Hall of Fame) – patterned skate flooring, 20% wall surface custom wood accent wall,

60% wall surface custom laminate and glass graphics and display. Ceiling edge gyp soffit, center high end ACT.

- Skate Rental – painted CMU walls, skate flooring, wood skate cubbies entire wall 2 walls. Wood base cabs with solid surface counter one wall. New metal "dutch" door with service counter ledge. Exposed painted ceiling.

Electrical , Mechanical, and Plumbing Requirements

Restrooms- Provide university standard plumbing fixtures and accessories.

- Accessories to include: mirrors, soap dispenser, paper towel dispenser and disposal, feminine napkin disposal and napkin dispenser units, surface mounted toilet paper holder and utility shelf in each toilet stall, and stainless steel grab bars in handicap stalls. Refer to MEP pricing narrative for more information.

Lighting:

- All areas u.n.o.- Assume 2x2 direct indirect fixtures throughout- (1) fixture per 80sf.
- Restrooms: Assume (2) LED down lights per room.
- Changing and Toilet/Shower spaces – Assume 2x2 direct indirect moisture resistant fixtures. Downlights at lavatory and grooming counters. Wet area sealed flush mount LED fixtures in showers.
- Locker room – variety of custom LED pinhole, 1x2 LED flush mount strip lighting, and center hung custom plastic lighted "M: logo fixture. LED pinhole downlighting in each level of each locker. Downlight directional lighting at video screen area.
- Kitchen – typical 2x2 lights. Under counter lights along all casework.
- Lounge – 2x2 direct indirect fixtures throughout. Downlighting at lounge video area and gaming areas. Edge downlighting for wall wash accents every 12 feet at perimeter.
- Team video room – dimmable controls at video screen/podium. Zoned downlighting over seating and video areas.
- Equipment workroom, Training rooms, equipment storage, laundry – 2x2 typical fixtures throughout. Under counter lights along all casework.
- Coaches locker – 2x2 direct indirect at main video area, wet use flush mounted LED downlight fixtures in locker and toilet/shower areas.

Modify / extend existing sprinkler system as required.

Power/ Data:

- Typical Rooms: (1) dbl duplex, (2) duplex and (1) voice data
- Head coach spaces: Same as typical with (1) additional voice/data and (1) duplex for wall mounted TV/ video review system.
- Team Locker Room, Video Room: power, voice, data at main display wall in casework and at video wall.
- Changing Room: power and USB power at each player's locker inside casework for charging personal devices.
- Equipment Work room: plugmold power along entire workbench.
- Team Lounge: (6) duplex, (2) voice data, (2) dbl duplex floor power/data at gaming area. Power & data at video wall (south) casework. Power/USB power at curved bar rail for device charging.
- Kitchenette: duplex GFCIs at 18" spacing along counters for serving.
- Training Room, Equipment Storage Room: plugmold GFCI along work counter.

Strength and Conditioning Renovation Area (Phase 2)

General

Items Not Included: Furniture, Audiovisual equipment, Move Costs, Art and Plants, hazardous abatement, specialty graphics unless noted otherwise.

Scope of Work:
The extent of this portion of the project is located on the First level approximately from Stair L and Elevator C east to extent of and including current Men's Hockey Administration.

See plans for demarcation lines.

Assumptions:
- Phone system and data activation to be provided by the owner.
- Provide in-wall fire treated blocking as required for all millwork and wall mounted accessories.
- Fire proof all penetrations as required.

Building Requirments

This portion of the Mariucci renovation project does not have an exterior component. All work is within existing building shell.

Demolition
- Refer to existing plans to identify extent of all walls being demolished.
- Collection, storage and disposal of all existing items to be removed are to be performed in accordance with University standards.
- Unless indicated otherwise, demolition is to include walls, doors, hardware, fixtures, ceilings, casework, millwork, and finish flooring as required to bring the space to an empty "shell" condition.

Materials & Finishes
- Unless noted otherwise, the following materials and finishes are to be used throughout weight room spaces.
- Walls – 8" CMU, sealed & painted. Some walls may receive graphic paint schemes (by this package) and applied branding graphics (by FFE package). Walls full height to underside of structure above. Some 4" and 6" CMU walls in select applications- alcove returns, wing walls, etc.
- Metal stud walls (3-5/8" or 6") to have batt sound attenuation blankets and finished gyp board both sides.
- Floors – Resilient sport flooring (Robbins Galaxy Fit); Ceramic floor tile; Antibacterial carpet; raised resilient flooring, synthetic turf, sealed concrete.
- Ceilings – ACT to be 2x2 moisture resistive tiles; moisture resistive gyp board; expose painted.
- Wood accents – dark oak stained paneling and running trim.
- Laminate – used in various areas including soffits and graphics
- Glass – frosted and other decorative glass used in displays and accents.
- Plastic toilet compartments – solid plastic with stainless hardware. Ceiling hung & braced.
- Solid surface counters – solid surface (Corian) or quartzite counters & backsplashes. Integrated sinks in kitchen areas, ceramic underset in lavs.
- Doors & frames – wood doors with vision glazing, painted hollow metal frames.
- Specialty Ceiling in open weight space - perforated metal on metal framing hung from structure above.

Description of Spaces
- Offices – assistant strength coaches share enlarged office. Painted mtl stud walls, vinyl base, carpet floors. ACT ceilings. Head strength coach viewing windows on 2 walls.
- Toilets/Showers – ceramic tile flooring and walls. Solid surface counters with ceramic lavs. Showers ceramic tile all wall and floor, vinyl curtain, plastic bench. Roll in curbs for floor water retention. Gyp

ceilings.

- Rapid Shot puck shooting stations – custom units will have mostly glazed walls, proprietary doors and ceiling lids at 10' AFF. End portion will have mtl stud walls for puck return equipment.
- Main weight room – Painted CMU with accent graphics. Some high end metal column covers (Centria 3000 series), mirrored walls on 100 lineal feet x 10 feet of space. Ceilings exposed painted with perforated metal high end ACT system accents between columns. Some gyp and laminate soffits and fascia at column lines.
    1. Flooring high impact sport flooring.
    2. Turf area (padded non-filled short grass pro or premium turf).
    3. Running track – high impact resilient track surface.
    4. Heavy and free weights area to have raised 3.25" padded resilient sport flooring to match deck height of rack units. Vinyl wall base.
    5. Vestibule – ceramic tile floor, (2) painted walls, (2) storefront walls, gyp ceiling.

Electrical , Mechanical, and Plumbing Requirements

Restrooms: Provide university standard plumbing fixtures and accessories. Accessories to include: mirrors, soap dispenser, paper towel dispenser and disposal, feminine napkin disposal and napkin dispenser units, surface mounted toilet paper holder and utility shelf in each toilet stall, and stainless steel grab bars in handicap stalls. Refer to MEP pricing narrative for more information.

Lighting:

- All areas u.n.o.- Assume 2x2 direct indirect fixtures throughout- (1) fixture per 80sf.
- Changing and Toilet/Shower spaces – Assume 2x2 direct indirect moisture resistant fixtures. Downlights at lavatory and grooming counters. Wet area sealed flush mount LED fixtures in showers.
- Main weight room – high efficiency LED downlights

Modify / extend existing sprinkler system as required.

Power/ Data:

- Office (typical): (1) dbl duplex, (2) duplex and (1) voice data.
- Coach offices: Same as Office with (1) additional voice/data and (1) duplex for wall mounted TV.
- Main Circulation/ Corridors: Convenience outlets as required.

Men's Hockey Administration/Women's Hockey Administration/Facilities Administration (Phase 2)

General
Items Not Included: Furniture, Audiovisual equipment, Move Costs, Art and Plants, hazardous abatement, specialty graphics.

Scope of Work:
The extent of this portion of the project is located on the first floor between Stair K and the West Entrance north of Stair M. The areas affected are defined as:

- Men's Hockey Administration
- Women's Hockey Administration
- Facilities Administration

See plans for demarcation lines.

Assumptions:

- Phone system and data activation to be provided by the owner.
- Provide in-wall fire treated blocking as required for all millwork and wall mounted accessories.
- Fire proof all penetrations as required.

Building Requirements
Provide entry vestibules at Women's Administration as well as New Public Entry to Stair L and existing elevator. Assume new glass entry doors at building envelope and interior aluminum storefront glazing between vestibule and Reception areas. Assume $5.50/sf for ceramic tile flooring/ Gyp board ceiling/ (4) compact fluorescent fixtures in Women's Entry, (6) compact fluorescent fixtures in Public Entry Vestibule.

Demolition

- Refer to existing plans to identify extent of all walls being demolished.
- Collection, storage and disposal of all existing items to be removed are to be performed in accordance with University standards.

Wall Types
FULL HEIGHT PARTITION (TYPICAL ALL PARTITIONS U.N.O.)
3-5/8" metal studs extended and attached to underside of deck above, full fit, sound attenuation batt insulation with 5/8" Gyp. Bd. both sides and prepared to receive final finish. – See Alternates.

SPECIALTY PARTITION (MEN'S AND WOMEN'S RECEPTION/VESTIBULES)

3-5/8" metal studs extended and attached to underside of deck above. 5/8" gyp. bd both sides. Provide allowance of $25/sf for specialty finish

Doors, Frames, Sidelights, Glazing and Hardware

Type A INTERIOR DOORS & FRAMES (NEW)- Storage, Restroom locations
3'-0" x 9'-0" solid core wood door- species: Quarter sliced, balanced and book matched Maple. Door frame to be 1" hollow metal (painted) frame with University standard lever set hardware.- See alternates.

Type B INTERIOR DOORS & FRAMES WITH SIDELIGHT (NEW)- Office locations
3'-0" x 9'-0" solid core wood door- species: : Quarter sliced, balanced and book matched Maple and sidelight with 1" hollow metal (painted) frame. At these locations provide 18" wide x full height integral sidelight with glass film- 3M or equal. Filmed area to be approximately 75% s.f. of the total glass area. University standard lever set hardware. .- See alternates.

Type C GLASS DOORS AND SIDELIGHTS- Conference Room locations
Provide channel set top and bottom full height clear glass windows with pivot hinge glass doors 3'0 x 9'0, (Herculite or equal)., Provide channel set top and bottom glass panels full length of corridor wall

of conference rooms. Provide glass film full width of panels- assume 75% of total glass area.

Type D INTERIOR SLIDING DOORS & FRAMES (NEW)- Head Coach, and Recruit Lounge locations
3'-0" x 9'-0" solid core wood door- species: : Quarter sliced, balanced and book matched Maple. Door frame to be sliding frame with University standard lever set hardware.- See alternates.

Finish Levels

Walls:

- All walls to receive painted finish, to be spray primed with Pratt & Lambert, "Supreme One" primer or equal, U.N.O.
- Specialty – At Reception areas provide for 20 linear feet of specialty wall covering (both sides of wall- 40 linear feet total) assume $30/ sf material.
- Women/ Men's Admin Restrooms – Ceramic Tile: Provide material allowance of $3.50/SF. Wall tile to be applied to all walls from 0" – 48" AFF.- all walls.
- Facility Admin Restrooms- Ceramic Tile: Provide material allowance of $1.50/SF. Wall tile to be applied to all walls from 0" – 48" AFF.- all walls.
- Wall Base –Wood: Provide maple wood base in Main Circulation, Conference rooms, Head Coach Offices and Recruite Lounge. Vinyl: Provide vinyl base in all other locations.

Floors:

- Main Circulation - Men's and Women's Hockey Admin – Carpet Tile: Provide material allowance of $36/yd.
- Main Circulation – Facility Admin – Carpet Tile: Provide material allowance of $28/yd.
- Office Areas – Men's and Women's Hockey Admin – Carpet Tile: Provide material allowance of $36/yd.
- Office Areas – Facility Admin – Carpet Tile: Provide material allowance of $28/yd.
- Women/ Men's Admin Restrooms – Ceramic Tile: Provide material allowance of $5.50/SF.
- Facility Admin Restrooms- Ceramic Tile: Provide material allowance of $2.50/SF.
- Mail/ Copy/ Break/ Employee Lounge: Direct glue linoleum.

Ceilings:

- ACT - Armstrong Ultima 2x2 tegular edge tile with 9/16" grid, or equal. (u.n.o.)
- Gyp. Bd. – Assume (2) locations of 300sf , Assume (2) locations of 600sf, Assume (1) location of 400sf.
- Specialty(RECEPTION & CONFERENCE): Assume (2) locations of specialty ceiling materials at $35/sf.

Millwork

- Reception- Men's and Women's Administration- Assume $12,000 per reception desk.
- Mail/ Copy – Break: Men's and Women's Administration- Assume quartz surface countertops at mail and Break- plam lower and upper cabinets.
- Employee Lounge: Facility Administration- plam countertops - plam lower and upper cabinets
- Women/ Men's Admin Restrooms – Assume quartz surface sink top.
- Provide(2) custom built display units for trophy/ storage and display (assume $8,000.00 unit)

Electrical , Mechanical, and Plumbing Requirements

Restrooms:
Provide university standard plumbing fixtures and accessories at restrooms and break / employee lounges: Accessories to include: mirrors, soap dispenser, paper towel dispenser and disposal, feminine napkin disposal and napkin dispenser units, surface mounted toilet paper holder and utility shelf in each toilet stall, and stainless steel grab bars in handicap stalls. Refer to MEP pricing narrative for more information.

Lighting:

- All areas u.n.o.- Assume 2x2 direct indirect fixtures throughout- (1) fixture per 80sf.
- Men's and Women's Conference rooms: Assume (12) dimmable LED recessed cans per conference

room, (6) 2”x72” recessed slim line linear fluorescent fixtures.
- Restrooms: Assume (2) LED down lights per room.
- Men’s and Women’s Reception Areas: Assume (6) LED down lights per Reception area, 16’ linear feet of adjustable track lighting. Assume 35’ linear feet of LED tape light at ceiling cove.
- Break Mail/ Copy: Assume under counter task lights/ (3) decorative pendants @ $350/ea.
- Display/Graphic Walls: Assume (1) adjustable wall washer fixture every 2’-0” at these locations

Modify / extend existing sprinkler system as required.

Power/ Data:
- Office (typical): (1) dbl duplex, (2) duplex and (1) voice data.
- Head coach offices and Recruit lounges: Same as Office with (1) additional voice/data and (1) duplex for wall mounted TV.
- Conference: (1) flush floor box for power and data, (2) wall duplex, (1) voice data, (1) wall mounted power and data for TV.
- Reception: (1) flush floor box for Reception desk, (2) wall duplex, (1) voice data.
- Mail/ Copy/ Break: (4) duplex, (4) double duplex, (2) voice data.
- Employee Lounge: (2) duplex, (2) double duplex, (2) voice data.
- Main Circulation/ Corridors: Convenience outlets as required.

Equipment

- Break Room / Employee Lounge: Provide allowance for (1) full sized refrigerator, under counter dishwasher, countertop microwave.
- Conference Rooms/ Recruite Lounges: Provide allowance for (1) GE profile glass front beverage cooler (or equal) at each locations, Men’s and Women’s.
- Alternate -New Premium level elevator cab- Match same # of stops as existing, and provide front and rear entry to cab at first floor level only. Assume Etched stainless steel doors (inside and out); Carpet flooring $36/ ydWalls to be 1/3 Back painted glass/ 2/3 stainless steel.- Cab ceiling to be stainless steel with led down lights.

Alternates/ Unit Costs:

In lieu of full height walls throughout, assume only conference rooms, head coach and recruit lounges are full height. Remainder of walls to be 6” above 9’0 ceiling grid.- brace as required

In lieu of wood doors as specified, provide University standard plain sliced red oak species.

M CLUB (PHASE 3)

General

Items Not Included: Furniture, Portable Bars, Audiovisual equipment, Move Costs, Art and Plants, hazardous abatement, specialty graphics.

Scope of Work:
The extent of the remodeling is primarily restricted to the area of the 3rd floor behind existing press box.

Note: There is a request to price 3 options for this M Club. Options will be labeled "A, B, C" (see attached drawing). At the time of the report, Option A (Large) is the preferred option and used for programming and design.

Assumptions:

- Phone system and data activation to be provided by the owner. Cabling and networking to be provided by Contractor.
- Provide in-wall fire treated blocking as required for all millwork and wall mounted accessories.
- Fire proof all penetrations as required.
- Material allowances identified are cost to contractor and do not include any applicable mark-ups, taxes or freight charges.

Demolition
Refer to existing plans to identify extent of all walls being demolished.

Collection, storage and disposal of all existing items to be removed are to be performed in accordance with University standards.

Wall Types
FULL HEIGHT PARTITION (TYPICAL ALL PARTITIONS U.N.O.)
3-5/8" metal studs extended and attached to underside of deck above, full fit, sound attenuation batt insulation with 5/8" Gyp. Bd. both sides and prepared to receive final finish.

At Option C only, provide for manually operated moveable wall system, Hufcor or equal, with fabric finish.

FULL HEIGHT GLASS PARTITION (SEE PLANS FOR LOCATION)

Provide ½" thick full height glazed partition with butt joint panels with patterned film channel set top and bottom. Provide silicone caulking. Assume glass film applied to face of glass

Doors, Frames, Sidelights, Glazing and Hardware

Type A — INTERIOR DOORS & FRAMES (NEW) TYP.
3'-0" x 8'-0" solid core wood doors. Species to be plain sliced red oak. Door frame to be 1" hollow metal (painted) frame with University standard lever set hardware.

