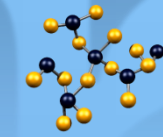




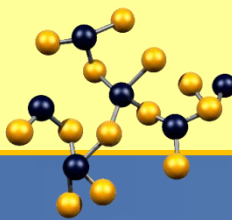
JSN



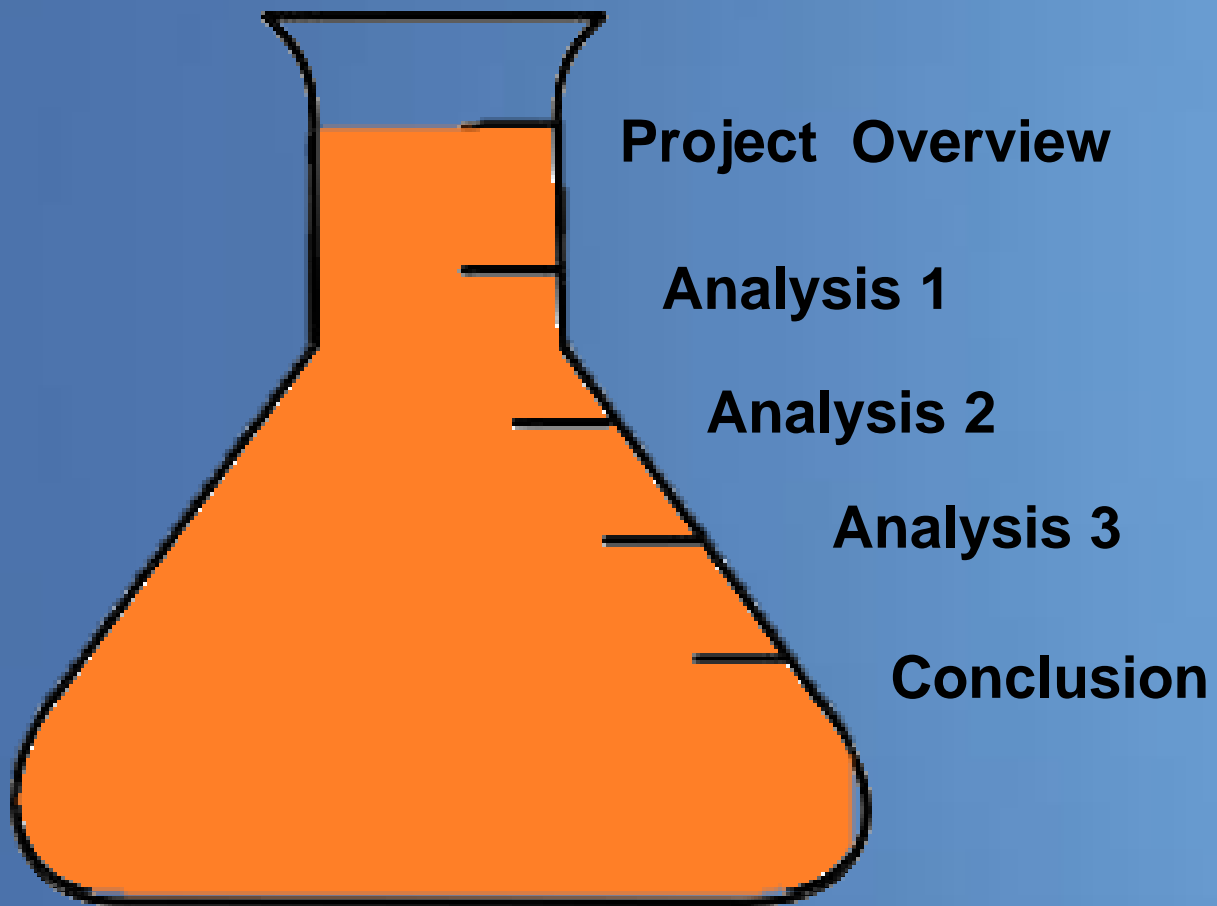
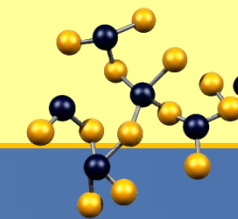
The Joint School of Nanoscience and Nanoengineering

Greensboro, NC

Aubrey L. Fulton | Construction Management

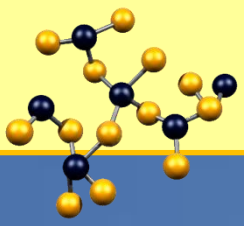


project overview

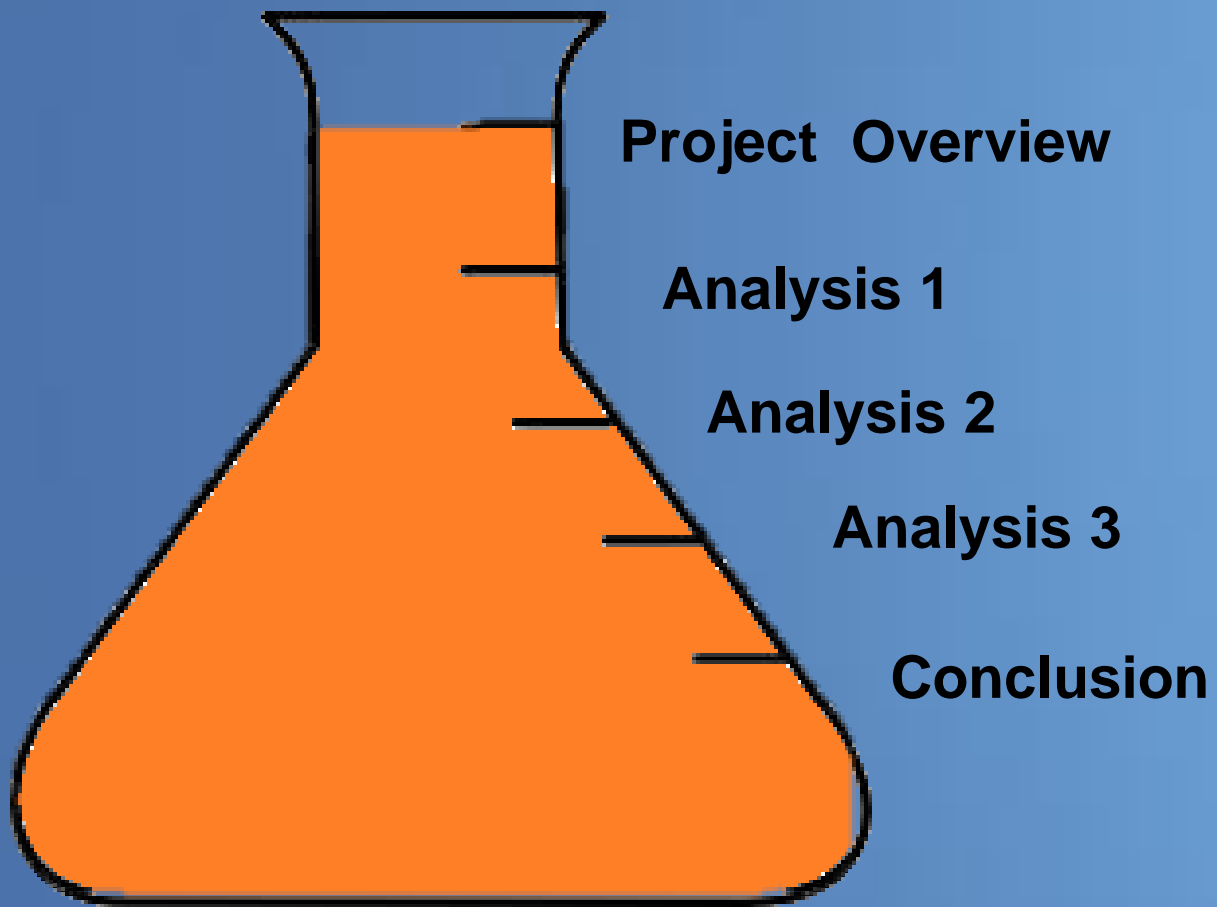
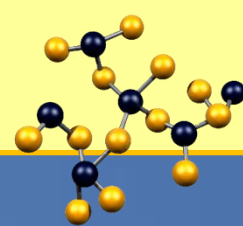


Size 92,337 Gross SF
 Location Greensboro, NC
 Project Cost \$54 Million
 Contract Type GMP and CM at Risk
 Schedule Mar 09 – Dec 11

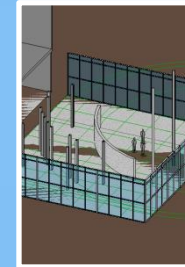




analysis overview



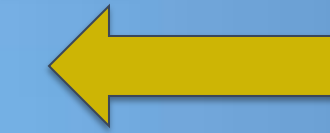
Analysis I – Aquatherm



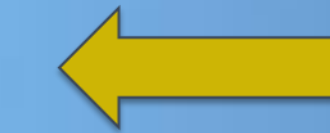
Analysis II – Material Storage Warehouse



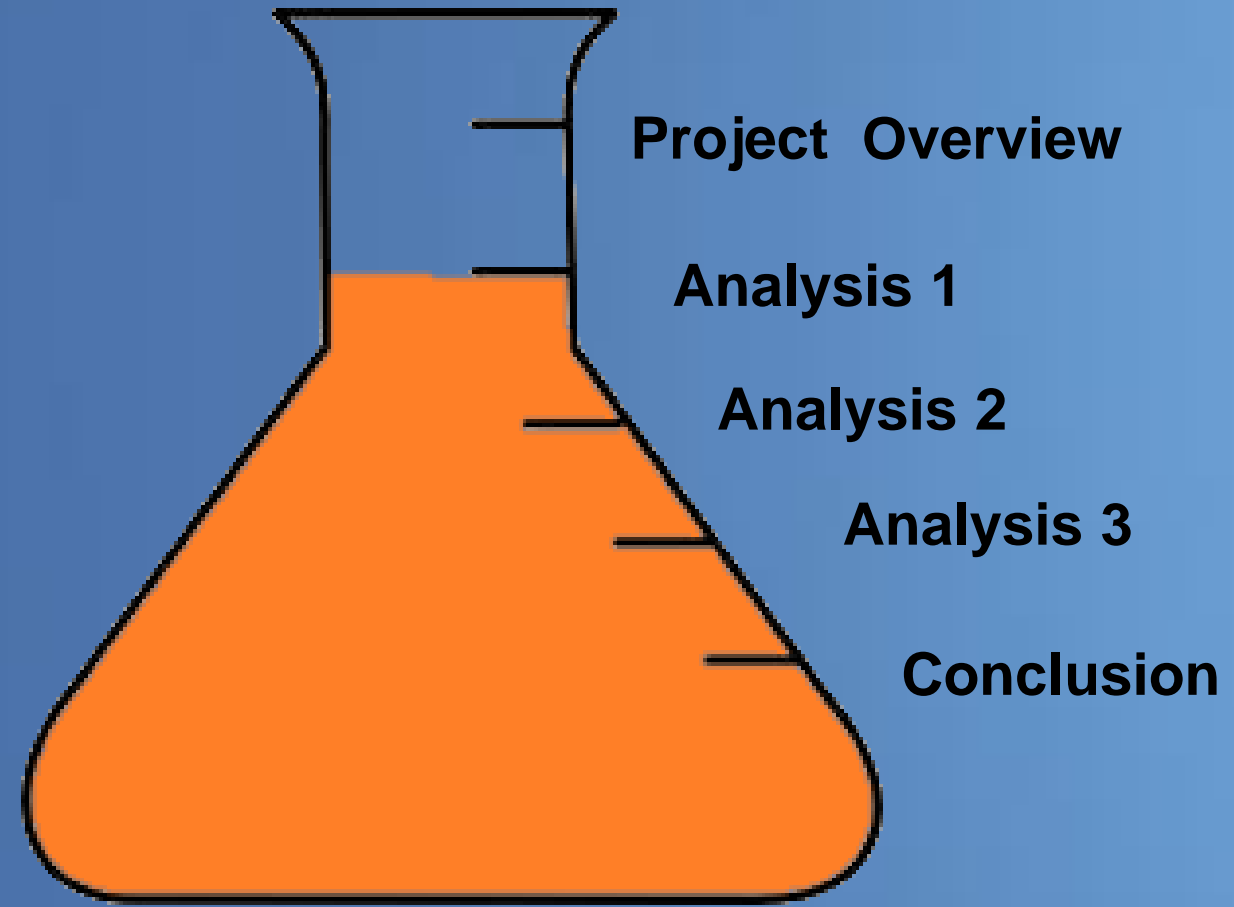
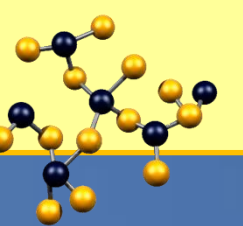
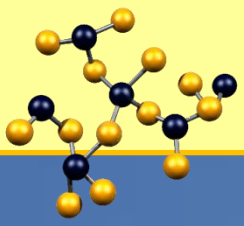
Analysis III – Wetland Preservation

