BETHLEHEM PUBLIC LIBRARY

Board Presentation

ASHLEY MCGRAW

January 25th, 2024

Presentation Goals or Agenda

1. Project Purpose
2. Schematic Design - Design and Estimate
3. Staff Development Day 12/1/23 - Recap
4. Proposed Value Engineering Items (VE)
5. Proposed Design Options (DO)
6. Geothermal
7. Value Engineering Items Comparison
8. Design Options Comparison
9. Discussion

Project Purpose

To position the Bethlehem Public Library as a community resource that is accessible to all, offering modern programming in a mindful environment that's nestled within the fabric of the community.

Designed in a way that's welcoming, simple to navigate, modern, and adaptable to a variety of programs, both inside the library and throughout the site.

Optimizing the library so that both patrons and staff have cohesive environments to suit their evolving needs, and to support the next generation of collaboration, discovery, and learning.

Schematic Design – Northeast Elevation

View from Borthwick Avenue at East Entry

Schematic Design:

Sub Total Construction Cost (Renovation & Additions)	$16,262,669
Site	$2,741,538
General Conditions, Overhead & Profit, Phasing, Design & Construction Contingency, Bid Contingency, Escalation	$10,926,348
Total Construction Cost:	$29,930,555
Trophy Point Revision #2 (11/13/2023)	
Soft Costs previously accounted for:	
FF&E	$1,913,490
CM Fees (anticipate 3-4%)	$1,197,222
Total	$3,110,712
Other soft costs:	
Site survey	$14,500.00
HazMat design phase testing costs	$3,890.00
energy efficiency options and modeling	$14,375.00
Geotech #2	$8,590.00
Geotech #1	$10,750.00
SD fee	$283,638.00
DD-CA fee*	$1,974,330.00
Moving costs, legal, fiscal advisors, commissioning & special inspections	TBD
SWPPP preparation and inspection	$30,000.00
design consultant reimbursables NTE	$24,679.13
Total	$2,364,752.13
Total Project Cost:	$35,406,019.33

Add Alternates	Trophy Point Revision #2 (11/13/2023)		
Alt #1 - Telescopic Seating & operable wall			$634,376
Alt #2 - Heated Sidewalk			$207,073
Alt #3 - HVAC Option 2		$3,269,242	~~$3,720,787~~
Alt #4 - HVAC Option 3		$3,344,493	~~$4,000,311~~

TROPHY POINT
Construction Services & Consulting

RENOVATIONS AND ALTERATIONS
BETHLEHEM PUBLIC LIBRARY
DELMAR, NEW YORK
ASHLEY MCGRAW

PROJECT NO: 22-0254a-0560
SCHEMATIC DESIGN UPDATE ESTIMATE
PUBLISHED: 11/07/2023
REVISION 3: 01/24/2024

PROJECT SUMMARY				TOTAL COST
ADDITION & RENOVATIONS			$	27,189,017
SITE			$	2,741,538
TOTAL PROJECT CONSTRUCTION COST			$	29,930,555
ALTERNATES				
ALT #1 - TELESCOPIC SEATING		ADD	$	633,024
ALT #2 - HEATED SIDEWALK		ADD	$	207,073
HVAC OPTION #2	#2 = $1,286,514 + $1,982,728 = $3,269,242	ADD	$	1,286,514
HVAC OPTION #3	January 24, 2024 (Revision 3) Trophy Point, LLC Construction Services & Consulting	ADD	$	1,361,765
GEOTHERMAL WELLS ADD	#3 = $1,361,765 + $1,982,728 = $3,344,493	ADD	$	1,982,728

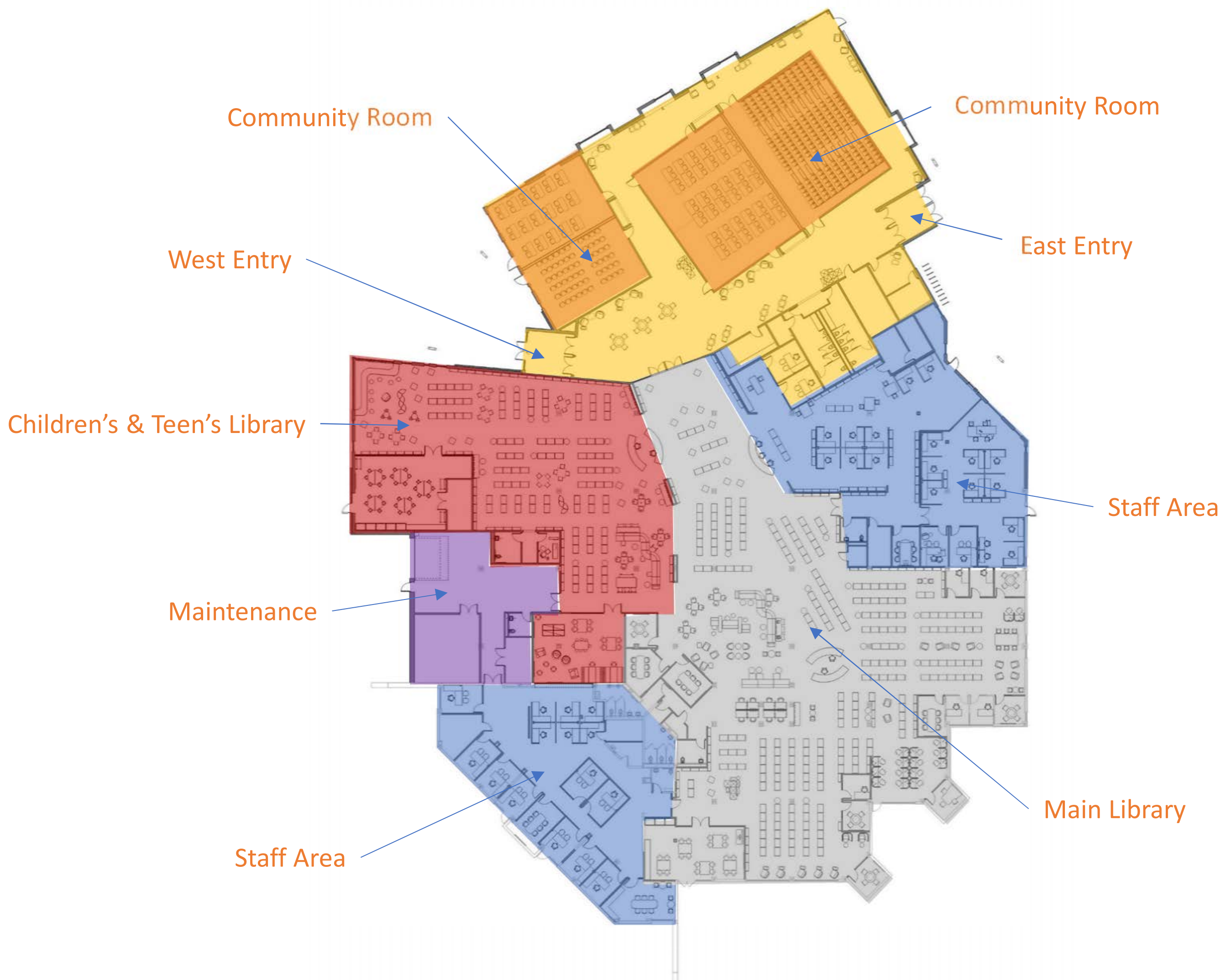
Schematic Design:

Site Plan:
Total Cost: $2,741,538.00 (includes mark-ups)

Schematic Design:

Floor Plan:
Construction Cost: $16,262,669.00
Mark-ups: $10,926,348.00

Total Cost: $27,189,017.00



Schematic Design – East Elevation

View from Borthwick Avenue at East Entry

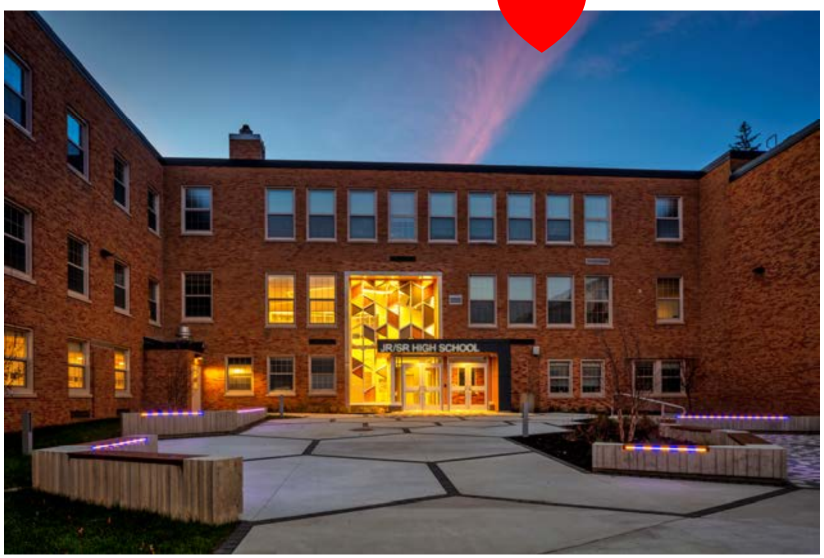

Site Plan


STAFF DEVELOPMENT DAY
12/1/23

- Keep all outside seating/table areas
- Need book drop in parking lot
- Bus Shelter / location within parking lot.
- Bus stop is on Delaware, people are often navigating with strollers/bags, etc
- Many patrons have mobility issues. Access to entrances is essential
- Check distances from various parking zones and bus stop to entrances.
- Big concern over not having an entrance on Delaware Ave. address is Delaware Ave.
- Designated employee parking and designated staff entrance?
- Add staff sidewalk along loading dock driveway
- Need separate staff entrance! Maybe near maintenance, maybe some handicapped spots
- Eliminate parking across from curbside circle
- No parking across from curbside circle due to traffic flow
- Cars need to cris-cross lanes to get to curbside window?
- Curbside pick up to also be drop box loop and currier delivery location.
- During popular community events, parking lot gets completely full
- Drainage needed at walkways. Fully paved, no more cobble/pavers.
- Need parking for library van – exterior (not in maintenance garage)
- Prefer the pavilion performance area to be against building (children's). Seating storage in shed or garage
- Green roof.

EXTERIOR

EXTERIOR CIRCULATION



EXTERIOR AMENITIES

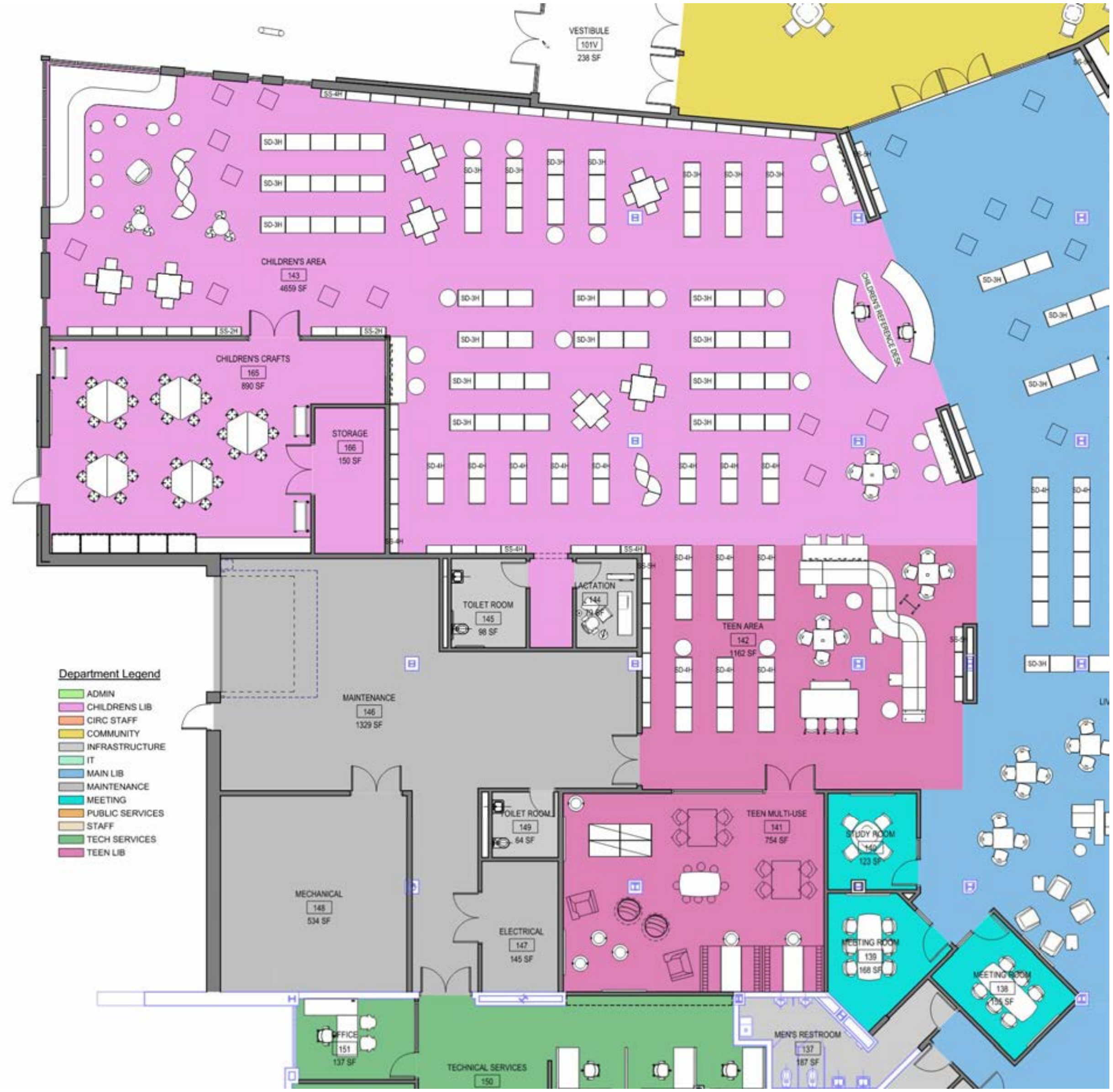
Gallery

- Would librarians like to have their own exhibit wall?
- Exhibit/gallery size – current exhibits are installed by patrons. Our parking lot entrance hall is most popular, as it is larger, but not sure how much larger it should be than that.
- Current gallery space accommodates a flexible display system which is great