Type B — INTERIOR DOORS & FRAMES WITH SIDELIGHT (NEW) N/A
3'-0" x 9'-0" solid core sepele wood door and sidelight with 1" hollow metal (painted) frame. At these locations provide 24" wide x full height integral sidelight with etched glass. Etched area to be approximately 12 s.f. of the total glass area. Sepele to be premium grade, quarter cut, clear finish, balance and slip match. University standard lever set hardware.

Type C GLASS DOORS AND SIDELIGHTS
At entry to M Club, provide channel set top and bottom full height clear glass windows with pivot hinge glass doors 3'0 x 8'0, (Herculite or equal). Assume 1 set of Double Doors (glass) with 3' 0" Sidelight. Provide 3M film to face of doors and sidelight.

Interior Finishes

Walls:

- All walls to receive painted finish, to be spray primed with Pratt & Lambert, "Supreme One" primer or equal, U.N.O. Media/ Press in all options to receive new paint.
- Existing Premium Elevator Lobby and Corridor to M Club to receive new paint.
- Specialty – Provide for Option A and B 500 SQ FT of specialty wall covering at $25/YD. Provide for option C 1000 SQ FT of specialty wall covering at $25/YD.
- Specialty – Provide Option A and B 500 SQ FT of maple veneer wall paneling. Provide for option C 1000 SQT of maple veneer wall paneling.
- Restrooms
    - Media - Ceramic Tile: Provide material allowance of $1.50/SF. Wall tile to be applied to all walls from 0" – 48" AFF.
    - M Club – Ceramic Tile: Provide material allowance of $3.50/SF. Wall tile to be applied to all walls from 0" – 48" AFF.
- Wall Base – 4" High maple base.

Floors:

- TYP. Carpet Tile (M Club and Premium Elevator Lobby/ Hallway) – Provide material allowance of $36/ SQ YD.
- Typ. Carpet Tile (Media/ Press) – Provide material allowance of $28/yd.
- Restrooms – Ceramic Tile: Provide material allowance of $5.50/SF.

Ceilings:

- ACT - Assume 200 SQ FT of Armstrong Ultima 2x2 tegular edge tile with 9/16" grid, or equal.
- Gyp. Bd Soffit – Assume 400 SQ FT of suspend ceiling element.
- Exposed – remainder of square footage to be exposed to view and painted
- Restrooms – Gyp Board.
- Specialty – suspended wood slat ceiling in maple species. Assume 300 SQ FT in Option A/B. Assume 600 SQ FT in Option C.

Millwork

Display – Assume 10 Linear FT of Display cabinet – maple wood and glass face.
Coats – Assume 12 Linear FT for Plastic Laminate Coat Rod/Shelf.
Restroom – Provide for quartz surface sink top.
Loge Seating Areas (Options B & C) – Provide for 10" Deep x 1 ½" Thick Quartz surface drink rail with stainless steel drink edge, length as indicated on drawings.
Press Box (Option C only) – provide cost to modify upper level press box as indicated on plan, include necessary wall construction, platform, stairs, and handrails.

Electrical , Mechanical, and Plumbing Requirements

Restrooms -

- Provide university standard plumbing fixtures and accessories. Accessories to include: mirrors, soap dispenser, paper towel dispenser and disposal, feminine napkin disposal and napkin dispenser units, surface mounted toilet paper holder and utility shelf in each toilet stall, and stainless steel grab bars in handicap stalls.

- Refer to MEP pricing narrative for more information.

Modify and/or expand sprinkling system.

Lighting –

- Assume Press Box Restroom to receive 1 fluorescent downlight each
- Assume M Club Restroom to receive 1 fluorescent downlight each, and 1 decorative sconce, assume $350/sconse
- Assume 12 compact fluorescent downlights at M Club entry
- Assume 400 LF of LED cove lighting at Option A/B and 800 LF of LED cove lighting at Option C
- Assume 8 decorative pendants at remainder of M Club area for Option C, Assume 4 decorative pendants at remainder of M Club area for Option A/B – Assume $2500/Pendant
- Assume Option A/B to receive 30 linear feet of adjustable track lighting, Assume Option C to receive 60 linear feet of adjustable track lighting
- Assume linear recessed flourescent at ACT and wood slat ceilings.

Power -

- In Option A/B provide for 2 flush mounted floor boxes, In Option C provide for 4 flush mounted floor boxes
- Provide for duplex power as required throughout. Assume duplex power at every 4 loge seats for Option B/C
- At Option C modified media locations: provide for wire mold power
- Provide for power and data at digital display locations

Alternates/Unit Costs

In lieu of plain sliced red oak doors, provide quarter tight red maple

STRUCTURAL SYSTEMS NARRATIVE

Puck Handling Area (Phase 2):
The option of carving into the unexcavated space located east of grid M is not ideal for two reasons. First the southern portion is backfilled (see hatched area in Drawing 1) and provides support to the concrete slab-on-grade above. Secondly, one of the existing footings (see clouded area in Drawing 1) is located above the floor elevation.

Details Associated to Ice Rink Modifications (Phase 4):
The proposed ice rink will decrease from the original ice rink width; 100 feet to 92.5 feet. These limits are identified in Drawing 2. This decrease in rink provides an opportunity for additional seating on each side of ice rink. The bottom row of existing seating bears on a concrete shelf of 16 inches rise and 33 inches run. Continuing these dimensions only allows (1) additional row of seating. Corresponding proposed concrete construction is shown on Drawing 3.

Drawing 4 is a plan view of the ice rink's west end. This end provides Zamboni access to the ice. A continuous concrete grade beam is located along the outside limits of the existing ice rink. It is identified in Drawing 4. Due to the concrete grade beams existing location and elevation, it will need to be replaced with a splice as shown in Drawing 5. The splice limits are shown on Drawing 4. Temporary support will be necessary to excavate and construct new concrete grade beam under the existing grade beam. Removing existing concrete beam will occur after new splice is fully cured.

"M Club" Structural System (Phase 4):
The limits of the proposed "M Club Revised Option A" are highlighted in Drawing 6. Proposed construction consists of 3.5 inch light-weight concrete reinforced with WWF on 3 inch – 18 gauge galvanized composite metal deck; for a total structural thickness of 6.5 inches. This floor system will be supported by structural steel beams with headed steel studs for composite action.

Alternative Options were reviewed as identified below. According to Facility Personnel, soil modifications were required for the 2001 Mariucci Suites Renovation project. The proposed infill is very similar, so we anticipate soil modifications will be required to increase allowable soil bearing capacity at building foundations for these alternative options.

1. Option A: The limits of the proposed "M Club" Option A are highlighted in Drawing 6A. Proposed construction consists of 3.5 inch light-weight concrete reinforced with WWF on 3 inch – 18 gauge galvanized composite metal deck; for a total structural thickness of 6.5 inches. This floor system will be supported by structural steel beams with headed steel studs for composite action. The probable estimated quantity of structural steel framing is 100,000 lbs.

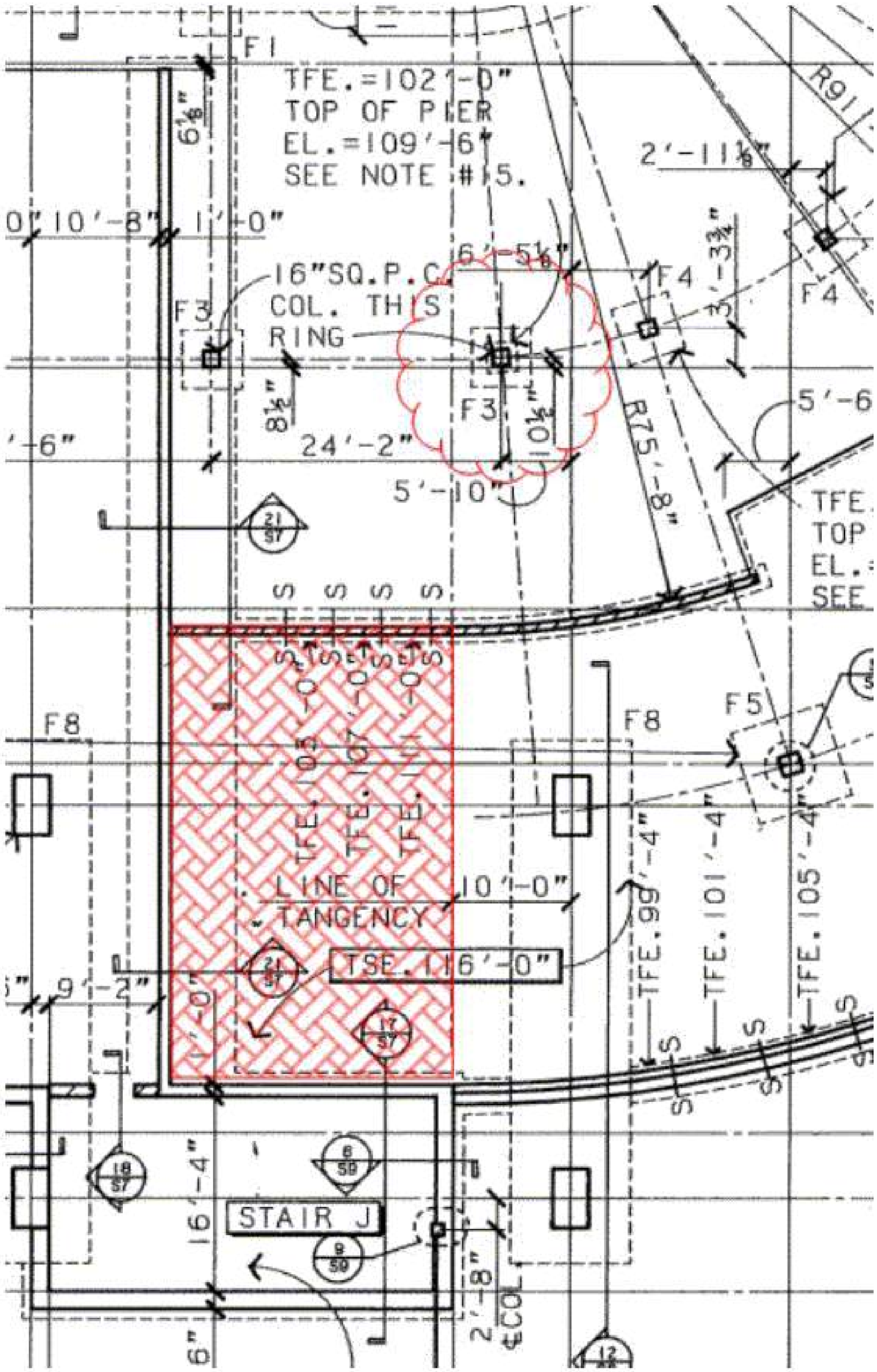
2. Option B: The limits of the proposed "M Club" Option B are highlighted in Drawing 6B. Proposed construction will be the same as Option A identified above. The probable estimated quantity of structural steel framing is 145,000 lbs.

3. Option C: The limits of the proposed "M Club" Option B are highlighted in Drawing 6B. Proposed construction will be the same as Option A identified above. The probable estimated quantity of structural steel framing is 170,000 lbs.

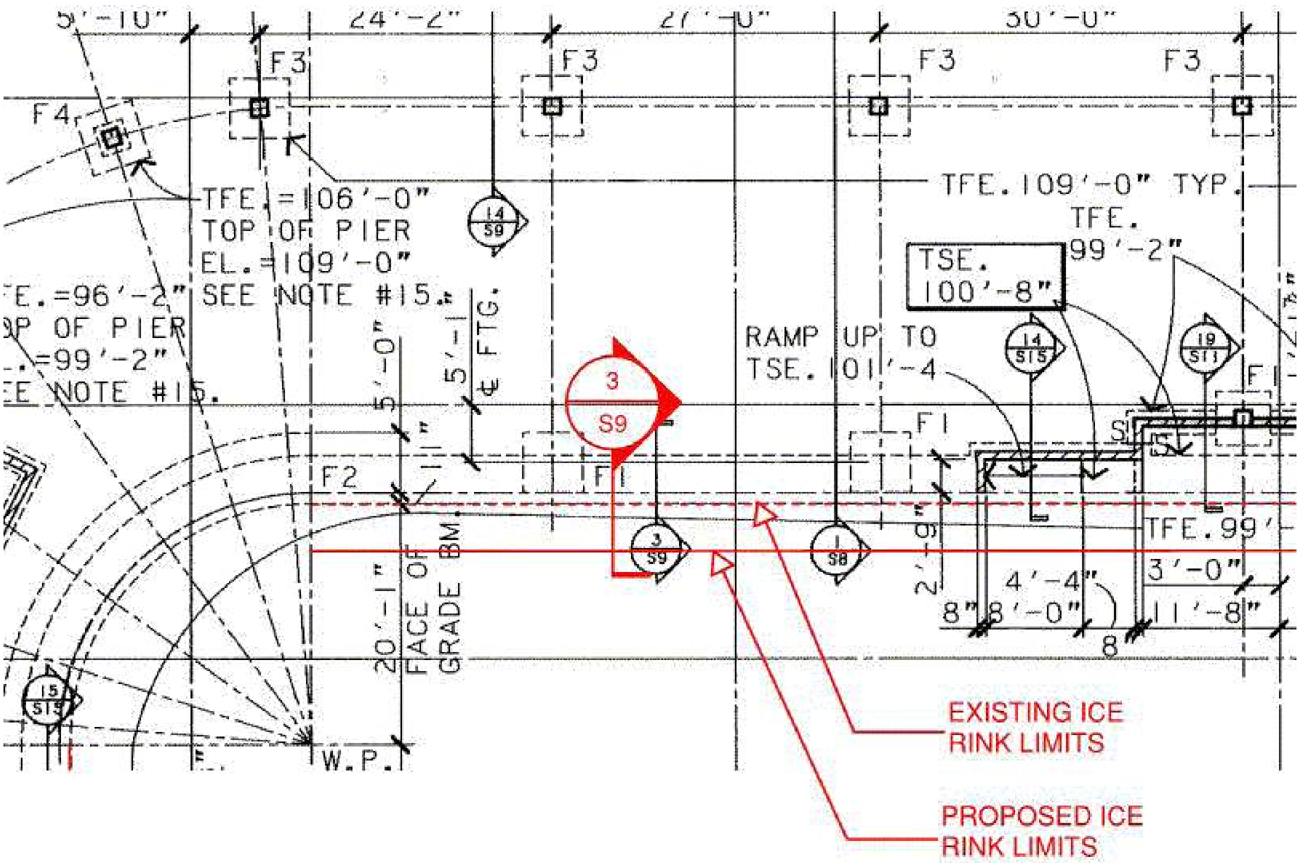
Storage Area (Phase 3):
A new storage area is proposed below the stadia alongside the ramp access in the northwest corner of the facility. This area would require a 6” thick reinforced concrete slab-on-grade and new steel lintel for the proposed opening in the existing CMU wall. Additional modifications are as follows:

1. The pictures show the soil sloping at a steep angle down to the ice level. Without a retaining system, this soil could become un-stable with the proposed additional surcharge loads (storage and forklift traffic). We propose either a retaining wall system be incorporated and/or limit the proposed storage area’s extents to a safe distance away from the sloped edge. The safe distance can be provided by a Geotechnical Engineer.

2. The pictures show the soil sloping down to the CMU wall of the Mechanical Room. The existing drawings indicate no reinforcement is provided in the CMU wall. This information leads us to believe the CMU wall is not intended to support lateral forces from soil backfill. Therefore, we propose the same options as identified in Comment #1 above.

