Sustainability: Geothermal Energy for Sherman Hospital

Sherman Health Replacement Hospital

People-focused Safe Innovative Efficient Environmentally-friendly Flexible

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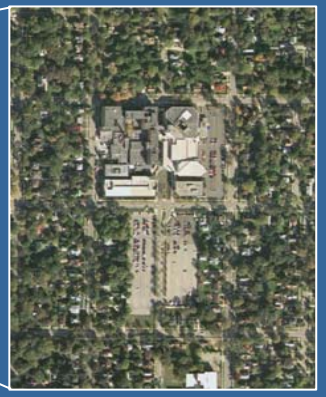
Sherman Hospital: Why Geothermal?

- Complete replacement hospital and campus redevelopment
- Located in Elgin, Illinois
- 255-bed facility
- 645,000 SF
- $201.4 m. (construction)
- 154 acre greenfield site
- 15 acre geothermal lake

Sherman Hospital: Why Geothermal?

Big Timber Site



Sherman Hospital Campus

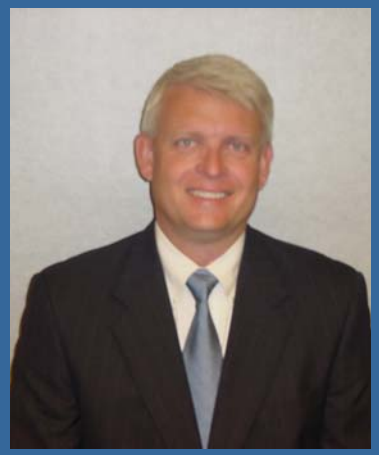
Sherman Hospital: Why Geothermal?

Design Team members

- **Shepley Bulfinch Richardson & Abbott**, Architect
- **KJWW Engineering**
- **Boldt Consulting Services,** Program Manager

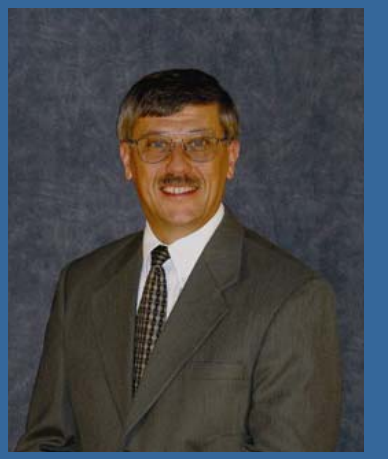
Guiding principles

- Environmentally friendly
- Innovative
- Efficient



Environmental Focus

- Energy efficient
- Sustainable landscape
- healing environment



Sherman Hospital: Why Geothermal?

Education Process

- Boldt Consulting, Shepley Bulfinch and KJWW presented educational information to Sherman's Master Facility Task Force
- Reviewed and compared traditional heating and cooling system to a geothermal solution
- Discussed pros and cons of each

Sherman Hospital: Why Geothermal?

Site Visit

– Boldt Consulting, Shepley Bulfinch and KJWW and Sherman representative visited KJWW's Great River Medical Center, Burlington, Iowa

Cost Benefit

– A 2003 survey of 100 Midwest hospitals of comparable size (using traditional systems) shows an average of **$2.43/sf** on utilities vs. **$.94/sf** for Great River Medical Center

Sherman Hospital: Projected Geothermal Economics

Payback

- Sherman planned to build a 5 acre lake for therapeutic reasons and storm water retention, geothermal or no geothermal.
- So the 15 acre lake would require an extra 10 acres. Two ways to calculate the payback period:
- Without Land 4.82 years
- With Land 6.52 years

Sherman Hospital: Geothermal Economics

Additional incentive

- $400,000 grant from the Illinois Clean Energy Community Foundation

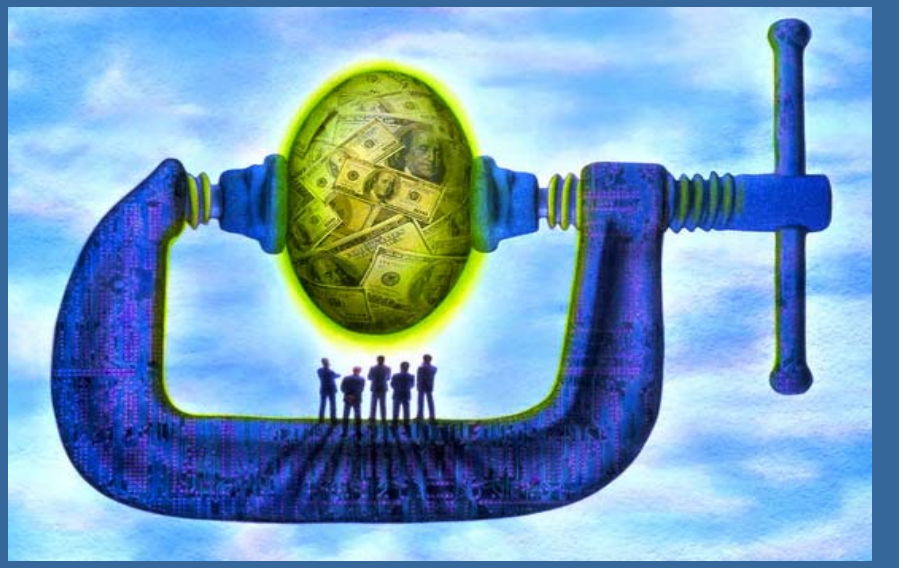
Sherman Hospital: Other Geothermal Benefits

- Use 25-40% less energy than traditional systems
- Offers significant annual operational savings
- Minimizes use of natural resources
- Provides clean, reliable, renewable, environmentally-friendly, flexible and cost- effective energy
- Therapeutic value of lake and fish
- Largest geothermal project in Illinois
- Largest geothermal healthcare project in the world

Financial Considerations

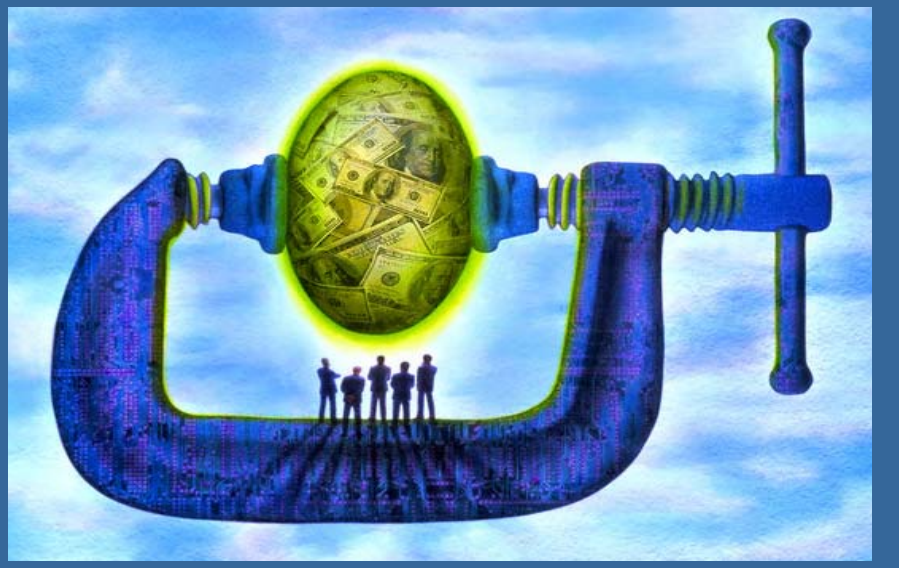
Today's Healthcare Costs

- Hospital spending expected to rise **73%** between 2000 to 2010
- Most hospitals are losing money or operating at very low margins; breaking even or operating at a margin of less than 1%
- Hospital charity care is being challenged
- Increased accountability and cost for litigation and legislation for medical errors



Today's Healthcare Costs: Energy

- According to 1999 DOE study, healthcare facilities accounted for only 4 % of commercial space, but consumed 9 % of total commercial energy.
- Healthcare spends $6.5 billion on energy annually
- Most hospitals spend 1.5%-2% of operating costs on energy; may not seem like much, but % is rising.
- Associated costs: plant maintenance, new equipment



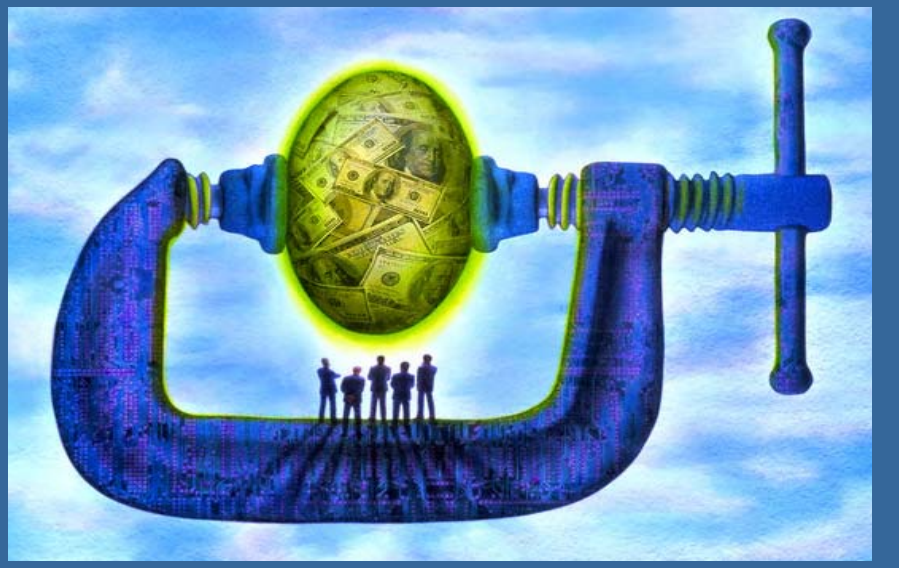
Today's Healthcare Costs: Energy

Sherman Energy Costs

May '05- April '06

Electric	$1,054,364
Natural Gas	$1,429,042
Total	$2,483,406

Natural gas price doubled in just 12 months through April '06!