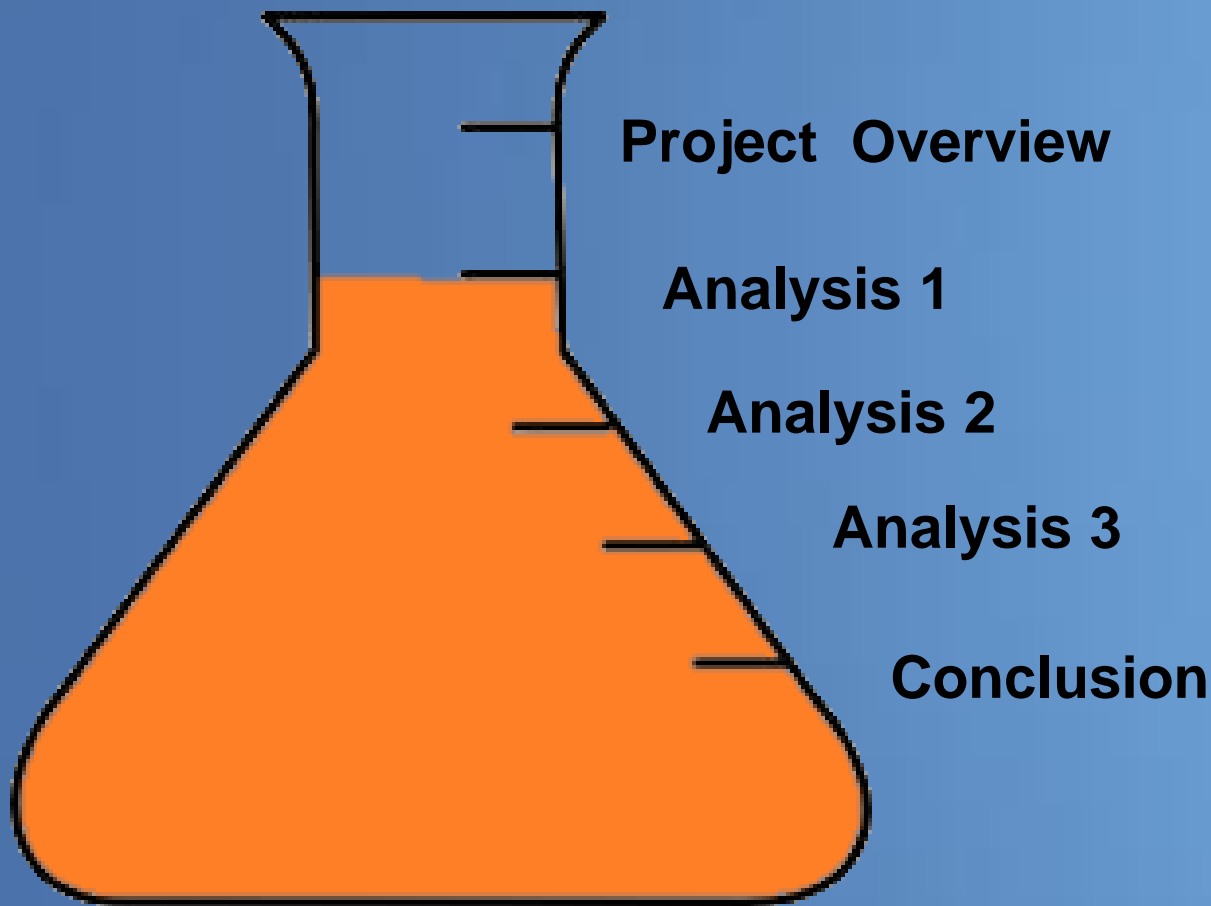
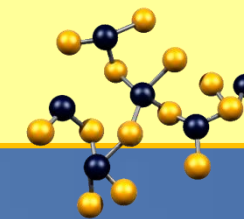
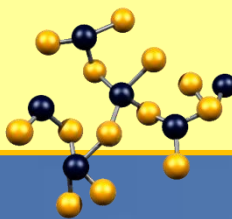


Mechanical Breadth
Pump Power- Output Reduction

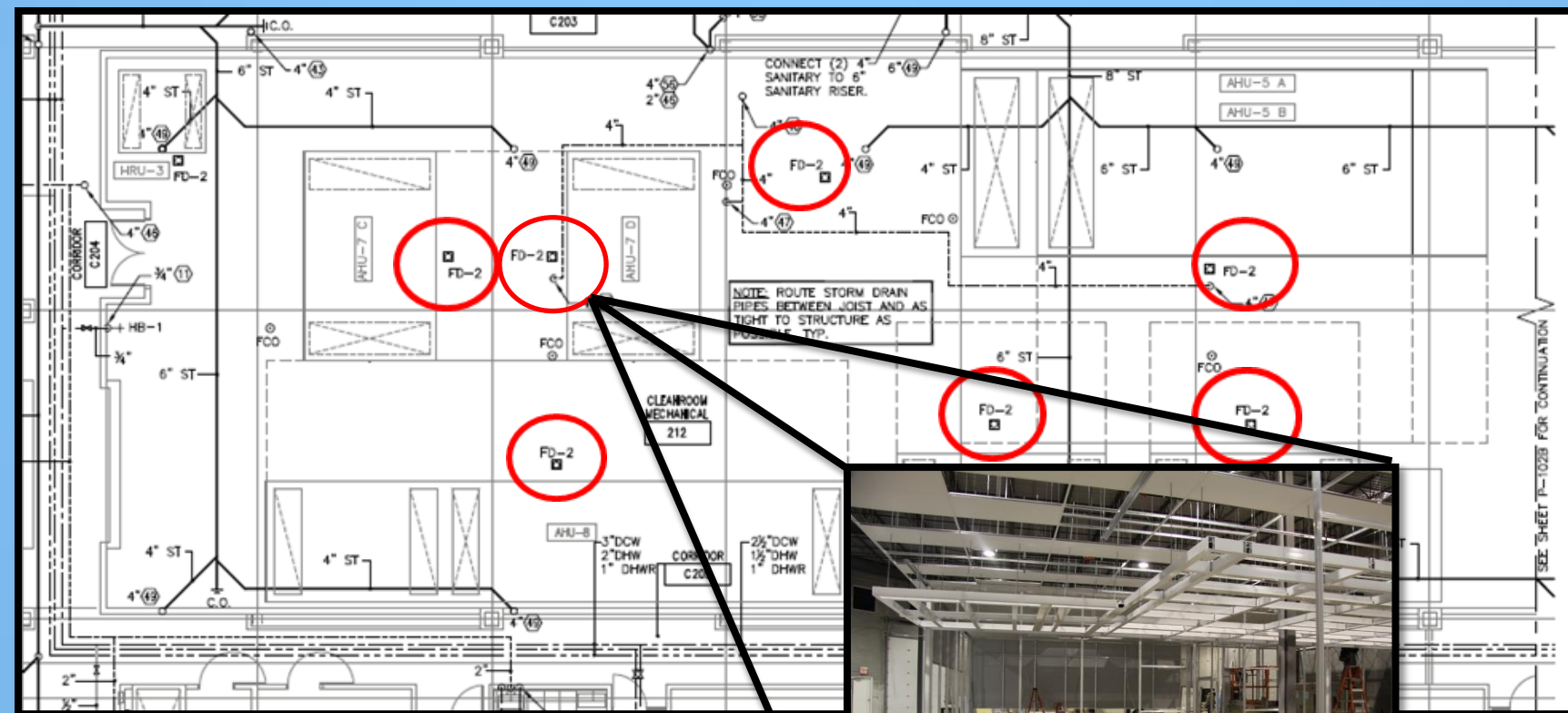


Structural Breadth
Slab on Grade Redesign





Background Info:

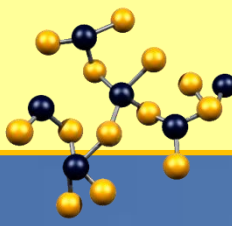


Armor Flex



Fiberglass Insulation

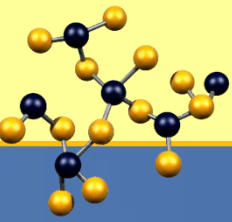




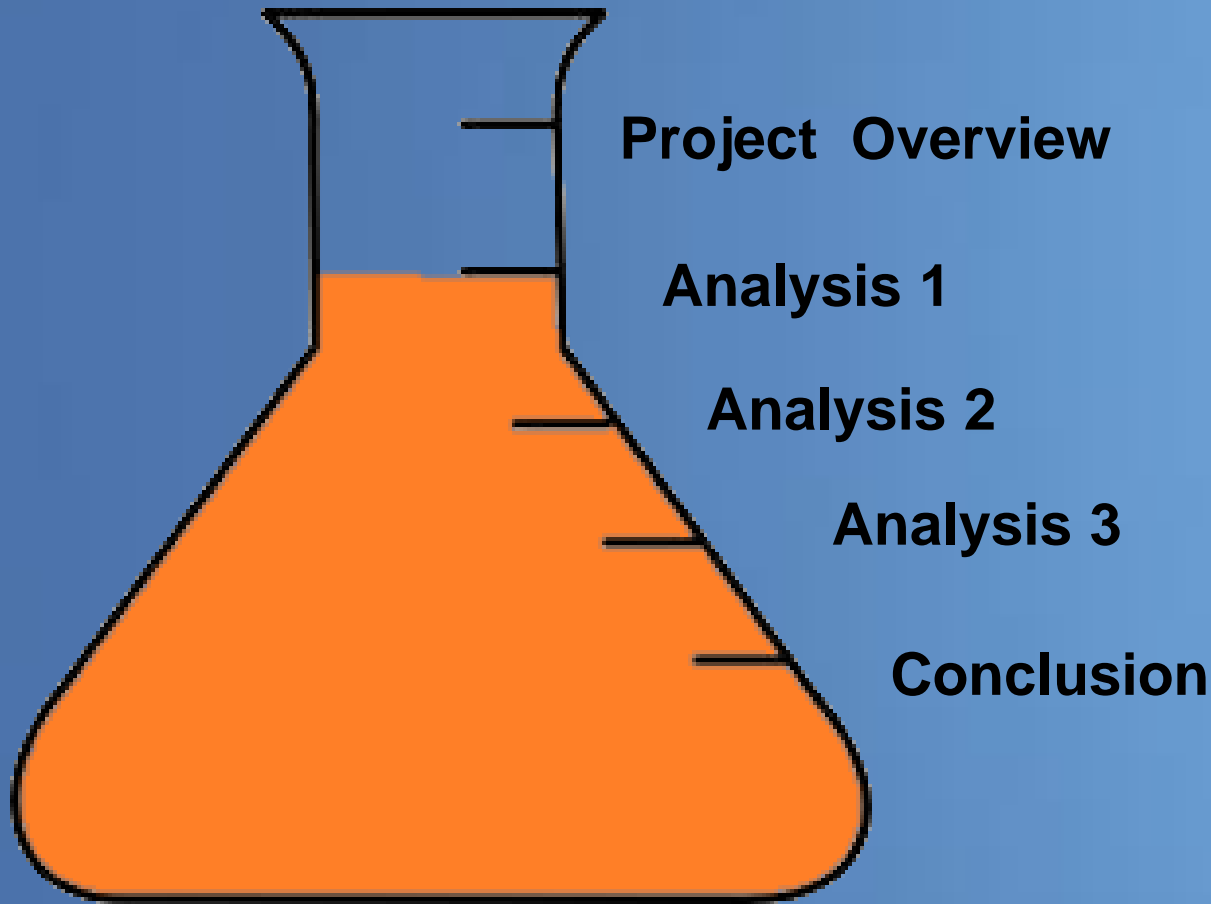
aquatherm

< analysis i >

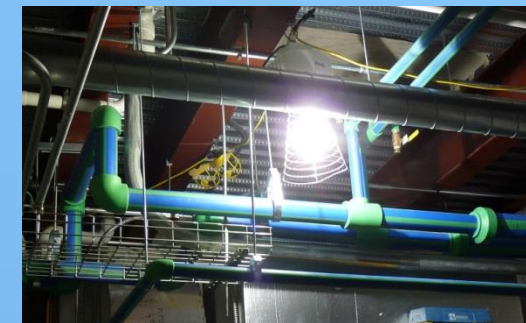
aubrey fulton | construction management



aquatherm



VS.

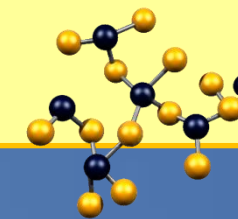
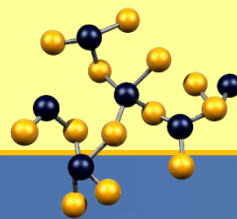


VS.



LONGEVITY

	AQUATHERM GREEN PIPE Aquatherm Green Pipe is our signature PP-R product and is used in potable, food-grade, residential sprinkler, and chlorinated water applications.		AQUATHERM BLUE PIPE Aquatherm Blue Pipe is the best choice for high-performance pressure piping systems in a wide range of non-potable applications.
	AQUATHERM LILAC PIPE Aquatherm Lilac Pipe is specially formulated for water conservation systems that use water from reclaimed, recycled and rain sources.		AQUATHERM BLACK SYSTEM Aquatherm Black System delivers radiant heating and cooling using water, which is more efficient, comfortable, and healthy compared to forced-air.
	AQUATHERM RED PIPE Aquatherm Red Pipe is specialized for fire sprinkler systems with integrated flame resistance.		

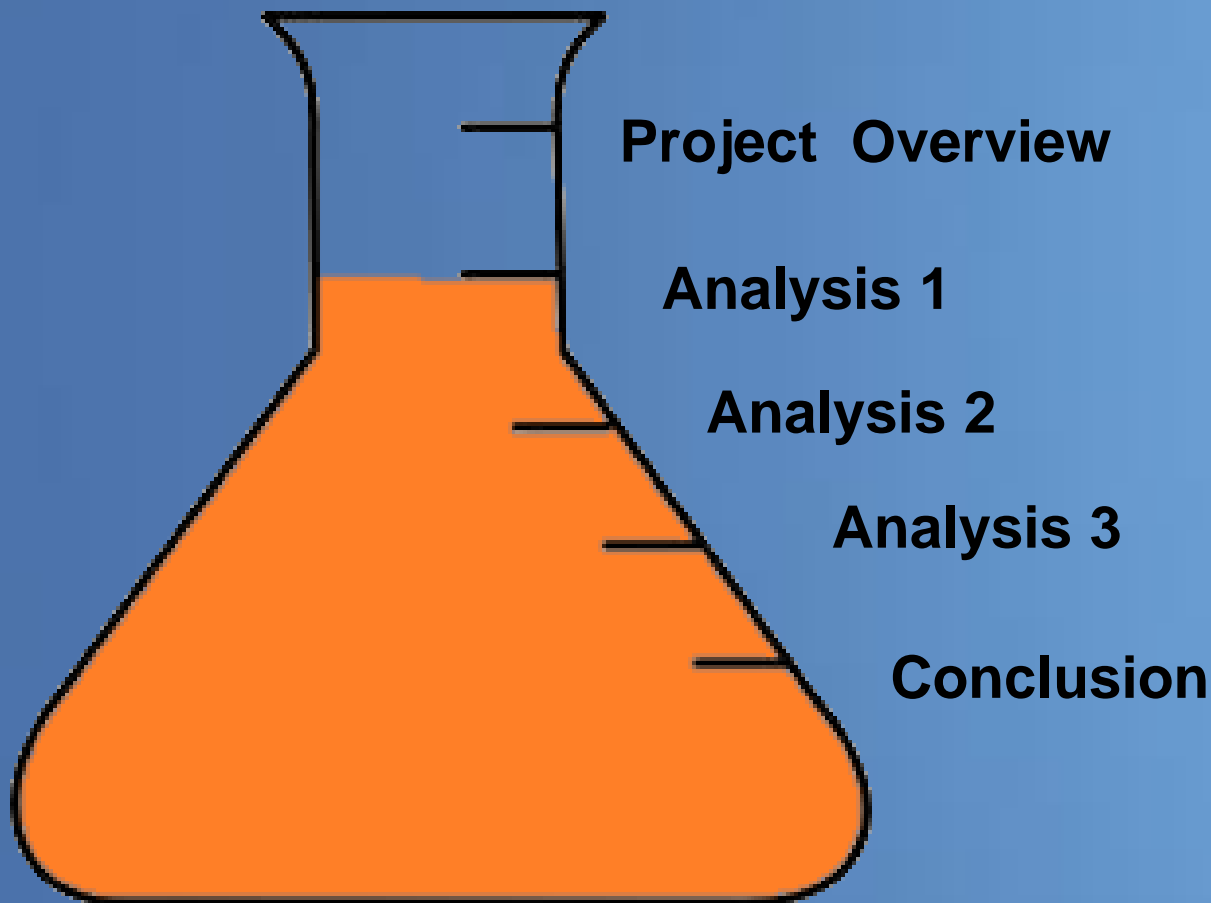


Cost Comparison:

Trade Specific Issue	Aquatherm Cost**	Type L Copper **
Material	\$50,613.11	\$ 55.390.63
Equipment	\$683.16	\$ 727.75
Insulation	\$0	\$ 1.411.08

**Cost derived for 2,797 LF of DCW piping

Condition	Thermal Insulation Required (Commercial)	Thermal Insulation Required (Residential)
Domestic Cold Water	No	No
Domestic Hot Water and Recirculated Hot Water	Yes	No
Heating Hot Water and Hot Water Return	Yes	Yes
Chilled Water, Above Grade	Yes	Yes
Chilled Water, Below Grade	No	No

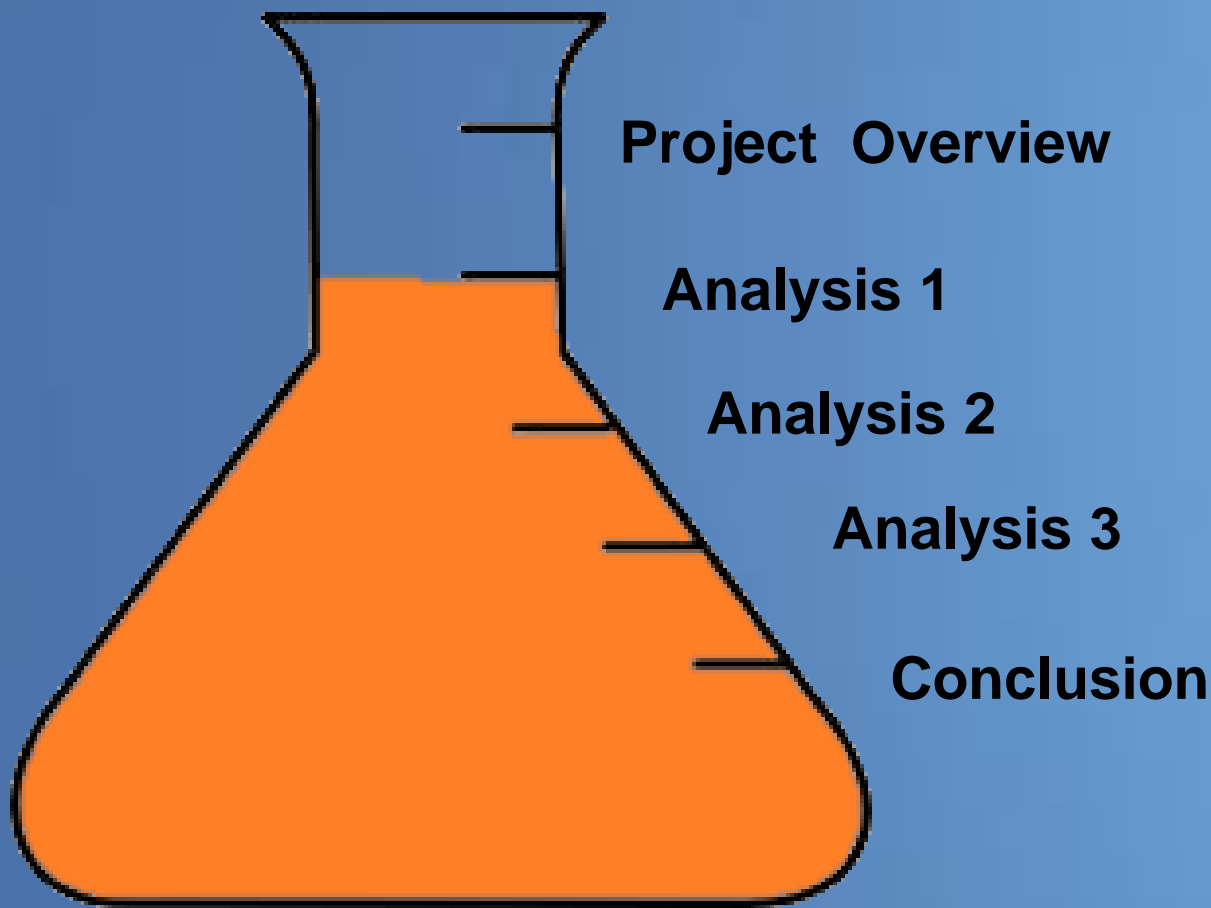
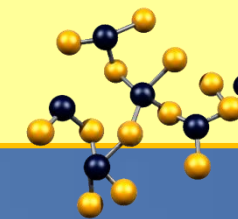
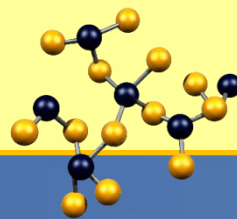


Gas Tank
 Pipe Stand
 Tube cutter
 Welding Rig
 Plumbers Dope
 Flux

Type L Copper Equipment List

Pipe Cutter
 Climasystem Welding Tool
 1" Welding Head

Aquatherm Equipment List



Mechanical Breadth:

Pressure Loss

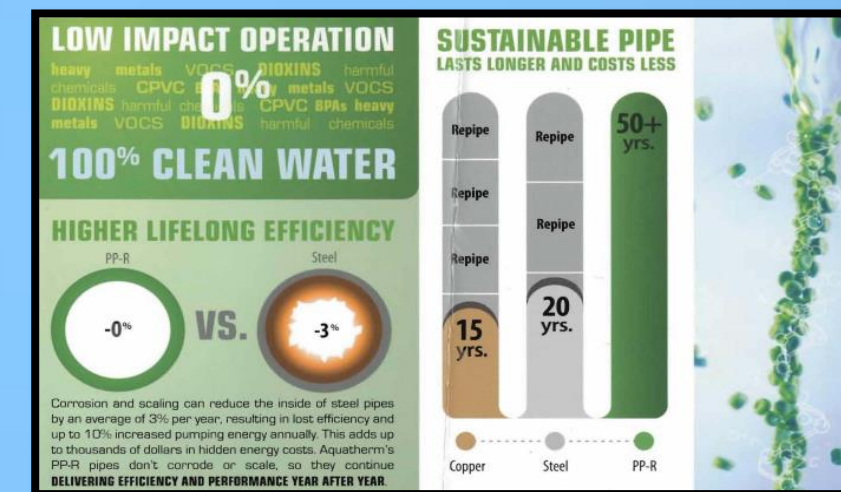
$$P_L = \frac{452}{d_i^{4.87}} \left(\frac{a}{c}\right)^{1.85}$$

Head Loss

$$H_L = 2.31P_L$$

Affinity Laws

$$\frac{H_n}{H_o} = \left(\frac{\dot{W}_n}{\dot{W}_o}\right)^{\frac{2}{3}}$$



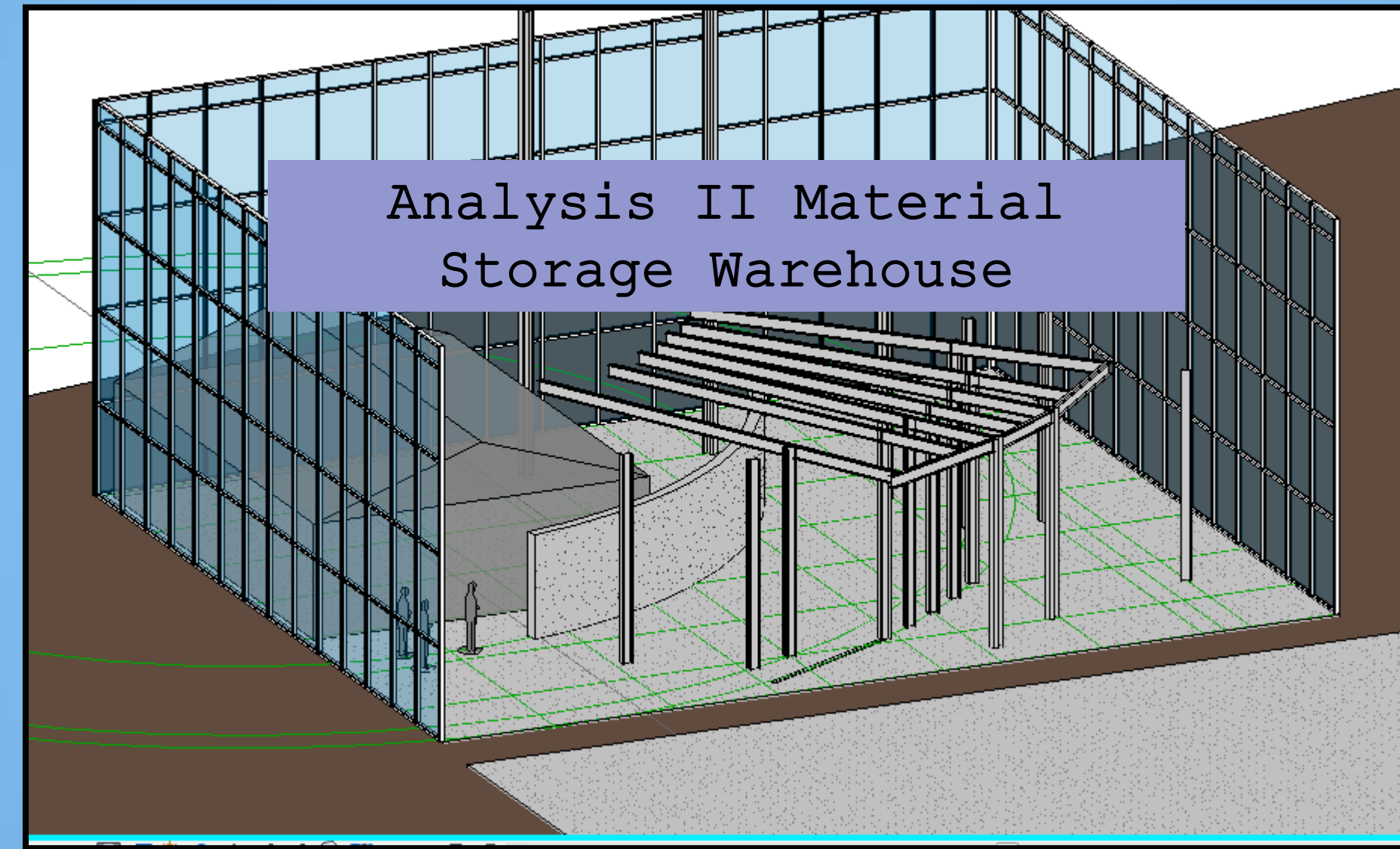
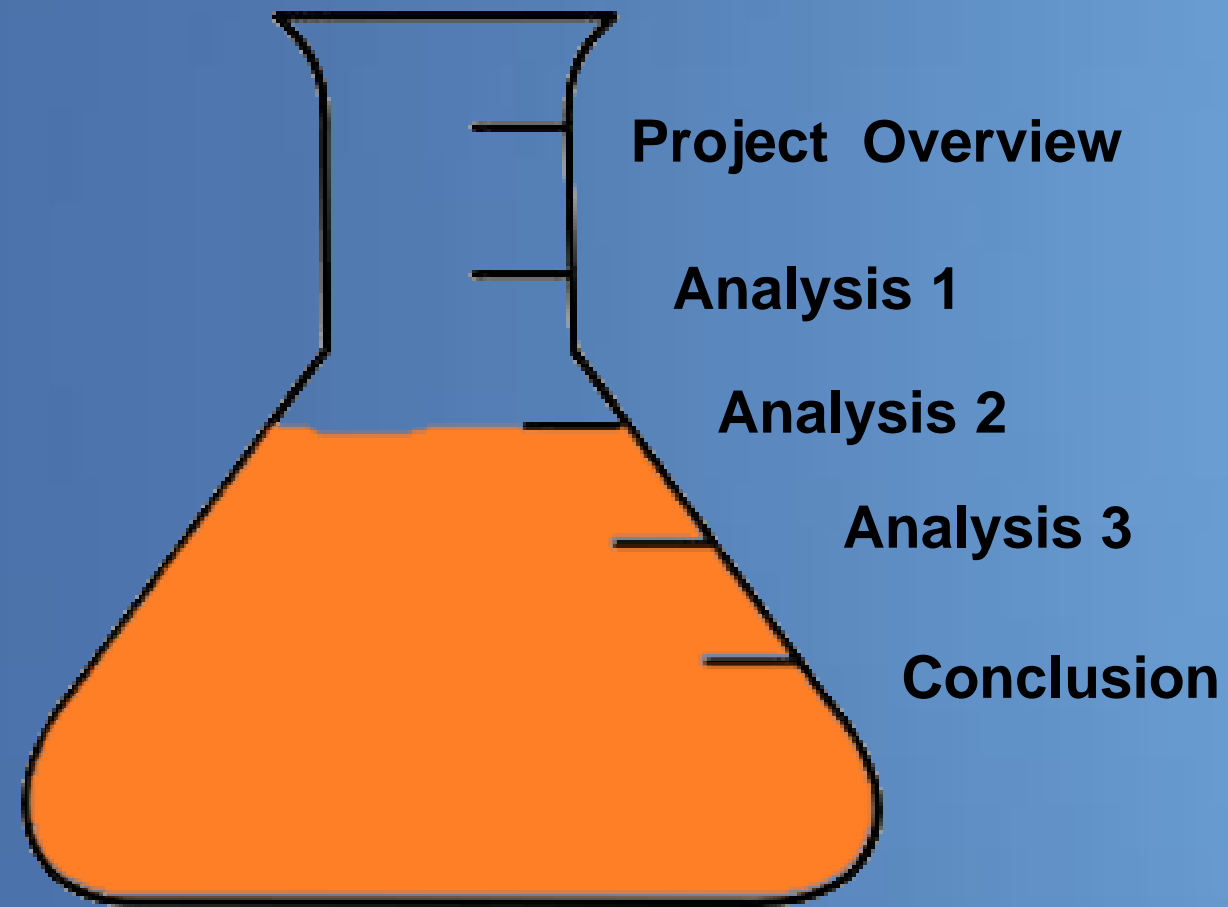
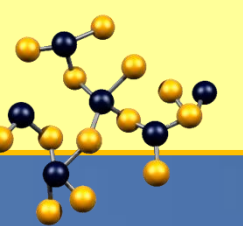
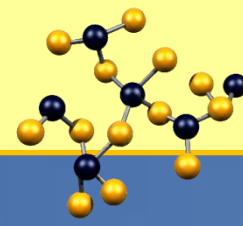
22% Power Reduction on Pump