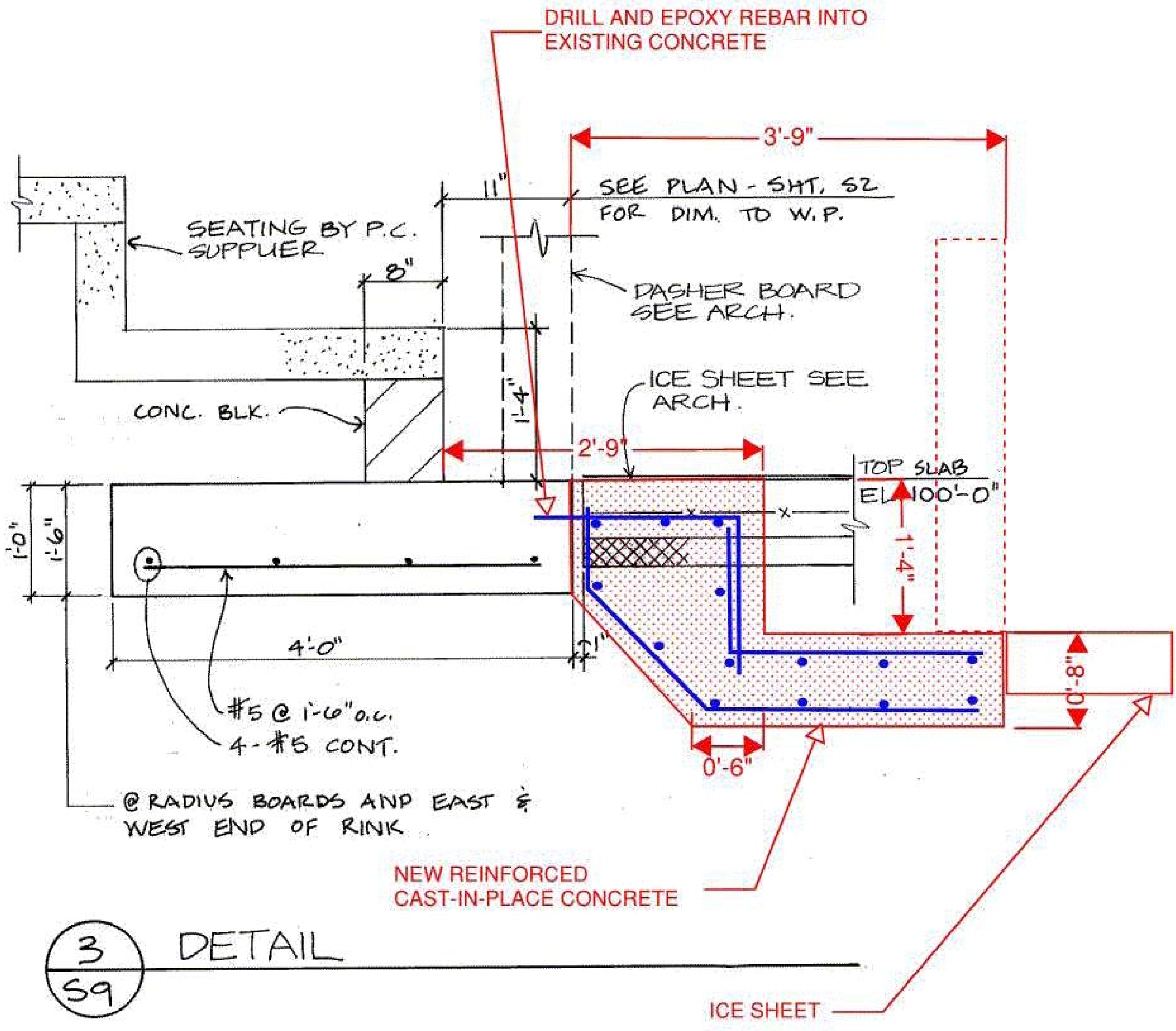


DRAWING 1 - PUCK HANDLING AREA (Phase 2)



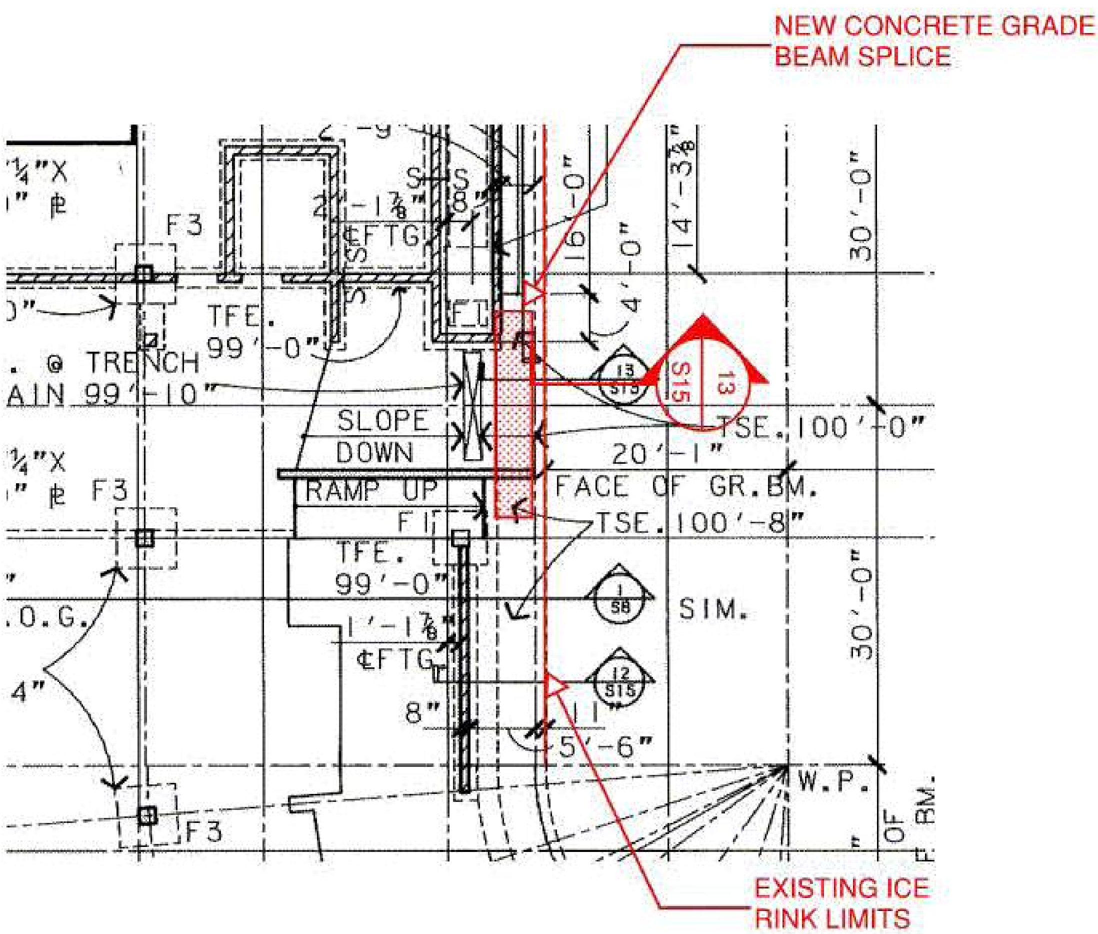
DRAWING 2 - NW CORNER PLAN VIEW OF RINK

(Phase 4)



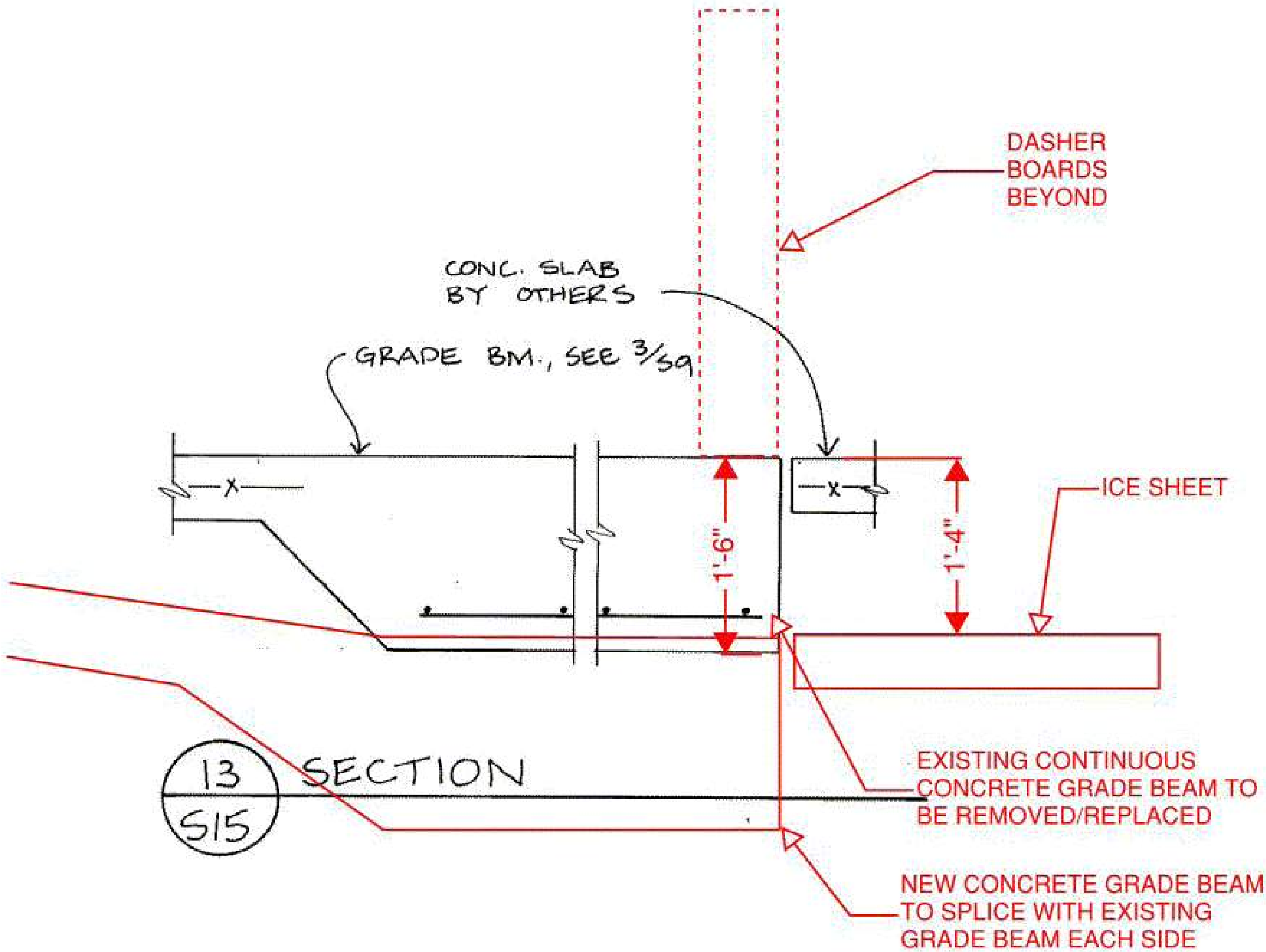
DRAWING 3 - RINK MODIFICATIONS

(Phase 4)



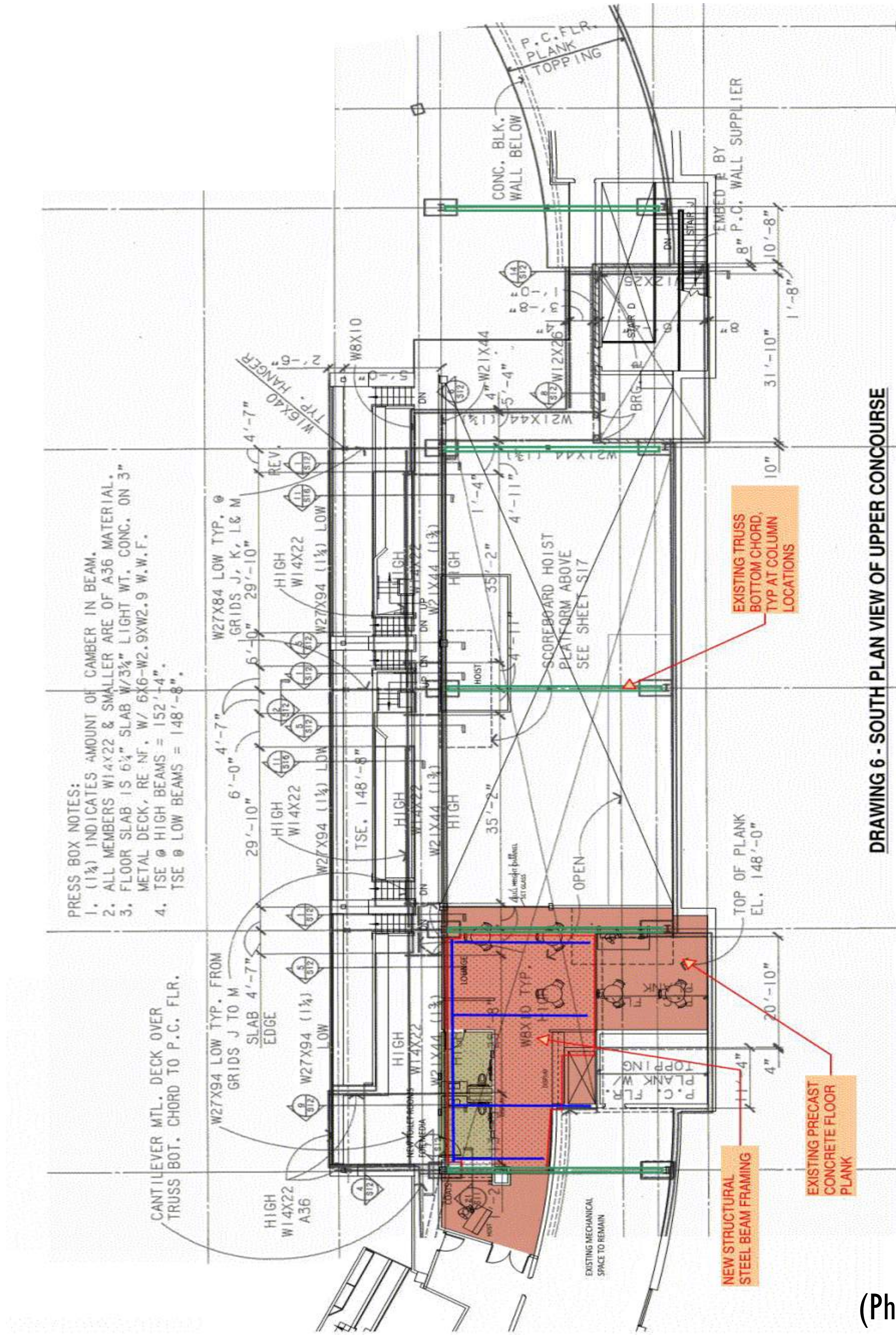
DRAWING 4 - WEST END PLAN VIEW OF RINK

(Phase 4)



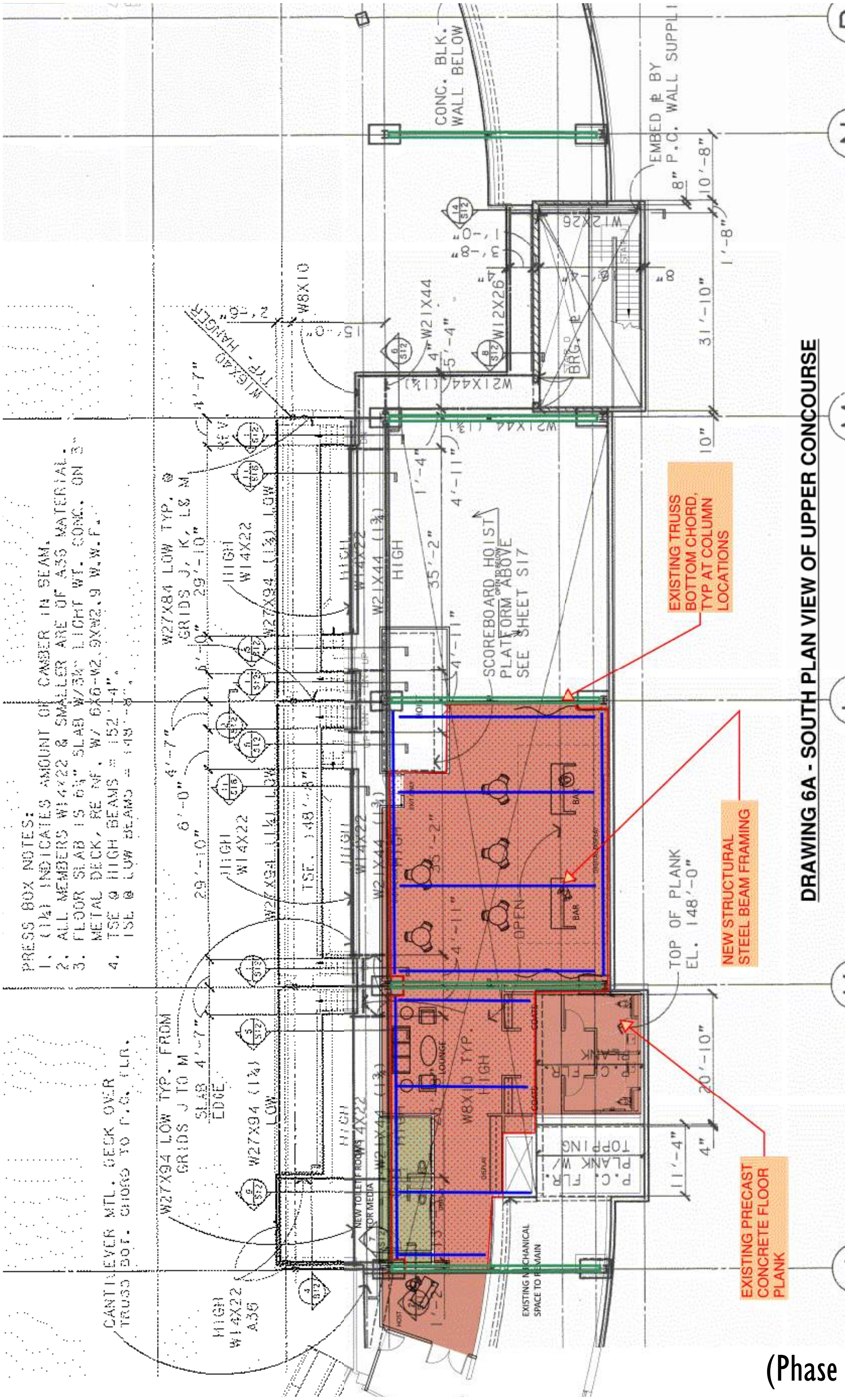
DRAWING 5 - RINK MODIFICATIONS

(Phase 4)