Community Rooms

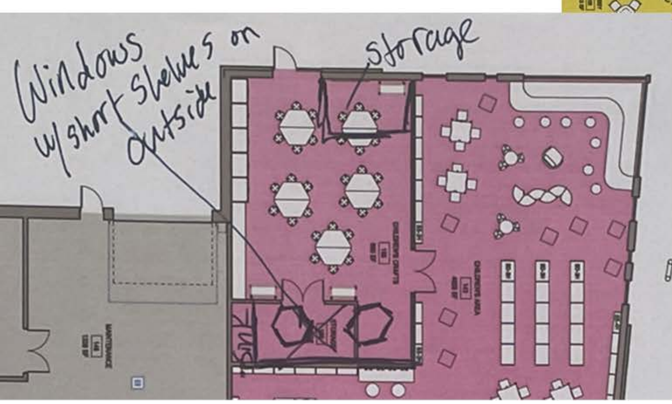
- Large meeting space – space for grand piano storage and performance use
- Need program supply room close to program rooms (community rooms)
- Need storage for outreach supplies
- Door / book drop into community room gallery hall

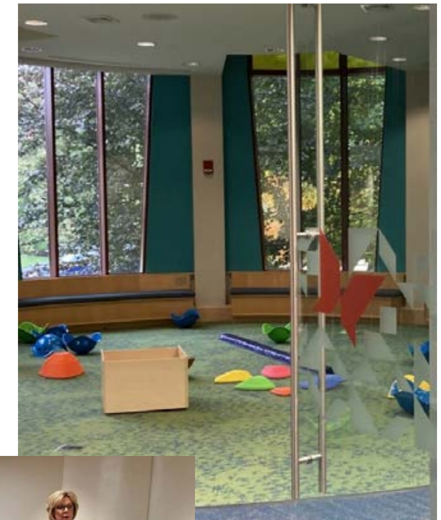
COMMUNITY AREA



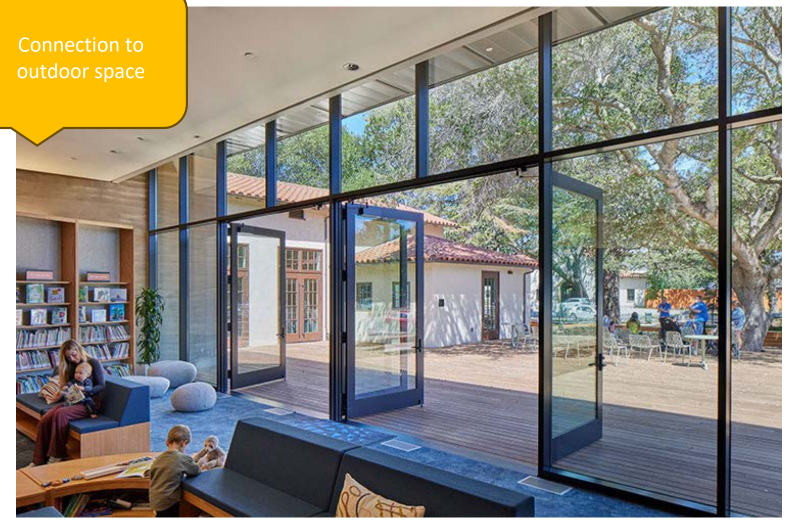
- Need 100% visibility / line of sight of young adults from children's desk
- Need to consider how to utilize the children's craft room outside of programs. Close the door? Leave open and unsupervised?
    - o Sink in craft room
    - o More visibility into craft room
- Children's reference desk will always need to staffed by two people
- Children's reference desk location as shows will be too front and center – catch lots of non-children's questions.
- Add another desk for teen reference desk
- More visibility into teen room
- More dedicated young adult / study rooms – 6?
- Concerned about noise and containing children's area – how enclosed should it be?
- Story time space within community room, adjacent to storage and family restroom
- Connection to outdoor space very important

CHILDREN/TEEN AREA





CHILDREN/TEEN AREA



CHILDREN/TEEN AREA

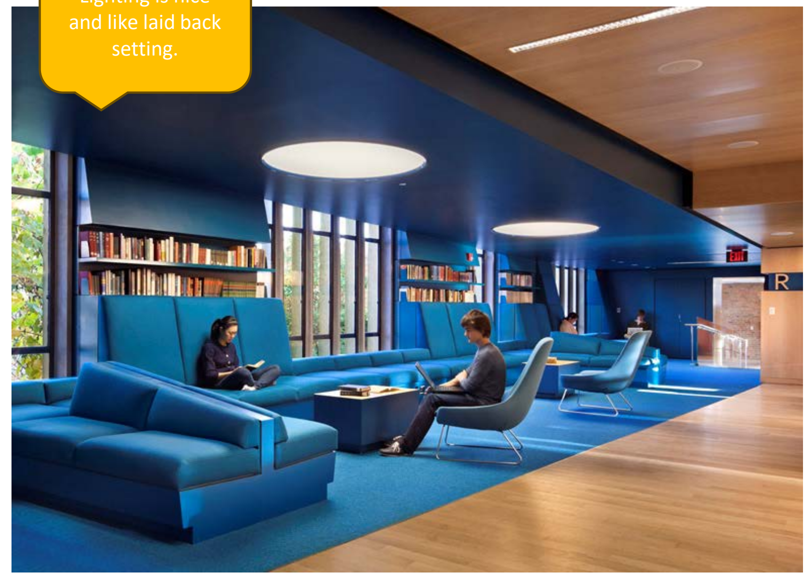
- Lots of greens. No orange
- More of a classic look that won't look aged in a few years.
- Not plush furniture; needs to be easy to clean
- Not always so bright – nice to have contrast
- Like some enclosed space
- Tilted bottom shelf makes it easier to reach – access.
- Some moveable shelving, some note moveable
- Display and new books display in middle of main library entry area
- Info desk is too far back. Needs storage space
- Meeting rooms/ study rooms are too spread out – difficult to monitor
- Currently have 3 study rooms that are un-reservable. Maybe at least 9 so some may be reserved.
- Reservable study rooms are requested for zoom meetings, interviews, work from home, social work, small staff retreats.

MAIN LIBRARY AREA

MAIN LIBRARY AREA

Some moveable shelving, some fixed, titled bottom shelf makes it easier to reach.

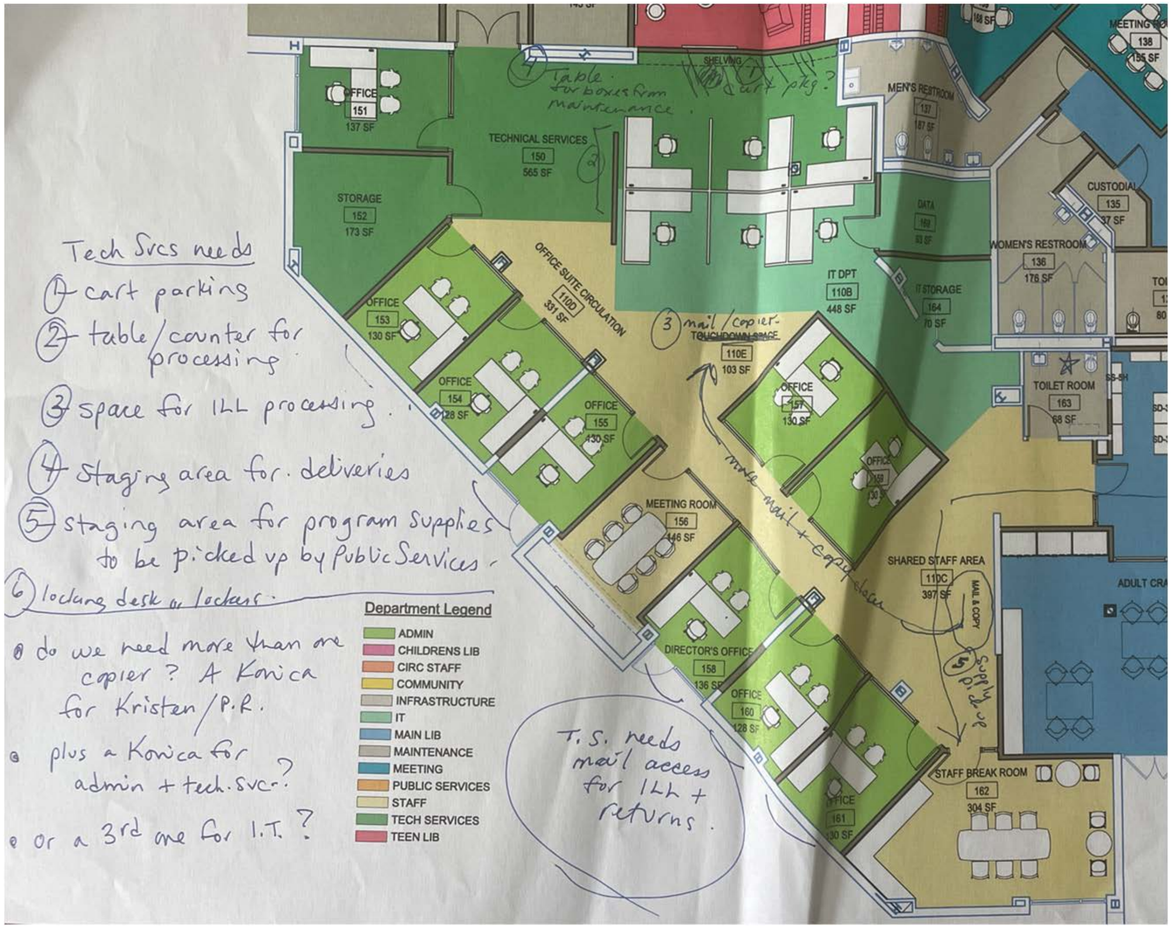
Lighting is nice and like laid back setting.