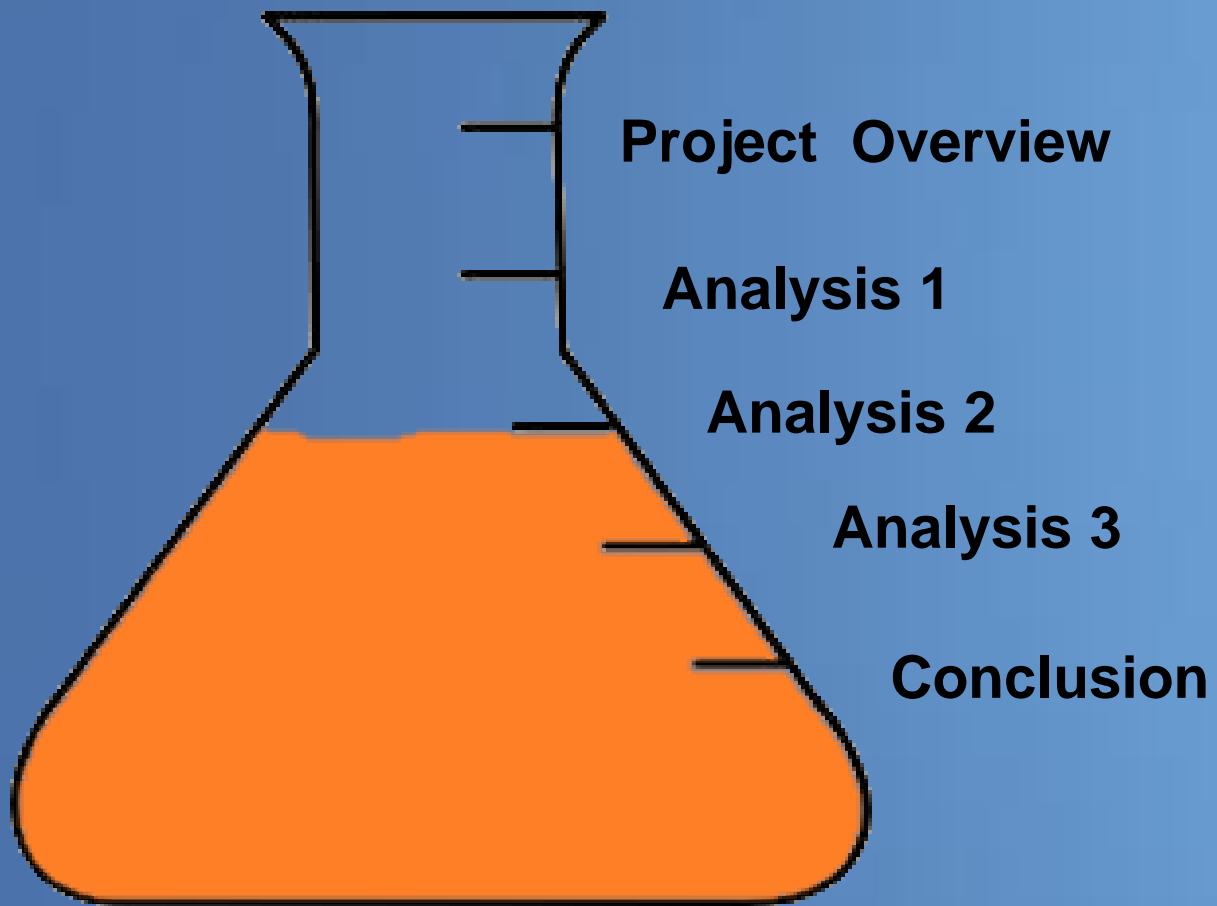
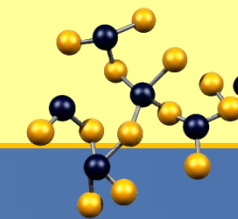
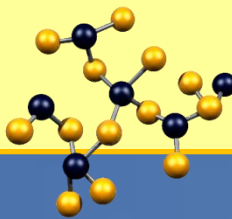


Recommendation:

- ❖ Overall Construction cost reduced through Aquatherm
 - Approximately \$7,000.00 per 3,000 LF of Type L Copper Pipe
- ❖ Longevity of system increase through chemical make-up of system
- ❖ First time use of Aquatherm is recommended for DCW, DHW

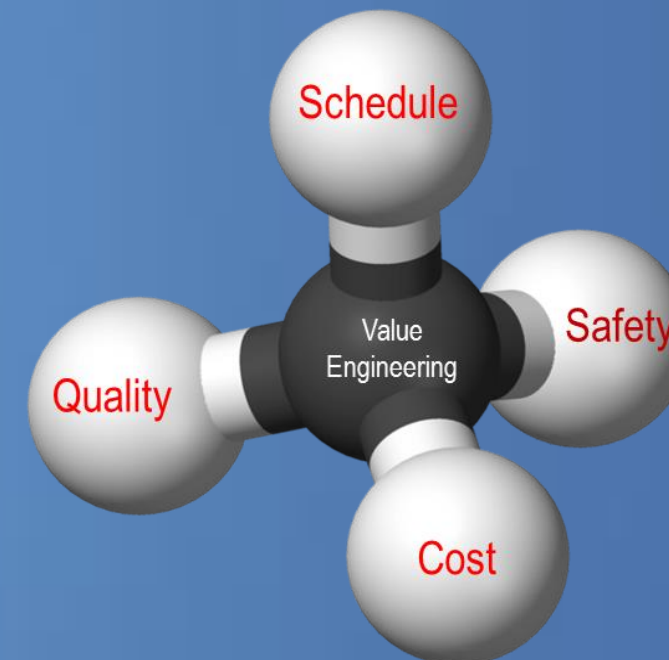


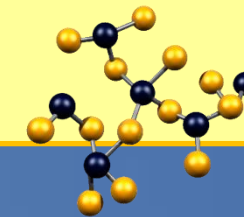
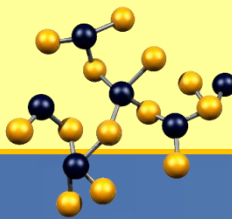




Clean Room Construction

- ❖ Levels of Protocol
- ❖ Reduce amount of debris in room
- ❖ Lead time coordination for installation of equipment





Material Storage Warehouse

- ❖ On-Site Prefabrication
- ❖ Storage facility for lab equipment



Proposed Structure Options:

Option 1: Standard 33' x 33' x 10' (10 m x 10 m) - 252 w/ 300 mm profile 10' height with a 24' Peak height Fabric Personnel Door Fabric Side Doors Fabric Schematics	\$ 5,000.00 \$ 12,800.00 \$ 17,800.00
Option 2: Fully Equipped & 10' height 33' x 33' x 10' (10 m x 10 m) - 300 mm profile structure 10' height with a 24' Peak height 1 - Metal Personnel Door 2 - 400 Watt Shop Lights 1 - Roll-Up Metal Door (14' x 14') 6 - Office Chooch Fans 8 - Bays of hand sides with two walls for office space	\$ 8,000.00 \$ 23,300.00 \$ 31,300.00

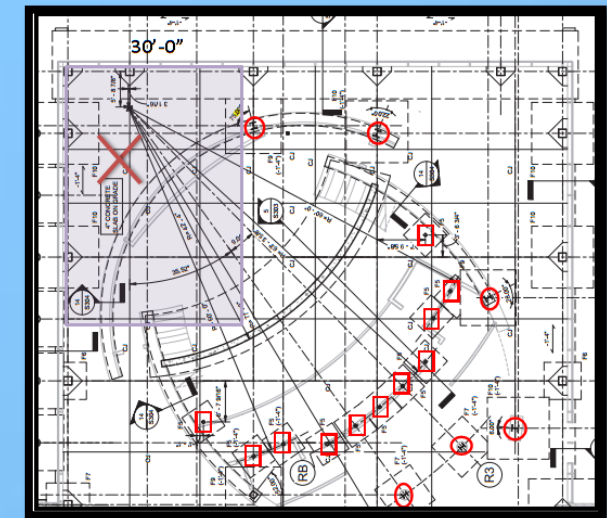
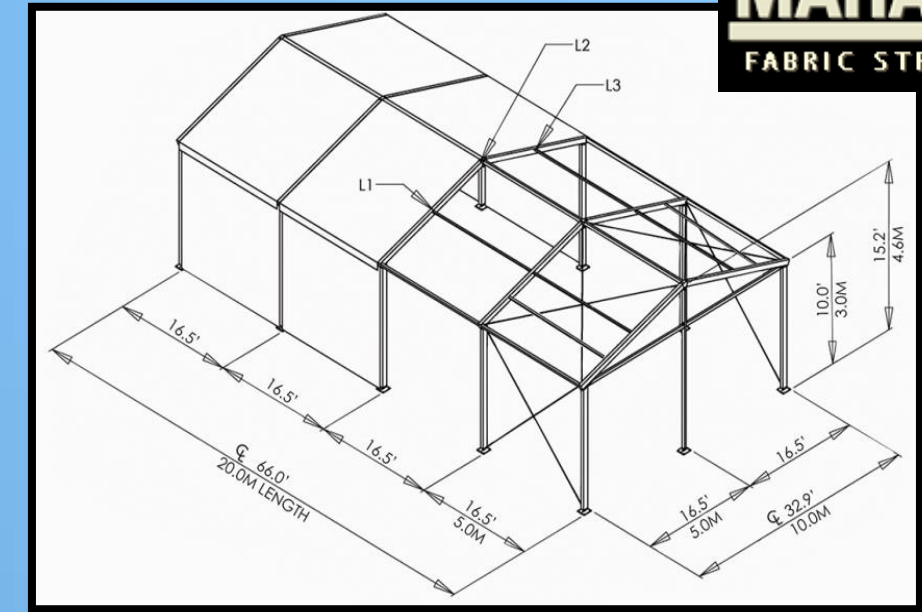
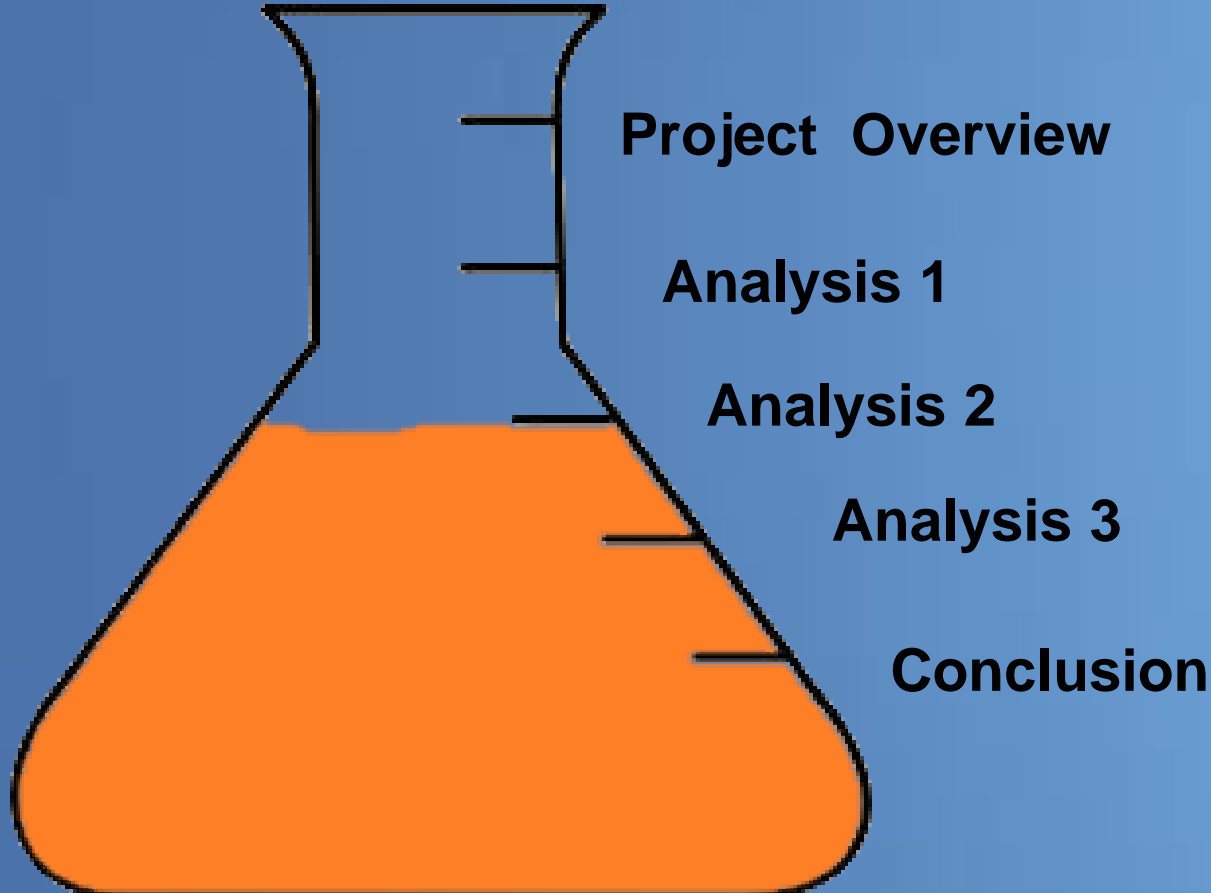
*Taxes and permitting not included.

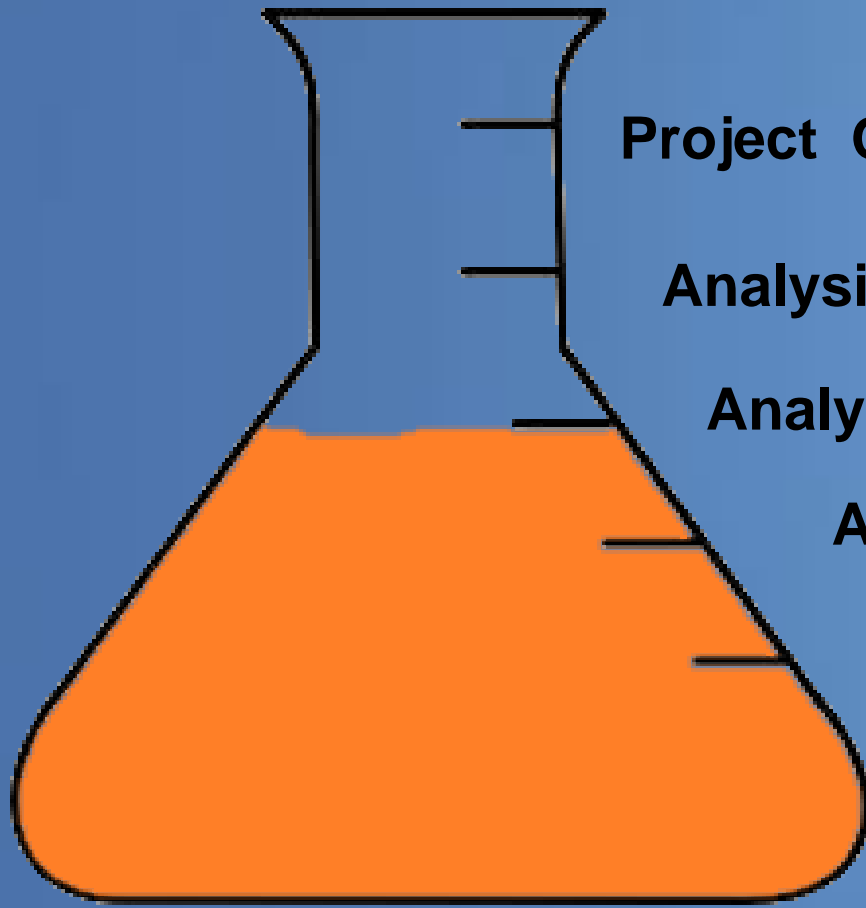
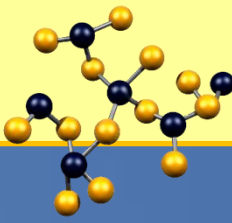
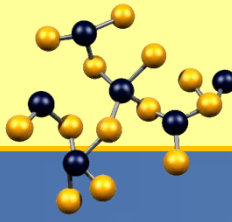
Notes: Proposal includes all non-union labor and equipment for installation. Pricing assumes anchoring into an undisturbed, level surface with access within 50' of main site. Applicable taxes, permits, and fuel surcharges are not included. This proposal is valid 30 days and is subject to equipment availability at the time the Lease Agreement is signed.