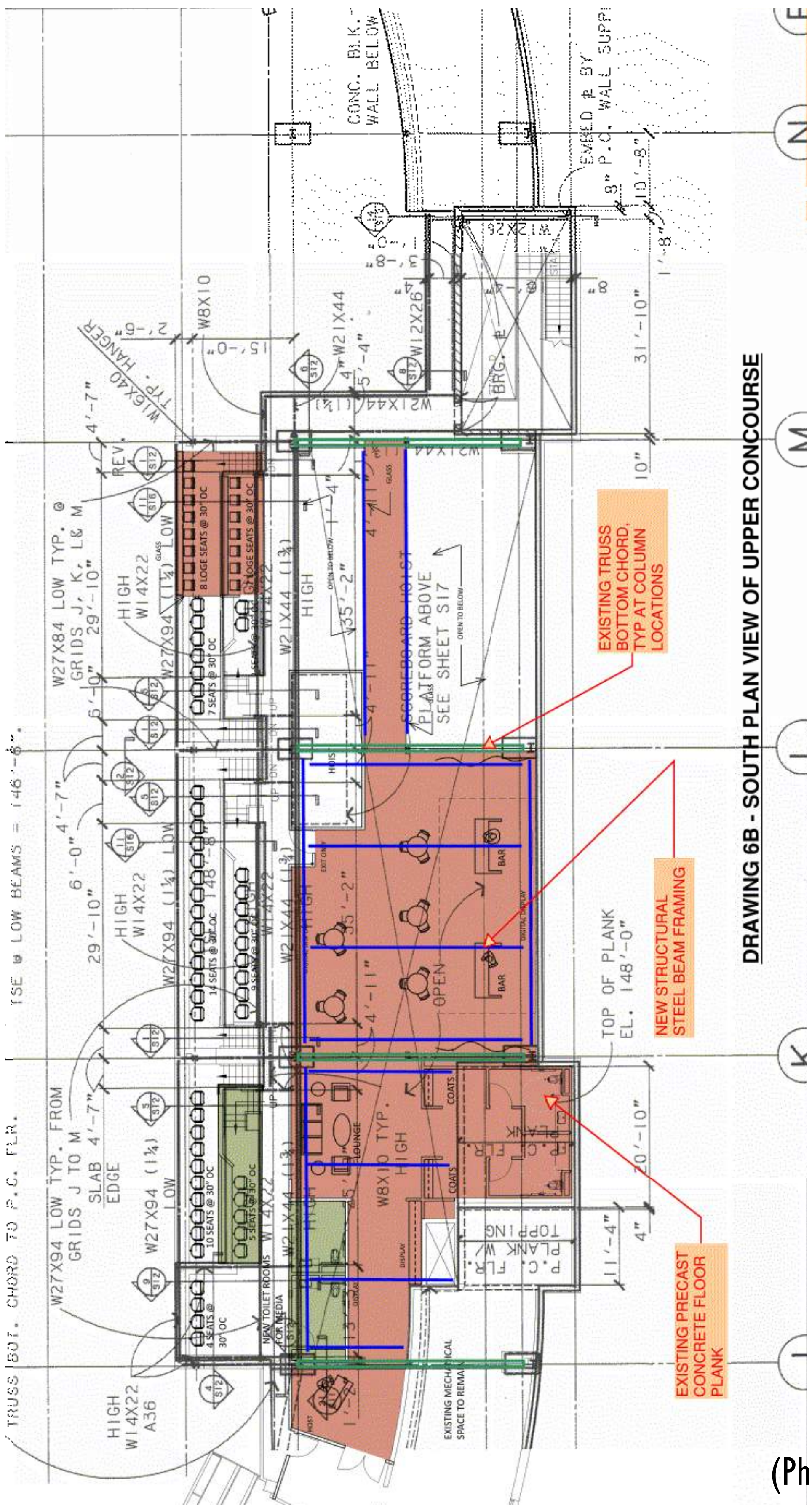
DRAWING 6 - SOUTH PLAN VIEW OF UPPER CONCOURSE
EXISTING TRUSS BOTTOM CHORD, TYP AT COLUMN LOCATIONS
NEW STRUCTURAL STEEL BEAM FRAMING
EXISTING PRECAST CONCRETE FLOOR PLANK
EXISTING MECHANICAL SPACE TO REMAIN
PRESS BOX NOTES:
1. (1¼) INDICATES AMOUNT OF CAMBER IN BEAM.
2. ALL MEMBERS W14X22 & SMALLER ARE OF A36 MATERIAL.
3. FLOOR SLAB IS 6¼" SLAB W/3¼" LIGHT WT. CONC. ON 3" METAL DECK, RE NF. W/ 6X6-W2.9XW2.9 W.W.F.
4. TSE @ HIGH BEAMS = 152'-4". TSE @ LOW BEAMS = 148'-8".
CANTILEVER MTL. DECK OVER TRUSS BOT. CHORD TO P.C. FLR.
SCOREBOARD HOIST PLATFORM ABOVE SEE SHEET S17
TOP OF PLANK EL. 148'-0"
CONC. BLK. WALL BELOW
EMBED ℙ BY P.C. WALL SUPPLIER
P.C. FLR. PLANK TOPPING

(Phase 3)

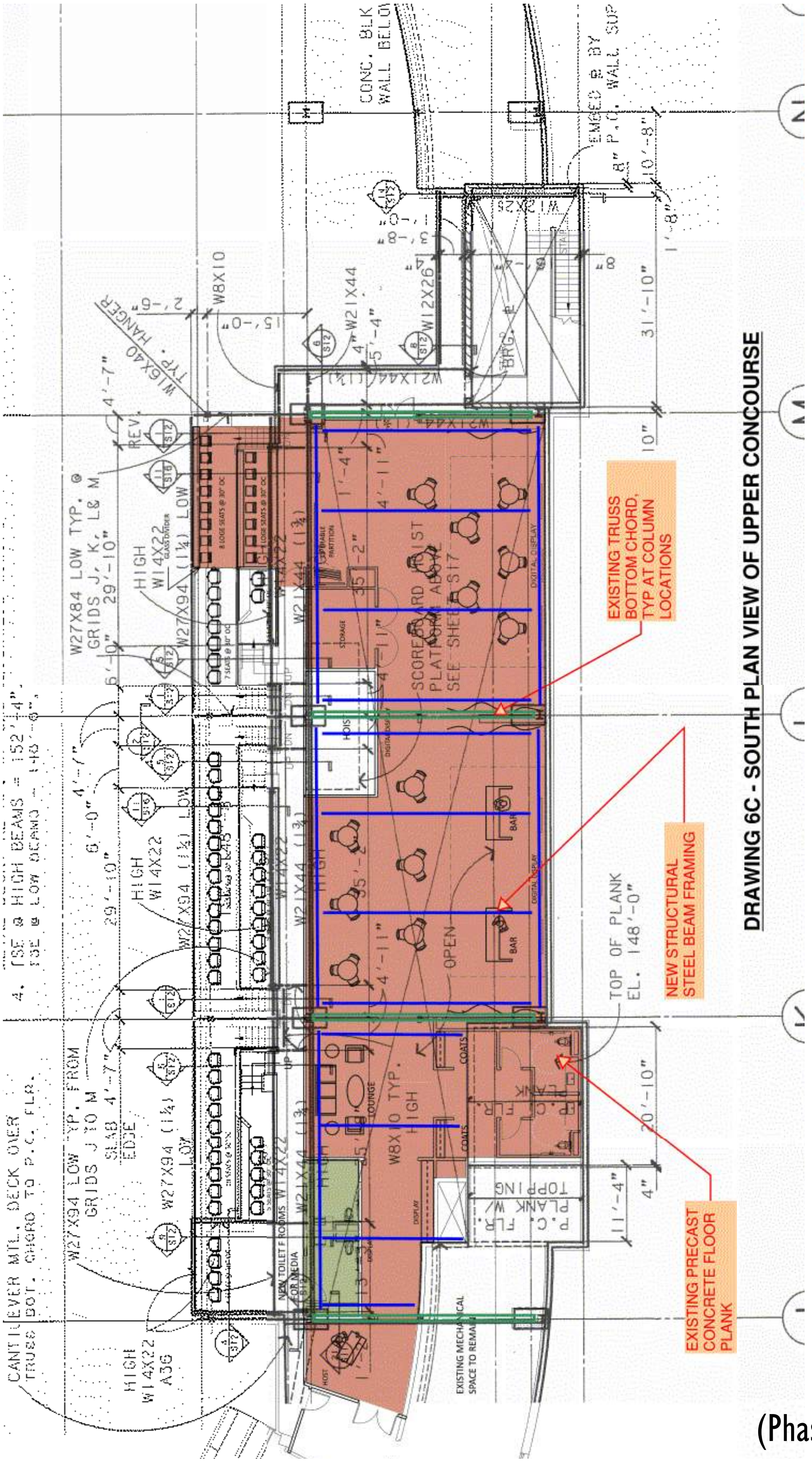


DRAWING 6A - SOUTH PLAN VIEW OF UPPER CONCOURSE
EXISTING TRUSS BOTTOM CHORD, TYP AT COLUMN LOCATIONS
NEW STRUCTURAL STEEL BEAM FRAMING
EXISTING PRECAST CONCRETE FLOOR PLANK
SCOREBOARD HOIST PLATFORM ABOVE SEE SHEET S17
EXISTING MECHANICAL SPACE TO REMAIN
TOP OF PLANK EL. 148'-0"
CONC. BLK. WALL BELOW

(Phase 3)


DRAWING 6B - SOUTH PLAN VIEW OF UPPER CONCOURSE
EXISTING TRUSS BOTTOM CHORD, TYP AT COLUMN LOCATIONS
NEW STRUCTURAL STEEL BEAM FRAMING
EXISTING PRECAST CONCRETE FLOOR PLANK
SCOREBOARD HOIST PLATFORM ABOVE SEE SHEET S17
TOP OF PLANK EL. 148'-0"
TRUSS BOT. CHORD TO P.C. FLR.
TSE @ LOW BEAMS = 148'-8"
CONC. BLK. WALL BELOW
EXISTING MECHANICAL SPACE TO REMAIN
NEW TOILET ROOMS FOR MEDIA
BAR
LOUNGE
COATS
OPEN

(Phase 3)


DRAWING 6C - SOUTH PLAN VIEW OF UPPER CONCOURSE
EXISTING TRUSS BOTTOM CHORD, TYP AT COLUMN LOCATIONS
NEW STRUCTURAL STEEL BEAM FRAMING
EXISTING PRECAST CONCRETE FLOOR PLANK

(Phase 3)

Mechanical Design Intent

The existing HVAC Systems and Equipment in the proposed remodeled areas have been reviewed. All of the equipment and systems in the building were installed when the building was new in 1994 and are therefore about 20 years old. The AHU's and systems are mostly in good enough condition and of an age that replacement is not required at this time. The major issue concerning the AHU's is the age of their temperature controls equipment and their accessibility for maintenance. The facilities staff indicated that all of the AHU's are capable of providing comfort and can therefore continue to be used.
All of the AHU's in the areas proposed to be remodeled will be provided with updated automatic direct digital temperature controls

Men's Locker Room (Phase 1) :

The AHU for the Men's locker room is variable air volume (at the unit only) and has a chilled water cooling coil, steam heating coil, heat recovery glycol heat coil, and relies upon 100% outside air. The associated existing Exhaust Fan (EF) has a heat recovery coil. The AHU and EF have VFD's installed to save energy. They can be slowed down by the facilities staff to save energy during unoccupied or low occupancy times.

One downside of the existing AHU for the Men's Locker Room is its location above the adjacent corridor ceiling and associated
accessibility for maintenance. The issue with the AHU and EF age is the ability and adaptability of the electronic temperature controls. The AHU and EF will be provided with new temperature controls and access to the equipment will be coordinated with general construction to make access more maintenance friendly.

The lockers will have ventilation air directly connected to ductwork behind them. The ventilation air provided to the lockers will provide a significant amount of flow to help dry the hockey players' practice uniforms and equipment and help prevent bacterial growth and odor.

The existing visiting team locker room area is ventilated with the same AHU that serves the adjacent space . This unit is a constant volume unit that has had a VFD installed to allow the AHU and EF to be modulated similar to the Men's Locker Room AHU and EF. Since this project only affects a part of that system, both the AHU and EF will remain "as is" and as much as possible of the existing ductwork will be reused. The system will remain constant volume.

Women's and Men's Administrative Areas (Phase 2):

The women's and men's administrative areas are provided with Variable Air Volume AHU's and duct distribution systems. There is a separate AHU for each area. The floor plan changes will require the duct distribution system to be
virtually new. In addition there is an exhaust fan that is in need of replacement in this area. New Electronic Automatic Temperature Controls will be provided on each AHU. All new VAV units will be provided and shall have new controls.

There was some concern expressed by the staff that the AHU's should be considered for replacement if budget allows. Replacing the units has been included in an alternate cost in the budget.

Strength and Conditioning (Phase 2):

The strength and conditioning area is currently fed by two constant volume AHU's called out as AHU-8 and AHU-12 on the existing plans. The AHU's are currently constant volume and will be provided with new Automatic Temperature controls to convert them to variable air volume. A new variable air volume duct distribution system will also be provided. The atmosphere in a weight room can feel stagnant and humid at times. A humidity control system will be provided that will consists of a humidistat in the space that will increase air flow which will at times require terminal heating of the supply air through the VAV terminal heating coil.

The staff indicated that AHU-8 may need to me reviewed for replacement. This cost is included under the mechanical alternate.

M Club (Phase 3):

The existing ductwork that would end up in the M-Club is too low to allow the area to be used. The ducts that feed the upper stadia at this point will need to be revised so that the smaller duct does not cross under the larger supply duct. The ductwork will be revised in such a way that the new M-Club space will be provided with a terminal heating coil for ventilation and temperature control.

HVAC SYSTEMS

Design Conditions

Outdoor Temperatures and Humidity
The monthly outdoor dry bulb and wet bulb temperatures data is based on the 1.0% values from Chapter 27, Table 4B in the 2001 ASHRAE Fundamentals Handbook for Minneapolis-St. Paul. The building cooling loads will be evaluated for each of the twelve months to determine the peak building load for incident solar angles, occupancy, and glass types.

The Winter Design dry bulb temperature represents the Minnesota Energy Code Heating Design Condition and corresponds to the 0.4% winter design condition in Chapter 27, Table 1A in the 2001 ASHRAE Fundamentals handbook for Minneapolis-St. Paul. This will be used to calculate the maximum heating envelope load for the building (where required).

Instantaneous outside air loads such as air handling unit pre heat coils will be calculated using a winter design dry bulb temperature of -30F.

Indoor Space Conditions
An ice arena is a specialized building with particular temperature and humidity requirements due to the needs resulting from the use of the ice. The ASHREA Handbook for Ice Rink HAVC Design will be consulted for design parameters as required. Existing Conditions in the Ice Arena itself are 70 F and humidity levels not greater than 60%. It is our understanding that ice is not currently "typically" maintained in the building during the summer months although at times ice will be made for short "camps". Most of the work on the project would not be in the Arena itself and will be more concerned with the locker rooms which have no standards to go by. The lockers will need to have odor and humidity control. The primary concern in this effort is the HVAC required for the locker rooms which are affected by the hockey players and ice skaters and the wet uniforms and water that melting off the ice skates.

Summer and winter interior space conditions will be based on the Minnesota Energy Code and University of Minnesota Standards.

Internal Heat Gains
Internal loads due to people, lights, and equipment will be determined based on the plans.

The heat release from occupants is determined based on an average sensible load of 250 Btu/hr per person and an average latent load of 200 Btu/hr per person. Lighting load estimates are based on AHSRAE Standard 90.1-1999 Table 9.3.1.2. Ventilation and exhaust rates are based on ASHRAE Standard 62-2004 Addendum N Table 2.

The effects of the ice sheet and associated temperature requirements on the surrounding spaces and associated loads will be taken into account. This includes spaces adjacent to the ice.

Noise Criteria
The HVAC related background sound levels will be designed to meet the design guidelines listed in the ASHRAE "Recommended Noise Levels". University of Minnesota Standards will also be consulted.

Central Heating and Cooling Systems

Central heating and cooling systems are available in the building. Steam is available for pre-heating outside air if required. Chilled water is available and already used at all AHU's that feed the existing spaces. Hot water is available and currently used in terminal hot water heating coils.

Heating system hot water is currently piped through all of the spaces being considered for remodeling. In most cases this hot water heating circuit will be used as the source of heat for the remodeled spaces.

A new steam to hot water/glycol heat exchanger may be considered for pre-heating 100% outside air for the locker rooms. Direct steam may be considered as an alternate. If direct steam is used the coils will be the vertical type with the steam supply header on the top and the condensate the bottom.

The heating equipment will include AHU heating coils, duct mounted terminal heating coils associated with VAV boxes, baseboard radiation, cabinet unit heaters and suspended unit heaters.

The AHU's will be provided with chilled water from the central chilled water system. The chilled water system has enough capacity for the changes to the AHU's that will be required. All central station air handling units will be designed with full airside economizer. All AHU's will be standard stock equipment from Trane, Daikin, York or Carrier.