Like the enclosed space

- Need a more private staff area for phone calls, etc for those who don't have a private office.
- Enlarge all-staff breakroom
- Cubicle workstations to have walls to provide sound absorption and some privacy
- Tech Services Needs:
  - Cart parking
  - Table/counter for processing
  - Counter for people to pickup orders / staging area for program supplies to be picked up by public services
  - Staging area for deliveries
  - Space for ILL processing
  - Locking desks or lockers
  - Mail access for ILL and returns
- Copier – how many are needed? Possibly 3
- Swap mail & copy area with "touchdown space" – which should become the supply pickup area
- More staff toilet rooms needed – often have a line

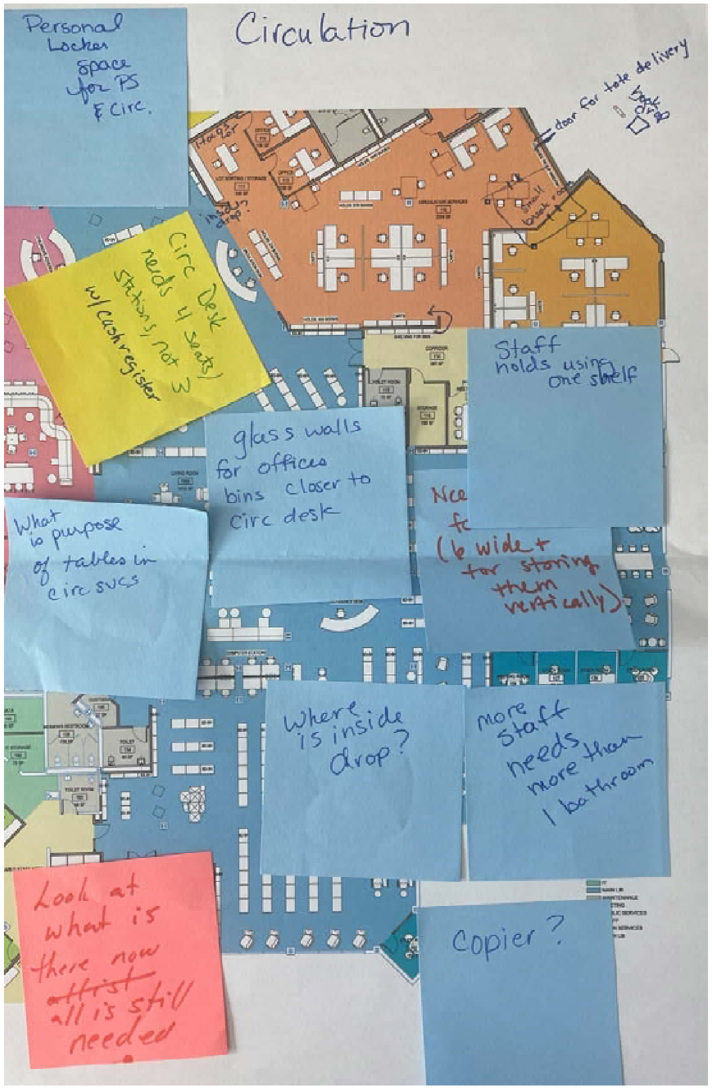
TECH SERVICES/ADMIN

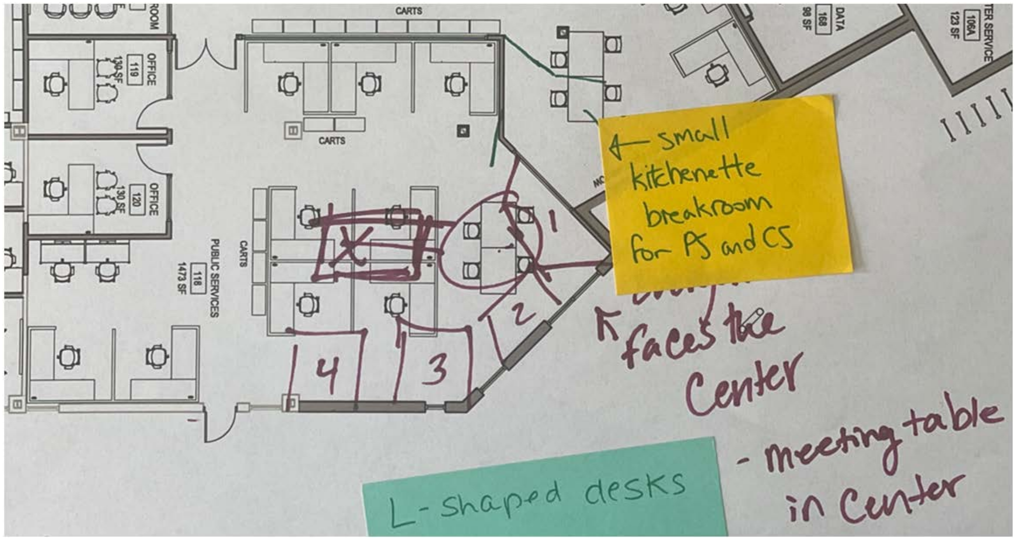


TECH SERVICES / ADMIN

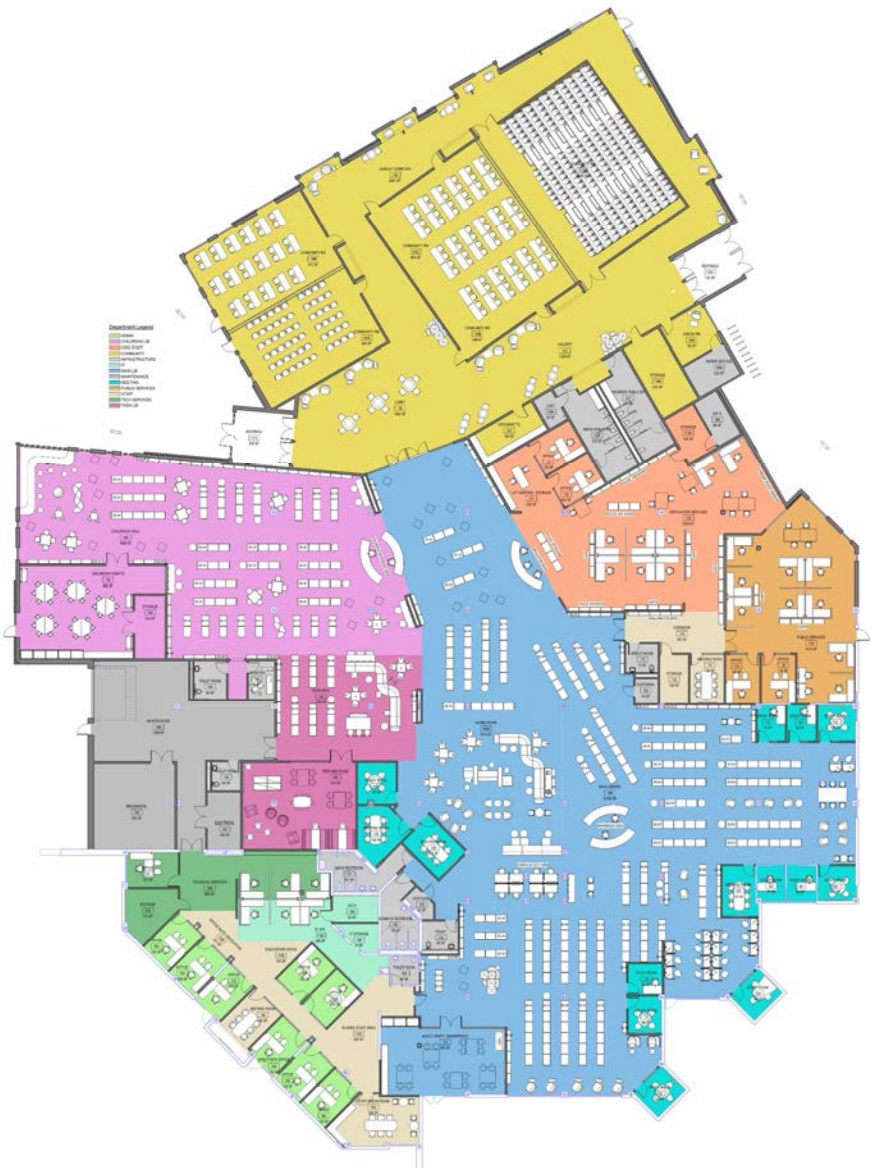
- Need breakroom/kitchenette – too far to go across library to one in the tech services/admin area
- Copier space needed
- More than one staff toilet room needed
- Need personal locker space
- Circ desk needs 4 staff seats/stations, with cash register, and one circ station behind desk
- Where is book drop? Outside and inside drop
- Glass walls at offices
- Need door to exterior for tote delivery
- Bins need to be closer to circ desk
- Need space for totes – 6 wide and for storing them vertically
- Need space for carts at desks
- Unclear on intent/need for tables in circ area
- Everything they have now is still needed
- General comments that public services is loosing significant amount of square footage
- Needs to be collaborative space, but not totally open
- 3 public services workstations missing
- Public services – want all workstations to be around the perimeter of room and face the center, with meeting table in the middle.
- Dark forest greens or light sage or blue. No orange or neon colors.
- Innovative/respite seating area

PUBLIC SERVICES & CIRC





PUBLIC SERVICES & CIRC



1. Curbside pickup loop to be revisited for pedestrian and vehicular safety.
2. Some community program space to be multi-functional Children's program space and outfitted accordingly.
3. Public Services area is undersized and is to be revisited.

BIGGEST TAKEAWAYS

Proposed Value Engineering Items (V.E.)

NO to LOW IMPACT on Design/Program:

Value Engineering Item #1:	Adjustment of CD and CA design fee to reflect $30M project cost.
Value Engineering Item #2:	Conduct construction as one construction phase. Will require renting a temporary space.
Value Engineering Item #3:	Reduction in escalation from eliminating phasing.
Value Engineering Item #4:	Eliminate or reduce sky lights and eliminate rated interior glazing at community rooms.
Value Engineering Item #5:	Eliminate terrazzo flooring and base from community room addition; swap for tile and resilient.
Value Engineering Item #6:	MEP/FP to reuse some existing piping and ductwork.
Value Engineering Item #7:	Remove blue VAT from Haz-mat estimate (already removed).

MEDIUM IMPACT on Design/Program:

Value Engineering Item #8:	Change roof design from modified butterfly to flat roof.
Value Engineering Item #9:	Reuse existing stacks.
Value Engineering Item #10:	Switch from motorized movable drop-down partitions to the manual side type.
Value Engineering Item #11:	Reduce Community Room heights.
Value Engineering Item #12:	Site Removals.

BIG IMPACT on Design/Program:

Value Engineering Item #13:	Structural savings for steel reduction and foundation reduction.
Value Engineering Item #14:	Eliminate Pavilion.

V.E. Option #1

Description:

Adjust CD and CA design fee to reflect $30M project cost.

Overall Cost Change: -$150,000.00

V.E. Option #2

Description:

Conduct construction as one construction phase. Will require renting a temporary space. Cost based on original construction cost.

Overall Cost Change: -$983,891.00

This is the number in the SD estimate. Costs for renting a temporary space to be determined.

V.E. Option #3

Description:

Reduction in escalation from eliminating phasing. Cost change dependent on Construction Cost.

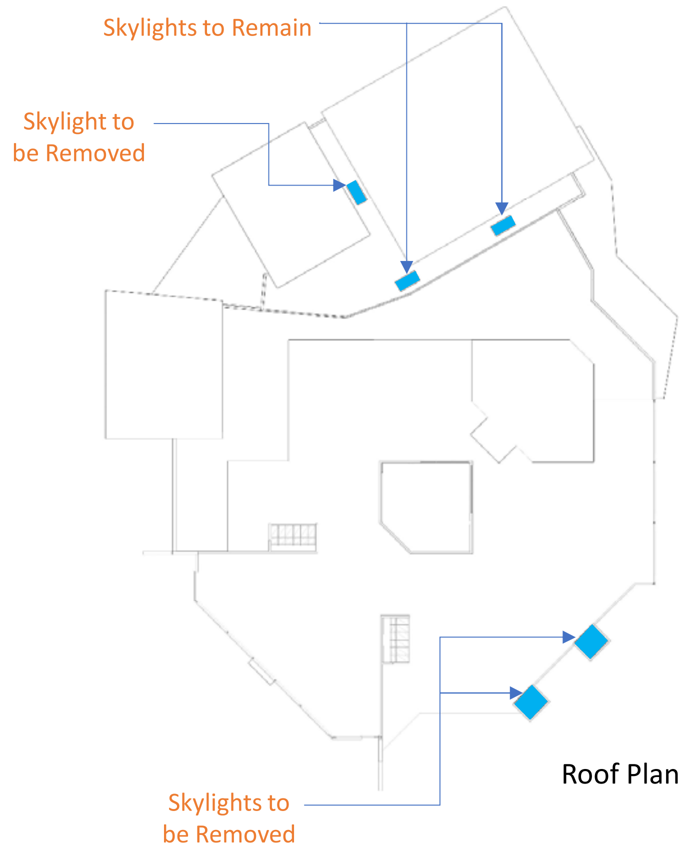
Overall Cost Change: -$185,491.00

V.E. Option #4

Description:

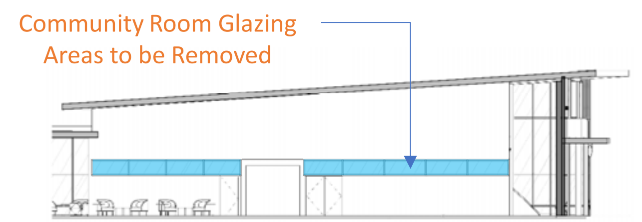
Reduce skylights & eliminate rated interior glazing at community rooms.