We included some photos from similar projects that we've completed across the country. Any additional pictures or CAD drawings are available upon your request. Installation of each structure will be approximately 10-14 days.

Please review the information provided. If you have any questions or need additional information, please do not hesitate to contact me. The next stage of the process is to schedule a site inspection with you and your team, or we can immediately reserve your equipment with a Lease Agreement. I will call you in a few days to discuss which way you'd like to proceed.

Best regards,
Mark H. Hunk
Mark H. Hunk
Director of Special Events
Project Manager
www.industrial-structure.com





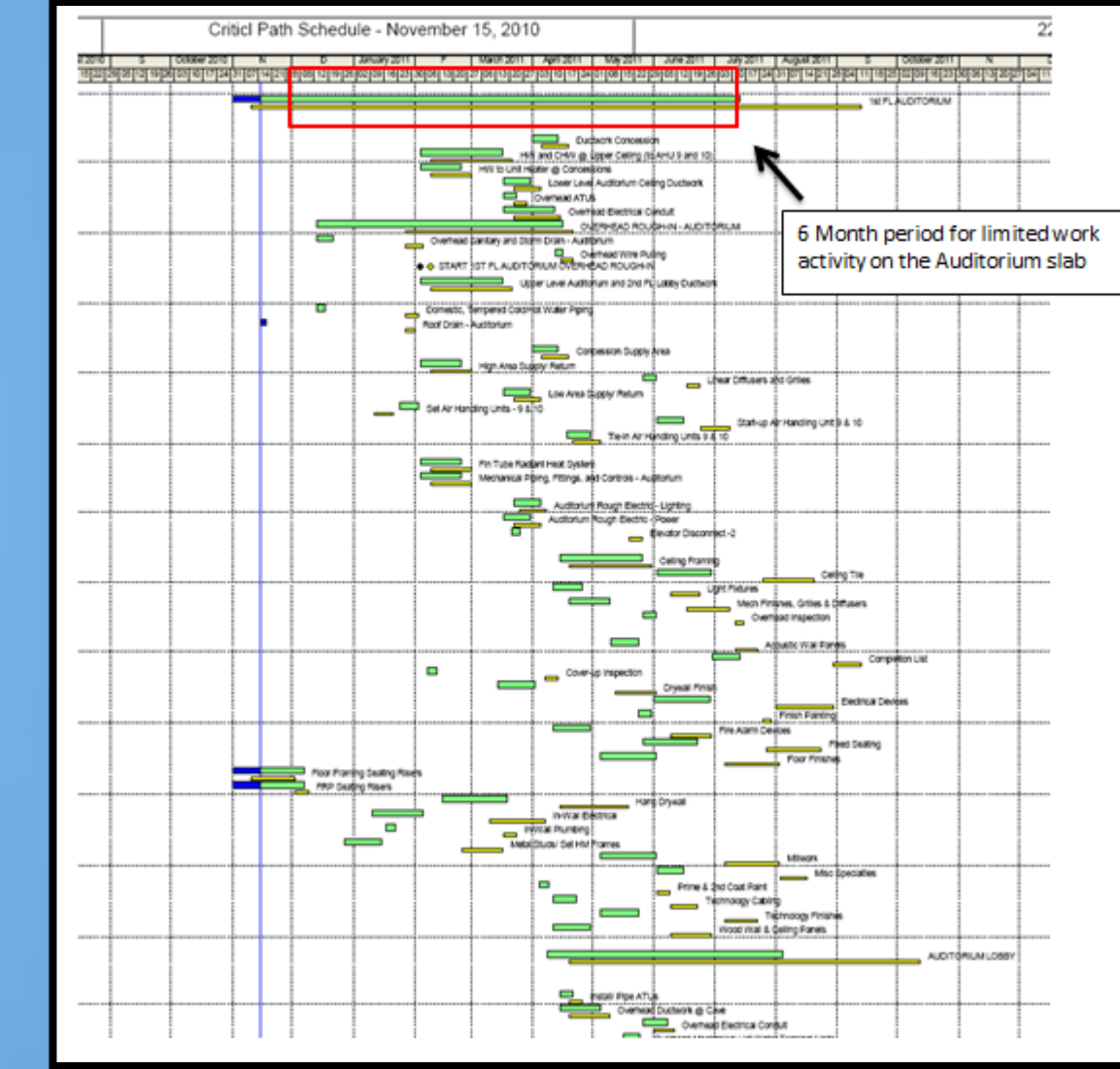
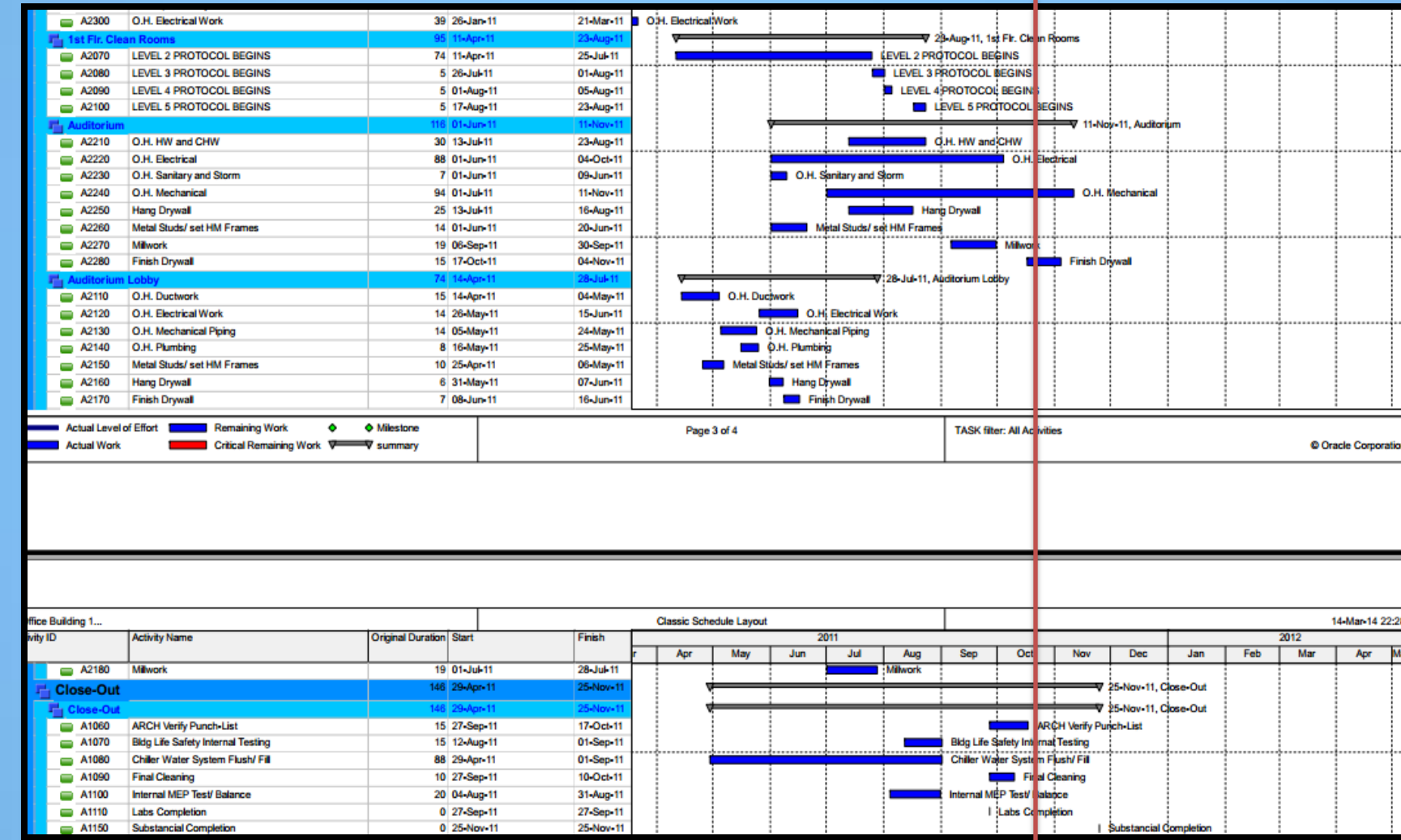
Project Overview

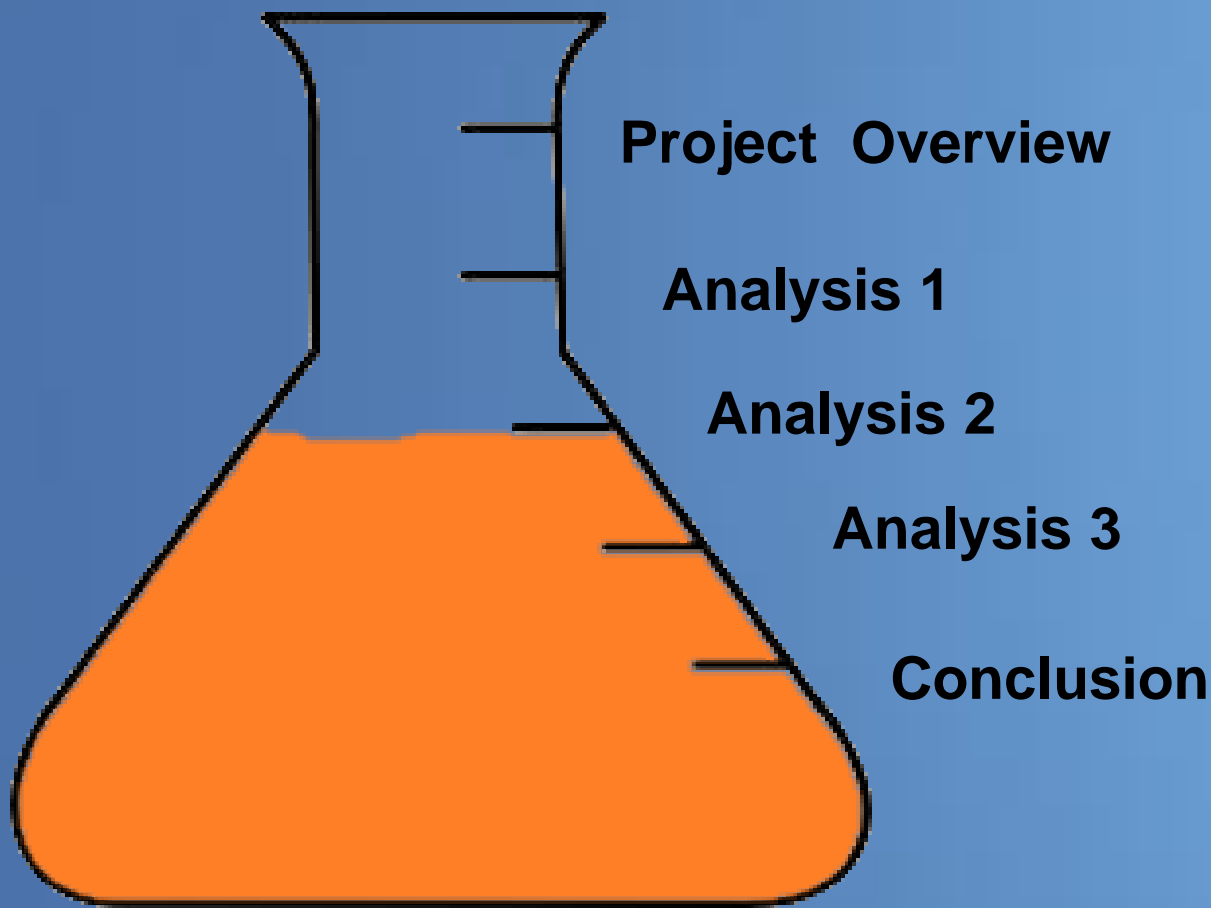
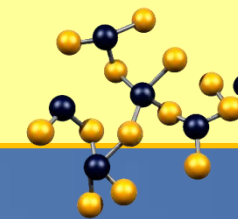
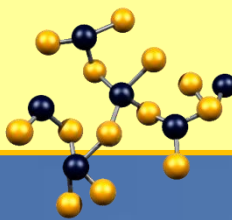
Analysis 1

Analysis 2

Analysis 3

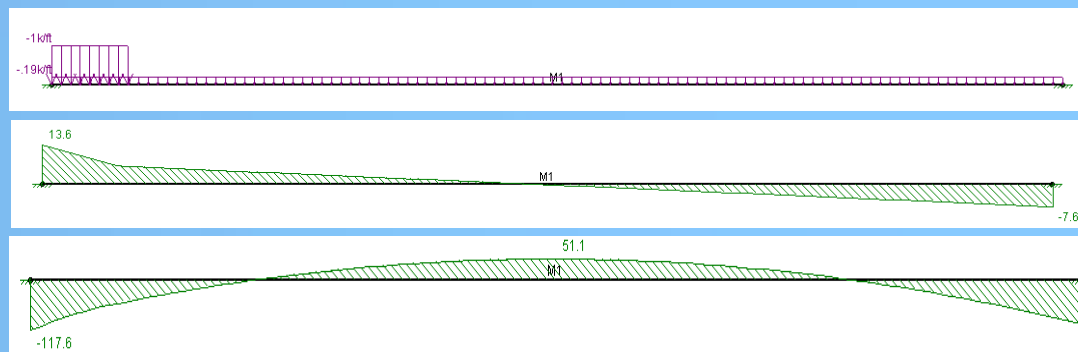
Conclusion



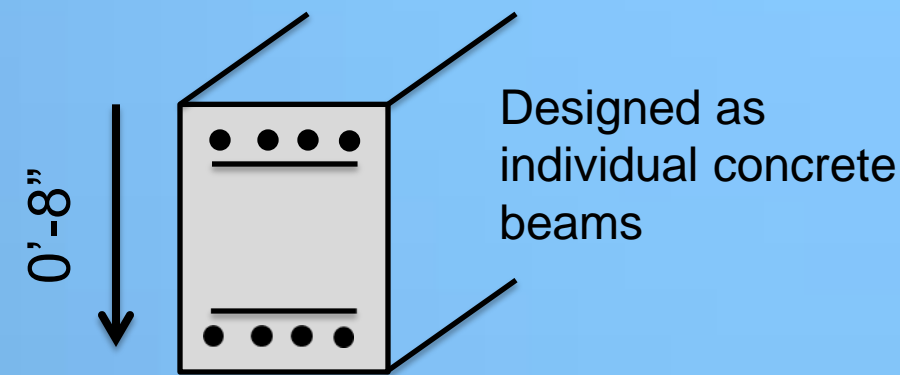


Structural Breadth:

RISA 2D – Added Weight from MRI

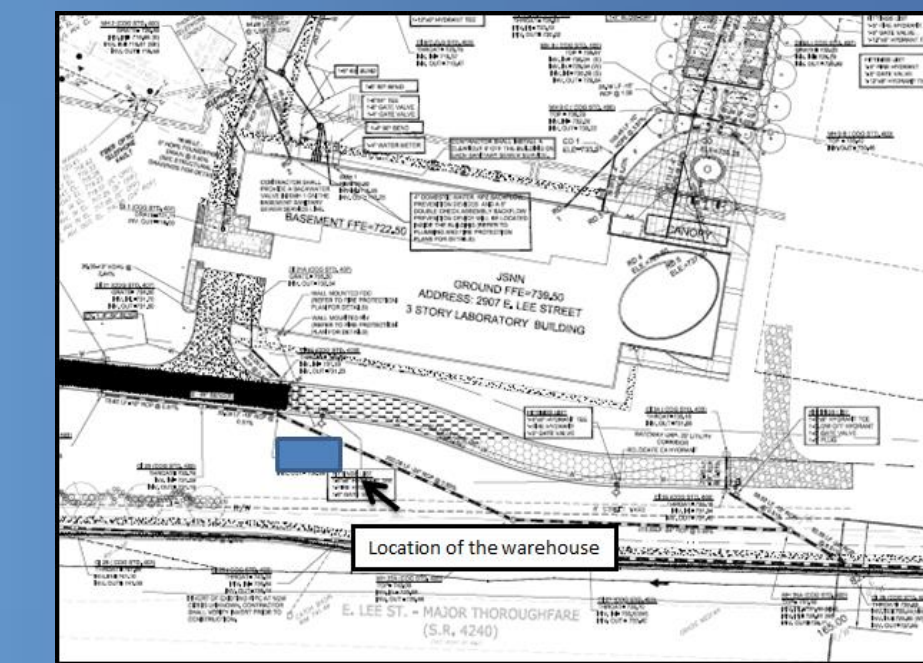


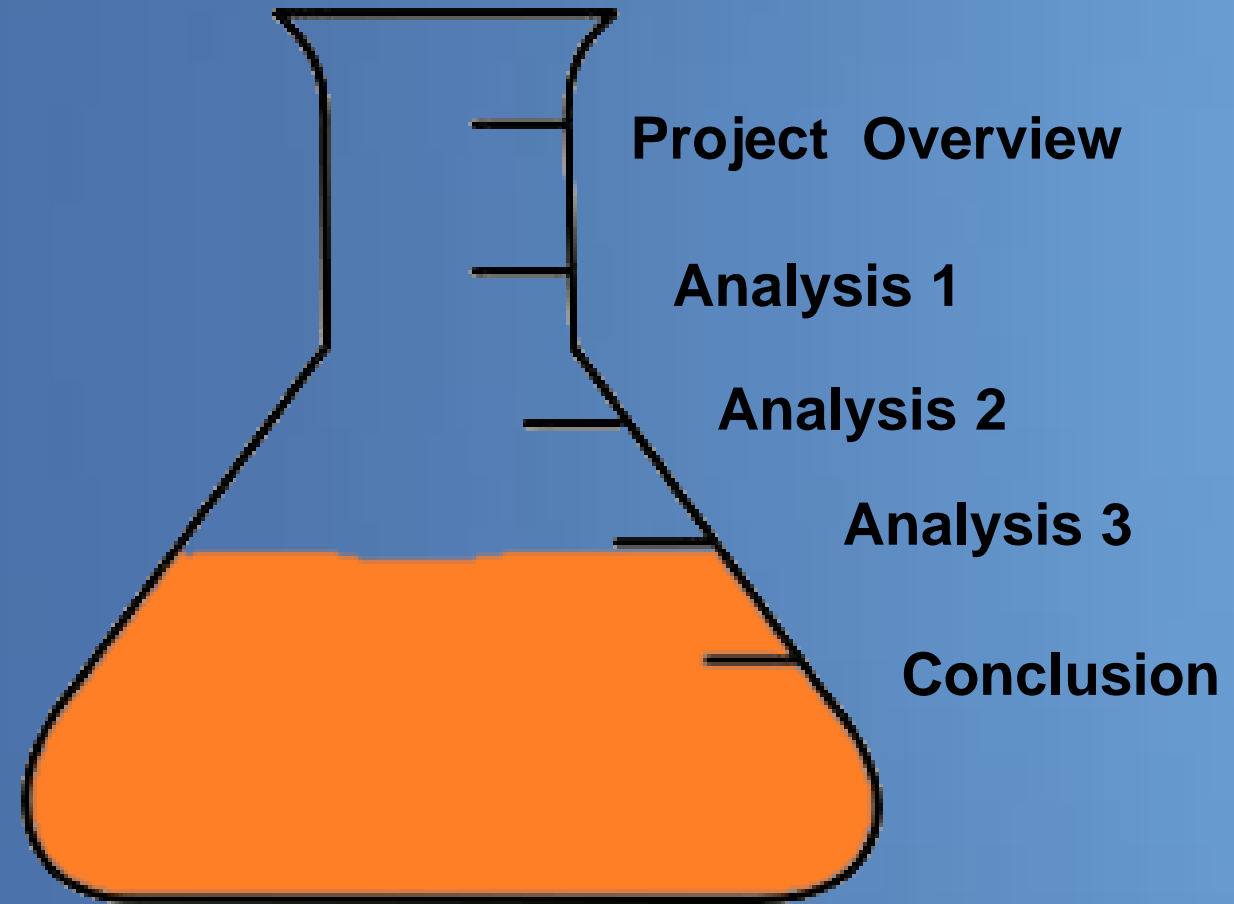
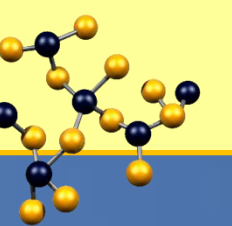
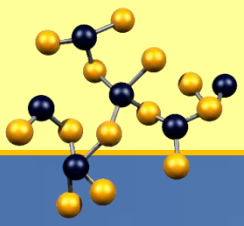
MRI adds 10 Ton at Rest and 13 Ton in operation to slab



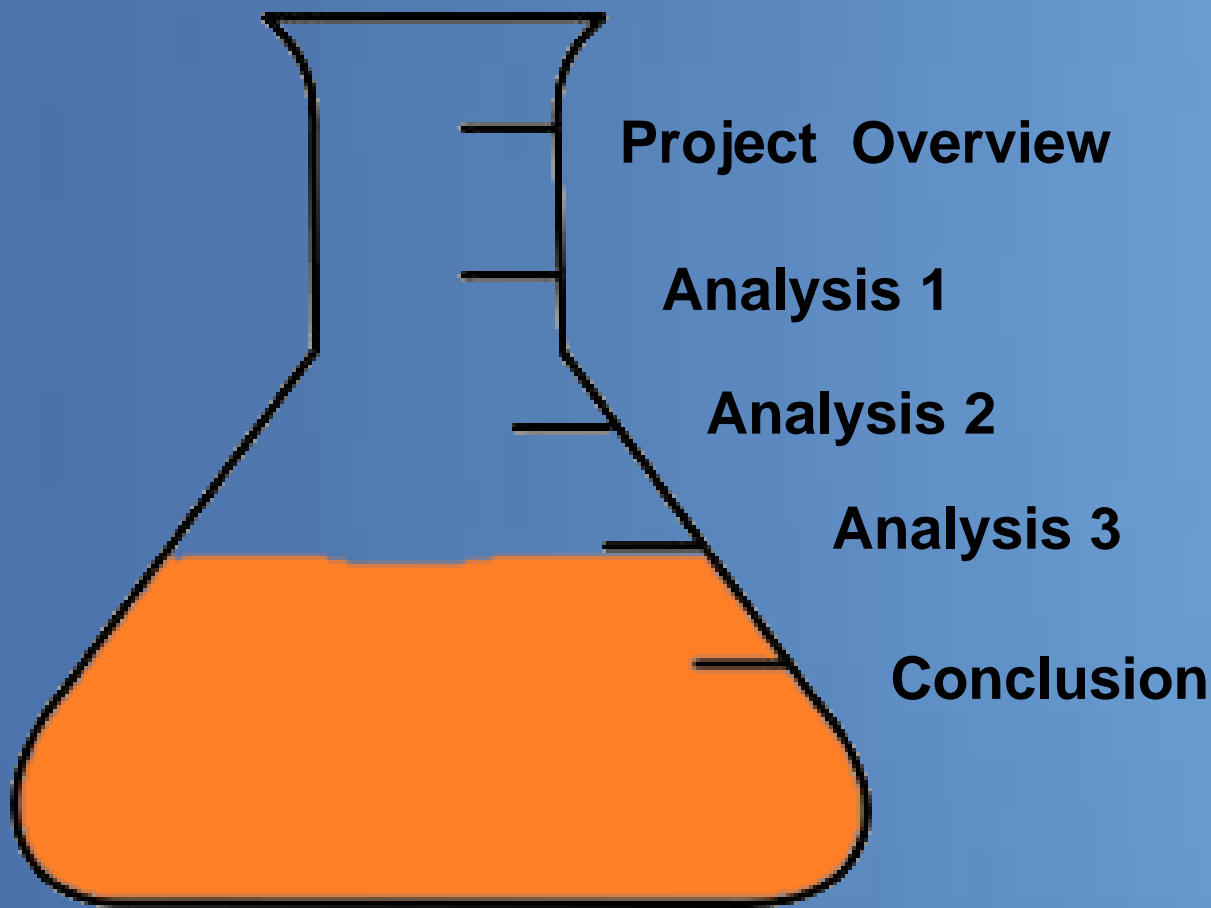
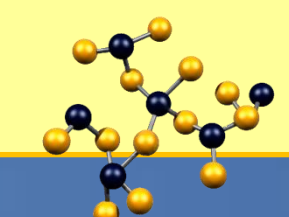
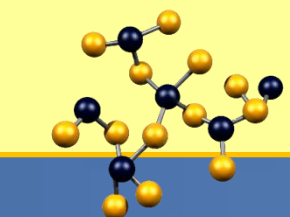
Recommendation:

- ❖ Placing warehouse on slab delays project 1 month
- ❖ Construct slab outside perimeter of building. Consider additional cost of \$5,147.63 to construct slab
- ❖ Slab used for prefabrication and temporary storage for lab equipment






Analysis III
Wetland Preservation



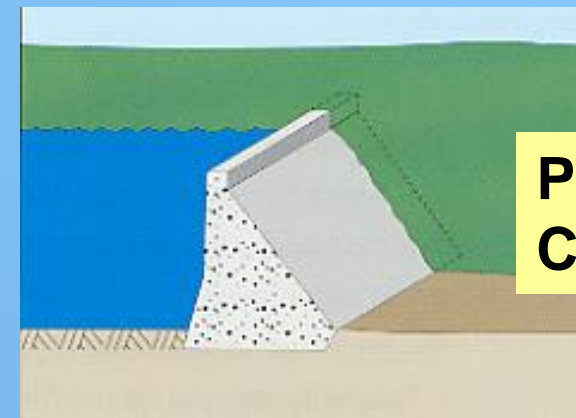
Improper Erosion Control
from previous contractor



\$13,000.00

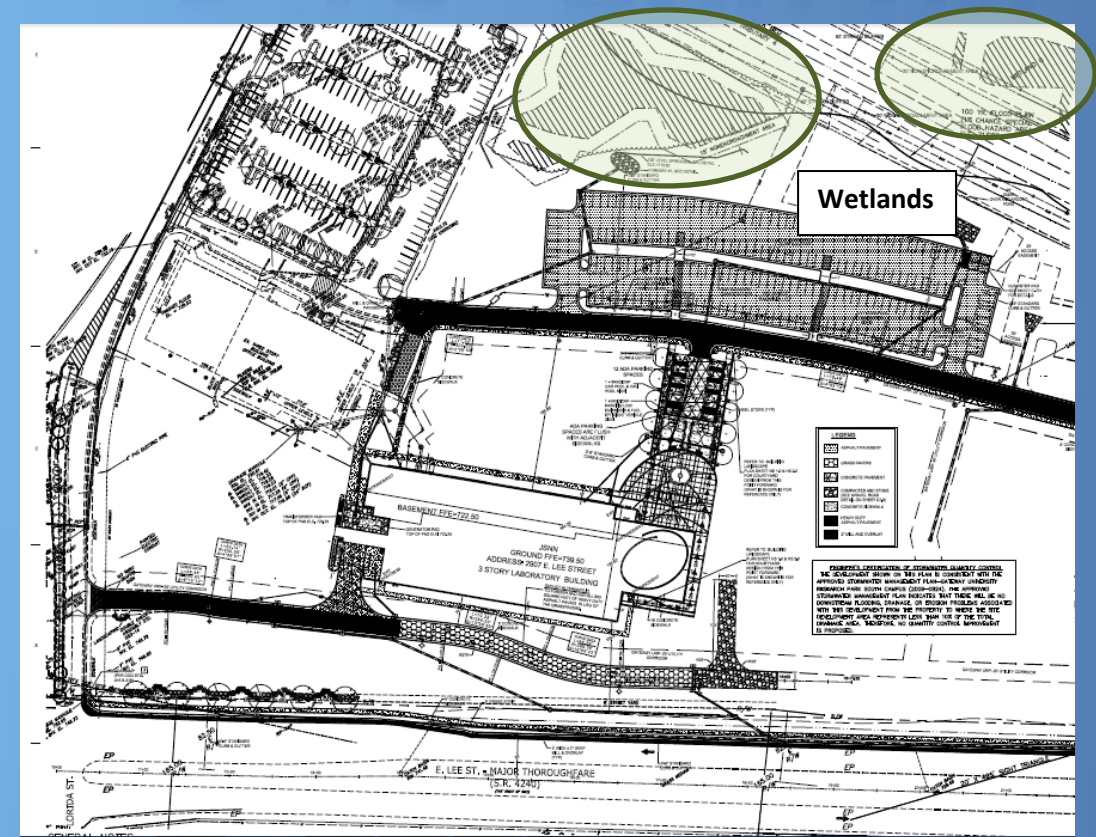
+

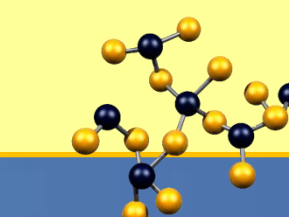
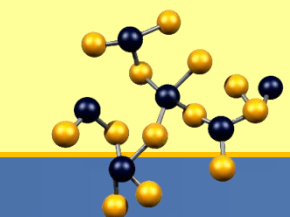
Post-Construction
Concrete Dam