Isolation valves, control valves, air vents, etc. in finished spaces shall be installed concealed but readily accessible.

Air Handling Equipment and Ventilation Systems

Locker Rooms:
The existing AHU for the locker rooms was a constant volume unit (now converted to variable air volume) that draws in 100% outside air and has a heat recovery coil to preheat the air as well as a steam heating coil for the remaining heat required. The AHU also has a chilled water cooling coil. The exhaust in the locker rooms is provided with a heat recovery coil in the exhaust fan cabinet. The heat recovery coil system is a glycol runaround loop type.

The AHU distributes the supply air into the locker room area. There are four constant volume terminal heating coils for temperature control of the different areas in the locker rooms. All of the locker room air is 100% exhausted.

The ventilation system to the locker room area will be changed to variable air volume with terminal heating coils. All of the supply and exhaust ductwork will be provided with VAV boxes to control air flow to the various spaces. Appropriate air quantities will be provided in the locker room areas that are prone to significant odors and need humidity control. The air to the locker rooms can be subcooled and heated at the AHU if high humidity levels are sensed in designated areas in the locker rooms.

Supply air and exhaust air in the locker rooms will have VAV boxes. The exhaust and supply air VAV boxes will modulate in unison with the exhaust being 5% higher than the supply to maintain a negative pressure in areas that need to have their odors contained. The Building Automation System will allow the building operators an opportunity to modulate or set air flow rates based on time of day or occupancy. The goal is to keep the locker rooms fresh while using as little energy as possible.

In addition to the odor control through the BAS, humidistats will be installed in the “wet areas” in the locker room. The humidistats will increase the VAV air flow to full to meet the humidity setpoint. The terminal heating coil will heat the air if required to maintain the thermostat set point.

In addition to the AHU for the overall locker room area a blower coil “bake-out” unit will be provided for the main locker room itself. This unit will allow the temperature in the locker room to be raised up to 100F for 2 to 3 hours to help dry clothing and equipment as quickly as possible. A distribution system that allows for air flow through the individual lockers to help dry cloths will be used. Additionally skate and glove drying systems will be provided as stand-alone equipment or built-in.

The existing locker room ventilation system heat recovery system is about 50% efficient. A more energy efficient AHU and Exhaust Fan could be provided with a heat wheel type energy recovery unit that will allow an increase to 70% heat recovery. The new AHU would have a heat recovery wheel, self-contained exhaust fan, hot water glycol heating coil (or steam), chilled water heating coil (installed prior to the heating coil), 2” Merv 8 and 4” Merv 13 filters on the exhaust and outside air in front of the wheel section and shall be variable air volume. Close attention to the space available for a new AHU of this type will be required. The alternate to replacing this unit has been budgeted for in the mechanical alternate.

Office and Team Space and Administration:
There are two existing AHU’s that feed the Team Space/Administration area. The AHU’s are variable air volume units that originally had inlet vanes. The inlet vanes have been locked open and a variable frequency drive has been added to the units. The AHU’s have an economizer section, filter section, hot water heating coil and chilled water coil. The AHU’s do not have direct relief air. The Arena has an air pressure control system and the relief air is exhausted as required through the pressure control system exhaust fans. The VAV boxes in the distribution system have terminal heating coils and old electronic controls.

The staff had expressed some concern with the age of the AHU’s. The two existing AHU’s are over 20 years old and could be replaced with a single new VAV AHU that would feed the entire remodeled area. This has been budgeted under the mechanical alternates. The new AHU would have an economizer system, 2” Merv 8 and 4” Merv 13 filter section, chilled water cooling coil, hot water heating coil (the requirement for this needs to be verified as it may not be required), and variable speed drive.

New VAV boxes with terminal heating coils will need to be provided for the remodeled areas and will have new DDC controls. The new VAV boxes and associated controls will allow for better temperature control and energy optimization along with trouble shooting at the Building Controls System Front End.

Strength and Conditioning:
There are two existing AHU’s that feed the strength and conditioning spaces. The AHU’s are constant air volume units that have had a variable frequency drive added. The AHU’s have an economizer section, hot water heating coil and chilled water coil. The AHU’s do not have a direct relief air. The Arena has an air pressure control system and the relief air is exhausted as required through the pressure control system exhaust fans. The AHU’s have individual thermostats that control the heating and cooling coils in the units to maintain thermostat setpoint.

The staff had expressed some concern with the age of the AHU’s. The two existing AHU’s are over 20 years old and should be replaced with a single new VAV AHU that would feed the entire remodeled area. This has been budgeted under the mechanical alternates. New AHU’s would have an economizer system, 2” Merv 8 and 4” Merv 13 filter section, chilled water cooling coil, hot water heating coil (the requirement for this needs to be verified as it may not be required), and variable speed drive. New VAV boxes will need to be provided for the remodeled areas and will have new DDC controls. The new VAV boxes and associated terminal heating coils and controls will allow for better temperature control and energy optimization along with trouble shooting at the Building Controls System Front End.

M-Club Option:
The area where the M-Club is proposed, is currently ventilated by two AHU's. One AHU feeds the Southeast corner of the Arena and one AHU feeds the Southwest corner of the Arena. Each of these AHU's has a branch duct that feeds the upper part of the Arena and the main duct feeds the lower part of the Arena stadia. Each of these two ducts has a heating coil to allow separate temperature control of the lower seating and the upper seating. The duct distribution is such that each of these smaller ducts that feed the upper part of the Arena have to go under the main ducts that feed the entire lower and middle seating sections of the Arena. This results in these ducts being very low. The smaller branch ducts in this area need to be revised and raised to increase head room in the proposed M-Club.

There are two options to ventilate heat and air condition the proposed M-Club area. The existing AHU's that currently feed the Arena do have cooling coils in the AHU's and have a terminal heating coil for the upper and lower level ductwork. Therefore the small ducts for the upper level could be used to provide for the HVAC needs of the M-Club However that would mean that anytime the M-Club is used during non-game times the two AHU's that serve the Arena would have to run. Due to this a separate VAV AHU for the M-Club will be provided. The AHU would have an economizer section, 2" Merv 8 and 4" Merv 13 filter section, cooling coil, heating coil (verify if required) and variable air flow fan. The M-Club could then be controlled on its own and could operate independent of other functions in the Arena.

The small ducts would then also be able to be revised so they do not extend below the larger Lower Arena ducts which will get the head room needed in the new space. They would potentially be revised to provide air flow below the new M-Club Suite.

New Ice Equipment Room:
The new ice equipment room will need to have an emergency exhaust system and 24 hour general ventilation system to keep fresh air moving in the room. A separate small AHU with economizer control as well as a room exhaust fan to maintain a negative pressure in the room will be provided. The AHU should have a cooling coil and heating coil to help maintain humidity in the room to reduce sweeting of the chilled water equipment and piping and keep the air in the room fresh.

The emergency exhaust system will consist of an emergency fan sized per code requirement for the refrigerant selected. There shall also be a non-heated make-up air system ducted directly to the outside. The exhaust air shall be discharged in a location that will not settle into potential breathing zones outside. The emergency ventilation system will be tied to sensors for whatever refrigerant is selected.

HVAC Terminal Equipment

Variable Air Volume Terminal Units (VAV Boxes)
The variable air volume air handling units will distribute air to VAV boxes with terminal heating coils serving each individual temperature control zone. Each VAV box shall have its own wall mounted DDC space temperature sensor to control it supply air damper and two-way hot water coil valve and/or perimeter heating valve.

Miscellaneous Heating Units
Horizontal hot water unit heaters will provide heating in unfinished areas with exterior wall exposures. Recessed hot water cabinet unit heaters will provide heating for stairwells and entrance vestibules. Hydronic finned tube radiation will be provided at offices with exterior exposures.

General Exhaust

Dedicated exhaust systems(s) will be provided for new toilet rooms and janitors' closets. If existing exhaust systems are available and have excess capacity and can be tied into, they will be used. TAB reports of the HVAC system will need to be verified.

Locker Room Exhaust
Locker room exhaust will be revised to variable air volume to control odors and humidity. The exhaust will be controllable/schedulable from the Building Automation System Front End.

Locker Room and Weight Room Humidity Control
The locker rooms and the weight/training areas will be provided with room level humidity control through the use of their VAV Boxes and humidistats in the room. When a humidistat set point calls for humidity reduction the VAV box will go to its full cooling ventilation rate to provide maximum air to the space. The space thermostat shall control the space temperature.

Heat Recovery/Energy Efficiency
Heat recovery from exhaust air and ice equipment as well as variable exhaust flow will allow the building to operate properly and efficiently.

All supply and outdoor air duct work shall be externally insulated. Ductwork in high finish areas shall be concealed. Flexible duct runs shall not exceed six (6) feet.

Sound levels of all HVAC systems and equipment shall be at or below University acceptable levels.
All HVAC systems shall be tested and balanced by a NEBB or AABC certified contractor.

Control Systems

The Arena currently has an electronic temperature control system by Trane. The system is 20 years old which is considered antiquated for an electronic control system. All new controls will be be provided for all new and re-used mechanical equipment and systems using current technology with BacNet MSTP. The new controls will be able to be monitored on the existing Front End. All AHU's, VAV boxes and heating equipment shall be tied into the DDC system and available for monitoring, modifying and trouble shooting.

Duct and Pipe Sizing Criteria

Duct Sizing Criteria: Ducts shall be sized based on a pressure drop of 0.075"/100ft until air velocity reaches 1,000 fpm which corresponds to about 3,000 cfm. Above 3,000 cfm ductwork should be sized at 1,000 fpm unless space requirements limit the size. Higher velocities can be used but sound will then need to be taken into account. Pipe Sizing Criteria: Hydronic piping for building heating and cooling systems shall be sized based on the following criteria:

Smaller than or equal to 2"
Maximum velocity = 7fps
Larger than 2"
Maximum pressure drop = 4 ft. w.g/100ft pipe
Design pressure drop = 3 ft w.g./100 ft pipe

Fire Protection System

The building has an existing fire protection sprinkler system that will be modified to handle all the new spaces.

Plumbing Systems:

The existing plumbing system in the building will be used to tie into any revised distribution and fixtures required. Floor cutting and patching will be required for the installation of new waste piping for new plumbing fixtures in the locker rooms.

All plumbing fixtures shall meet University of Minnesota standards.

The new domestic hot water, cold water, recirculating hot water, waste and vent piping will be connected to existing. Existing piping should be adequately sized.

Electrical Systems Narrative

Overview
This narrative document summarizes the existing electrical work associated with the major electrical systems (Division 26), electronic communications systems (Division 27), and electronic safety and security systems (Division 28) work to be included in the project.

This document is intended to serve as a basis to support discussion, further design, and aid in preliminary cost estimating.

The project includes:
- Renovation of the Administrative office spaces (Men's & Women's Hockey staff)
- Renovation of the existing Home & Visitor locker rooms
- Renovation of the Strength Training area
- Addition of the 'M' Club area
- Ice replacement
  1. Lowering of the ice sheet elevation & refrigerant replacement
  2. Additional perimeter seating
- Alternate- Retrofit of the existing elevator
- New NW Storage Area.

Scope

This document will review existing installations and electrical work required for the project.

Electrical systems (Division 26) discussed in this document:
- Low voltage power distribution system.
- Emergency power distribution system.
- Engine-generator.
- General interior lighting systems.
- Lighting control systems.
- Emergency interior and exterior lighting systems and egress signage (exit signs).

Electronic communications systems (Division 27) included in this document:
- Structured cabling for voice / data communication systems.
- Audio / Video systems.
- Electronic safety and security systems (Division 28) included in this document:
- Fire alarm system.
- Video surveillance system equipment (cameras, video recorders, etc.).
- Electronic Access Control and Door Monitoring System.

Technical Criteria

Codes: The following is a partial list of applicable codes governing the systems described herein:
- International Building Code (IBC) 2006.
- International Mechanical Code (IMC) 2006.
- International Fire Code (IFC) 2006.
- Energy Standard for Buildings Except Low-Rise Residential Buildings ANSI/ASHRAE/IESNA Standard 90.1-2004.
- NFPA 70 National Electrical Code - 2011.
- NFPA 72 National Fire Alarm and Signaling Code.
- NFPA 101 Life Safety Code.
- Americans with Disabilities Act (ADA).

Standards: The following is a partial list of design and installation standards governing the systems described herein:
- BICSI Telecommunications Distribution Methods Manual.
- IES Lighting Handbook, Tenth Edition.
- International Electrical Testing Association (NETA) Standards.
- National Electrical Contractors Association (NECA) Standards.
- University of Minnesota Capital Planning and Project Management Design Standards.
- Sustainability requirements of the State of Minnesota Sustainable Building Guidelines (B3-MSBG) while not required they will be used as a guide during design. Sustainable and energy efficient design is a high priority for the project.

Description of Electrical Systems

General Notes on Existing Systems

- The existing 3,000-amp, 480/277-volt electrical service has adequate capacity for the proposed renovations with the exception of option for ice system replacement (see below).
- The existing emergency generator providing emergency lighting has adequate capacity to provide emergency lighting power for the proposed renovations.
    1. Existing installation will need to be reviewed for code compliance to review separation of NEC defined emergency loads from legally required stand-by and optional stand-by loads.
    2. Likely a new automatic transfer switch and branch circuit panels needs to be added for emergency loads.
- The existing fire alarm system include voice evacuation.
- Existing security system equipment will be replaced throughout the renovated areas of the project. Currently these systems are planned to be owner furnished owner installed equipment.
- Review the mechanical narrative for associated mechanical equipment changes. Each space will include new air handling equipment (some spaces two smaller units are replaced by a new single larger unit). The M Club will be provided with a new air handling unit.

Administrative Office Spaces (Men’s & Women’s Hockey Staff) - (Phase 2)

- There is currently one electrical room located in the proposed renovated space.
    1. It is likely that new general use 208/120-volt branch panels and transformers will need to be added to serve branch circuits in these areas.
- Existing lighting in this area is to be demolished. New lighting will be provided. The lighting design in these areas will important to match the level of architectural finish in these areas.
- New lighting systems should strive to be as energy efficient as possible including reducing the installed lighting Watts per square to be less than code minimums.
- Lighting controls will be included to turn lights off when spaces are unoccupied. Occupancy sensors will be used throughout with manual override switches located in spaces that allow lights to manually be turned off when desired.
- Structured cabling for voice and data will be demolished and new cabling will be installed. There is an existing cable tray running through the space.
    1. Space should be planned in this space or the strength training area for a telecommunications room to serve these spaces.
- The existing fire alarm control panel is located in this area and will need to be relocated.
- Wireless LAN coverage to be provided throughout.

Renovation Of The Existing Home & Visitor Locker Rooms (Phase 1)

- There is currently one room with an electrical panel located in the proposed renovated space. This panel will be relocated and replaced with new. With the addition of hydrotherapy pools a new 208/120 volt panel and transformer will be needed.
- In this area there is laundry equipment that will need to be relocated along with new electrical circuits to the new laundry area.
- The renovated locker area will include hydrotherapy pools.
- Existing lighting in this area is to be demolished. New lighting will be provided. It is anticipated that the locker rooms, media rooms, and similar spaces will include dimmable lighting. The lighting design in these areas will important to match the level of architectural finish in these areas and to meet the project goals. Lighting design in these areas is likely to be very high end.
- New lighting systems should strive to be as energy efficient as possible including reducing the installed lighting Watts per square to be less than code minimums.
- Lighting controls will be included to turn lights off when spaces are unoccupied. Occupancy sensors will be used throughout with manual override switches located in spaces that allow lights to manually be turned off when desired. Lighting control systems in the locker room and team video room will include RS-232 type interfacing with A/V systems provided in these rooms. Showers will be provided with wall box timers for lighting control in lieu of occupancy sensors.
- Structured cabling for voice and data will be demolished and new cabling will be installed. There is an existing cable tray running through the space.
- The existing fire alarm control panel is located in this area and will need to be relocated.
- New fire alarm devices will be provided.
- There is an existing sound system in the locker room that will be replaced.

- New audio / video systems will include:
    1. High quality video displays and sound system in the locker room and team video room.
    2. Both rooms will require video switching (allowing both digital and VGA inputs), audio switching, local input plates, and touch panels with control system.
    3. Anticipated that inputs for both the locker room and video room will include (but not limited to) the following:
        - Streaming from LAN
        - Live arena video and audio feed.
        - Satellite TV.
        - Cable TV.
        - Local blue ray player.
        - Local CPU.
    4. It is anticipated that a Smart podium or similar system be provided for use with the displays in the film room and locker room.
- The new locker rooms will include wireless LAN coverage throughout.

Renovation Of The Strength Training Area (Phase 2)

- There is currently one electrical room located in the proposed renovated space. It is anticipated that this room will be relocated these panels should be replaced with new.
    1. One room in area 3 (at grid T-15), includes two general use branch panels and one transformer.
- It is likely that new general use 208/120-volt branch panels and transformers will need to be added to serve branch circuits in these areas.
- Existing lighting in this area is to be demolished. New lighting will be provided. Again, the lighting design will need to be matched to the level of architectural finish and should strive to provide high level of finish to the space.
- New lighting systems should strive to be as energy efficient as possible including reducing the installed lighting Watts per square to be less than code minimums.
- Lighting controls will be included to turn lights off when spaces are unoccupied. Occupancy sensors will be used throughout with manual override switches located in spaces that allow lights to manually be turned off when desired.
- Structured cabling for voice and data will be demolished and new cabling will be installed. There is an existing cable tray running through the space.
    1. Space should be planned in this space or the administrative office area for a telecommunications room to serve these spaces.
- Wireless LAN coverage to be provided throughout.
- New fire alarm devices will be provided.