Hospital Energy Consumption

2003 Study of energy use by 100 Midwestern Hospitals

High:	375,000 BTU/sf/year	
Average:	240,000 BTU/sf/year	$2.39/sf/yr
Best non-geothermal:	161,000 BTU/sf/year	
Geothermal @ Great River:	96,000 BTU/sf/year	$ .94/sf/yr

Sherman Hospital: Projected Geothermal Economics

Upfront Costs for Sherman

Geothermal vs. Traditional	$4,544,894
10 extra acres of land	+$1,600,000
Total added upfront cost	$6,144,894

Annual Energy Savings

Δ/sf = $2.39/sf - $.94/sf = $1.47/ sf

645,000 sf @ $1.47/sf= $ 935,250

Payback

- Without Land **4.82 years**
- With Land **6.52 years**

Sherman Hospital: Projected Geothermal Economics

Well-field option

- Decided NOT to pursue supplemental well-field below parking lot– would have eliminated boiler, but cost an additional $1m
- Longer payback period
- Limits of construction $

Engineering

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Mechanical Systems in Hospitals

Chiller Plant

Boiler Plant

Mechanical Systems in Hospitals

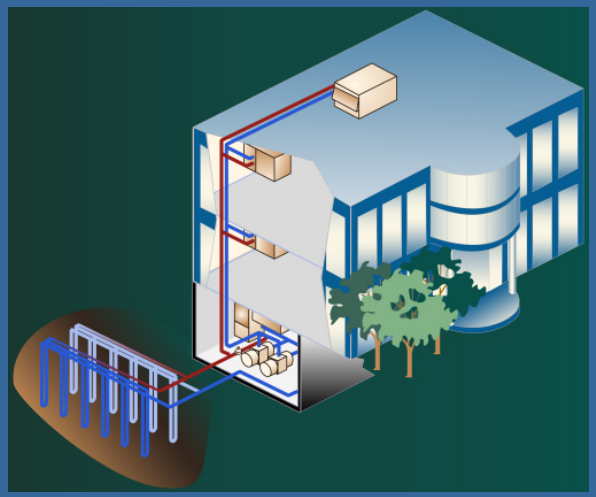
Cooling Towers

- Noisy
- Big
- Unsightly

Service Yard

- Noisy
- Best separated from patient care areas

Geothermal vs. Traditional



Geothermal

–Lakes for cooling and heating

–Wells for heating

–Constant volume ventilation air handlers

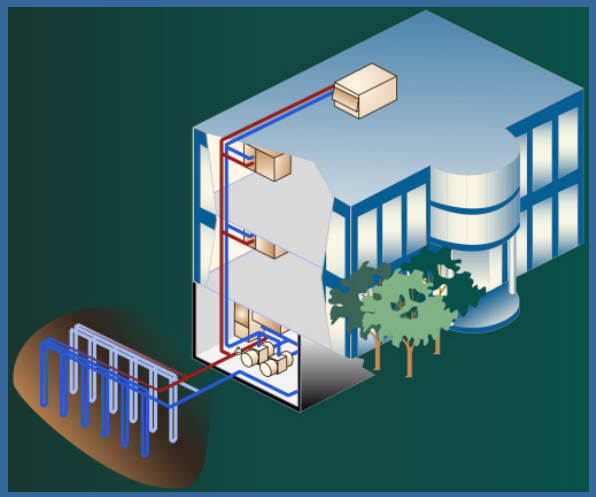
Traditional

–Chillers with cooling towers

–Steam boilers for heating

–Variable air volume ventilation air handlers

Geothermal vs. Traditional



Geothermal pros

–More energy efficient

–Uses less natural resources

–Reduced operating costs

–No cooling towers, chemicals

–Marketing potential

–Therapeutic value

Geothermal cons

–New system type/training

–Added 1st cost for lake or wells

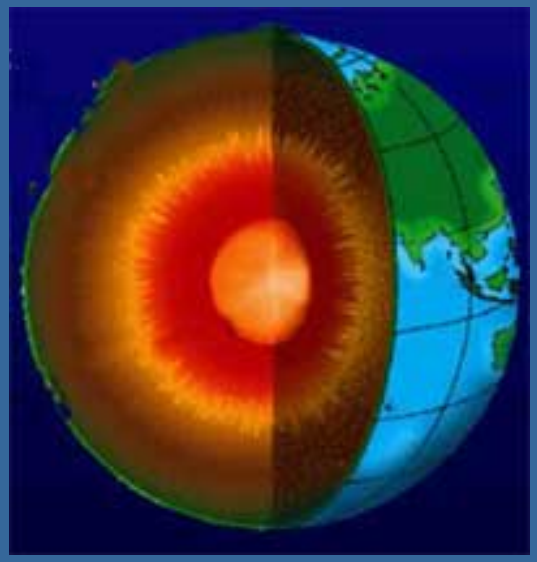
–Uses extra acreage

–Maintenance of heat pumps

–Shorter equipment life (15 years vs. 25 years)

Geothermal Systems: The Basics

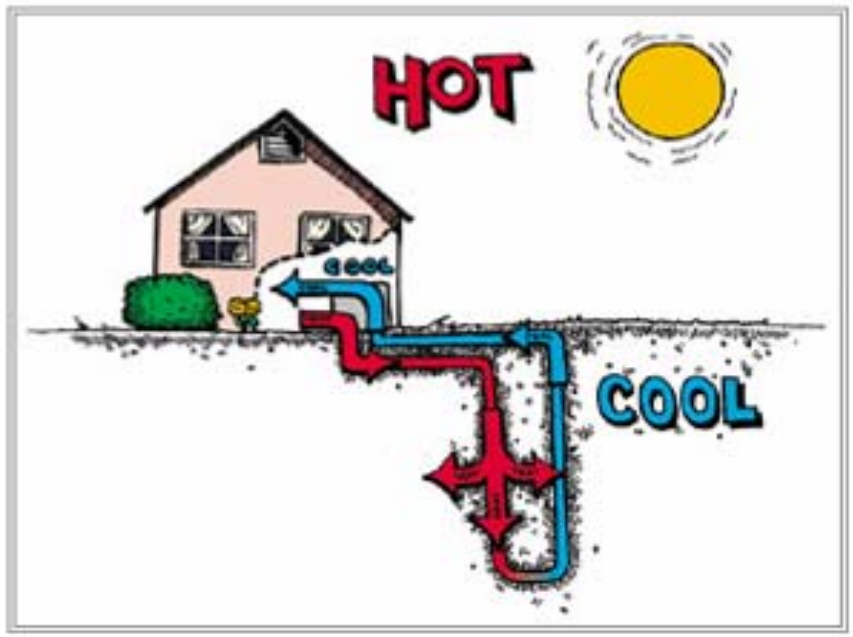
- Earth absorbs 50 percent of all solar energy.
- Heat is stored in the earth's crust.
- Remains a constant 55° F below the frost line. Geothermal technology uses this constant temperature to exchange energy between your building and the earth



Geothermal Systems: The Basics

The Seasons

- In winter, water circulating inside the loop absorbs heat from the earth and carries it to the geothermal unit.
- It is compressed to a higher temperature and sent as warm air to the indoor system.
- In summer, the system reverses itself and expels from your building into the cooler earth via the loop: in Chicago, hospital system in cooling mode 10 months of year!



Geothermal Systems: The Basics

Geothermal Options

- Vertical wells drilled into the earth
- Horizontal piping drilled into the earth
- Vertical or horizontal piping loops with water sealed inside exchange heat with the earth
- Horizontal piping rests at the bottom of a body of water

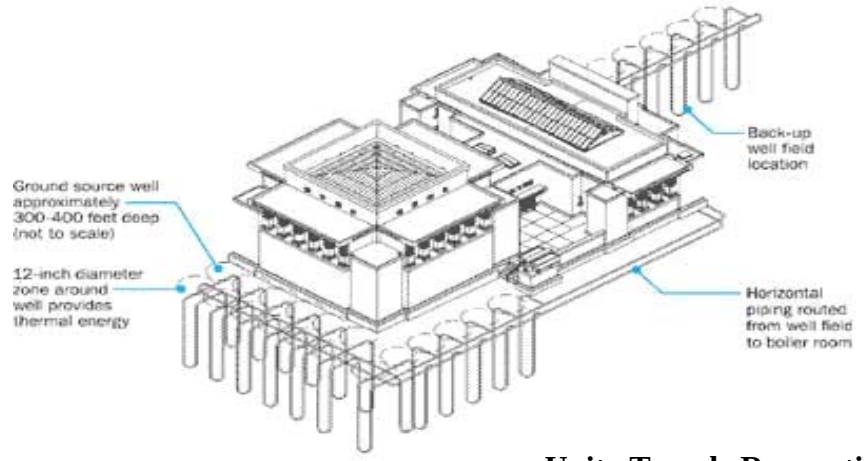


DIAGRAM OF GEOTHERMAL HVAC SYSTEM

Unity Temple Renovation
Oak Park, Illinois

Case Study: Great River Medical Center

- 800,000 sf campus opened 2000
- 15-acre, 12-foot deep, man-made lake
- 1,800 ton cooling system
- Hospitals are well suited to geothermal steady rate of heat exchange: constant, low-level occupancy (vs. school or office building)
- Geothermal lake temp does not remain constant– varies between 38° and 85° F, but air/water temp Δ, and water density, provide plenty of potential energy

Case Study: Great River Medical Center

Heat Exchange

- Like a giant automobile radiator
- **Limnologist** designs raft layout
- 105 rafts with 14 coils of pipe at the bottom of lake serve as heat exchangers
- Each raft contains 4,200 feet of pipe (= 85 miles total)

Case Study: Great River Medical Center

Manifold Room

- stainless steel pumps & heat exchangers sit over lake inlet
- 3 pumps push 5,000 gpm of water thru 85 mile recirculation system
- Air to air heat recovery

Case Study: Great River Medical Center

Patient Room

- Water passes thru 800 heat pumps to provide individual room temperature control

Surgery Suite and Critical Care

- Uses conventional heating and cooling systems in Surgery, ED and ICUs to comply with codes

Case Study: Great River Medical Center

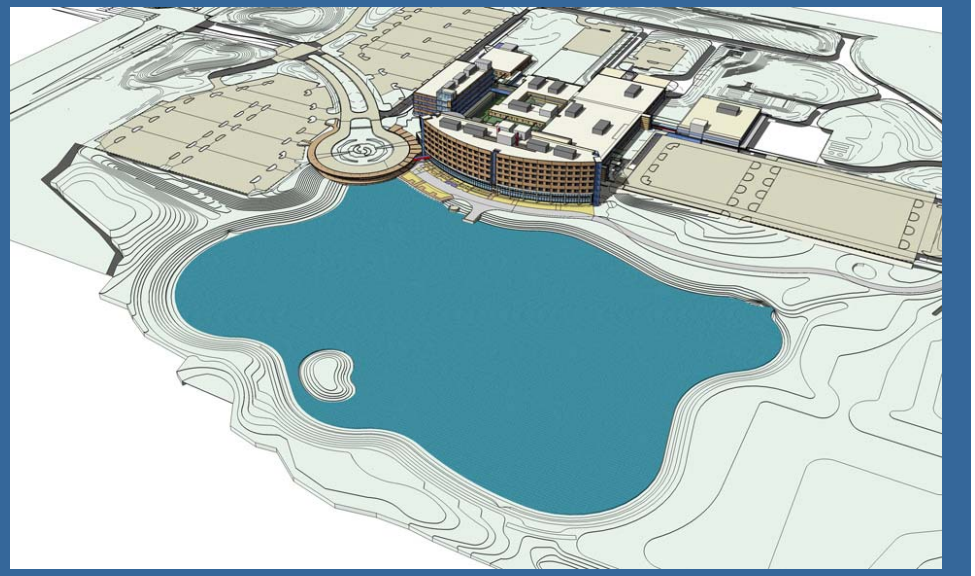
Heat Pumps

- Maintenance can be done on individual pumps, eliminating shutdown of entire system
- Flexibility to expand system as campus expands
- Full-time employee to change filters on large campus; instead of more highly skilled personnel
- Heat pumps boost geothermal savings, but not required: use where possible