\$5,500.00

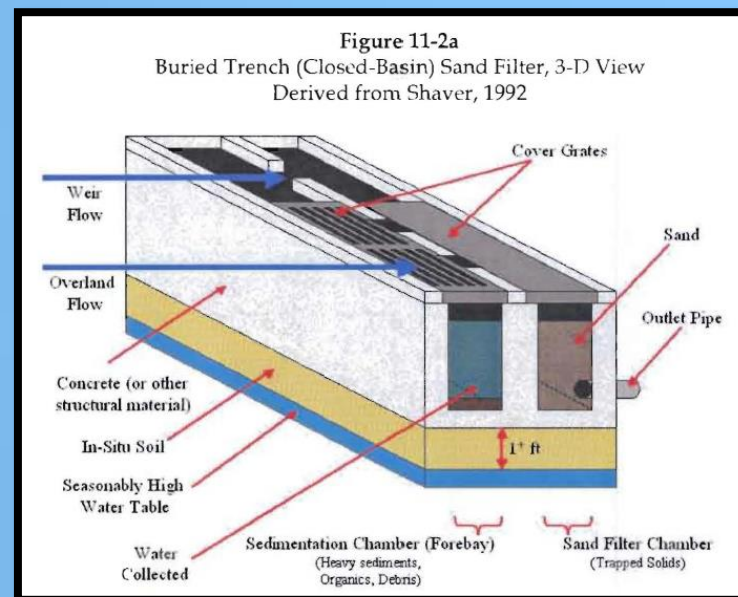
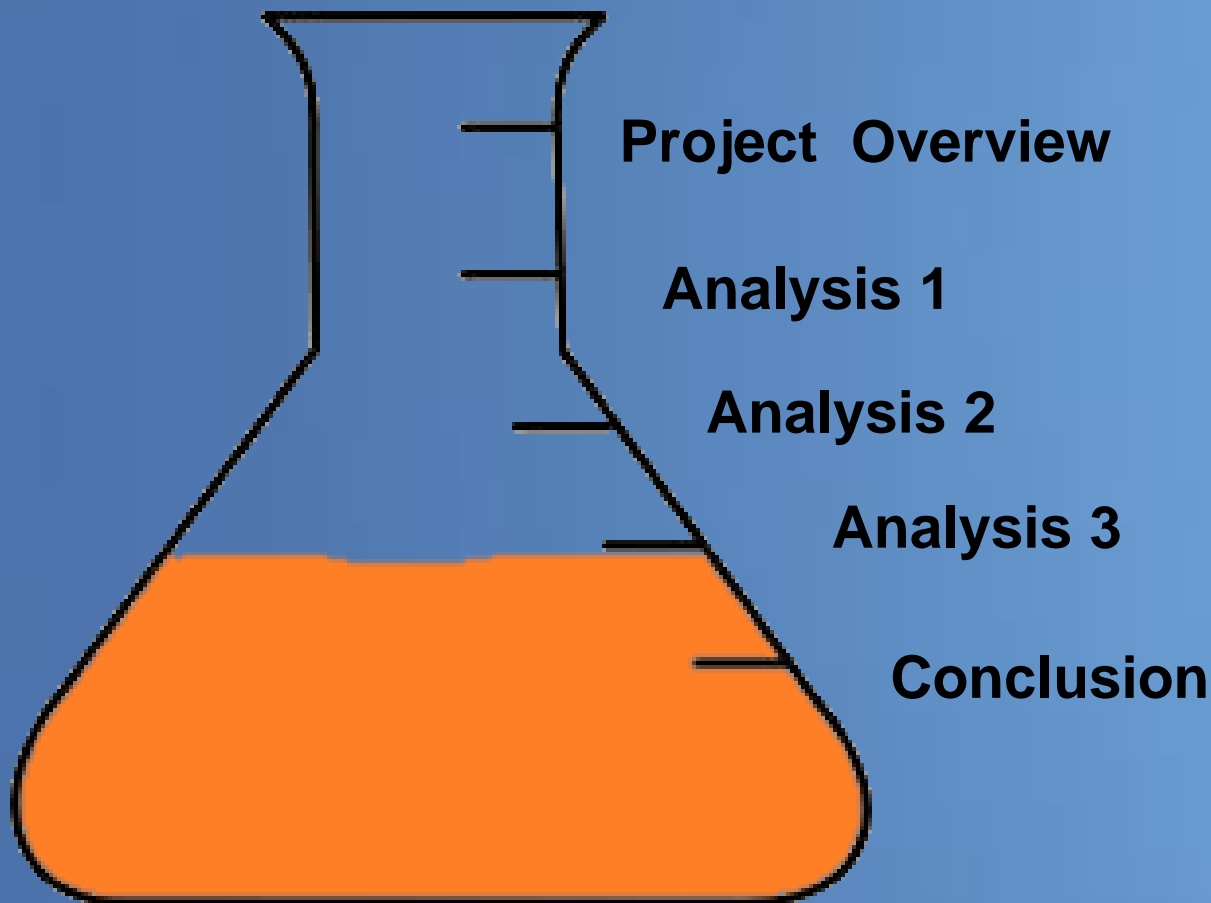
= \$ 18,500.00





Construction of Sand Filter

Perimeter of sand filter 1120 FT.



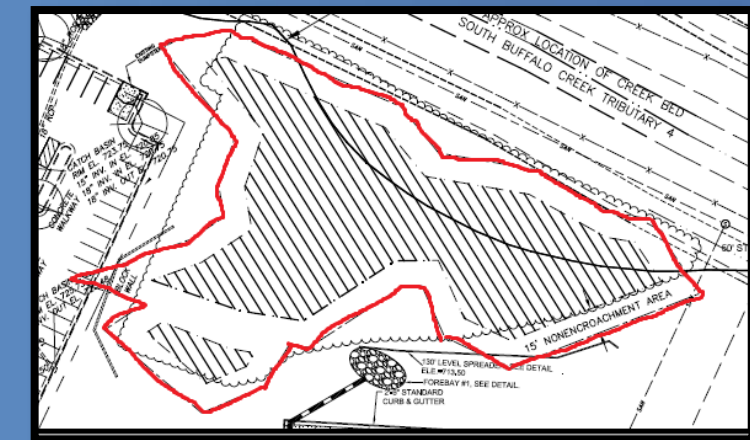
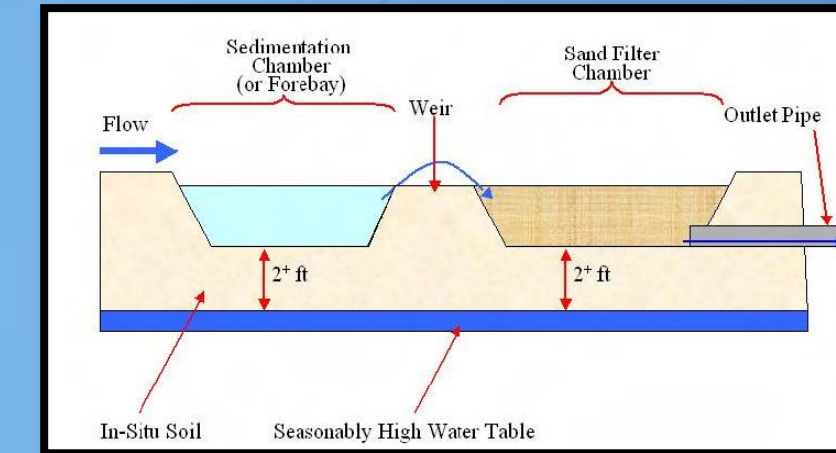
$$A_s (ft^2) = -\frac{Q_o \left(\frac{ft^3}{sec} \right)}{w \left(\frac{ft}{sec} \right)} \times \ln(1 - E)$$

$$A_s (ft^2) = -\frac{\left(\frac{WQV (ft^3)}{24hr} \right) \times \left(\frac{1hr}{3600sec} \right)}{0.0004 \left(\frac{ft}{sec} \right)} \times \ln(1 - 0.9)$$

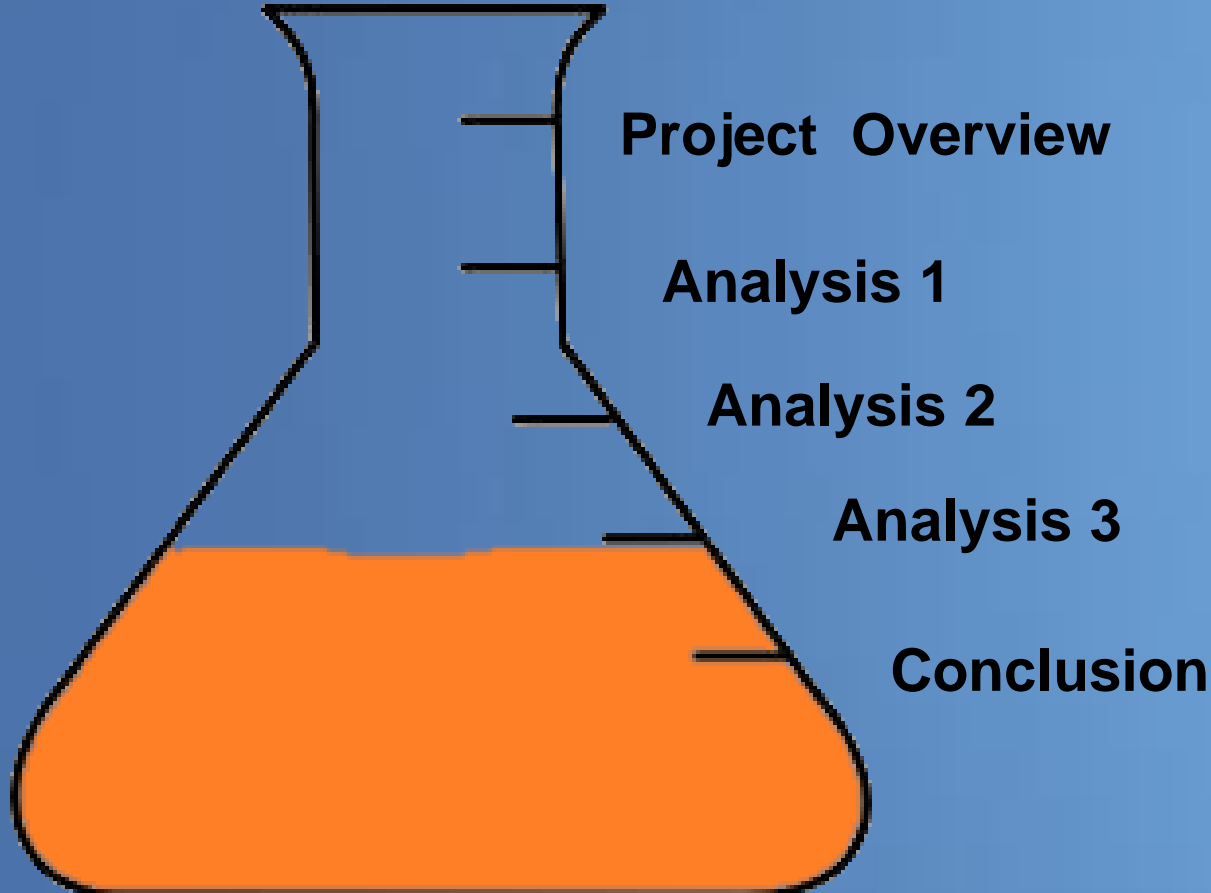
$$A_s (ft^2) = 0.066WQV (ft^2)$$

$$A_s (ft^2) = 0.066 \left[\frac{R_v (unitless)}{1} \times \frac{A_D (Acres)}{1} \times \frac{43,560 (ft^2)}{(Acre)} \times \frac{1 (in)}{1} \times \frac{1 (ft)}{12 (in)} \right] (ft^2)$$

$$A_s (ft^2) = [240 * R_v (unitless) * A_D (acres)] (ft^2)$$



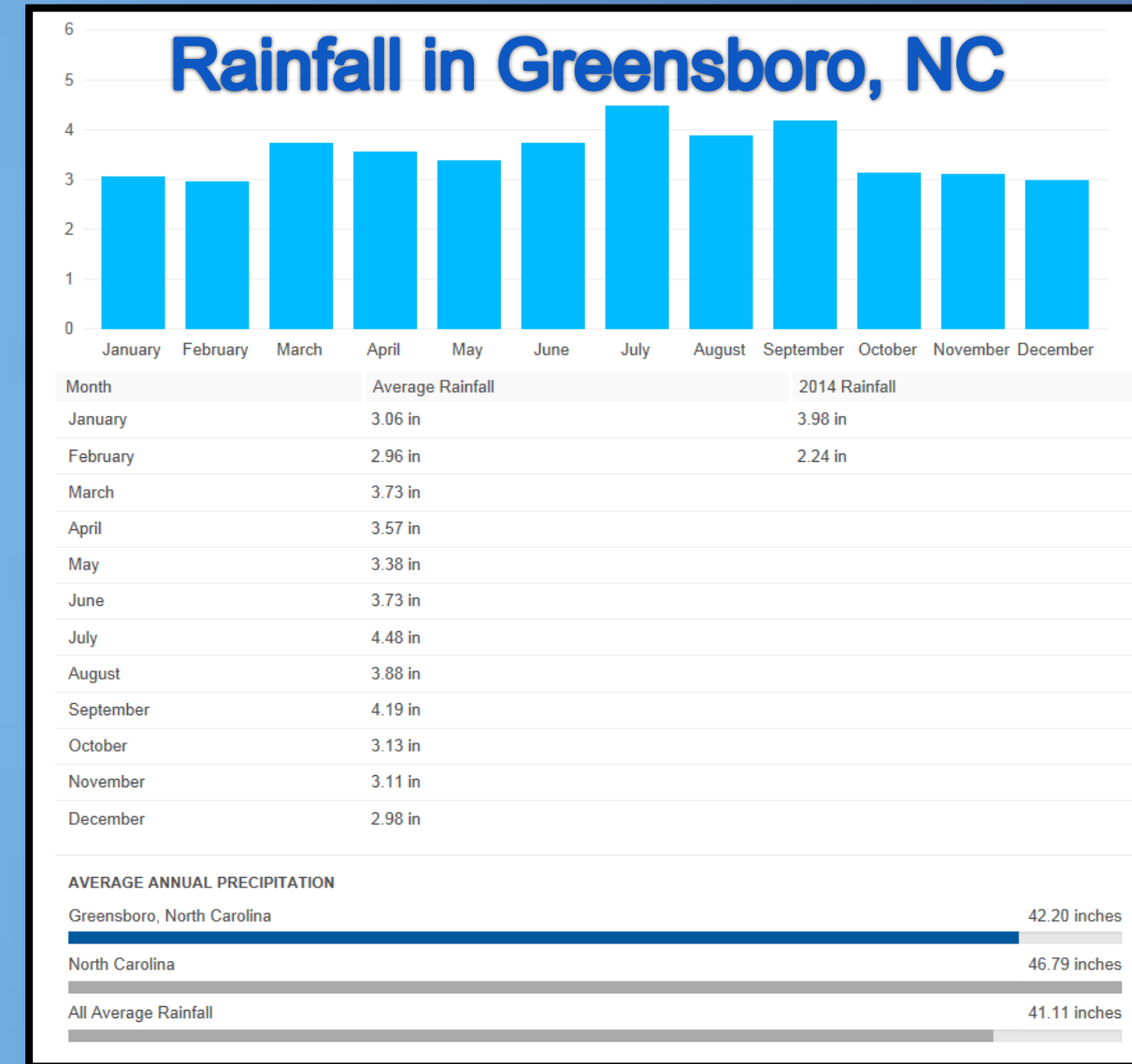
- ❖ Highly effective at filtering TSS
- ❖ Underground sand filters are useful where space is limited
- ❖ Perimeter sand filters useful for small sites with flat terrain or high water table