Addition Of The 'M' Club Area (Phase 3)

- There is currently one electrical room located adjacent to this space. In this room is four branch circuit panels and three transformers along with a panel serving the scoreboard. With the addition of club space a new 208/120 volt panel and transformer will be needed.
- Existing lighting in this area is to be removed and reinstalled below the new 'M' club floor similar to the installation under the suites on the opposite side of the concourse.
- New lighting will be provided in the 'M' Club. It is anticipated that dimmable lighting will be provided. The lighting design in these areas will important to match the level of architectural finish in these areas and to meet the project goals. Lighting design in this areas is likely to be very high end.
- New lighting systems should strive to be as energy efficient as possible including reducing the installed lighting Watts per square to be less than code minimums.
- Lighting controls will be included to turn lights off when spaces are unoccupied. Occupancy sensors will be used throughout with manual override switches located in spaces that allow lights to manually be turned off when desired. Lighting control systems will include RS-232 type interfacing with A/V systems provided in this room.
- Structured cabling for voice and data will be provided for wired LAN outlets and wireless LAN access points.
- There is an existing cable tray running through the space. That will need to be worked around or relocated.
- The fire alarm system will need to be extended to cover the new 'M' club. New fire alarm devices will be provided.
- New audio / video systems will include:
    1. High quality video displays and sound system to be provided in the 'M' club.

2. System will require video switching (allowing both digital and VGA inputs), audio switching, local input plates, and touch panels with control system.
3. It is anticipated that inputs will include (but not limited to) the following:
   - Streaming from LAN
   - Live arena video and audio feed.
   - Satellite TV.
   - Cable TV.
   - Local blue ray player.
   - Microphone (wired).
   - Wireless microphone.
4. The new locker rooms will include wireless LAN coverage throughout.
5. Lighting under the M-Club will be designed to be consistent with the adjacent concourse lighting in regards to light levels, uniformity, and aesthetics. Consideration will be given to matching the lighting layout provided on the opposite side of the arena under the suites.

Ice Replacement (Phase 4)

Currently, multiple options for ice system replacement are being considered.

- Scenario 1: Replace Mariucci's refrigeration system with new indirect system of similar capacity.
  1. Demolish existing electrical wiring to allow equipment removal.
  2. Replace existing 800-amp motor control center with new 1,000-amp motor control center and provide branch circuit wiring to new equipment. Include replacement of 800-amp switch at main switchboard with 1,200 switch fused at 1,000-amps.
- Scenario 2: Replace Mariucci's refrigeration system with a system that will serve both Mariucci and Ridder.
  1. Demolish existing electrical wiring to allow equipment removal.
  2. Demolish existing 800-amp motor control center.
  3. Provide new 1,600-amp motor control center and provide branch circuit wiring to new equipment. Include new 600-amp 15 kV pad mounted switch, 15 kV feeders to tie into existing system, and new 2,000-amp service switchboard.

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ICE SYSTEMS (PHASE 4)

BACKGROUND

The ice system (refrigeration system and ice rink floor) is original to the construction of Mariucci Arena in 1993. The 21-year old *direct*-type refrigeration system has been very well maintained and has served the facility well. However, the upcoming phase-out of the R-22 refrigerant in the current system (8,000 pounds), along with associated safety and environmental concerns requires the University to plan for its replacement. The existing dasher board system was replaced in 2010.

As an industry overall, ice system designs are currently evolving due to some fairly significant factors:

- Many ice systems are nearing the end of their useful life and will require major repairs, improvements or replacement to maintain a safe and reliable operating system.
- Ozone depleting refrigerants, such as R-22, are currently being phased out. Refrigerants with high Global Warming Potential (GWP) are also starting to see more restrictions.
- New technology is improving the efficiency and reducing the energy use of equipment and systems.
- Innovation in the industry is bringing forward new concepts and ideas.
- Funding opportunities are increasing through utilities and being discussed more frequently at the State level.

PURPOSE

The ice system is one of these most critical systems to the operation of Mariucci Arena. Planning for the replacement of this system is part of the University's continued effort to improve the safety, performance, operation and efficiency of the facility and continue to provide the highest ice quality for its rich and storied tradition of Division I hockey, recreational leagues and other user groups.

The primary objectives of this pre-design study are as follows:

- Identify and evaluate the best system options for replacing the existing ice system that will increase safety, maximize performance and energy efficiency and provide superior ice quality for the next 25+ years.
- Identify and evaluate uses for waste heat recovered from the refrigeration system.
- Identify related improvements that may be required.
- Consider the future replacement of the ice system in Ridder Arena (14-years old) and potentially sharing a refrigeration system to improve efficiency and minimize costs.
- Provide accurate conceptual cost estimates and project schedules to assist the University in making informed decisions on the recommended project(s).
- Recommend improvements that maximize energy efficiency while incorporating sustainable design practices that reduce the use of fossil fuels, the production of greenhouse gas emissions, and reduce total energy use of the systems and facility.
- Identify potential regulatory or patent restrictions for recommended options using new technology.

It is recommended that the findings presented in this section be used to plan for the future replacement of the ice system and related improvements. The information in this report should also be used to assist in identifying possible rebates or grant programs from utility or energy companies or departments, state and federal agencies, or other sources.

ICE SYSTEMS – EXISTING CONDITIONS

GENERAL

Both Mariucci and Ridder Arenas are served by *direct-type* ice systems that include a refrigeration system, ice rink floor and dasher board system. R-22 refrigerant is used as the primary refrigerant in both systems. Mariucci Arena's ice system is 21-years old and is nearing its expected life of 25-years. Ridder Arena is 14-years old.

Definitions for the two types of ice systems used in ice rink facilities and several other common terms referenced throughout this section are provided below:

- *Ice System:* A term that collectively refers to the refrigeration system, ice rink floor system, waste heat recovery systems and dasher board systems.
- *Direct System*: A *direct* refrigeration system circulates the primary refrigerant (e.g. R-22) directly through the ice rink floor. There is no secondary solution or refrigerant. **This is the type of system that serves both Mariucci and Ridder Arenas.**

- *Indirect System:* An *indirect* refrigeration system uses two refrigerants. A primary refrigerant (e.g. R-22) which is stays confined in the refrigeration room and a secondary refrigerant (e.g. glycol or calcium chloride) that is circulated in the rink floor. The heat exchange between the primary and secondary refrigerants takes place in the refrigeration room.
- *HCFC:* Hydrochlorofluorocarbon (e.g. R-22, etc.)
- *HFC:* Hyrdrofluorocarbon (e.g. R134a, R404A, R407C, R410, R507, etc.)
- *Natural Refrigerants:* Natural occurring refrigerants such as ammonia (R717), carbon dioxide (CO2, R744) and hydrocarbons.
- *Synthetic Refrigerants:* Artificial refrigerants such as HCFC and HFC type refrigerants.

EXISTING CONDITIONS - MARIUCCI ARENA

Stevens toured Mariucci Arena with the University personnel and the facility's management and operating and maintenance personnel and have the following observations and comments.

a. Ice operational season: September 1 to March 15 (7 months) and from late July to early August. The facility's ice system has the capacity to operate year round (12 months).
b. Overall, the ice system has been very well maintained by the facility's operational and maintenance personnel. An operation log is maintained by the facility's staff.
c. Refrigeration System. Mariucci Arena is served by a direct-type refrigeration system manufactured by Holmsten Ice Rinks. The majority of the components include three 8-cylinder York compressors, one low pressure receiver, three pumper drum vessels, and one motor control center. The total system capacity is approximately 210 tons. The 21-year old refrigeration system is nearing its expected life of 25 years. The system is in fair condition for its age. It is becoming more difficult to maintain with its outdated electrical and control systems, discontinued compressors units, etc. Some improvements have been performed on the refrigeration package over the years including several leaks.
d. Cooling Tower. The existing cooling tower is an evaporative condenser type system, manufactured by Baltimore Aircoil and replaced new in 2010. This system uses air and water to dissipate heat for the refrigeration processes. The water is treated with several different chemicals to prevent algae and scale build-up. The remote sump and pump for the unit is located in the emergency generator room.
e. Waste heat recovery system(s). There is a waste heat recovery system that recovers a portion of the waste heat generated from the refrigeration system and uses it to serve the existing subfloor heating (front prevention system) beneath the ice rink floor and the snow melt pit. The subfloor heating system is reportedly in good working order minimizing the concern of frost build-up beneath the ice rink floor. The ground temperature next to the rink floor was recently measured at 56 F by facility personnel. Frost build-up beneath the ice rink floor, is a common concern and problem with the Holmsten direct systems. There are no current visible or reported signs of frost heave, such as cracked perimeter concrete or building walls.
f. Ice rink floor. There were no existing as-built drawings to reference for the ice rink floor design, however, a typical Holmsten Ice Rink floor design includes: 6 inch subfloor sand layer and heating system; 4 inches of floor insulation; ½ inch schedule 40 steel tubing installed at 4 inches on-center with welded connections at each end of the continous piping; and 6 inches of reinforced concrete. This floor is nearing its life expectancy of 25 years. It is very typical for the rink floors in a Holmsten Ice Rink System to be the first components to fail which make it the weakest part of the system. So far, there are no reported problems with the existing rink floor or with ice quality.
g. Refrigeration room. The existing refrigeration room is located in the lower level of Mariucci Arena on the west end of the facility and is approximately 850 square feet in size. There are two egress points for this room neither of which go directly to the exterior of the building.
h. Life safety systems. The refrigeration room is equipped with an R-22 leak detection system. There is no emergency power shunt trip for the refrigeration system or an energizer switch for the emergency ventilation system on the exterior of the mechanical room door(s) as required by code. It was not noted when pressure relief valves on the systems were last replaced. Replacement is required every 5 years.
i. Ventilation system. There is an existing mechanical ventilation system in the refrigeration room as required by code. .
j. Dasher board system. The existing dasher board system was replaced in 2008 and is in very good condition except for the soft caprail material on top of the dasher board panel. This material is showing signs of wear will need to be replaced soon. The dasher board system is an aluminum-framed system with a supported tempered-glass shielding system.
k. Site. The existing groundwater table was reported to be an issue during the original construction of the facility. No water has been observed this spring or summer, during a period of substantial rainfall, in the existing six foot deep sump well in the lower level of the facility.

ICE SYSTEMS – PROPOSED SYSTEMS OR RECOMMENDATIONS

GENERAL

Holmsten Ice Rink's R-22 *direct*-type ice system is one of the most efficient systems designed for ice rink applications. However, because of the following factors, this type of system is no longer a viable type of system to use in today's ice arena facilities:

- Requires a large quantity of R-22 refrigerant (8,000 pounds vs. 1,200-1,500 pounds on a modern *indirect* system).
- Refrigerant is circulated through the ice rink floor, potentially exposing spectators to refrigerant if a leak occurs.
- R-22 is currently on a phase out schedule mandated by the EPA.
- The rink floor, with its ½ inch diameter steel piping, is typically the first part of the system to fail. The supply of the tubing has been limited since 2005 and alternate material is labor intensive to install, making the replacement of a *direct* floor very costly.

Since this is a pre-design study for a new ice system, and given the age of the existing system; the option of simply making improvements to the existing *direct* refrigerated ice system and essentially operating the same system would not address the system's primary failure point, the ice rink floor. All of the options presented in this study include changing from a *direct* system to an *indirect* system except for one CO2 based option. *Indirect* systems require a secondary heat exchange process making them less energy efficient than *direct* systems. However, increasing the use of waste heat and/or sharing a common refrigeration system for both arenas will lessen the difference in efficiency between the two types of systems.

In addition, the equipment, materials and systems recommended in this study are of the similar quality and life expectancy as the existing systems, which is general classified as industrial-grade refrigeration. As opposed to a lesser quality or lower cost options such as commercial-grade type systems that can be found in, and are comparable to, supermarket applications.

The following options will be discussed in this section:

Option 1: Do nothing. Continue to maintain existing systems.
Option 2: Make improvements to the existing *direct* system(s).
Option 3: Convert to an *indirect*, industrial grade, R-22 or other hydrofluorocarbons (HFCs) based system using the existing refrigeration equipment.
Option 4: New *indirect*, <u>industrial</u> grade, HFC based system.
Option 5: New *indirect*, <u>industrial</u> grade, ammonia based system.
Option 6: New *indirect*, carbon dioxide (CO2) based system.
Option 7: New *direct*, carbon dioxide (CO2) based system.
Option 8: Combined, *indirect,* <u>industrial</u> grade HFC system to serve 2 ice rinks.
Option 9: Combined, *indirect,* <u>industrial</u> ammonia system to serve 2 ice rinks.
Option 10: Combined, *indirect, carbon* dioxide (CO2) system to serve 2 ice rinks.
Option 11: Combined, *direct, carbon* dioxide (CO2) system to serve 2 ice rinks.

DESIGN CONSIDERATIONS

Before the system options are discussed in more detail, a general discussion of seven (7) major design factors and considerations that the design team feels are most important to consider when evaluating ice system options are presented below. A general understanding of these factors, we believe, will aid the University in making the best possible selection for improving or replacing the existing ice systems. In a historically slow-changing industry, the somewhat recent updated environmental regulations and increasing energy costs have brought new innovations and technology to the ice rink industry.

1. Selection of Primary Refrigerant

Many countries, including the United States, have set targets, established regulations and developed programs with goals for reducing the environmental impact caused by the emissions or release of synthetic refrigerants to the atmosphere.

R-22 refrigerant has been the most popular refrigerant used in ice rink applications in recent history and the most recent synthetic refrigerant to be targeted. With the signing of the Montreal Protocol, the United States Environmental Protection Agency (EPA) implemented the final rule of Section 604 of the Clean Air Act in July 1992, limiting the production and consumption of a set of chemicals known to deplete the stratospheric ozone layer as measured by their ozone depleting potential (ODP). R-22, which also has a high global warming potential (GWP), is one of these targeted chemicals.

Regulations on R-22 started taking effect in 2010 and will continue to significantly reduce the allowances to produce and import R-22 through 2020 when production and importation in the U.S. will be halted all together. The U.S. EPA has proposed to significantly reduce allowances by 11-17% per year through 2014.

In addition to the current regulations on refrigerants that affect the ozone, there is now pressure to consider phasing-out refrigerants that contribute to global warming, as measured by their global warming potential (GWP). This affects mainly hydrofluorocarbons (HFCs) like those used in blended refrigerants such as R-507A, R407C, R-404A etc. The European Union has been on the leading edge of this change. The European Parliament passed legislation called the "F Gas Directive" that became effective in 2007, that requires very strict inspection of systems for leakage, rigorous record keeping, and mandatory training and certification on systems using HFCs. Most recently, the European Union has tighten these restrictions with an informal agreement in December, 2013. The changes include increasing taxes on HFC's and providing incentives for using natural refrigerants.

Currently, the ice rink industry is caught in a transition period for refrigerants as new environmental regulations are implemented. Careful consideration and evaluation of the current refrigerant options should be made. The replacement refrigerants for HCFC refrigerants (i.e. **R-22**, etc.) are fairly new with a limited history and performance data in this application. The almost certain future regulations of HFC refrigerants (i.e. **R-507, R407C**, etc.), which are used in many of the R-22 replacement refrigerants, should be considered.

Manufacturers are developing transition refrigerants with no significant impact on the environment such as HFO's (hydrofluoro-olefins) a fourth generation fluorine-based gas. HFOs have zero ozone depleting potential and low global warming potential. Their availability is limited and not currently being used in the ice rink industry.

Large global companies, such as Coca Cola, are leading the charge to ban HFCs and use natural refrigerants such as **CO2**, hydrocarbons and **ammonia**. Both ammonia and CO2 are naturally occurring refrigerants with zero ozone depleting potentials (ODP). The global warming potential (GWP) is zero for ammonia and one for CO2. Between 2004 and 2012, twenty four ice skating facilities in Europe have switched over to using CO2 as the secondary refrigerant with ammonia as the primary. The first CO2-based ice system in North America, and the first *direct* CO2-based system in the world, opened in 2011 in Quebec, Canada with a second rink opening in Montreal in 2012.

In addition to environmental and regulatory concerns, other factors that should be considered when comparing primary refrigerants are listed below.

Location: it is important to consider local temperatures and weather patterns when selecting refrigerants. For example, CO2 is more likely to be affected by ambient conditions than other refrigerants. CO2 is most efficient in colder climates. The following is a partial list of CO2 ice rinks that are currently in operation or under construction world-wide. Note that most if not all are located north of Montreal or Quebec, Canada:

Indirect CO2 Systems
Dollard-des-Ormeaux Civic Centre, Canada, 2012
Stade de la Cite des Jeunes – Riviere-du-Loup, Qc, Canada. Complete Nov. 2013
Lacroix-Dutil Sport Complex – St-Georges, Qc, Canada. Complete Nov. 2013
Curling Roberval – Roberval, Qc, Canada. 3 sheets. Complete Nov. 2013
Rosaire-Belanger Sports Center – Riviere-Bleue, Qc, Canada. Complete Nov 2013
Cynthia-Coull Arena – Longueuil, Qc, Canada. Complete Nov. 2013

Direct CO2 Systems
Arena Marcel Dutil, Les Costeaux, Qc, Canada. 1 Sheet. 2010.
Concordia College, Montreal, Canada. 1 sheet, 600 seats. Recently completed.
St-Gedeon-de-Beauce Arena, Canada.
Isatis Sport Chambly, Chambly, Qc, Canada. 3 sheets, Completed July 2012.