Case Study: Great River Medical Center

Lessons Learned from Great River

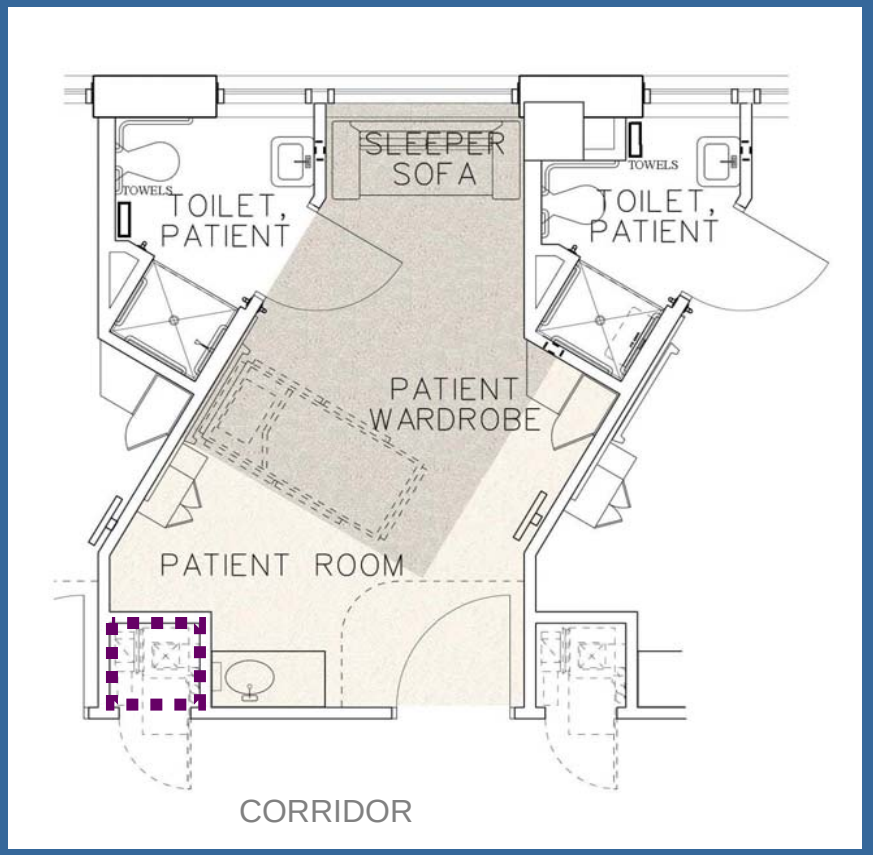
- Hybrid system with wells is more efficient for heating
  - 400-ton well system added
  - No antifreeze in loop
- Heat wheels can be too efficient
- Building heats itself with ambient temperatures above 20º F
- Move heat pump into patient corridors



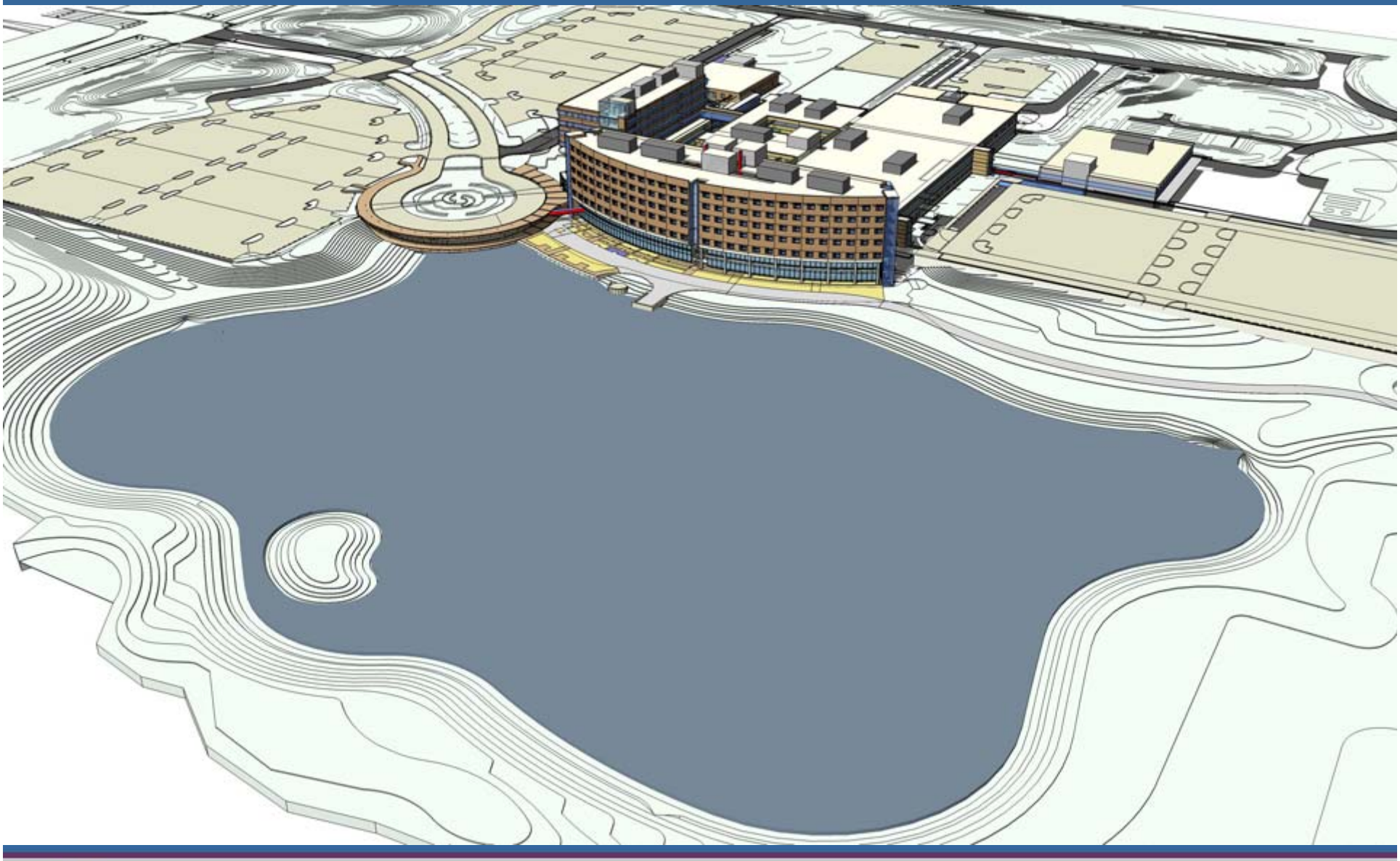
Sherman Hospital: Patient Room

Heat Pump Closet

- 3’ x 3’ Pump closet along patient corridor for easy service access
- Sits above storage alcove in Patient Room



Aerial View



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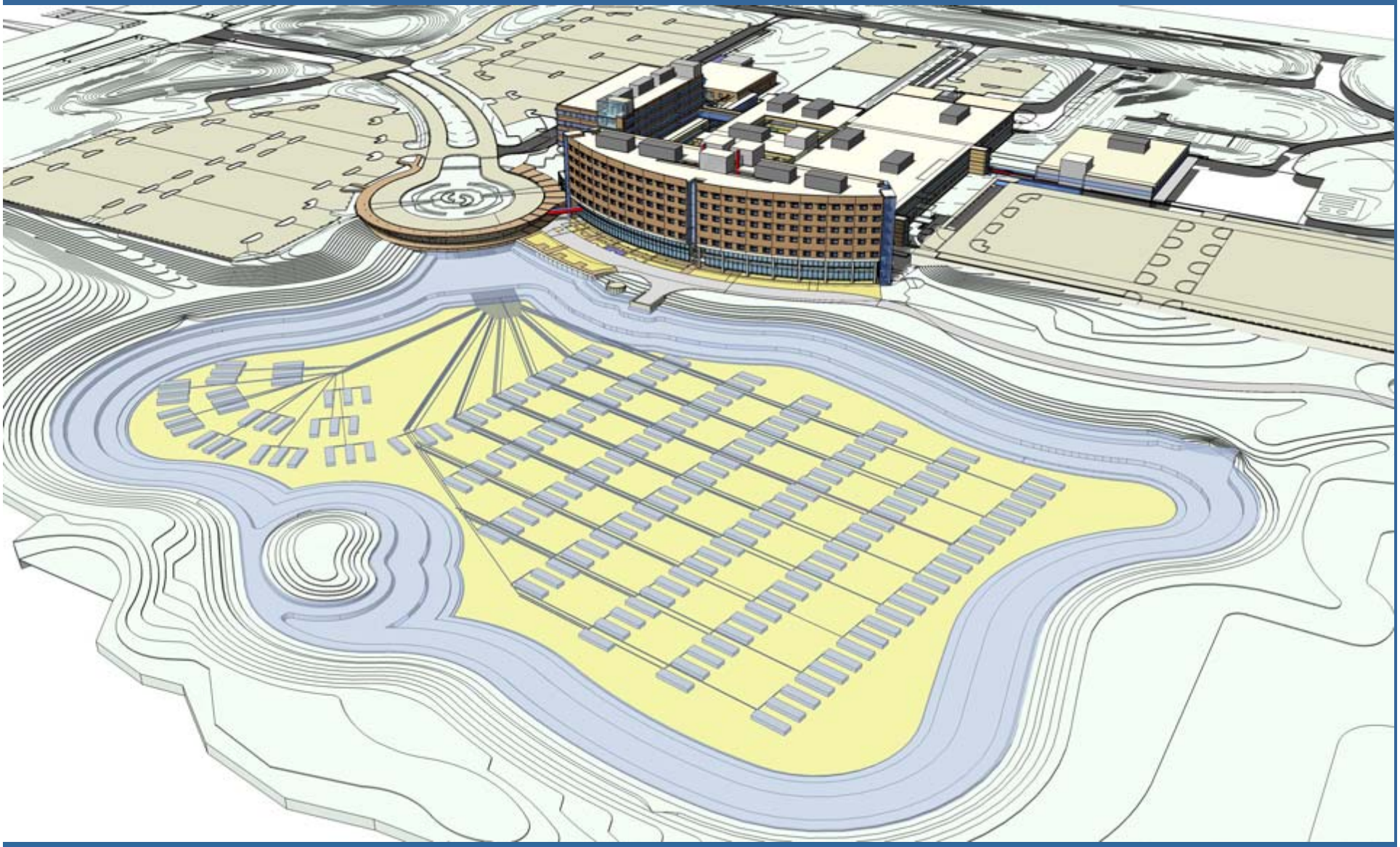