Element:	Skylights & Glazing
Overall Cost Change:	-$200,000.00



Roof Plan

Floor Plan



A - Community Room Interior Elevation

V.E. Option #5-a

Description:

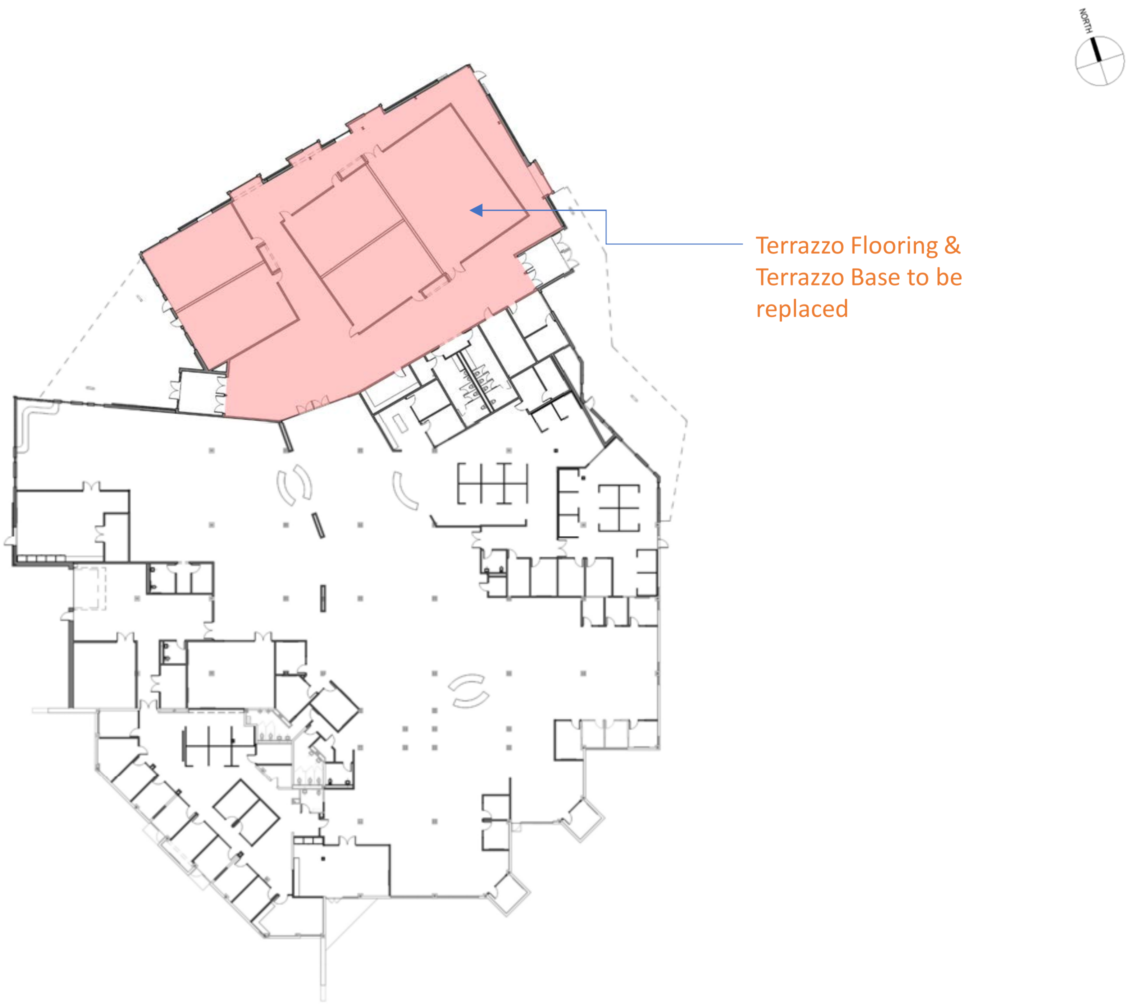
Eliminate terrazzo flooring and base from community room addition; swap for tile and resilient.

COMMUNITY ROOMS AND PERIMETER COMMON SPACES:

Flooring
Terrazzo - 10, 731 sq. ft. x $44.08 (M&L) = $473,022.48 x 1.67% (mark-up) = $789,947.54
Resilient - 10, 731 sq. ft. x $10.22 (M&L) = $109,670.82 x 1.67% (mark-up) = $183,150.27
$789,947.54 - $183,150.27 = $606,797.27
Base
Terrazzo - 597 lin .ft. x $25.37 (M&L) = $15,145.89 x 1.67% (mark-up) = $25,293.64
Resilient - 597 lin .ft. x $3.65 (M&L) = $2,179.05 x 1.67% (mark-up) = $3,639.01

$25,293.64 - $3,639.01 = $21,654.63
$606,797.27 + $21,654.63 = **$628,451.90 total savings say $628,450.00**

Element:	Flooring & Base
Overall Cost Change:	-$628,450.00



Floor Plan

V.E. Option #5-b

Description:

Eliminate terrazzo flooring and base from community rooms only; swap for tile and resilient.

COMMUNITY ROOMS ONLY

Flooring
Just changing out the community rooms is 5,433 sq. ft. so just about half - $606,797.27 divided by 2 = $303,398.64
Base
Terrazzo - 422 lin .ft. x $25.37 (M&L) = $10,706.14 x 1.67% (mark-up) = $17,879.25
Resilient - 422 lin .ft. x $3.65 (M&L) = $1,540.30 x 1.67% (mark-up) = $2,572.30
$17,879.25 - $2,572.30 = $15,306.95

$303,398.64 + $15,306.95 = **$318,705.59 total savings say $318,700.00**

Element:	Flooring & Base
Overall Cost Change:	-$318,700.00

Floor Plan

V.E. Option #6

Description:

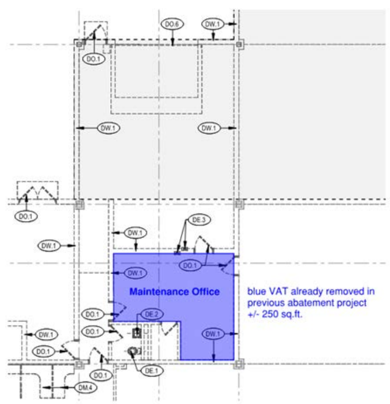
MEP/FP: reuse some existing piping and ductwork. Savings depend on Selected Option. If selection of HVAC is Option #1 or Option #2, savings is -$150,000.00.

Element:	Piping & Ductwork
Overall Cost Change:	-$150,000.00

V.E. Option #7

Description:

Remove blue VAT from Haz-mat estimate (already removed)

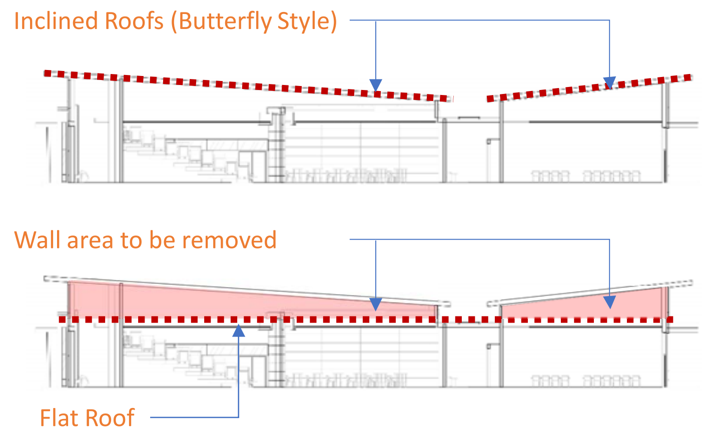


Element:	Blue VAT
Overall Cost Change:	-$15,308.00

V.E. Option #8

Description:

Change roof design from modified butterfly to flat roof.



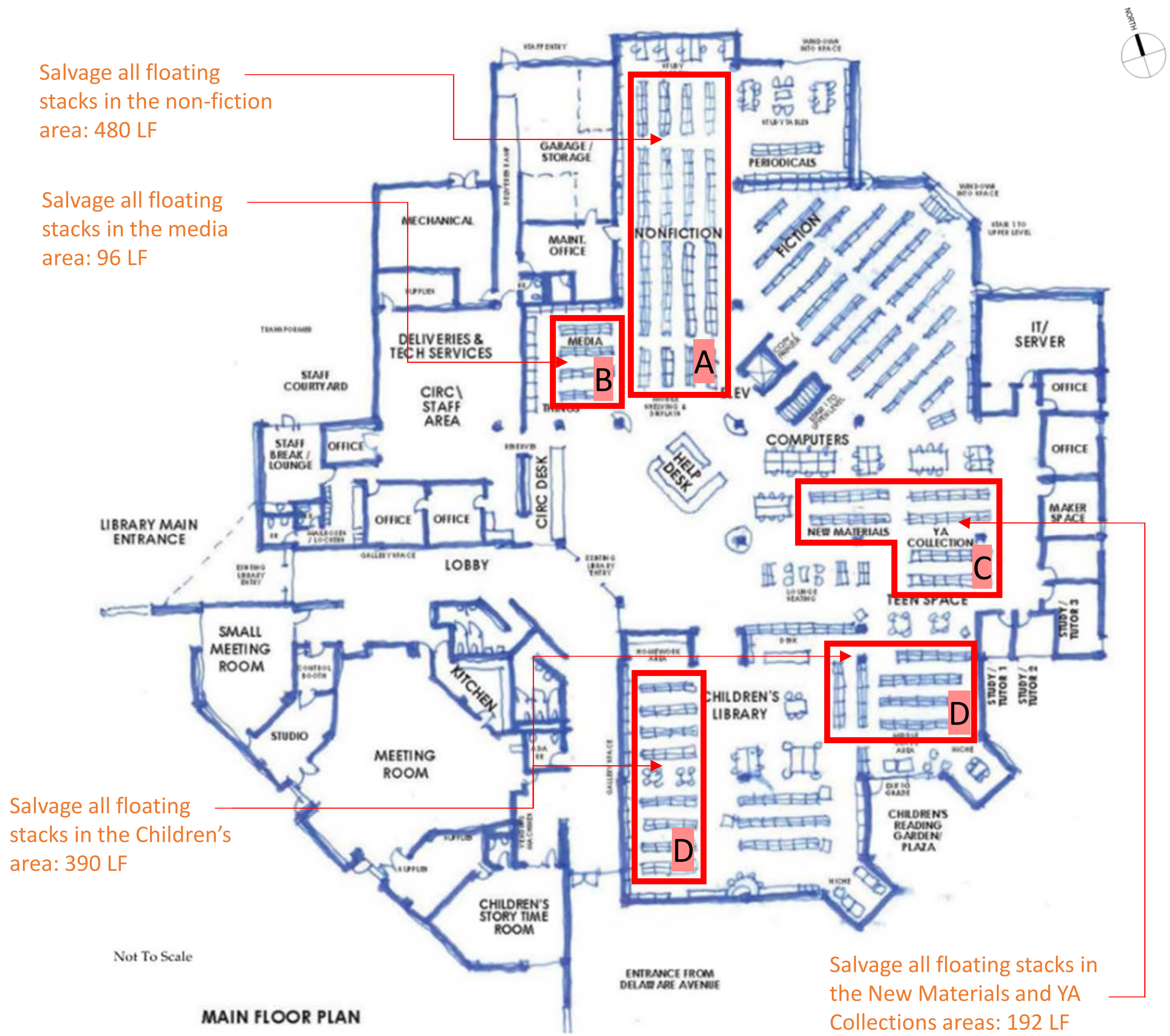
Element:	Roof Style
Overall Cost Change:	-$125,000.00

V.E. Option #9

Description:

This option intends to salvage and re-install the existing stacks found to be in good condition, purposeful, and feasible to reinstall.