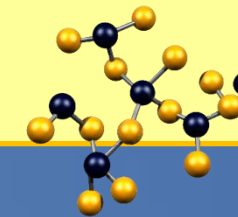
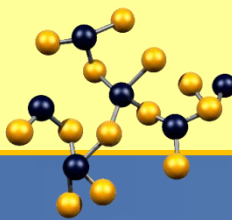


Evaporation Rate Greensboro, NC



	January	February	March	April	May	June
Amount Evaporated	0.18	0.18	0.22	0.21	0.2	0.22
Amount Rainfall	3.06	2.96	3.73	3.57	3.38	3.73
Net Retainage	2.88	2.78	3.51	3.36	3.18	3.51
	July	August	September	October	Novemeber	December
Amount Evaporated	0.27	0.23	0.25	0.19	0.19	0.18
Amount Rainfall	4.48	3.88	4.19	3.13	3.11	2.98
Net Retainage	4.21	3.65	3.94	2.94	2.92	2.8





Cost Dispute

Item	Unit	Estimated Cost
Excavation	11,200 Cubic Ft	\$ 1,456.00
Concrete	197 YDS	\$ 22,655.00
Sand	2240 Cubic Ft	\$ 10,402.00

\$ 34,500.00

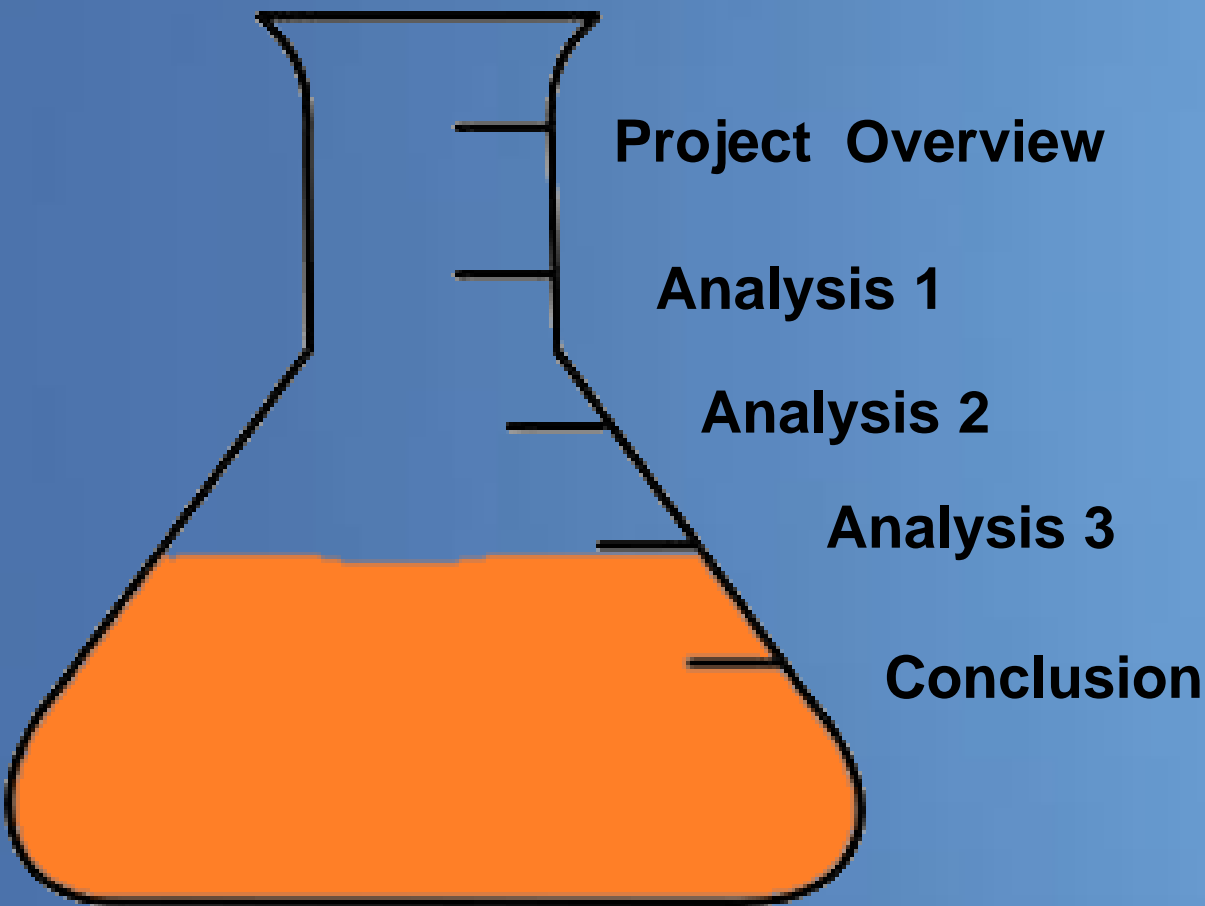
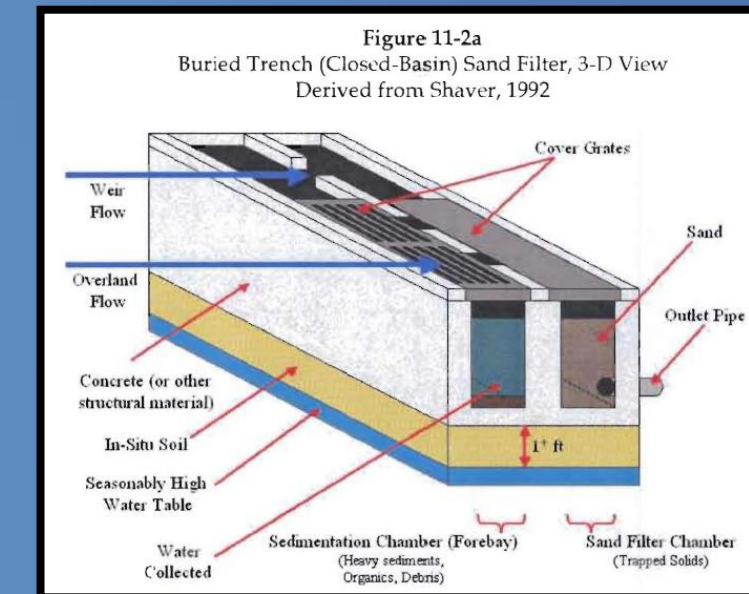
VS.

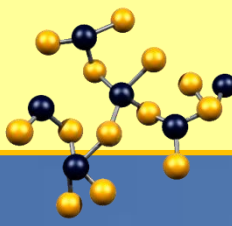
\$ 18,500.00

Recommendation:

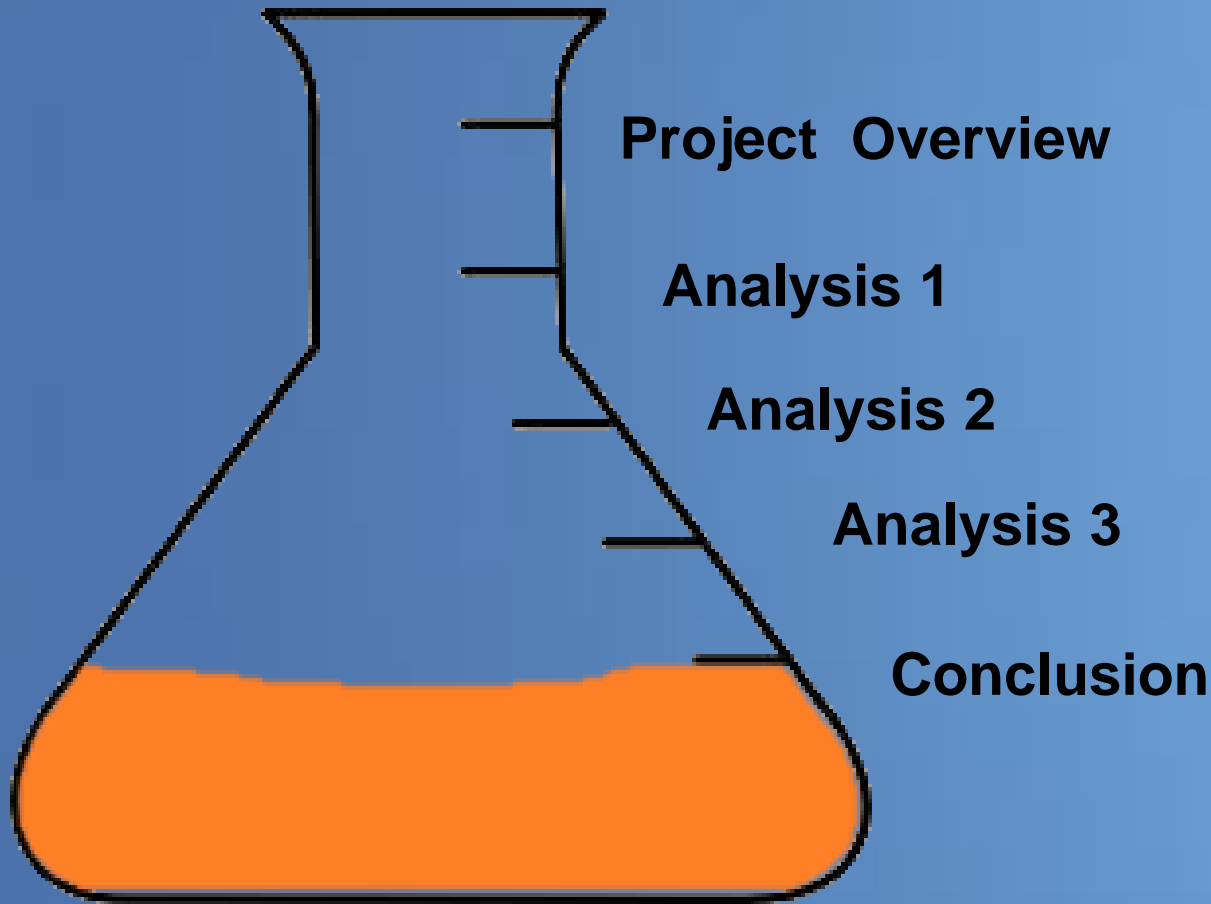
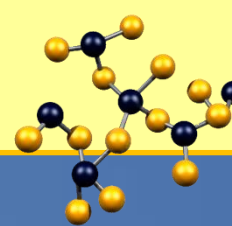
- ❖ Sand Filter considered as an investment to the Gateway Campus

- ❖ Spend the \$34,500.00 now instead of over \$50,000.00 for the construction of Gateway





conclusions



- Analysis I**
Aquatherm


 - No insulation required on DWC line
 - Cost Savings of \$6,177.00 for approximately 3000 LF of pipe
 - Pipe design increase longevity of system and reduce the power output on pipe
- Analysis II**
Material Storage Warehouse

 - Temporary storage for laboratory equipment
 - On-site Prefabrication
 - Use of auditorium building footprint increase size of slab 0'-4"
 - Overall schedule is delayed one month
- Analysis III**
Wetland Preservation

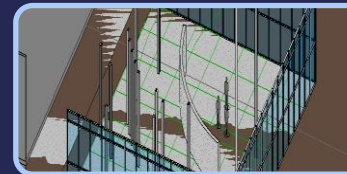
 - Use of Sand Filter as permanent protection from run-off and storm water management
 - Added cost of \$34,500.00
- Analysis IV**
Total Cost of Ownership

 - Establish a third-party non-profit organization for management of facility
 - Select software systems for the campus such as Maximo or Maintenance Connection


Recommendation:

- 

Make use of Aquatherm in applicable lines designed for the correct purpose

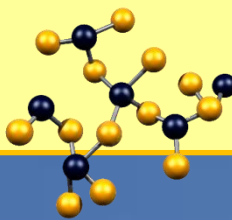
 - Aquatherm can extend the life of the system in potentially reduce maintenance costs over time
 - Safer installation for workers
- 

Warehouse should not be constructed on slab due to delay of overall construction schedule

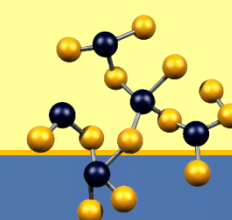
 - Added cost for slab outside of building is \$5,147.00
 - Ease protocol for quality control and place equipment in safe location until ready for installation
- 

Sand Filter should be an investment considered for the remainder of the work on the Gateway campus

 - Use of natural filtration system will enhance wetlands and alleviate concern for protection of run-off and storm water



Acknowledgements



University

Advisor **Dr. Craig R. Dubler**

Dr. Steven Treado

Dr. Jason DeGraw

Dr. David Riley

James A. Faust

Robert Holdon

The Department of Architectural Engineering
and the
Class of 2014.

Personal

Carl, Denise, and Austin Fulton

Ksenia Tretiakova

Stephen Pfund

AE Class of 2015

Julia Coldren

Chi Alpha friends

Tom and Becky Reigle

God

Industry

Dean Slate – Barton Malow

Matthew Hoerr – Barton Malow

Doug Stelljes – Barton Malow

Karen M. Ryan – Gateway Research

John Merrill – Gateway Research

Susan Homewood – NCDENR

Matthew Martin – Aquatherm

Geroge Kyler – McClure

Doug Tressler – Penstan Supply

Mark Huels – Mahaffey Advantage