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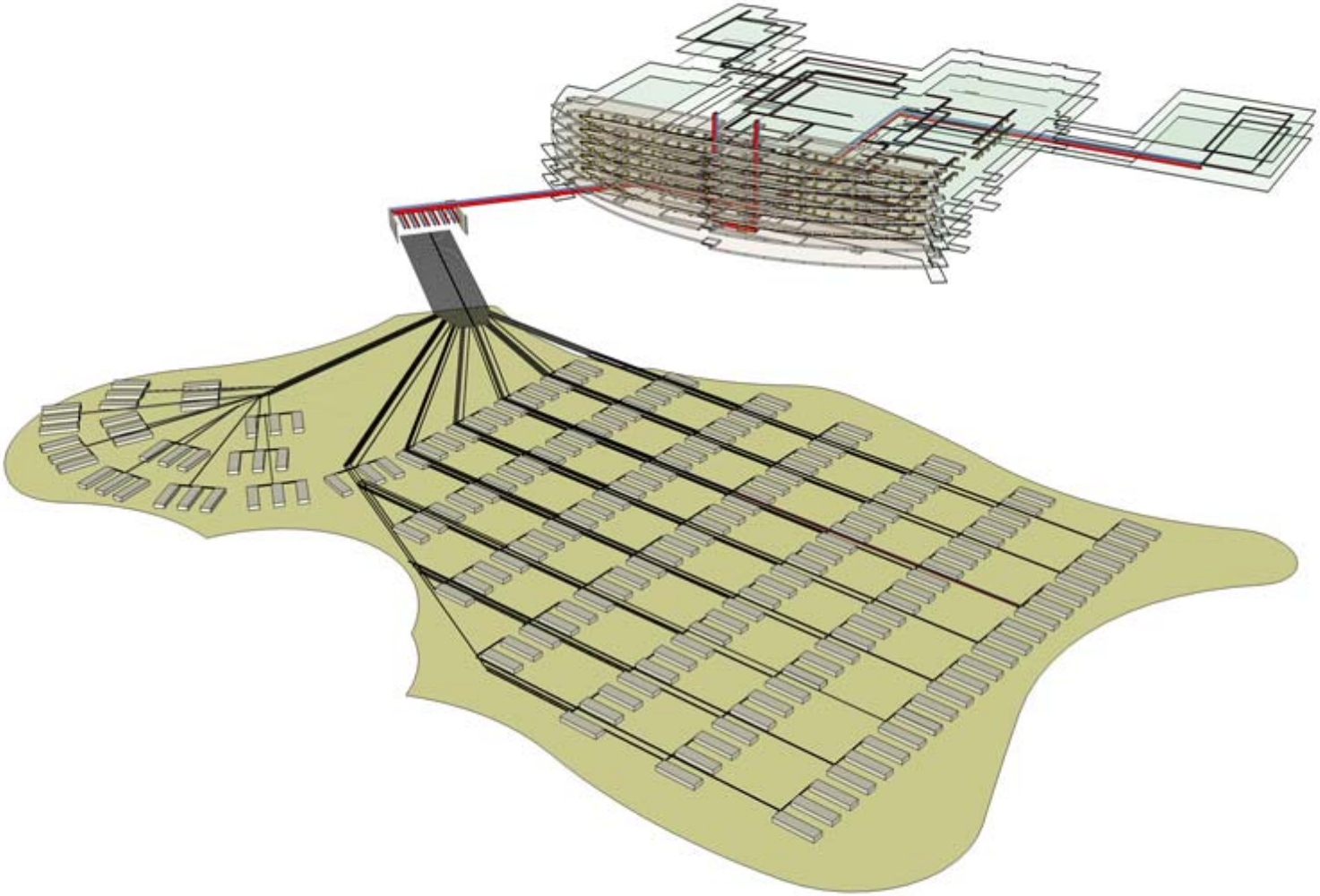
Aerial View



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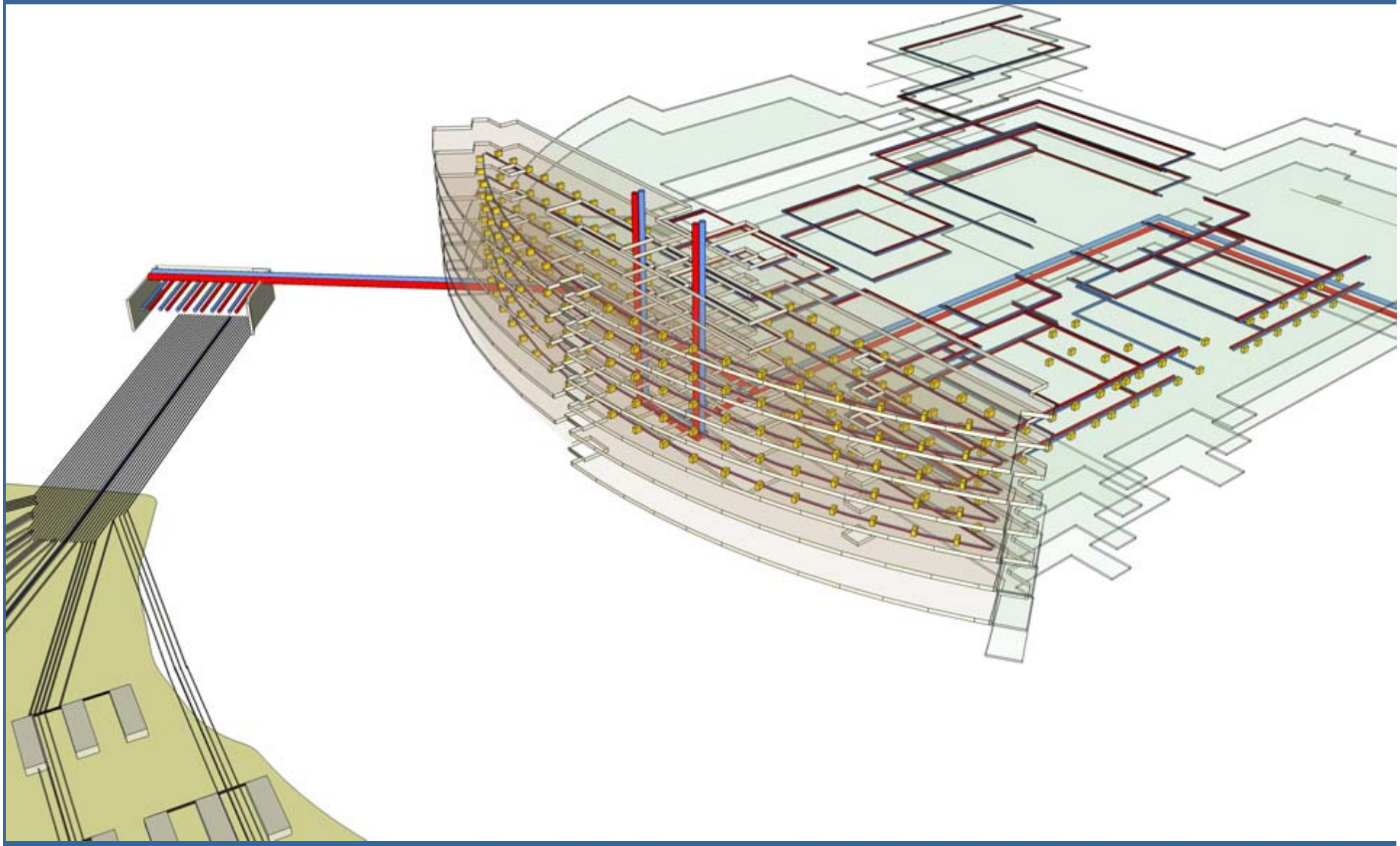

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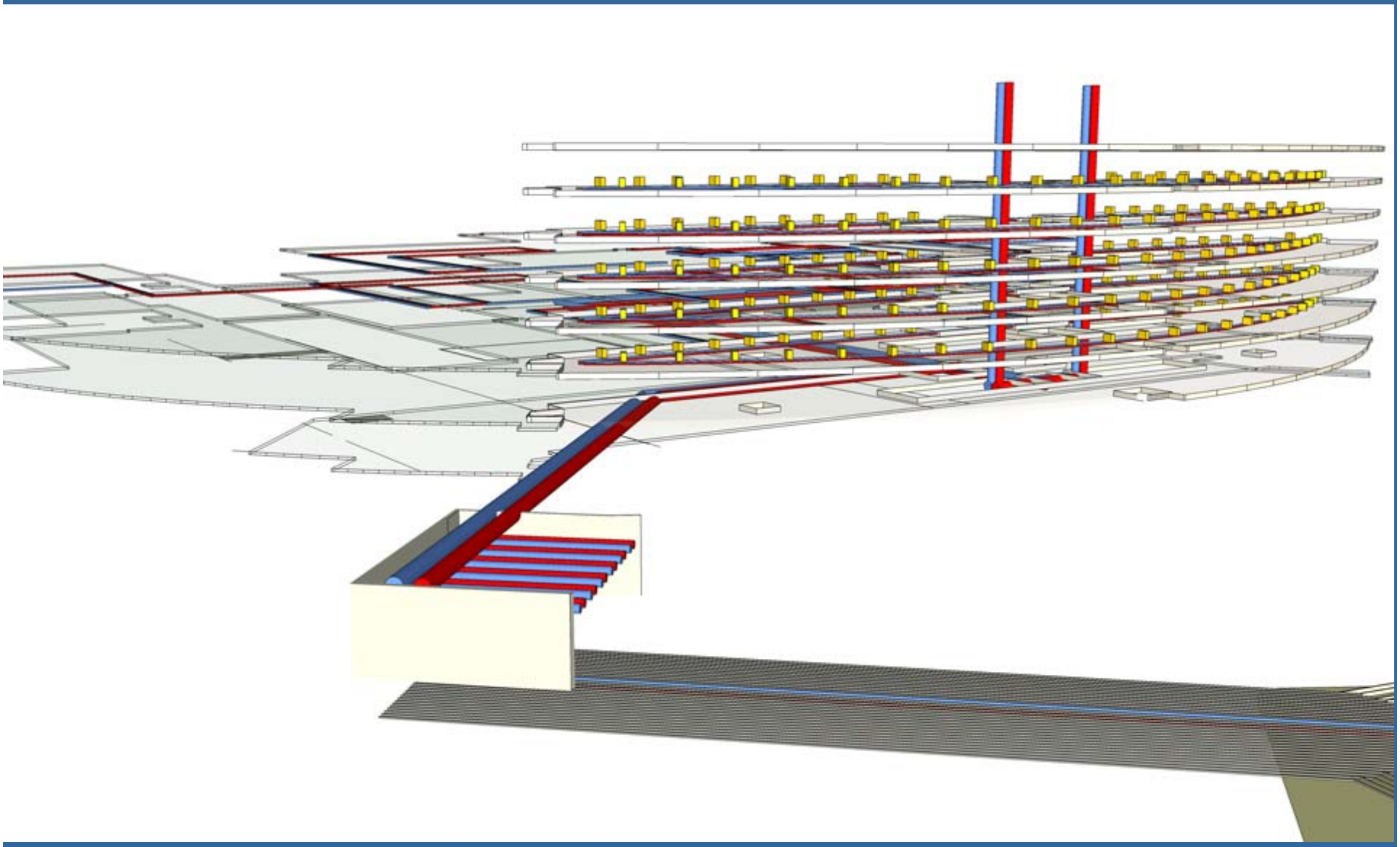