Element:	New Stacks
Proposed Linear FT:	2,340 LF
Element:	Existing Stacks
Salvageable Linear FT:	1,158 LF
Overall Cost:	Storage & Reassembly (TBD)
Overall Cost Savings:	+/- $225,000.00



V.E. Option #9

Description:

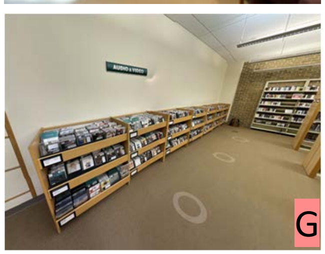
Stacks not to be salvaged include:
Fiction stacks – Structurally Integrated into low-ceiling

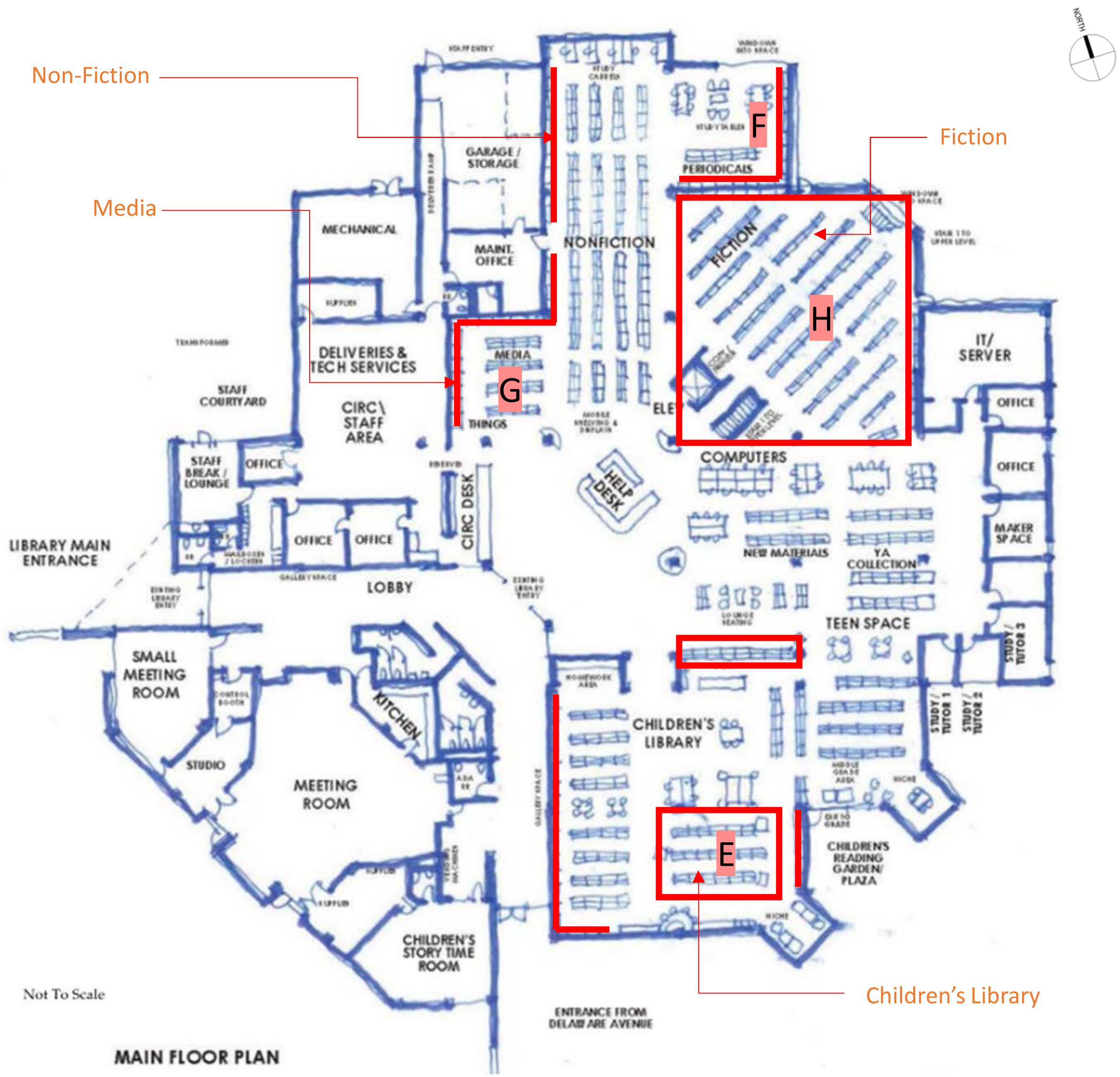
Children's short stacks – To be replaced as requested with browsing bins

Perimeter single-faced Stacks – Unfinished structures

Specialty storage stacks i.e., CDs will need to be evaluated to be kept as the way specialty items will be stored may change.

Freestanding Feature Displays – To be salvaged as requested by the owner.



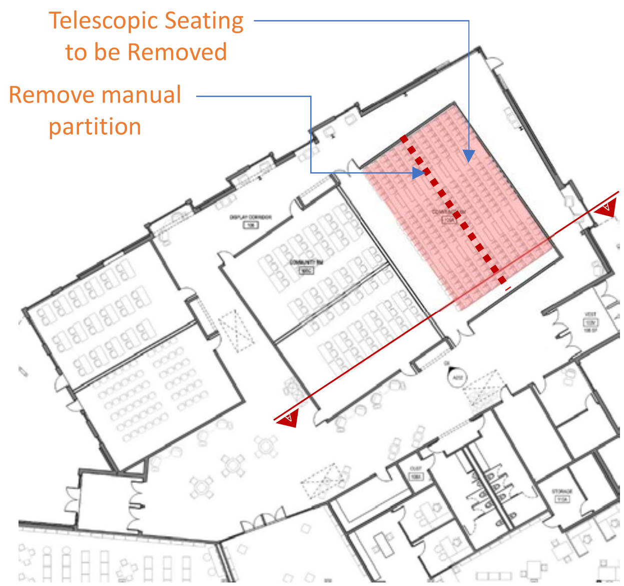


V.E. Option #10

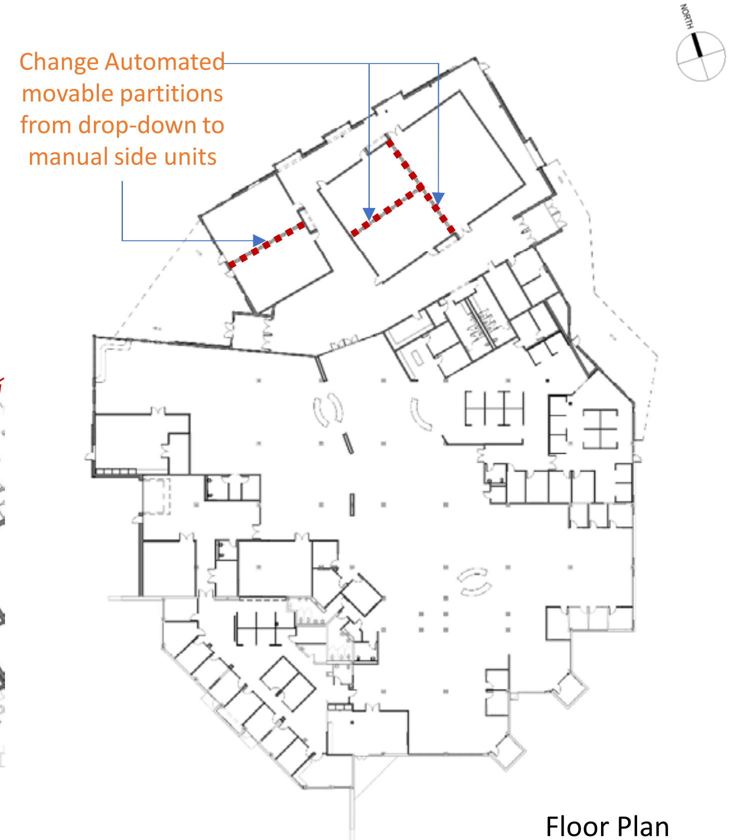
Description:

The intent of this option is to Change three (3) automated movable drop-down partitions to manual side units.
With the elimination of the telescopic seating alternate, the manual movable side partition that was meant to conceal the telescopic seating in its closed position will now also be eliminated.
Elimination of the telescopic seating also allows for further review concerning height restrictions.

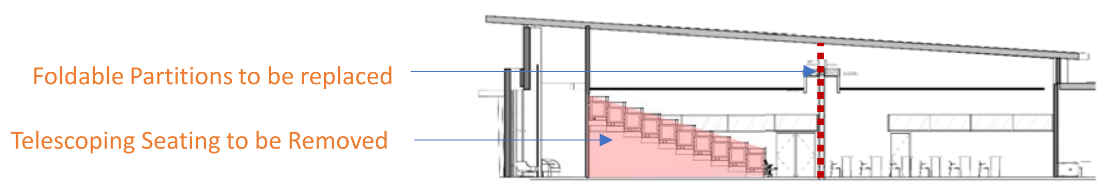
Element:	Movable Partitions
Overall Cost Change:	-$731,250.00



Enlarged Floor Plan – Community Rooms



Floor Plan



A-A - Community Room Interior Section

V.E. Option #11

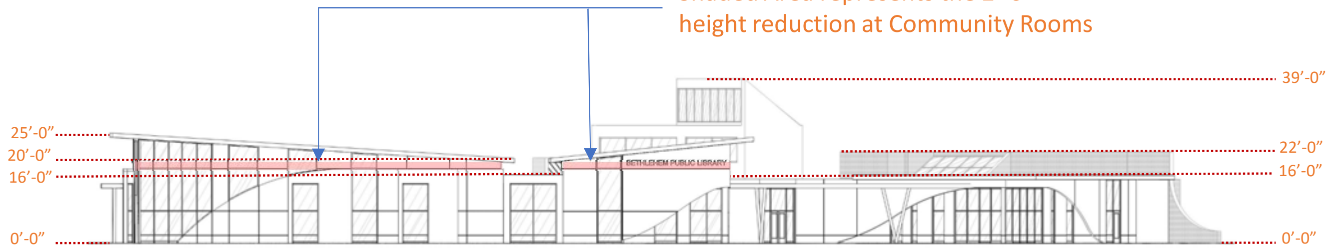
Description:

The intent of this option is to reduce 2'-0" the height of the Community Rooms after eliminating the telescoping seating (alternate)

Reducing the height of community rooms will cuts down on sq. ft. of materials in walls and curtain wall costs.

Element:	Reduce C.R. Heights
Overall Cost Change:	-$100,000.00

Shaded Area represents the 2'-0" height reduction at Community Rooms



North Elevation

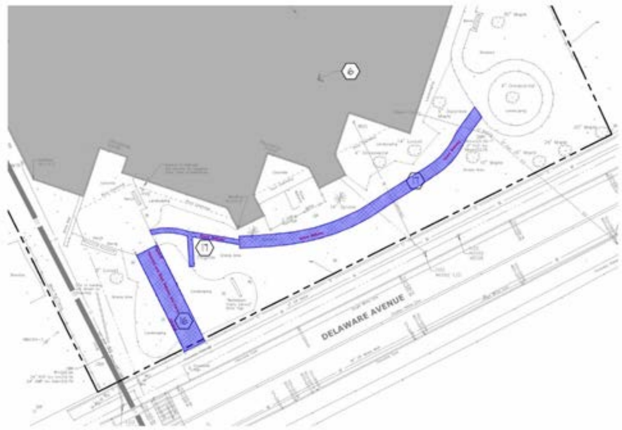
V.E. Option #12

Description:

Site Removals:

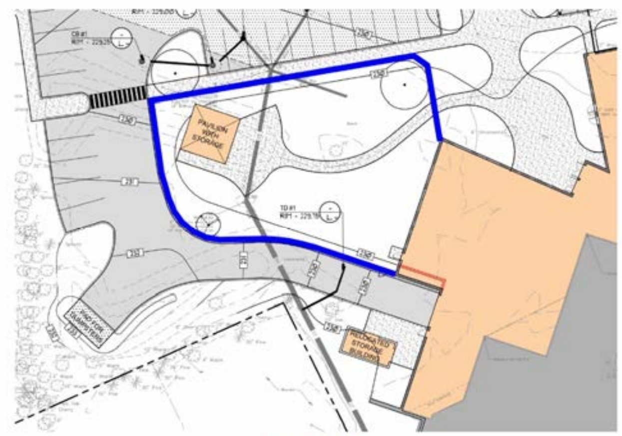
- Removal of existing ramp / access to Delaware 550 sf.
- Removal of new concrete walk to Delaware and along face of building 1200 sf.
- Removal of Staff Patio area 300 sf.
- Removal of fencing around Pavilion / Outdoor area 300 lf.