30+ direct CO2 or Ammonia/CO2 systems in Europe
CO2 ice rink systems started in the year 2000 in Europe.

Efficiency: Compared to HFCs, ammonia and CO_2 refrigerants are significantly more efficient, providing greater capacity at less horsepower. The winner between ammonia and CO_2 is less clear. It has been shown that CO_2 is most efficient in colder climates. As the ambient temperature rises above CO_2's critical temperature of 86 F, the capacity and performance of the system drops mainly due to the change from subcritical operation (condensing with gas cooler) to transcritical (no condensing takes place). It has been determined that, in general, the efficiency of CO_2 based ice systems is greater than HCFC-based systems.
A technical paper presented at the 2013 Industrial Refrigeration Conference and Exhibition presented by the International Institute of Ammonia Refrigeration (IIAR) concluded that an indirect ammonia/glycol ice system with waste heat recovery is the best solution from an energy perspective when compared to a transcritical CO_2 system and an ammonia/glycol system without waste heat recovery systems.

In contrast, a September 2012 Master of Science Thesis paper on "Carbon Dioxide in Ice Rink Refrigeration" by Tuyet Nguyen at the KTH School of Industrial Engineering and Management, Stockholm, Sweden showed through simulation that *direct* CO_2 systems in ice rink applications is 30% lower in energy consumption than an *indirect* ammonia/brine system and 46% lower than and *indirect* CO_2/brine system. CO_2 systems also had the highest energy savings in regards to waste heat recovery potential. The study also concluded that the overall life cycle of a direct CO_2 system is approximately 13% lower than an *indirect* ammonia/brine system. Finally, it was noted that a direct CO_2 system has the high potential to be the next generation refrigeration system in ice rink applications but the transcritical working may restrict it to cooler climates.

In both cases, significant modeling was performed with numerous scenarios. It is likely that, as the rapid development of CO_2 in the supermarket industry continues and further development of CO_2 transcritical (both subcritical and supercritical states of operation) technology progress, greater system efficiencies will be realized in the near future.

System Charge: The following table lists approximate system charges for the proposed ice systems with various refrigerants. One main restriction when using CO_2 direct systems is current industry codes restrict the amount of refrigerant in a system based on arena volume or space. Depending on the size of the facility, a direct CO_2 system may not meet code requirements.

Table 1. Typical System Charge for Single Ice Sheet

Refrigerant	Charge (pounds)
Ammonia (indirect)	600-800
HFC (indirect)**	1,200-1,500
CO_2 (indirect)	600-800
CO_2 (direct)	5,000–7,000

** Omni Center systems

Composition: While ammonia and CO_2 are natural or "pure" refrigerants, the HFC refrigerants replacing R-22 are "blended" refrigerants, meaning they are a mixture of several different, individual refrigerants. Since refrigerants have different properties, each one reacts differently to changes in its properties, such as pressure and velocity. When a leak occurs, varying amounts of each refrigerant may leak out, throwing the original mixture out of balance and potentially forcing the replacement of the entire charge, rather than simply adding the amount that was lost.

Safety: HFC refrigerants have the least safety concerns of the refrigerants that are discussed in this report, although they can be difficult to detect without a leak detection system. Ammonia on the other hand, is considered a high health hazard because it is corrosive to the skin, eyes and lungs. Exposure of 300 parts per million (ppm) is immediately dangerous to life and health. It can be explosive if released in an enclosed space with a source of ignition or if the vessel is exposed to fire. It is fortunate that ammonia has a low odor threshold (20 ppm) forcing people to seek relief at much lower concentrations, and because if its efficient composition, the system charge can be significantly reduced. Ammonia has mild flammability. There are also safety devices and systems available to help detect, signal, and prevent dangerous situations.

CO_2 is a non-toxic, non-flammable and non-explosive gas. The one disadvantage of using CO_2 in ice rink applications is the operating pressures are between pressures of 300 and 1800 psi compared to ammonia and HFC-based systems that operate at maximum pressures of 300-350 psi. The following is table comparing CO_2 and ammonia safety limitations.

Table 2. Refrigerant Safety Limitations

Parameter	Ammonia	CO2
TLV (Threshold Limit Value)	25 ppm	5,000 ppm
STEL (Short Term Exposure Limit)	35 ppm	30,000 ppm
Revised IDLH (Immediate Dangerous to Life and Health)	500 ppm	40,000 ppm
LFL (Lower Flammability Limits)	15%	Non-flammable
GROUP (ASHRAE, 1992)	B2 Toxic	A1 Non-Toxic

Cost: The increasing environmental regulations are certainly impacting the price of R-22. As the industry experienced in March of 2012 when the price suddenly jumped overnight from $7 per pound to $13 per pound. The cost is currently fluctuating from highs around $18 to $22 per pound to low around $8 per pound. Replacement or "drop-in" refrigerants for R-22 are currently on the market and becoming more available. Ammonia and CO2 are currently $2.00 per pound.

Additional Regulations: Regulations on HFC refrigerants would be similar to the existing R-22 system. Ammonia is probably among the most regulated refrigerants. For example:

- Facilities containing 500 pounds of ammonia or more must be reported to the local emergency planning committee.
- Facilities containing over a threshold quantity (TQ) must submit a risk management plan to the U.S. Environmental Protection Agency. Typically TQ around 10,000 pounds.
- Losses of over 100 pounds must be reported to the National Response Center within 15 minutes.

Since CO2 is very new to the ice rink industry in North America, it will likely be regulated similar to an ammonia-based system. This assumption was used in this evaluation and in determining cost estimates.

Reporting a Release of R-22: With the existing aging R-22 direct refrigeration system at the facility it is important to understand the reporting requirement if a release occurs. There are requirements for governments, local authorities and facilities to report hazardous and toxic chemicals. For accidental releases of refrigerant a report must be filed under the Emergency Planning and Community Right-To-Know Act (EPCRA). For an ice system, the reporting trigger leak for CFC (e.g. R-12) or HCFC (e.g. R-22) type refrigerant is 35 percent annually. The Environmental Protection Agency, under the Clean Air Act (Section 608), also requires a report for the release of HCFC type refrigerants.

There are government regulations for repairing leaks in a refrigeration system. If during the course of a 12-month period, an appliance is leaking refrigerants beyond the trigger rate, the owner must take action to repair it. In general, the owner needs to make suitable repairs to the appliance within 30 days of finding out about the leak. Or, make plans to retrofit or retire the appliance within 30 days, and act on the plan within a year of the plan date.

Other Considerations**:** It is recommended that prior to making a change in the type of refrigerant that is used, that the proposed changes be reviewed in detail with the University's insurance carrier, risk management consultant, the fire marshal, fire department and other interested parties.

2. Selection of Secondary Refrigerants

There are two main secondary refrigerants that are used for ice arena applications, *calcium chloride* (often referred to as "brine") and *ethylene glycol*. In some cases, although fairly rare, *propylene glycol* is used. A diluted *ammonia* solution is being used in Europe with increased frequency. A comparison of the secondary refrigerants provided below.

Efficiency: The efficiency of the secondary refrigerant is determined by a number of factors including thermal conductivity, specific heat, fluid flow characteristics, surface area, etc. Calcium chloride is a salt and water mixture. The chemical properties of the calcium chloride solution allow it to be pumped easier and to transfer heat at a higher rate than glycol. Therefore, the refrigeration equipment can be reduced in size. This leads to an overall system efficiency of 8% of 12% greater than ethylene glycol. Propylene glycol is less efficient than ethylene.

Environment: Since calcium chloride is a mixture of salt and water it poses little harm to the environment if a leak or spill occurs. Ethylene glycol on the other hand will remain in high concentrations in the soils for long periods of time. Propylene glycol is less toxic than ethylene glycol. It is a food-based glycol that is much more environmentally friendly than ethylene glycol.

Corrosiveness: The disadvantage of using calcium chloride is that it can become corrosive when exposed to air. Systems using calcium chloride require more monitoring and maintenance. Once mixed with ammonia refrigerant, the corrosiveness increases substantially and potentially turns into a hazardous chemical. There are inhibitors that are mixed with the solution to aid in corrosion prevention and many rinks in North America have used this solution for 50+ years. Glycol on the other hand is not corrosive.

Typically, the types of heat exchangers available for use with CO2 systems are limited because of the higher operating pressures and usually require a glycol solution.

Cost: At a mixture of 21% concentration, calcium chloride is approximately $1.00 per gallon compared to glycol, 35% concentration at $9.00 per gallon. A new indirect ice system for this facility will require approximately 4,000 gallons of a secondary refrigerant.

Monitoring: A more extensive monitoring program will be required with calcium chloride than with glycol and generally requires sampling and testing once or twice a year.

3. Quality of Materials and Equipment
Balancing the initial cost of materials and equipment with energy savings can be difficult during the budgeting process of the project.

For example, in the ice rink floor, there are several different types of piping arrangements and designs to consider. The traditional design of rink floor piping systems used clamped connections using hose clamps to connect the poly rink piping to a steel header system. Around 1995, the industry replaced the hose clamp connections with heat fused connections, similar to what the natural gas companies' use for their pipelines. Fusion weld technology has eliminated the need or use of corrosive materials in the rink floor and provided the opportunity for a virtually seamless piping system that can extend the life of the rink floor from 25 years to over 40 years. Another important choice is the selection between the use of steel pipe or polyethylene pipe. Polyethylene pipe is significantly less cost but does not transfer heat as efficiently. For most community based rinks, polyethylene pipe is the most cost effective pipe material. For larger venues such as Mariucci Arena, steel pipe systems are preferred.

4. System Design
A thorough design of the ice system is critical in maximizing its efficiency. Examples of design elements that should be thoroughly evaluated during the design phase include:

- *Reduce refrigerant charge.* Minimizing the amount of refrigerant used in the systems will reduce the safety, environment and financial risks.
- *Lowering condensing temperatures.* Lowering the condensing temperature of the refrigeration system increases its efficiency but decreases the amount of waste heat that is generated.
- *Compressor options.* Depending on the refrigerant selection, there is typically more than one option for the type of compressor that could be used including semi-hermetic, open drive or reciprocating, screw, etc. Continuous advances in technology are increasing the number of options available for ice rink applications.
- *Floating head pressure.* Allowing the head pressure of the system to vary based on ambient temperatures can provide a significant energy savings over a fixed setting. However, this results in less waste heat being available from the system and, in one recent study, has been shown to have an overall negative effect on energy savings. *Variable frequency drives.* The use of variable frequency drives on pumps and compressors can be beneficial not only for energy savings but control of ice temperatures as well.
- *Variable frequency drives.* The use of variable frequency drives on pumps and compressors can be beneficial not only for energy savings but control of ice temperatures as well.
- *Controls.* System control options range from very basic to a complete integrated building or energy management system.

Finding the balance between system and equipment options is key to a successful and efficient design.

5. Energy Source
As energy costs rise, alternative sources of energy, such as geothermal, natural gas, or co-generation, may look more attractive. Electricity still remains the most practical energy source for these types of systems. Stevens has designed several geothermal systems and can provide information on these systems if desired. However, geothermal technology is not likely a good fit for this facility.

6. Waste Heat Recovery
Refrigeration systems generate a large amount of heat that is typically wasted into the atmosphere. A refrigeration system for a single ice sheet can typically generate enough waste heat to serve the subfloor heating system, snowmelt pit, the dehumidification system, and potentially preheat domestic water source or in-coming air. Historically, ice rink facilities have only captured and reused approximately 25% of the waste heat generated. It has now become normal design practice in the ice rink industry to capture 90% or more of the waste heat and reuse this "free energy" throughout the facility. While all ice rinks have a demand for heat during most, if

not all of the season; the heat recovery systems are especially beneficial for arenas where the greatest heat is required for the longest period of time (e.g. northern U.S. and Canada). At least one recent major study shows that systems that recover waste heat and use it throughout the facility will operate much more efficiently than systems that do not.

Table 2. Estimate of Total Waste Heat Available

Units - MBH	Winter	Spring/Fall	Summer
1 sheet	410	550	700
2 sheets	800	1100	1500

Some uses for waste heat include:

Snow Melt Pit Operations (basic heat recovery): This is a very common use of the waste heat. In this option, waste heat is captured from the refrigeration process through the use of a heat exchanger which will reject the heat into a solution of glycol and water. The glycol solution is then pumped to a coil located in the snow melt pit. This process will eliminate or greatly reduce the use of other sources of heat such as natural gas or electric boiler systems.

This system will also eliminate the need to melt snow with hot water from the domestic water system which is often installed as a band-aid for an underperforming or broken system. A boiler can be connected to the waste heat system to provide snow melting when the ice plant is turned off.

Subfloor Heating System (basic heat recovery - frost prevention system): This is another very common use of waste heat. In this option, waste heat is captured from the refrigeration process through the use of a heat exchanger which will reject the heat into a solution of glycol and water. The glycol solution is then pumped through a system of pipes located beneath the ice sheet and insulation system. The subfloor heating system prevents the ground from freezing below the ice rink floor. Frost heave is a common problem with the direct Holmsten Ice Rink systems, especially for the earlier installations were the piping systems used thin walled pipe and hose clamps and had a high failure rate.

Domestic Hot Water Preheat (enhanced heat recovery): In this option high temperature waste heat is captured from the refrigeration process through the use of heat recovery water heaters. The water heaters are specifically designed to capture heat from the refrigeration systems. The system has proven to greatly reduce the domestic water heating needs of the facility.

Resurfacer Water Preheat (enhanced heat recovery): Most ice arena facilities have water heaters dedicated to providing the ice resurfacers with hot water for flooding and resurfacing the ice sheet. A waste heat recovery system could be installed that is similar to the domestic hot water preheat system described above.

Building Heat (enhanced heat recovery): Waste heat can be used to offset the heating needs of the building. Ice arenas require heat on nearly a constant basis. In this option waste heat is captured from the refrigeration process through the use of a heat exchanger which will reject the heat into a solution of glycol and water. The glycol solution is then pumped over to a heating coil located in an air handler unit. The air handler can run whenever the refrigeration system is operational. This process is attractive because it presents a nearly constant use for the waste heat.

This option is viable for most refrigerant systems and becomes even more viable for the CO2-based refrigeration system. The CO2-based refrigeration system operates at very high pressures and the heat rejected from the system will be at correspondingly higher temperatures. It is much less expensive to use the waste heat when it is at the higher temperatures provided by the CO2-based refrigeration system. However, waste heat from CO2 systems can be limiting when ambient air temperatures are higher.

Exterior Snow Melting System: Waste heat can also be used for exterior snow melting use. Piping can be installed in sidewalks or ramps and waste heat from the ice plant can be used to keep the surfaces clean of snow and dry. This can be a good use of the waste heat but its use is limited to a small percentage of the total hours available in a year.

Pictures from left to right: snow melt pit, subflooring heating, preheating water

During the design phase, the facility's layout and potential use for waste heat from the refrigeration system should be evaluated in depth to determine the benefit of each system.

7. Sustainability

Sustainability goes hand-in-hand with all the items in this list of considerations. Energy savings, through smart design practices, translates directly into the reduction of green house gas emissions such as carbon dioxide. There is a significant opportunity for the University to lower the carbon footprint of Mariucci and Ridder Arenas by reducing or eliminating the use of HCFC refrigerants and increasing the use of waste heat from the refrigeration system.

ICE SYSTEM REPLACEMENT OPTIONS - RECOMMENDATIONS

The following improvement options were evaluated in this study with the following recommendations:

Option 1: *Do Nothing – Maintain Existing Systems.* The University may elect to keep operating the existing R-22 *direct* refrigeration system. Some of the potential downsides, or risks, involved in continuing to operate the existing system for too much longer are as follows:

- On-going Maintenance and Equipment Costs: The equipment and parts on the refrigeration system will continue to require replacement in the near term. It's similar to driving a vehicle with high miles; the longer it runs, the more costly it becomes to repair and the lower the return on investment. Parts for the existing York compressors are no longer manufactured and becoming extremely difficult to find and costly to purchase. Some valve manufacturers (like Sporlan) no longer manufacture some of the valves used on the system. Major improvements to the existing refrigeration system will soon be required to extend its safe and useful life.
- Safety: The direct ice system circulates R-22 refrigerant in the ice rink floor, which is located in the occupied space of the facility, potentially exposing hundreds to thousands of spectators, skaters and workers to leaking refrigerant as the floor system ages.
- Dependability: The risk of problems occurring with the refrigeration system, and therefore, the risk of losing the ice sheet, increases as the system ages.
- Cost and future availability of refrigerant: As the system ages, the risk of a major release of refrigerant increases. A single direct system like Mariucci contains approximately 8,000 pounds of R-22 refrigerant with a replacement costs (refrigerant only) ranging from $144,000 to $176,000. As the phase-out date for R-22 approaches, the cost will continue to increase. Since 2005, the cost of R-22 refrigerant has risen 850%. Depending on the availability of R-22 when this occurs, the University may be forced to install a new blended refrigerant which will require additional modifications to the system. The total estimated R-22 charge for both arenas is 14,000 to 16,000 pounds.
- Environmental: The existing system uses a large volume of R-22 refrigerant with a high ozone depleting potential (ODP) and global warming potential (GWP) rating. R-22 refrigerant is scheduled to be phased out of production in the near future.