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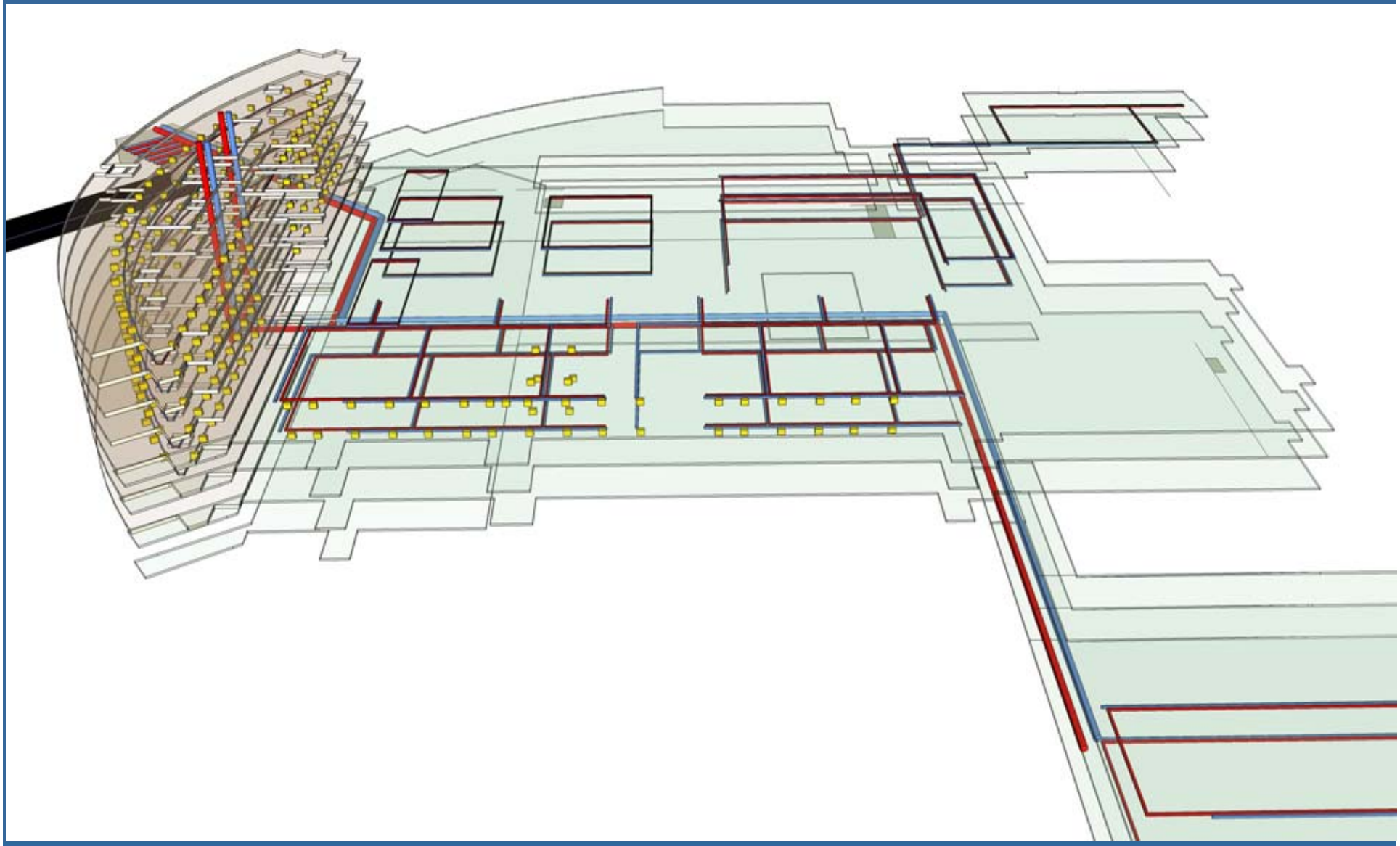
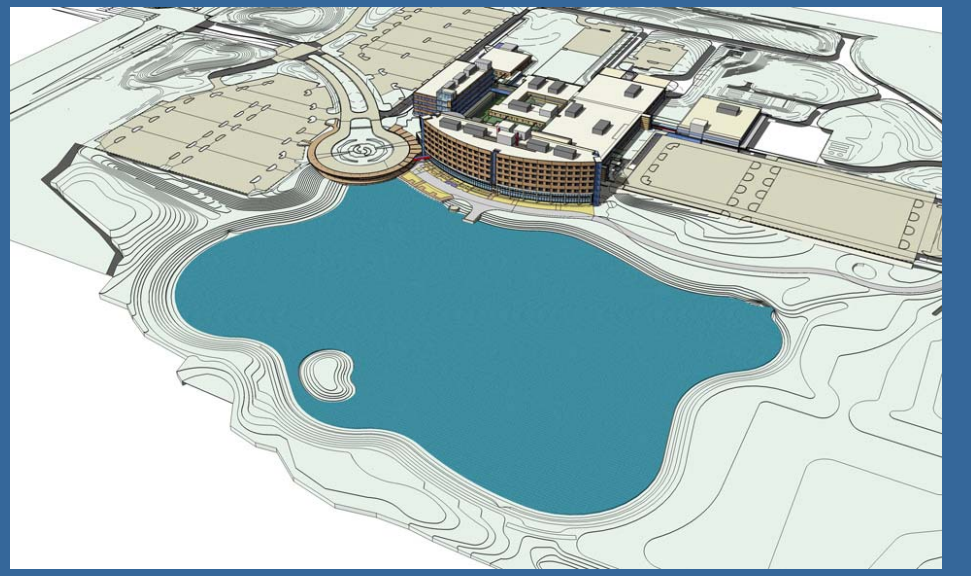


Sherman Hospital: Geothermal Benefits

- 15 acre, 17’ deep lake at Sherman will provide 2400 tons cooling
- Can expand to 3400 tons in future within lake footprint
- 175 rafts (150 miles of piping)
- 750 water-to-air heat pumps for comfort cooling
- 50 water-to-water heat pumps for infrastructure, air-handling systems
- Water level maintained with two wells: up to 6” evaporation during July



Sherman Hospital: Why Geothermal?

Innovation

=

"Best thing since they put beer in a can"

Masterplanning and Architecture

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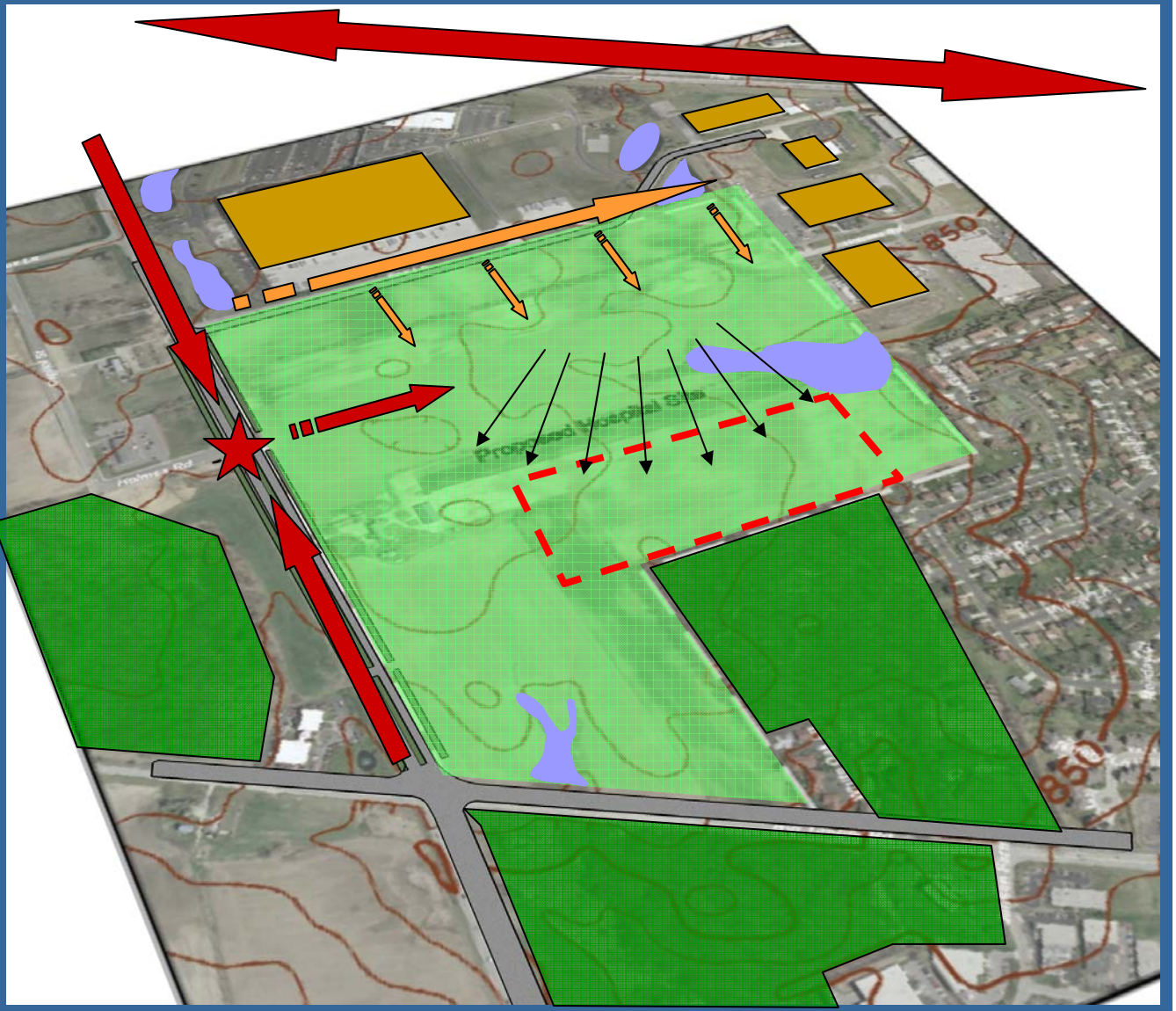
Site