Element:	Site Removals
Overall Cost Change:	-$107,087.00



DEMOLITION

PROPOSED

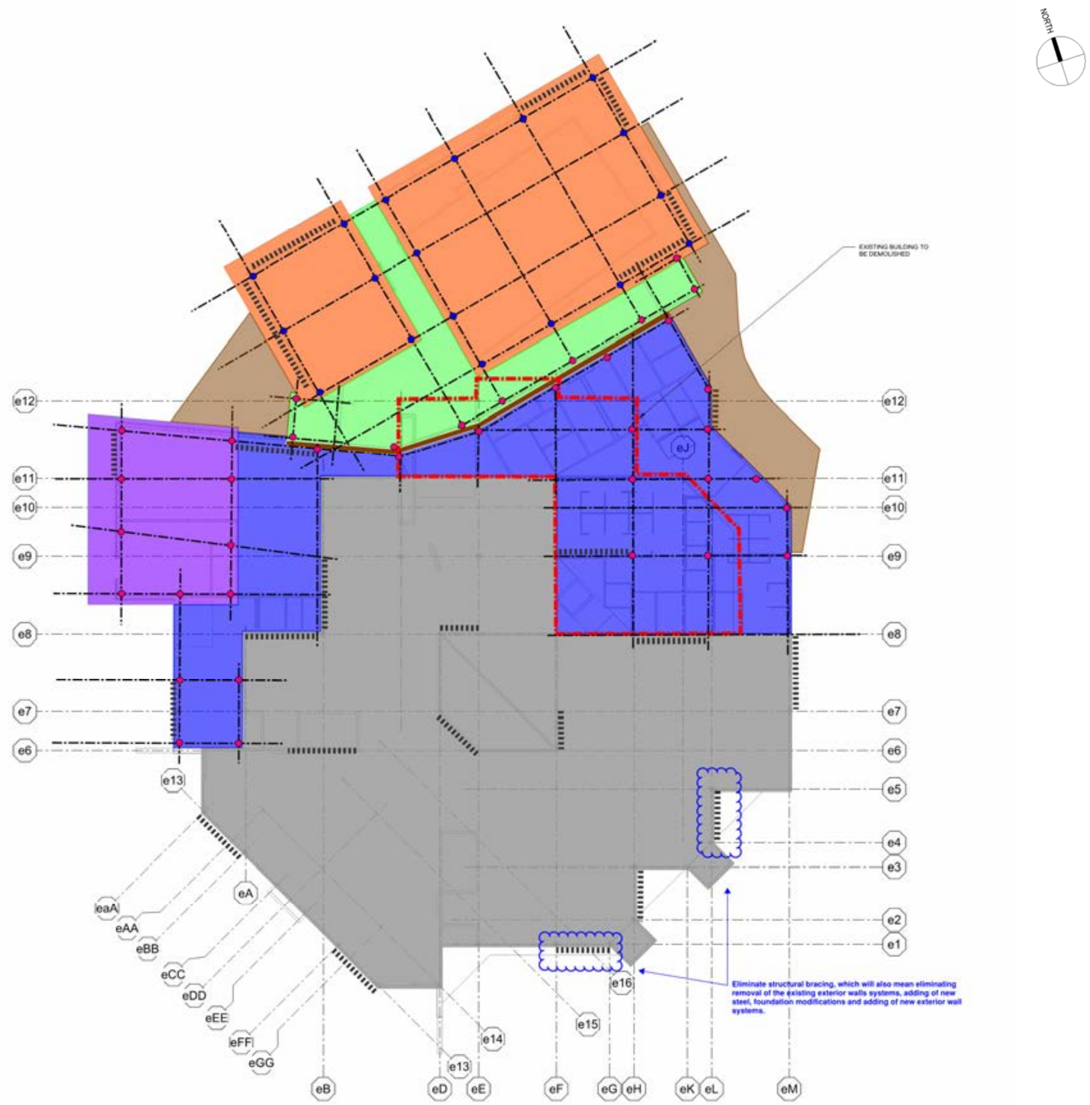


PROPOSED

V.E. Option #13

Description:

Structural savings for steel reduction and foundation reduction. Elimination of exterior structural bracing, which will also mean eliminating removal of the existing exterior walls systems, adding of new steel, foundation modifications and adding of new exterior wall systems.



Element:	Eliminate Structural Bracing and Related Work
Overall Cost Change:	-$185,000.00

V.E. Option #14

Description:

Site Removals:

- Eliminate pavilion.

Pavilion to be Removed

Element:	Eliminate Pavilion
Overall Cost Change:	-$160,000.00

Proposed Design Options (D.O.)

BIG IMPACT on Design/Program:

Design Option #1:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library.

Design Option #2:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room to the east side. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.

Design Option #3:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one), and limiting the circulation, which it's replaced with two entry-squares; facilitating the access from the parking. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.

Design Option #4:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library. Complementary, an entry-square in the North accentuates the access and the pick-up loop is set independently from the parking.

Design Option #1

Description:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library.

Building footprint as SD:	48,000 SF
Building footprint Option 1:	46,042 SF
Total reduction:	1,958 SF
Overall Cost Change:	**-$1,108,228.00**

Design Option #2

Description:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room to the east side. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.

Building footprint as SD:	48,000 SF
Building footprint Option 2:	46,490 SF
Total reduction:	1,510 SF
Overall Cost Change:	**-$854,660.00**

Design Option #3

Description:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one), and limiting the circulation, which it's replaced with two entry-squares; facilitating the access from the parking. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.

Building footprint as SD:	48,000 SF
Building footprint Option 3:	45,466 SF
Total reduction:	2,534 SF
Overall Cost Change:	**-$1,777,240.00**

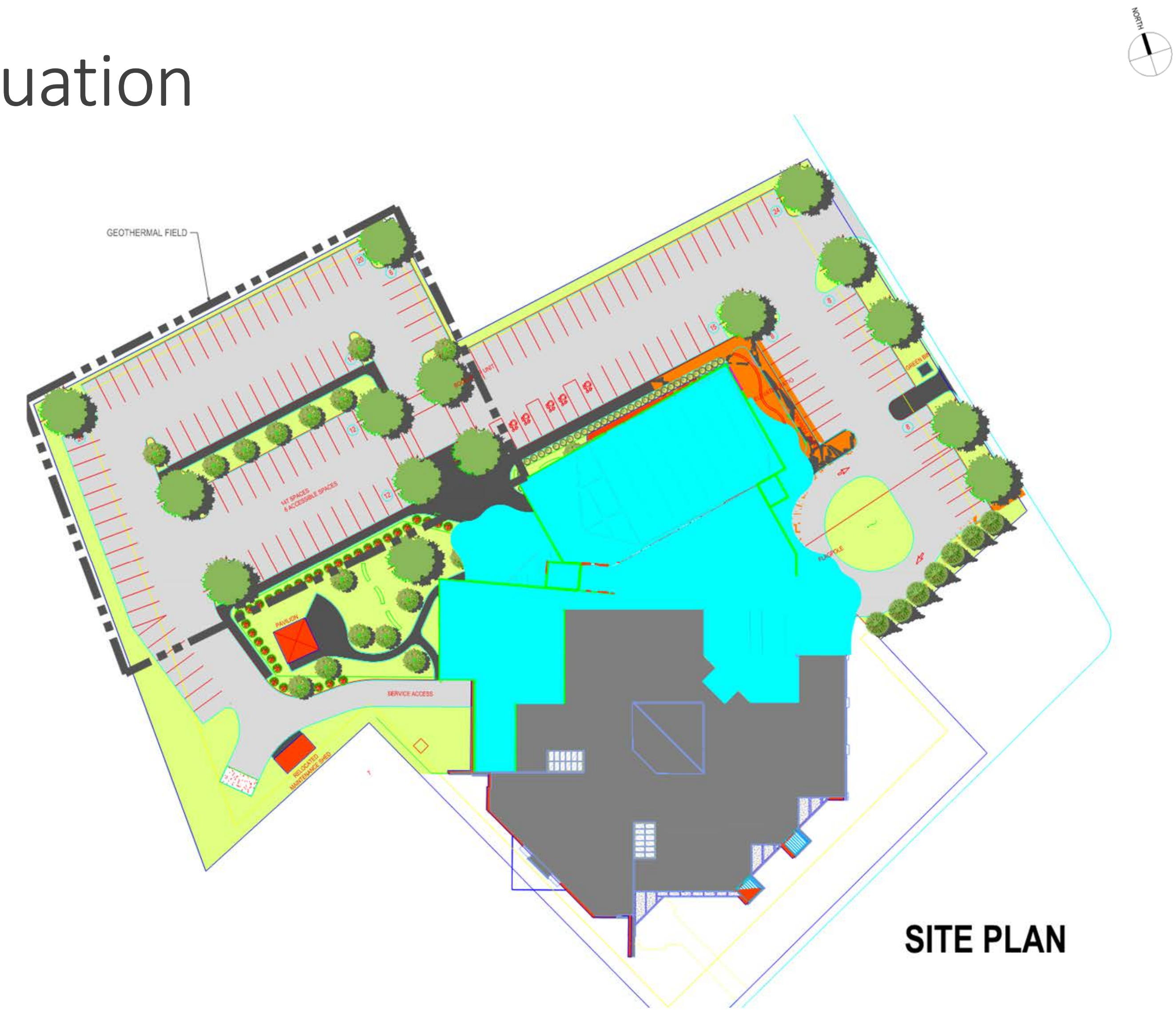
Design Option #4

Description:

The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library. Complementary, an entry-square in the North accentuates the access and the pick-up loop is set independently from the parking.

Building footprint as SD:	48,000 SF
Building footprint Option 4:	47,066 SF
Total reduction:	1,495 SF
Overall Cost Change:	**-$846,170.00**

Geothermal Evaluation



SITE PLAN

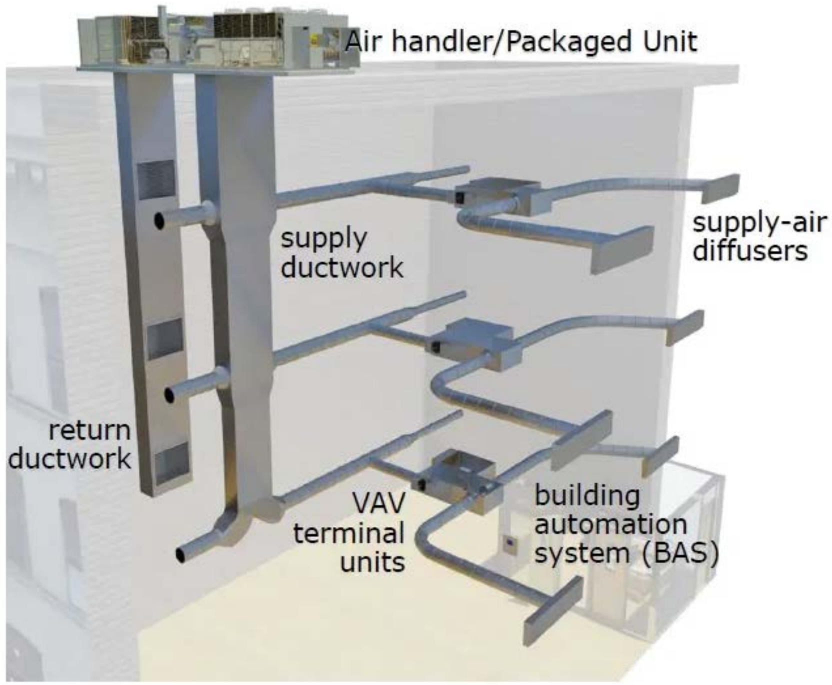
HVAC Options

Option 1 – Traditional Gas Fired Rooftop Air Handling Units with VAV terminal units for zoning