Because of these concerns, we do not recommend replacing the existing *direct* refrigeration system with a new *direct* R-22 refrigeration system or rink floor in any of the facilities.

Option 2: *Make Improvements to the Existing Systems.* Holmsten Ice Rinks provided good quality vessels (e.g. high pressure receiver, pumper drums, etc.) with their systems. This opens up the option of renovating the existing refrigeration system to extend its useful, dependable, and safe life. This option has successfully been performed at several facilities such as Gustavus Adolphus College, University of Minnesota-Duluth, Verizon Wireless Center-Mankato and others.

If the existing refrigeration system(s) is going to remain in place, whether in its current operation as a *direct* system, or converted into an *indirect* ice system, we recommend the following improvements be performed on the existing refrigeration system.

a. Replace relief valves on all vessels: Relief valves are required on all high pressure vessels and should be replaced every five years. These are important safety devices and should be maintained on a regular basis. This work will include installing pressure reliefs on the pumper drums which were not typically installed.
b. Replace and install monitoring devices on the refrigeration system: Quality monitoring devices such as pressure, temperature and pressure gauges are extremely important in monitoring and troubleshooting the system. These devices will allow the facility's staff to more accurately assess and adjust the performance of various systems and to pinpoint problem areas.
c. Investigate the integrity of the existing steel vessels and piping systems: Corrosion along the bottom of the low pressure receiver is common in these systems and is visible by staining on the jacket or covering of the insulation systems. The extent of any corrosion cannot be determined without removing the insulation. The recommended repair includes: removing several sections of the existing insulation on the system; conducting a visual inspection of the vessels and piping; and conducting a non-destructive ultra sound tests of the steel. If high levels of corrosion are found, the entire insulation system should be removed; the surface of the vessels and piping should be sanded, primed, painted; and then the entire system should be re-insulated.
If the steel vessels and piping systems are found to be in good shape, this system could last another 15 or more years with the other recommended improvements completed and with continued proper maintenance. If extensive corrosion is found, the vessels should be repaired and recertified and/or replace and piping should be replaced before reinsulating. Poor insulation can aid in pre-mature corrosion and loss of efficiency.
d. Reinsulate vessels and piping. New insulating systems will improve the efficiency and integrity of the system and extend its life expectancy.
e. Painting. Prime and paint all exposed steel equipment, piping and supports.
f. Isolate the compressors: It is common to find vibration problems in skid-mounted packages such as this one. Although there are no reported vibration issues with this system, it is recommended that the frames beneath the two compressors be separated from the skid package.
g. Replace dump solenoids on each pumper: The coils in the existing solenoid valves (typically Sporlan) have a tendency to dry out. Solenoid valves manufactured by Hanson or Parker seem to work better for this application and reportedly have fewer problems. Replace one valve on each pumper drum.
h. Replace vent solenoids on each pumper with same materials: Inspect and replace the existing valve (typically a Sporlan MA50) with same model. This valve cannot be replaced with a higher quality valve as manufactured by Hanson due to the inadequate space.
i. Replace existing compressor controls: A control system for the compressor can vary greatly in cost depending on the programming and level of control and monitoring desired. The cost provided in the table below is for a fairly basic control system with remote access and monitoring capabilities.
j. Replace compressors: Parts for the existing York compressor can be difficult to find since they are no longer in production. These compressors can be rebuilt and reused for well over 30 years. However, if the compressors need replacement, they should be replaced by compressors that can be used in a future refrigeration system.

Option 3: *Convert existing direct system to an indirect, industrial grade, R-22 or other hydrofluorocarbons (HFCs) based system using the existing refrigeration equipment.* Only recently has this option proven feasible for converting Holmsten refrigeration packages from *direct* to *indirect* systems while using the existing refrigeration equipment.

The option includes converting the existing refrigeration system to an *indirect* system by installing a new heat exchanger and rink pumps. This option includes reusing the existing low pressure receiver, pumper drums and piping, and main motor control center. The existing system would be updated as recommended in Option 1.

This option will substantially reduce the charge of R-22 in the system to approximately 1,200 pounds. A reduction from 8,000 pounds of R-22 down to 1,200 pounds of R-22 will noticeably reduce the facility's carbon footprint. The University could store the extra R-22 refrigerant for future use at Mariucci and Ridder Arenas.

Under this option the ice rink floor would require replacement. The University would like lower the elevation of the rink floor and reduce the width of the floor. See the architectural section of this report for discussion on lowering the ice sheet and associated changes to site lines, etc. The current ice rink floor (ice sheet) is 100 feet wide x 200 feet long (Olympic size) with a 20 foot radius. The typical radius of an Olympic size ice rink floor is 28 feet. The University requested the rink be reduced to 90 feet x 200 feet x 24 foot radius. The 2012-2014 NCAA rulebook recommends 85 feet x 200 feet x 20 foot radius. However, we have found that the newer Collegiate Division 1 Men's hockey facilities are increasingly selecting a rink width of 90 feet over the traditional NHL standard width of 85 feet. The following tables outline standard NHL, NCAA and USA Hockey rink dimensions and some comparable college facilities.

Table 3. Standard Ice Rink Dimensions

Level	**Rink Dimensions (ft)**		
	Length	**Width**	**Radius**
NHL	200	85	28
NCAA (2012-2014)	200	85	20
USA Hockey (2007)	200	85	28

Table 4. Examples of Ice Rink Floor Sizes for Collegiate Division 1 Facilities

Facility	**Rink Dimensions (ft)**		
	Length	**Width**	**Radius**
Mariucci Arena, University of Minnesota – 1994	200	100	20
Mariucci Arena, University of Minnesota – 2015 future	200	92.5	24
Ridder Arena, University of Minnesota – 2007	200	85	22
Ralph Engelstad Arena, Univ. of N. Dakota – 2000 Main	200	85	28
Ralph Engelstad Arena, Univ. of N. Dakota – 2000 Practice	200	100	28
Amsoil Arena, University of Duluth – 2010	200	85	28
Sanford Center, Bemidji State – 2010	200	85	20
Kohl Center, University of Wisconsin - original	200	93	
LaBahn Arena, University of Wisconsin – 2012	200	90	28
Compton Family Ice Arena, Notre Dame-2012 Rink 1	200	90	22
Compton Family Ice Arena, Notre Dame-2012 Rink 2	200	100	28
John Macinnes Student Arena, Mich Tech, 1975 & 2012	200	85	22
Pengula Ice Arena, Penn State, 2013 Rink 1 – **prelim only**	200	85	28
Pengula Ice Arena, Penn State, 2013 Rink 2 – **prelim only**	200	85	28
Verizon Wireless Center, Minnesota State, 1994	200	100	28
Verizon Wireless Center, Minnesota State, 2013	200	88.3	24
Yost Arena, University of Michigan, 1975 & 2012	200	85	28
Sullivan Arena, University of Anchorage-AK, 1981	200	98	24

Option 4: *New indirect, industrial grade, HFC system.* This option includes replacing the entire refrigeration system and concrete ice rink floor with an industrial grade flooded chiller, new blended HFC refrigerant, reciprocating compressors, pumps, and concrete rink floor (as described in Option 3).

Option 5: New *indirect*, industrial grade, ammonia based system. This option is the same as Option 5 but replaces the use of a new blended HFC type refrigerant with ammonia refrigerant. This option typically requires more extensive modifications to the refrigeration room to meet safety and code requirements such as vestibules constructed at existing doors as discussed later in this section.

Options 6 and 7: *New indirect or direct, carbon dioxide (CO2) based system.* Continuing the discussion from the refrigerant discussion earlier in the report, the use of CO2 refrigerant will likely be the next substantial "innovation" in the ice rink industry. Currently European countries are using CO2 as a secondary refrigerant in twenty four ice rink applications. After this fall more than 15 rinks in Canada will be operating with CO2 ice systems with several direct systems. CO2 applications in the U.S are rapidly increasing mainly in the supermarket industry. However the selection of equipment is limited and the regulatory codes are still under development.

The use of carbon dioxide as the primary refrigerant changes the type of refrigeration equipment presented previous options. CO2 systems will be provided on equipment or skid packages as shown in the photographs in this section. Further design is required to determine whether a CO2 based system will fit in the existing refrigeration room. The north wall will need to be removed to provide access.

Because this is a new technology and application, there is fairly limited information on the systems. The cost estimates should be updated as the desired project date approaches.

The most efficient CO2 system is the *direct* system where CO2 is circulated throughout the rink floor. This type of system has been successfully installed, in the past year, in a facility in Montreal, Canada. The rink floor is constructed with stainless steel tubing with mechanical connections at 4 inches on center. The main concern and relatively unknown is the cost and durability of the rink floor materials. The alternate to stainless steel pipe is poly coated copper piping as is used in many of Europe's CO2 based ice rinks.

In addition to its efficiency, the waste heat that is generated from these systems ranges from 140-170 F as compared to an HFC or ammonia system where the majority of the useable waste heat is at temperatures of 80-85 F. The higher temperature waste heat allows the heat recovery systems to be size up to 20% smaller than standard systems.

It is recommended that a CO2 refrigerant based ice systems be further evaluated during the design phase of the project because technology is changing fairly quickly. If the University is interested in pursuing the use of CO2 refrigerant, we encourage a site visit to at least one facility that is currently using this type of system along with in-depth discussion with the facility's management and operation personnel and manufacturer's representatives. Possible locations include:

- Quebec and Montreal Canada – CO2 based ice systems
- Sweden – direct Ammonia/CO2 ice systems and CO2 equipment manufacturers.
- Eagle River, Alaska – schedule to start up in the fall of 2014.

Option 8: *Combined, indirect, <u>industrial</u> grade HFC system to serve 2 ice rinks.* See general discussion of common systems in Option 9 below.

Option 9: *Combined, indirect, <u>industrial</u> ammonia system to serve 2 ice rinks.* This option includes replacing the existing two individual refrigeration systems in Mariucci and Ridder Arenas with a new common system. A common refrigeration system that includes both ice sheets offers advantages such as lower life cycle costs, higher efficiency, and lower operation and maintenance costs compared to two separate single ice systems. Stevens completed a detailed energy study for the renovation of a two-sheet ice arena in 2010. The results of the study showed the following:

- A new combined *indirect* ammonia/brine system replacing the two existing individual systems (R-22 *direct* and R-22 *indirect* systems) results in <u>12% decrease</u> in electrical energy use.
- New combined ammonia system in-place-of two new individual *indirect* R-22 *indirect* industrial grade systems results in <u>27% decrease</u> in electrical energy use.
- New combined *indirect* ammonia/brine system in-place-of two new individual *indirect* R-507 commercial grade systems results in <u>58% decrease</u> in electrical energy use.

While the major advantage of a combined or common refrigeration system serving multiple ice sheets is an increase in efficiencies; a disadvantage is that a major problem with the refrigeration system could cause both ice sheets to be out of service. However, this can be addressed by designing back-up systems where deemed cost effective.

A common ice system could be installed in phases. This is a real advantage for the University. The new refrigeration system for Mariucci could be replaced with a system that is designed to serve both arenas in Phase 1. The extra equipment for Ridder would not be installed until that existing 14-year old system is ready to be replaced. In the meantime, the R-22 refrigerant salvaged from Mariucci's system can be used to keep Ridder's system up and running, minimizing R-22 refrigerant replacement costs. Phase 2 would include installing the final compressors, pumps, piping and controls to serve Ridder Arena, replacing the existing ice rink floor with a concrete rink floor, and other improvements.

The existing ice rink floor in Mariucci Arena would be replaced with a concrete rink floor as described in Option 3. Building and HVAC improvements would be performed as discussed in elsewhere in the report.

Options 10 and 11: Combined, *indirect or direct, carbon* dioxide (CO2) system to serve both Mariucci and Ridder Arenas as described in the previous options.

Summary of Ice System Replacement Recommendation: It is recommended that the existing refrigeration serving Mariucci Arena be replaced with an ammonia based industrial grade refrigeration system as described

Picture Window (from left to right)
Options 4&6 – Industrial grade “skid package” refrigeration system.
Options 6&7 – CO2-based refrigeration package system.
Options 8&9 – Industrial grade, “combined” refrigeration system designed for multiple ice sheets

in Option 5 for the following reasons:

- Best available proven technology for this application;
- Proven performance and dependability;
- Maximum operational efficiency;
- Longevity of equipment and refrigerant. Other refrigerants may be faced with future restrictions;
- Low cost refrigerant;
- Availability of equipment and parts; and
- Availability of skilled ammonia contractors

It is also recommended that the concrete ice rink floor be replaced with an indirect type system that uses steel rink piping in place of commonly used polyethylene piping. Steel piping will provide higher performance and faster reaction time for game events.

It is not recommended that a combined refrigeration system (Options 8-11), serving both Mariucci and Ridder Arenas, not be installed. The existing Mariucci refrigeration room is on the smaller side (850 square feet) of what is required to support a common refrigeration system, even taking into account that part of the refrigeration system (i.e. the condenser tank, water pump, etc.) could be located in the emergency generator room as it is now. Ridder Arena’s refrigeration room is much larger at 1,000 SF and would likely be adequate for a common system, however, given the 14 years old system has 16 plus years of useful life, the timing doesn’t work out. At this time, unless there is space adjacent to Mariucci’s refrigeration room to expand the current footprint of the room, we recommend maintaining two separate refrigeration systems.
Safety should be considered the highest priority as discussed under the Design Considerations section of Section 4.0. Additional safety devices and systems are required by code regulations for an ammonia based system. In addition, we recommend the University conduct a wind or air dispersion study to model a potential ammonia release, through the refrigeration room ventilation system, to determine how the ammonia would be dispersed in this area of campus.

The University may also want to consider adding a scrubber system to the refrigeration room ventilation system to lessen the concern over a release. The most common type of scrubber for this application is a wet scrubber where a water stream absorbs the ammonia from the air stream. The ammonia is highly soluble in water. The ammonia contaminated solution is either returned to a water tank or to the sanitary sewer. The waste water will contain a solution of ammonia sulfate that, in most cases, can be introduced into the public sewer system, if approved by the local sewer utility. In some cases may need treatment before disposal. Possible locations for the scrubber where not identified in this study and will require a rated space if located inside the facility. Locating the unit outdoors will require freeze protection of the unit and other complications. The exhaust will need to be located 25 feet from any building opening. A scrubber system is not currently required by any codes or regulations. The cost of this system has been included in the study as an option

BUILDING SYSTEMS – RECOMMENDATIONS

The following are recommended improvements to the existing refrigeration room. With an area of 850 square feet, the existing refrigeration room is large enough to house a new indirect refrigeration system to serve Mariucci Arena. A preliminary code review has determined that an exterior egress is not required if ammonia refrigerant is selected as long as both existing doors are enclosed with vestibules. This will decrease the existing room by approximately 80 square feet leaving a room of 770 square feet for the new refrigeration system. However, it was noted that the existing condenser tank, pump and chemicals is located in the generator room lessen the space requirements for the new system.

The existing room is of marginal sized for a combined refrigeration system especially if ammonia is selected and may also be tight for a CO2 packaged system.

HVAC, plumbing and electrical system modifications to the existing refrigeration room are discussed elsewhere in this report.

OTHER RECOMMENDATIONS

Dasher Board System Improvements. Budget for replacing the soft caprail on the dasher board system. Expected life of this material is 5 years. Evaluate the feasibility and benefit of changing from tempered glass shielding to acrylic. Acrylic shielding is now common in NHL facilities and becoming more common in college facilities. Acrylic shielding will increase safety but also increases maintenance costs.

Waste heat recovery systems. Heat recovery systems should be incorporated in the design of the new system. In addition to the standard heat recovery system for the snow melt pit; the waste heat should be used for other purposes such as preheating resurfacer or domestic water.

Groundwater. Continue to monitor the groundwater levels.

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11.0 Appendices

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Summary of Appendix

ZweigWhite & Architecture Week Magazine's America's Top 20 Architecture Firms to Work For

Inc. Magazine
Hire Power Award

Young Professionals
Grow Grand Award

Architectural Record
Top 300 Architecture Firms

Minneapolis/St. Paul Business Journal's Top 25 Firms

ZweigWhite Top 100
National Hot Firms

National American Institute of Architects Intern Development Program Outstanding Firm Award

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DECI Development of the Year Awards
Education Design Honorable Mentions
St. Paul Heritage Preservation Awards
Minnesota Preservation Awards
Prime Site Awards of Excellence
North Dakota Barrier-Free Design Awards
North Dakota Concrete Products Awards
MC Landscape Design Awards
Mid-America EDC Redevelopment Awards
North Dakota Housing Finance Production Awards
Grand Forks Chamber City Beautification Awards
Grand Forks Chamber Special Achievement Awards
National School Boards Association Awards
Committee on Urban Design and Environment Awards

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