Proposed Sherman Hospital
Replacement Campus
Holmes Rd
Fox Lane
Holmes Rd
Illinois Rte 31
County Hwy 34

Site Considerations

- I-90
- Randall Rd Entry
- Warehouses & service access
- Water Retention
- Forest Buffer
- Views & Light
- Open Space



Interview Scheme

Site Plan: Designed for Growth

Phase 1

Long Term

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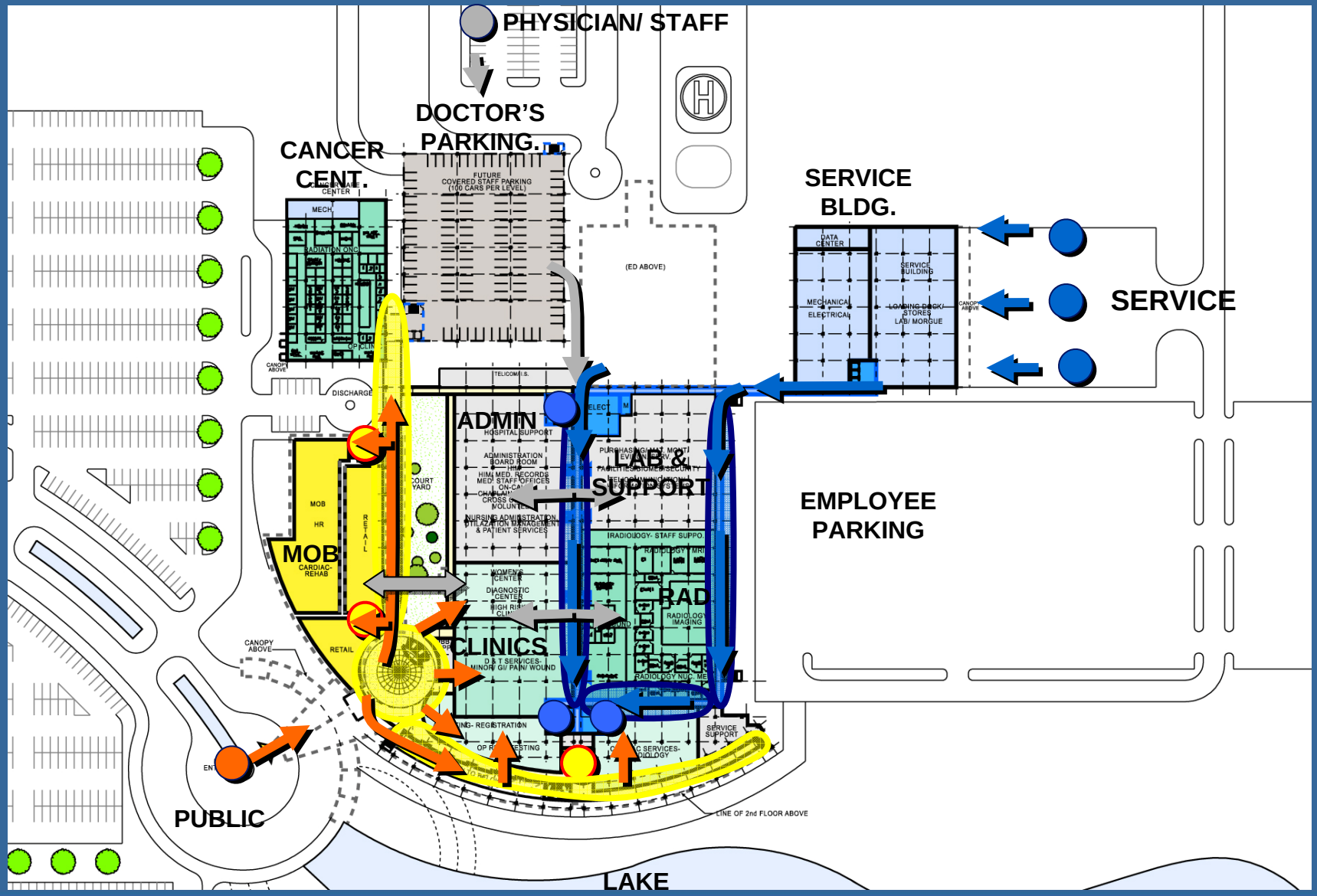
Site Plan: Designed for Growth

Intuitive Wayfinding



Healing Environment: Integration with the Landscape

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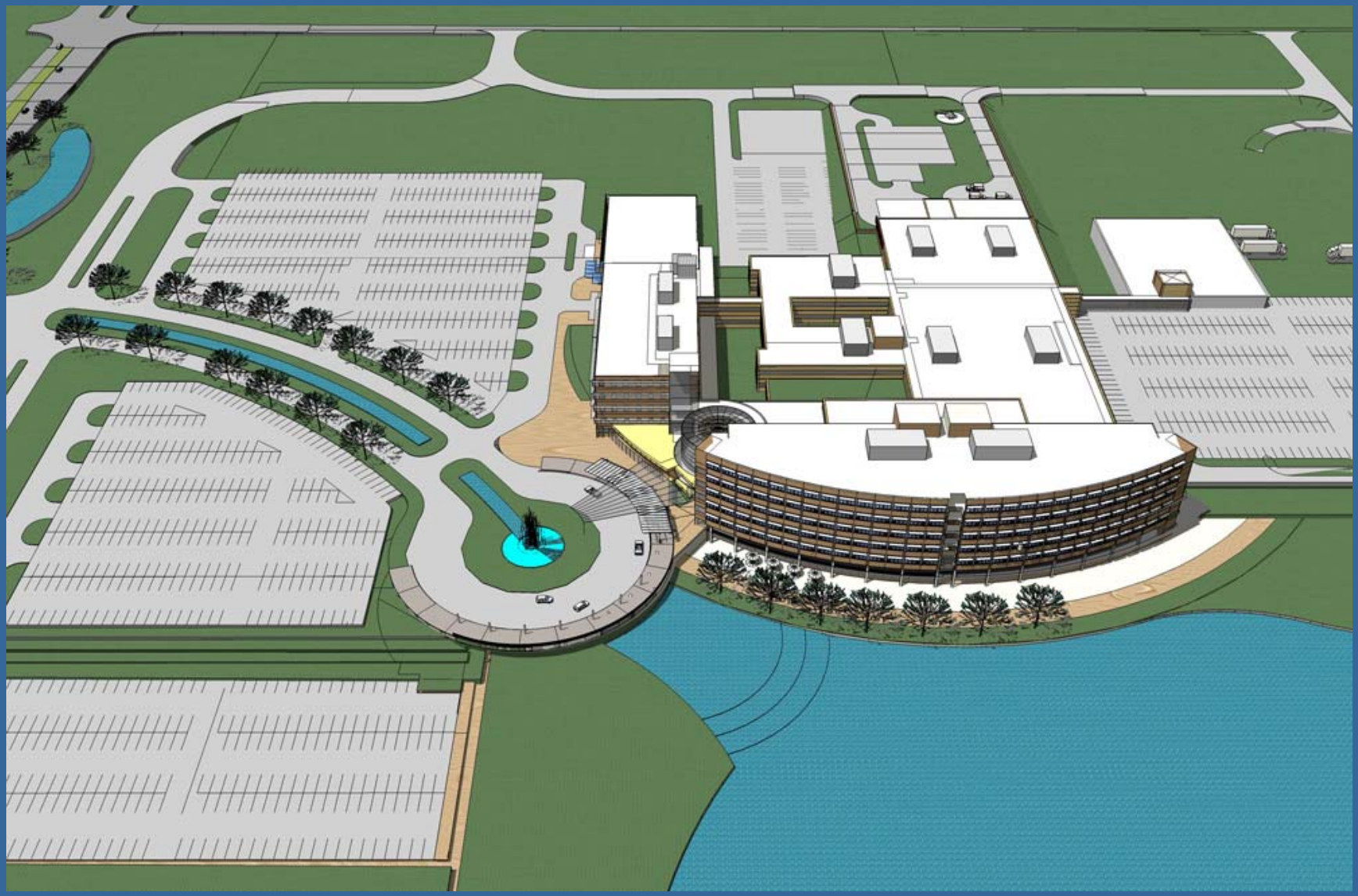