EUI 62.9 total site energy / EUI 105 total source energy

EUI - **E**nergy **U**se **I**ntensity

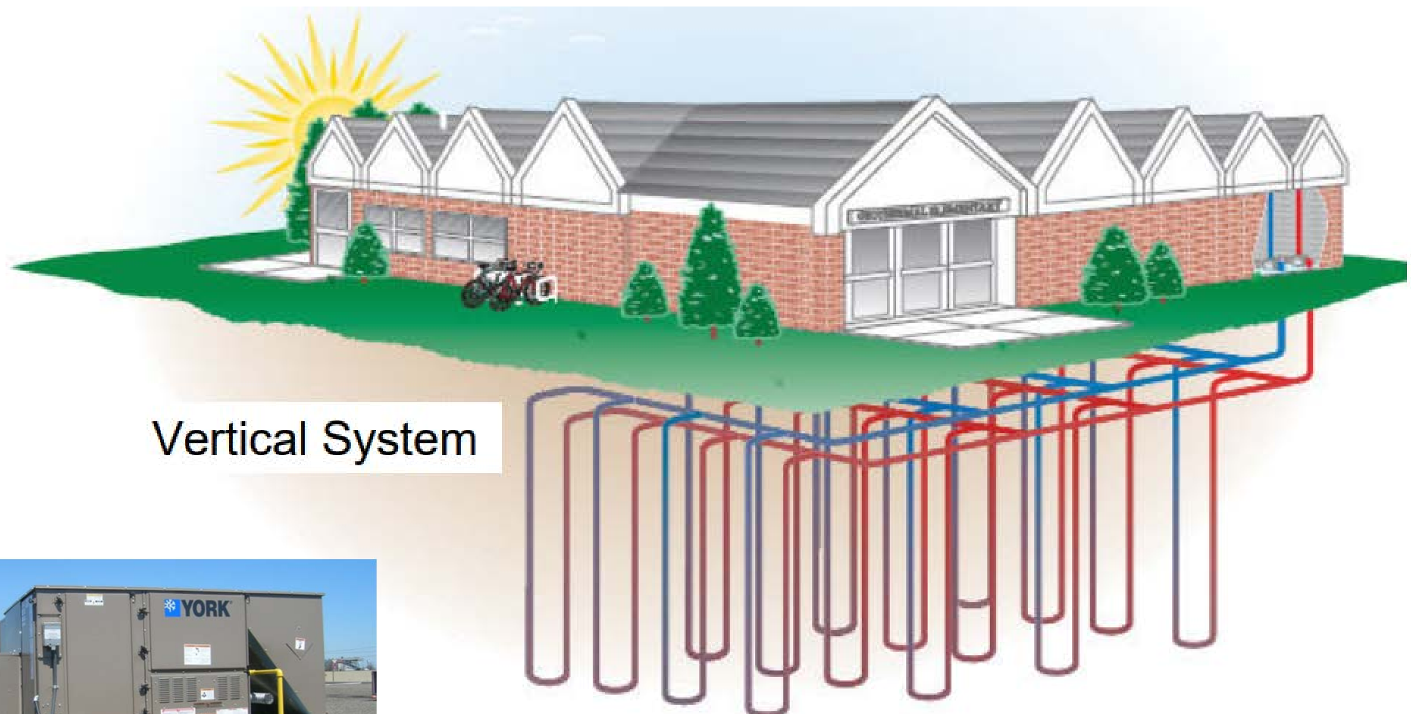
Energy Consumed Per Square Foot Per Year - Typical Library: 71 site / 143 source



HVAC Options

Option 2 – Water Source Heat Pump Rooftop Air Handling Units
VAV terminal units for zoning

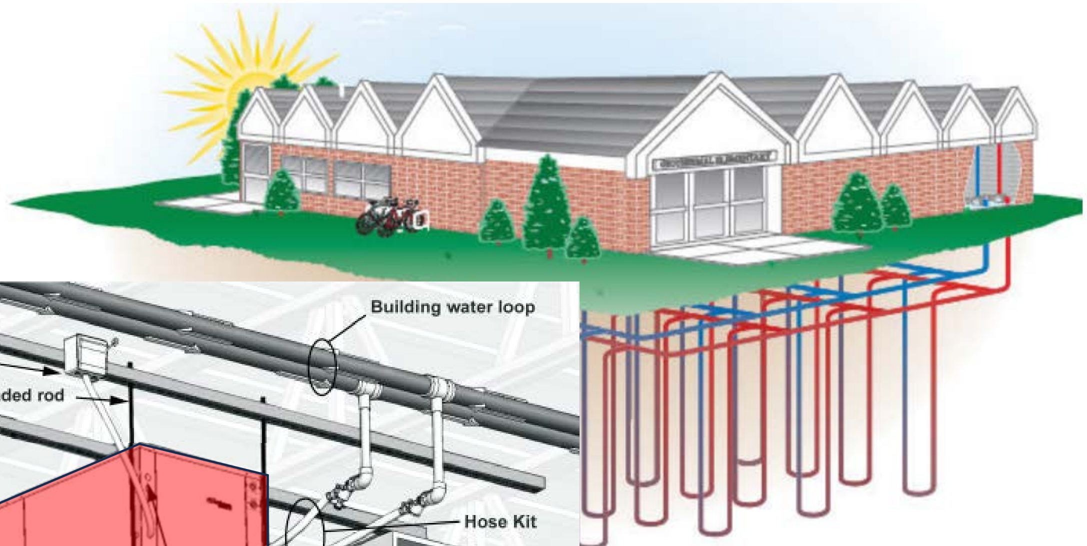
EUI 39.5 total site energy / EUI 118.6 total source energy

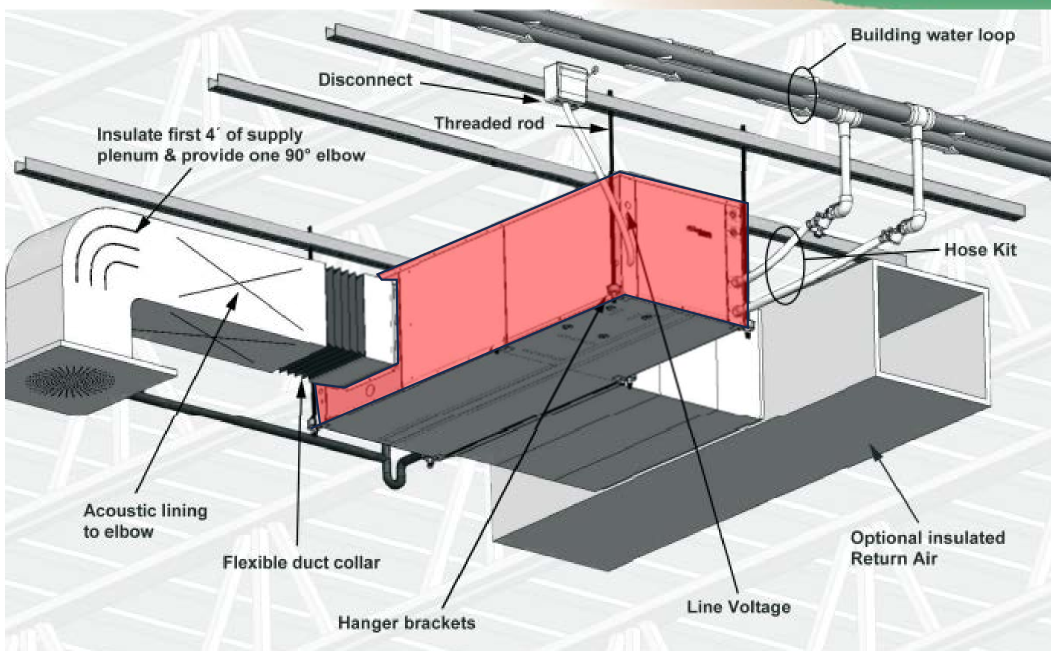


HVAC Options

Option 3 – Distributed Water Source Heat Pump Units and DOAS

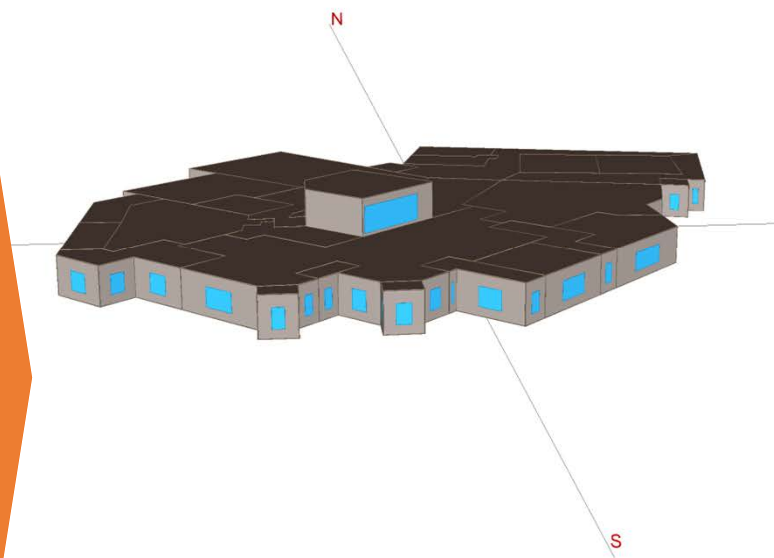
EUI 24.2 total site energy / EUI 72.7 total source energy

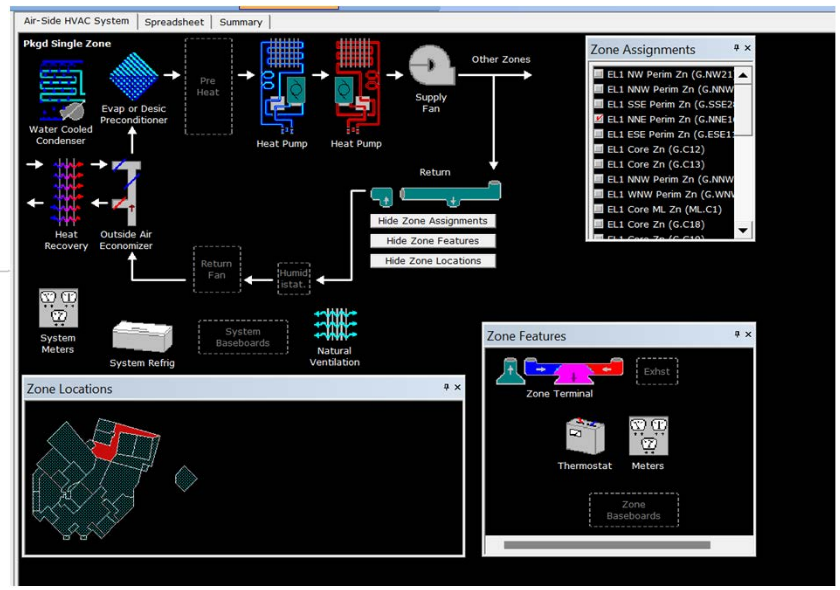




Energy Model

HVAC Options Pros & Cons





		Electricity			Natural Gas			TOTAL	
		MBTU	KWH	Cost	MBTU	THERM	Cost	Energy (MBTU)	Cost
Option 1	Gas-fired, VAV zoned RTU's	1,069.70	313,422.00	$ 59,550.18	2,127.10	21,271.00	$ 22,547.26	3,196.80	$ 82,097.44
Option 2	VAV zoned heat pump RTU's	1,909.00	559,329.00	$ 106,272.51	---	---	---	1,909.00	$ 106,272.51
Option 3	Distributed heat pumps	1,232.90	361,253.00	$ 68,638.07	---	---	---	1,232.90	$ 68,638.07

Cost Comparison

HVAC Options Pros & Cons

	Construction Estimate	National Grid Rebate (estimate)	IRA Incentives (40%)	Net Investment	Annual Energy Cost
Option 1 Gas-fired, VAV zoned RTU's	$ 4,019,930	$ -	$ -	$ 4,019,930	$ 82,097
Option 3 Distributed heat pumps	$ 7,364,423	$ 150,000	$ 2,945,769	$ 4,268,654	$ 68,638
			Difference	$ 248,724	$ 13,459

NEW YORK STATE OF OPPORTUNITY. NYS Clean Heat Program

Federal **Tax Incentives**

For Commercial Geothermal Heat Pumps

BENEFITS OF TAX INCENTIVES:

Up to 30% credit on system cost

Up to 10% credit for domestic content

Up to 10% credit for energy communities

Up to $5 per square foot tax deduction

5-year accelerated depreciation and a **1-year** bonus depreciation

HVAC Options Pros & Cons

Option 1 – Roof Top Units

Pros

- Lower Upfront Cost
- Less Equipment to maintain

Cons

- Less Efficient Than Geothermal
- No Reduction in Greenhouse Gases

Option 3 – Geothermal with Distributed Heat Pumps

Pros

- Increased Energy Efficiency
- Eco-friendly
- Less Rooftop Equipment

Cons

- Higher Upfront Cost
- More Equipment to Maintain

Advantages of a Geothermal System

Why choose Geothermal Option?

Cost – When considering refundable tax credits from the Federal government and a rebate from National Grid, the cost of a geothermal option becomes comparable to that proposed for the "standard" HVAC option, utilizing similar rooftop units as the existing library. The net cost difference between the two options is roughly 5%, which is negligible given the project's early design stages and the long-term sustainability benefits of geothermal energy. It's important to note that the Library must initially cover the cost of the geothermal option, with the Federal refundable tax credit and utility rebate becoming accessible only after the completion of construction.