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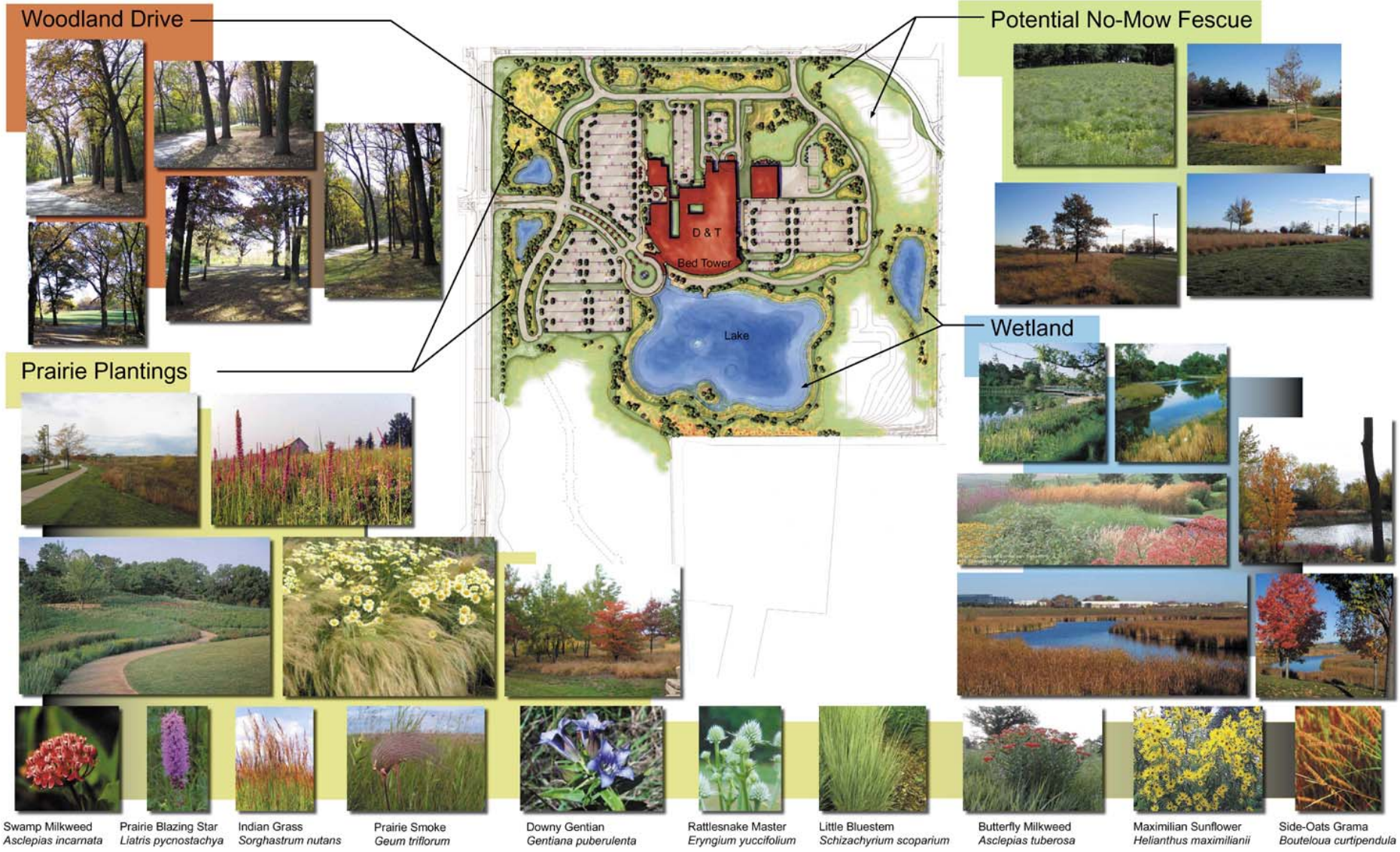
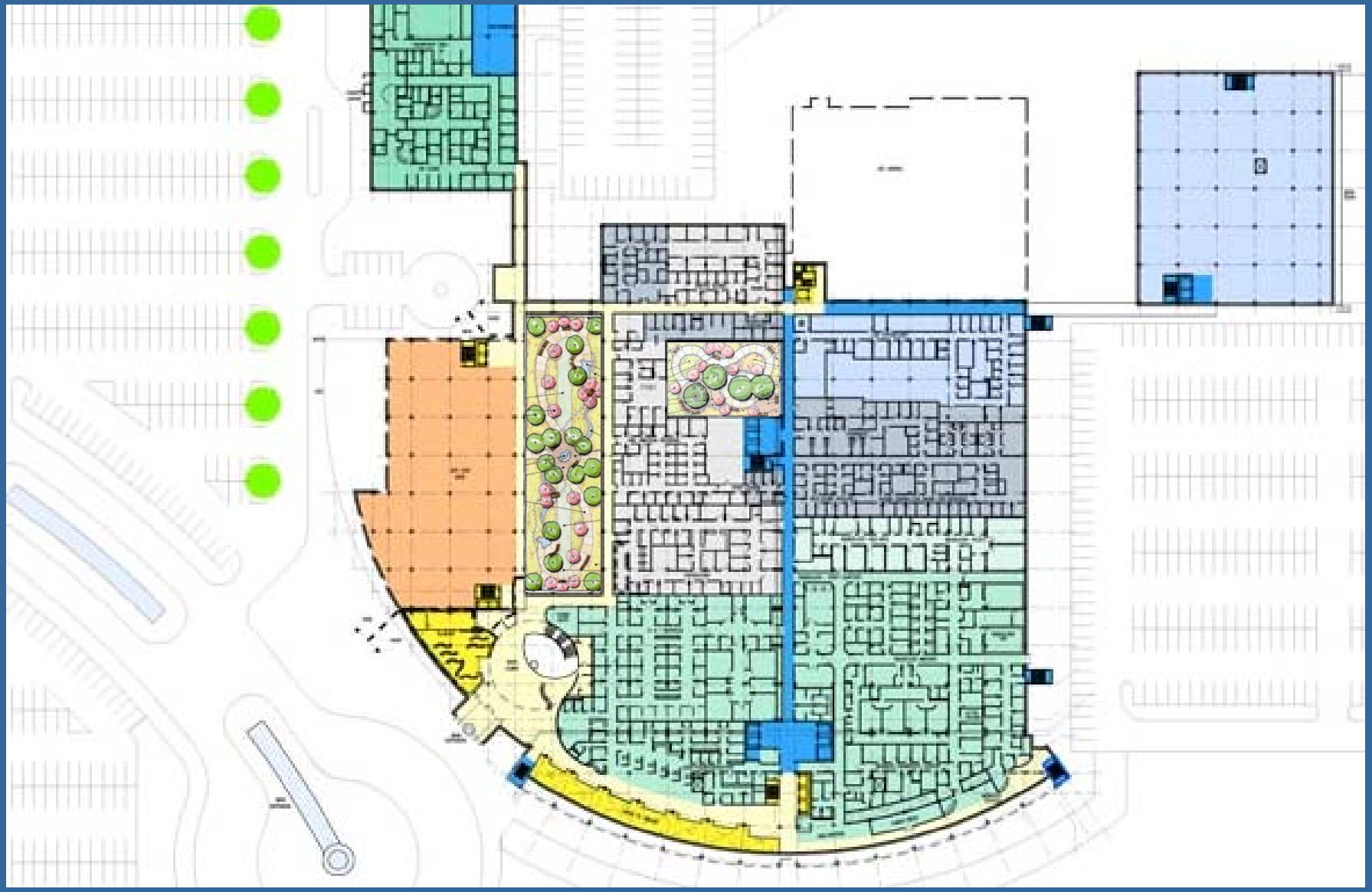
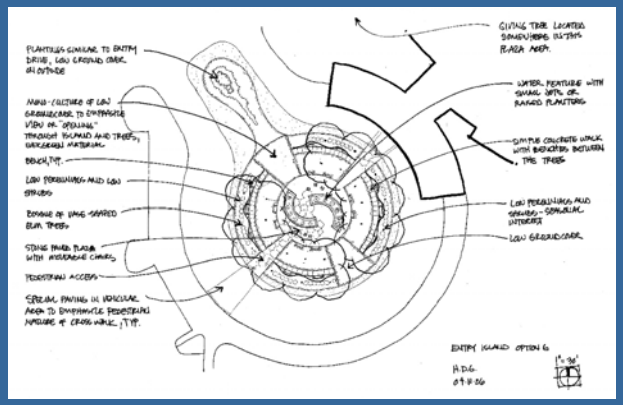
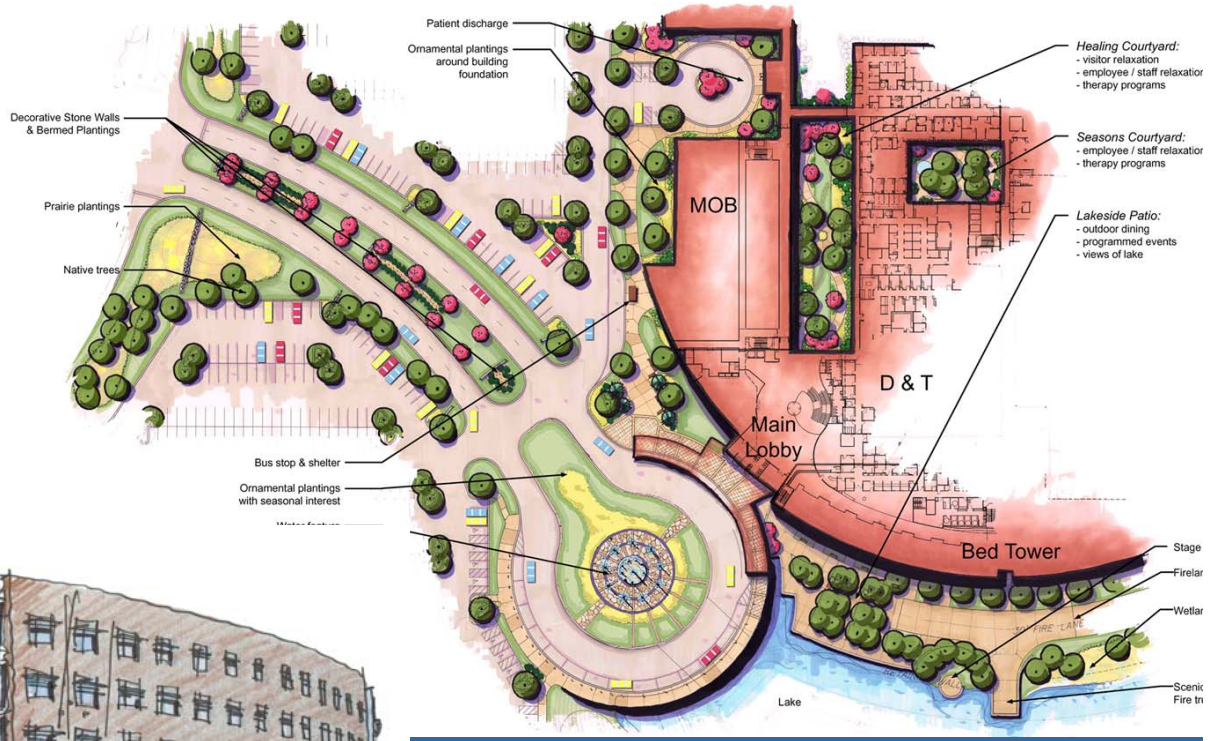