Energy Efficiency - The energy efficiency will be greater for geothermal than the standard HVAC option resulting in an annual energy savings of over $13,000 per year.

Carbon Footprint Reduction – No fossil fuels will be utilized on site. A geothermal heat pump option would be the most efficient system for heating and cooling the building using an all-electric energy source.

Energy Source Long Term Reliability – Although natural gas is presently a cheaper fuel source than electricity, that is unlikely be the case in the years ahead. Both federal and state governments have developed climate legislation to drastically reduce reliance on fossil fuels for energy consumption. This is projected to increase both the future cost and availability of natural gas for heating buildings in New York State. Switching to an all-electric HVAC option will align with NYS and *Federal energy and climate goals, plus associated energy and building code development.

Noise - The proposed geothermal option will provide heat pumps above the ceiling inside the building. Neighbors' concerns about noise from present roof top HVAC equipment will be alleviated. The heat pumps themselves would include acoustic insulation and be designed to operate at low fan speeds to ensure quite operation in a library setting.

Maintenance - Water source heat pumps have been used in buildings in the US for over 50 years. There are many contractors in the capital region who are able to reliably service and maintain them. The units would be readily accessible above ceilings or in mechanical spaces. If service or repairs were required in public areas, that work could be performed early in the morning before the library opens, when service companies prefer to start their day.

Consideration for alternative, all-electric options

The use of air-source heat pumps was considered. This option would be similar to the standard HVAC option except the gas-fired units would be replaced with air-source heat pump roof top units. The efficiency of this system is less than half that of a geothermal system and there are no federal incentives with this option. A geothermal option, after federal and local utility rebates are included, will be less expensive to construct and more energy efficient than an air-source heat pump option. For this reason, an all-electric, non-geothermal option is not recommended.

A** November 2023 report from the US Department of Energy focused on the impact of Geothermal Heat Pumps (GHP) on the US energy system and concluded, "…the mass deployment of GHPs can electrify the building sector without overburdening the US electric power system." Link to the full text here: ***U.S. Department of Energy Analysis Highlights Geothermal Heat Pumps as a Pathway to a Decarbonized Energy Future | Department of Energy

V.E. Items Comparison:

V.E. #1	V.E. #2	V.E. #3	V.E. #4	V.E. #5	V.E. #6	V.E. #7
Adjustment of CD and CA design fee to reflect $30M project cost.	Conduct construction as one construction phase. Will require renting a temporary space.	Reduction in escalation from eliminating phasing.	Eliminate or reduce sky lights and eliminate rated interior glazing at community rooms.	Eliminate terrazzo flooring & base from: V.E. #5-a: Full addition **-$628,450.00** V.E. #5-b: Community RMs	MEP/FP: reuse some existing piping and ductwork. If selection of HVAC is Option #1 or Option #2.	Remove blue VAT from Haz-mat estimate.
-$150,000.00	**-$983,891.00**	**-$185,491.00**	**-$200,000.00**	**-$318,700.00**	**-$150,000.00**	**-$15,308.00**

NO to LOW IMPACT on Design/Program

V.E. #8	V.E. #9	V.E. #10	V.E. #11	V.E. #12
Change roof design from modified butterfly to flat roof.	Reuse existing stacks.	Switch from motorized movable drop-down partitions to the manual side type.	Reduce Community Room heights.	Site Removals.
-$125,000.00	**-$225,000.00**	**-$731,250.00**	**-$100,000.00**	**-$107,087.00**

MEDIUM IMPACT on Design/Program

V.E. #13	V.E. #14
Eliminate Structural Bracing and Related Work.	Eliminate Pavilion.
-$185,000.00	**-$160,000.00**

BIG IMPACT on Design/Program

Design Options Comparison:

D.O. #1	D.O. #2	D.O. #3	D.O. #4
The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library.	The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room to the east side. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.	The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one), and limiting the circulation, which it's replaced with two entry-squares; facilitating the access from the parking. Simultaneously, the Staff area switch positions with the Children's & Teen's Library, consolidating only one staff area in the West, with the Pick-up Loop adjacent to it; and situating the Pavilion in front of the Children's & Teen's Library.	The overall area is reduced by constraining the community rooms (400 SF less for the big one and 200 SF less for the small one) and moving the smaller community room adjacent to the Children's & Teen's Library. Complementary, an entry-square in the North accentuates the access and the pick-up loop is set independently from the parking.
-$1,108,228.00	**-$854,660.00**	**-$1,777,240.00**	**-$846,170.00**

BIG IMPACT on Design/Program

Schematic Design – Northeast Elevation

View from Borthwick Avenue at East Entry

Open Discussion……

Thank you.

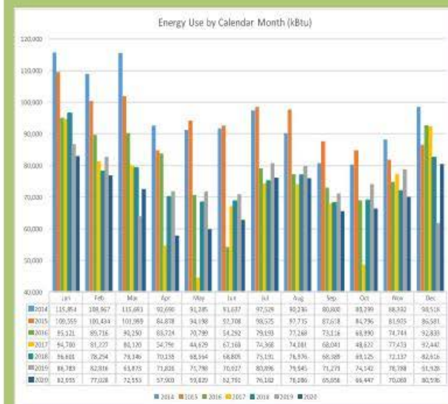
We had completed extensive energy efficiency improvements to the library and needed to replace an old, inefficient, oil-powered HVAC system. The town had appropriated funds to replace the library's boiler and cooling tower and to design and install a new heat pump system.

The engineers provided options for the replacement system, including installing a newer version of the oil-fired system and changing to a geothermal system. The rate of return (ROI) analysis performed by the engineering firm indicated that a geothermal HVAC system design for the library would have the most favorable ROI (12 years) and be the least invasive to the building.

The project was funded through the combined financial support of the Governor and Executive Council's award of a NH Public Utilities Commission Renewable Energy Fund grant and an Energy Efficiency Services Rebate from Eversource Energy, in combination with Town funds. This funding combination made it possible to install a state of the art closed loop geothermal thermal system at the Library.

A touch screen monitor highlighting the project is on view for the public to learn about our geothermal system.

Project cost:	$880,000
NH Public Utilities Commission Renewable Energy Fund grant:	$387,842
Eversource Energy Efficiency Services rebate:	$50,000



Timeline:

- ⇒ 2013: Facilities Study identified HVAC in need of replacement
- ⇒ 7/2014: Engineering Study completed
- ⇒ 9/2014: REF Grant submitted
- ⇒ 6/2015: Executive Council approved grant
- ⇒ 9/2015: Test pits dug
- ⇒ 10/2015: RFQ issued
- ⇒ 12/2015: Town Council approved additional funds & awarded contract
- ⇒ 2/2016: Surveying and tree cutting completed
- ⇒ 3/2016: Well drilling began
- ⇒ 4/2016: Ductwork cleaned
- ⇒ 5/2016: Borings covered and trench connecting to building completed
- ⇒ 5/2016: Lower level units replaced
- ⇒ 6/2016: Upper level units replaced
- ⇒ 6/2016: Lower level units operational
- ⇒ 8/2016: Upper level units operational

Revised 03/2021

Geothermal Heating & Cooling

This Library uses geothermal heat pumps to cool and heat the building.

Bedford Public Library
3 Meetinghouse Road
Bedford, NH 03110
Phone: (603) 472-2300
www.bedfordnhlibrary.org

What is geothermal heating and cooling?

- The geothermal system uses the stored energy of the earth for heating and cooling inside the building.
- Below 4 to 6 feet, the earth maintains a relative constant temperature year round, this is used to heat the water in the winter, and cool it during the summer.
- A typical geothermal system will consist of indoor heat pumps, a system of buried pipes and vertical bore holes.

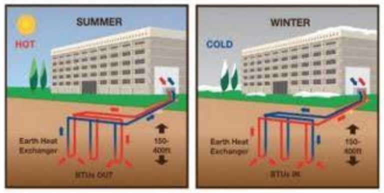


Fig.1: Overview of geothermal system operation in summer and winter.

What are the benefits of a geothermal system?

- The system has less mechanical components compared to a conventional system, which typically means less maintenance.
- It lowers peak electrical load on the electric system, freeing up power on the grid to be used for other purposes.
- The system does not use combustion for heating, thus it doesn't create any greenhouse gases in its operation.
- Compared to a hot water boiler, geothermal systems are much more efficient. The best boilers can get 95% efficiency. This means for 1 unit of energy that is input into the boiler, we can convert it to 0.95 units of energy for heating. With geothermal, we can get 400% efficiency, meaning for 1 unit of energy we input (the electricity needed to run the system) we can transfer 4 units of energy for heating.

History of Geothermal Heating and Cooling

- In 1904 the Italian scientist Piero Ginori Conti invented the first geothermal electric power plant, which used steam to generate power.
- In 1946 the first geothermal heat pump was installed at the Commonwealth Building in Portland, Oregon.
- In 1960 Pacific Gas & Electric opened the first large scale geothermal power plant (11 MW) near San Francisco, California.
- After the 1973 oil crisis, renewable energy sources gained a new importance and by the 1980's geothermal heat pumps had increased in popularity.
- In 2012 US geothermal energy produced 17 million MWh of electricity, almost enough to power the state of New Hampshire.

Previous HVAC system at the Bedford Public Library

- Water sourced heat pumps (WSHP) located throughout building.
- Heating provided by oil fired hot water boiler.
- Cooling provided by water cooling tower.

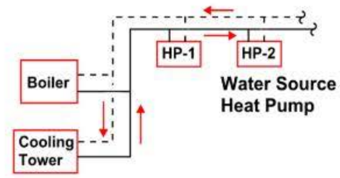


Fig.2: Simple diagram of previous HVAC system.

New HVAC system at the Bedford Public Library

- The existing cooling tower, boiler and heat pumps have been removed.
- 20 bore holes were drilled to a depth of 500 feet beneath the existing field adjacent to the parking lot.
- New geothermal water source heat pumps were installed.
- Emergency back-up heat will be provided by an oil fired hot water boiler should the geothermal system encounter a problem.

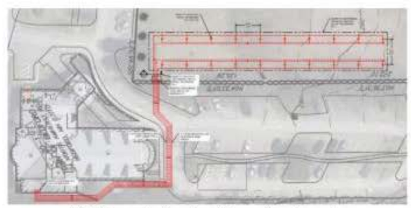


Fig.3: Layout of water piping going to wells.

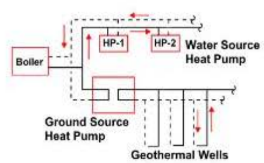


Fig.4: Simple diagram of the new HVAC system. The ground source heat pump (GSHP) separates the water loop of the water source heat pumps and the geothermal wells. In the GSHP, heat is transferred between the two loops.

How does a water source heat pump work?

- All heat pumps use the basic refrigeration cycle, which consists of 4 major components: the compressor, condenser, expansion valve and evaporator.
- In this cycle, a special liquid, called the refrigerant, changes phases from liquid to gas and vice versa.
- When the refrigerant changes from liquid to gas, it takes in heat, meaning it provides cooling. This occurs in the evaporator.
- When the refrigerant changes from gas to liquid, it gives out heat, meaning it provides heating. This occurs in the condenser.
- The main idea behind the heat pump is that it can switch between being an evaporator and being a condenser.
- For the heat pump to work properly it has to release heat energy in the summer and absorb heat energy in the winter. This is where the water comes into play.
- The water in a water source heat pump will absorb or release the heat energy, depending on the mode of operation.

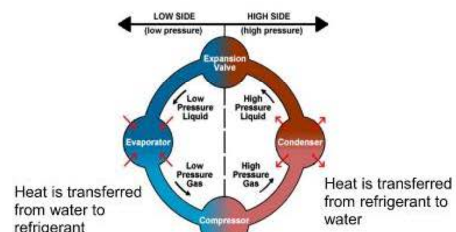


Fig.5: Simple diagram of the refrigeration cycle. This is what would be inside HP-1,2 as seen on Fig. 4 and 2. When in cooling mode, water would be receiving heat from the condenser, and when in heating mode, water would be releasing heat from the evaporator.

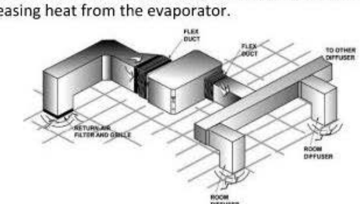


Fig.6: How an installed water source heat pump with supply & return ductwork may look.

CSI ENGINEERING