Healing Gardens



Healing Environment: A Sense of Place





Main Entry

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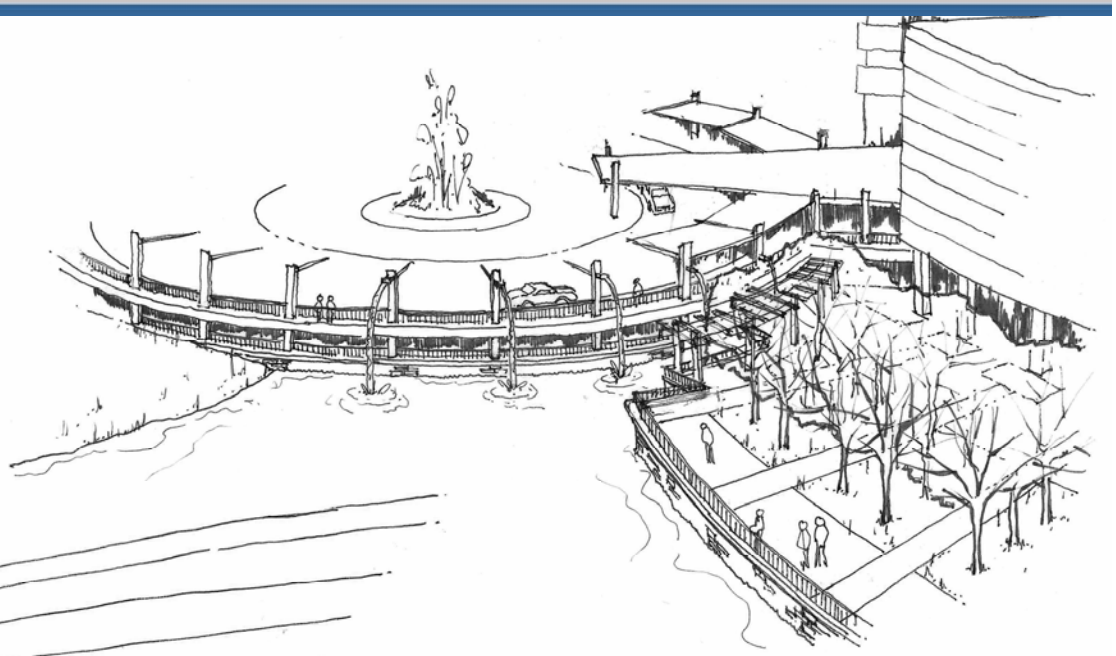
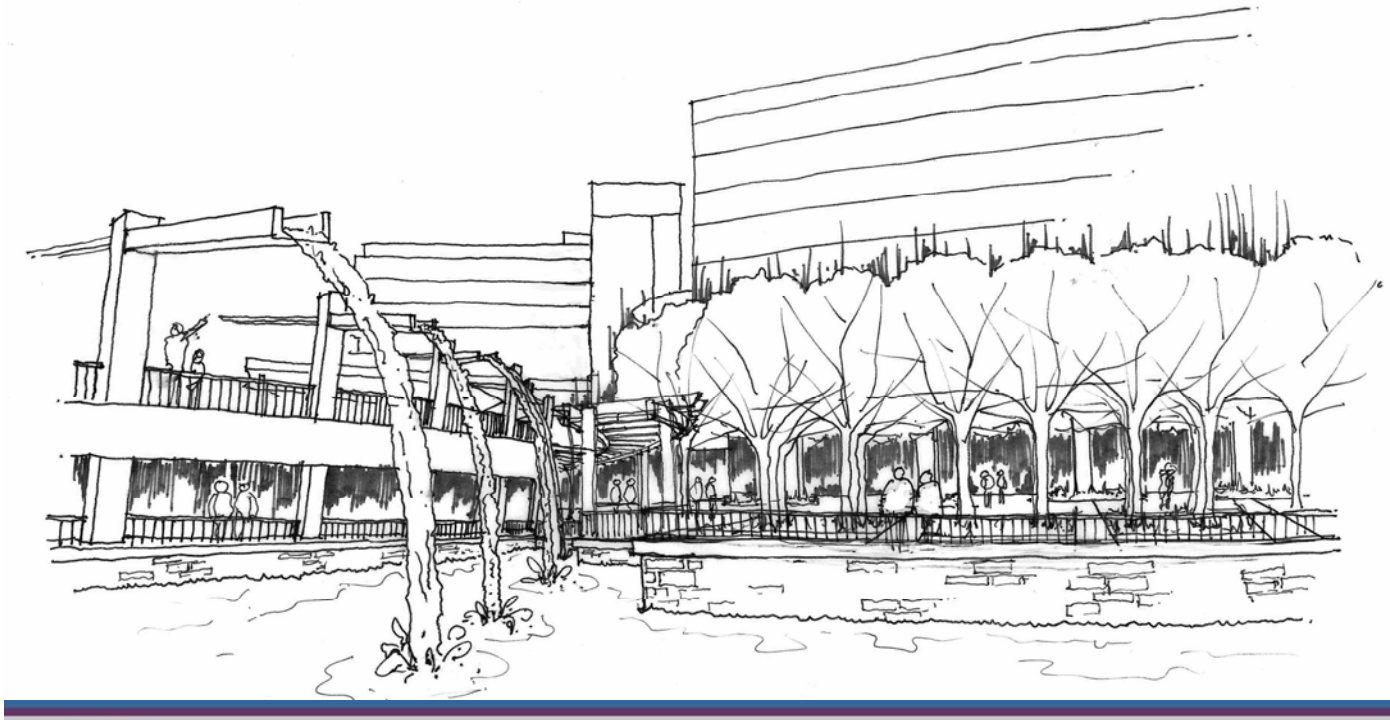
Healing Environment: A Sense of Place





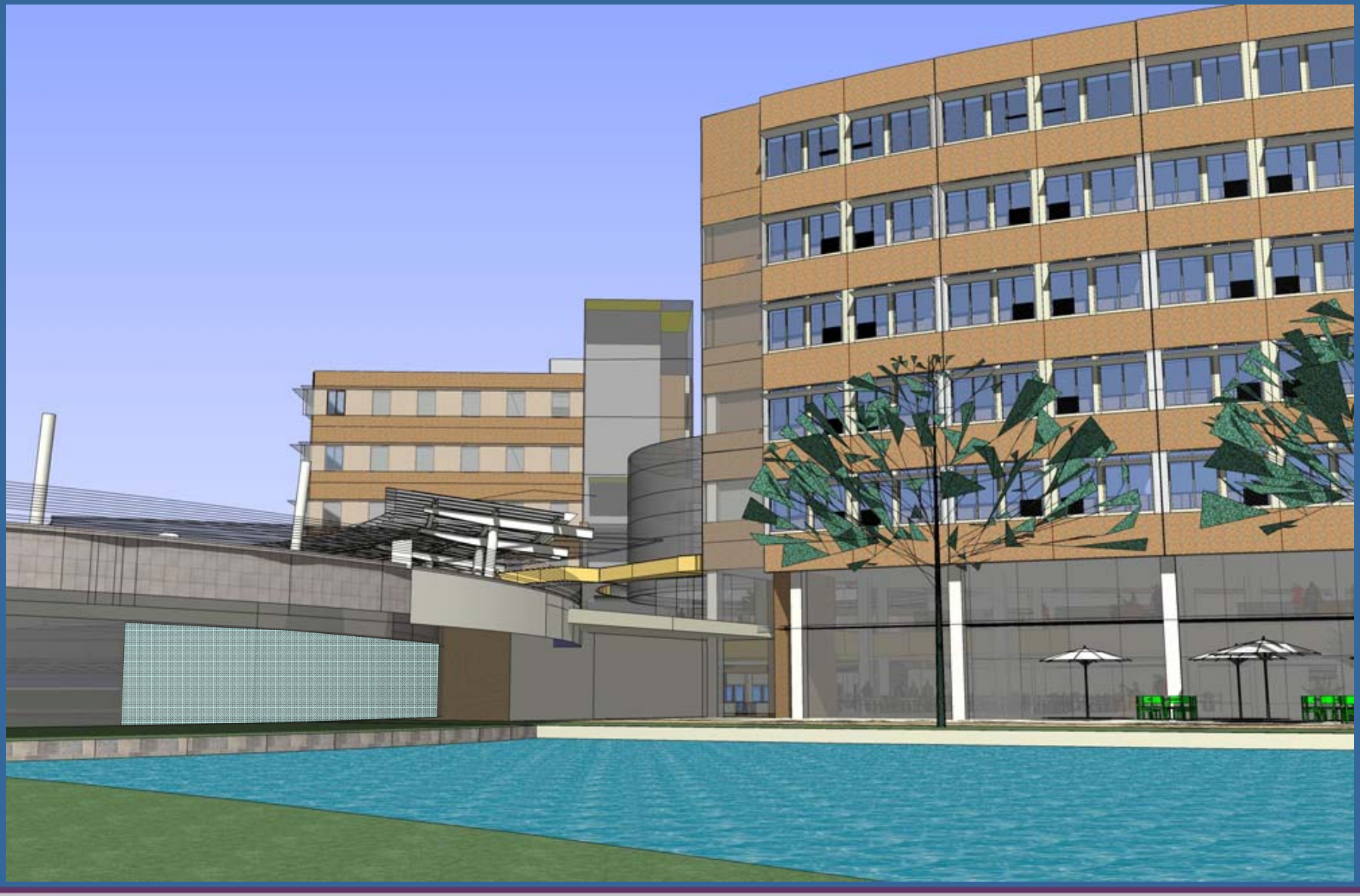
Healing Environment: A Sense of Place

Healing Environment: Prairie Aesthetic

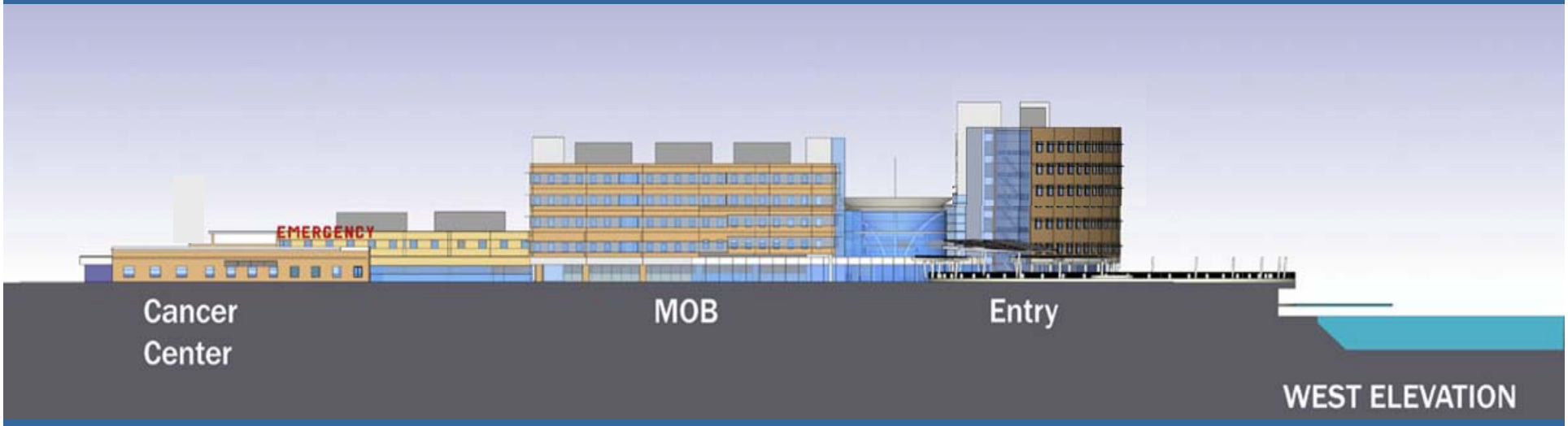
Healing Environment: Prairie Aesthetic

Lake Level Walk and Patio

Integration of Manifold Room and Main Entry



Healing Environment: Tree of Life Atrium



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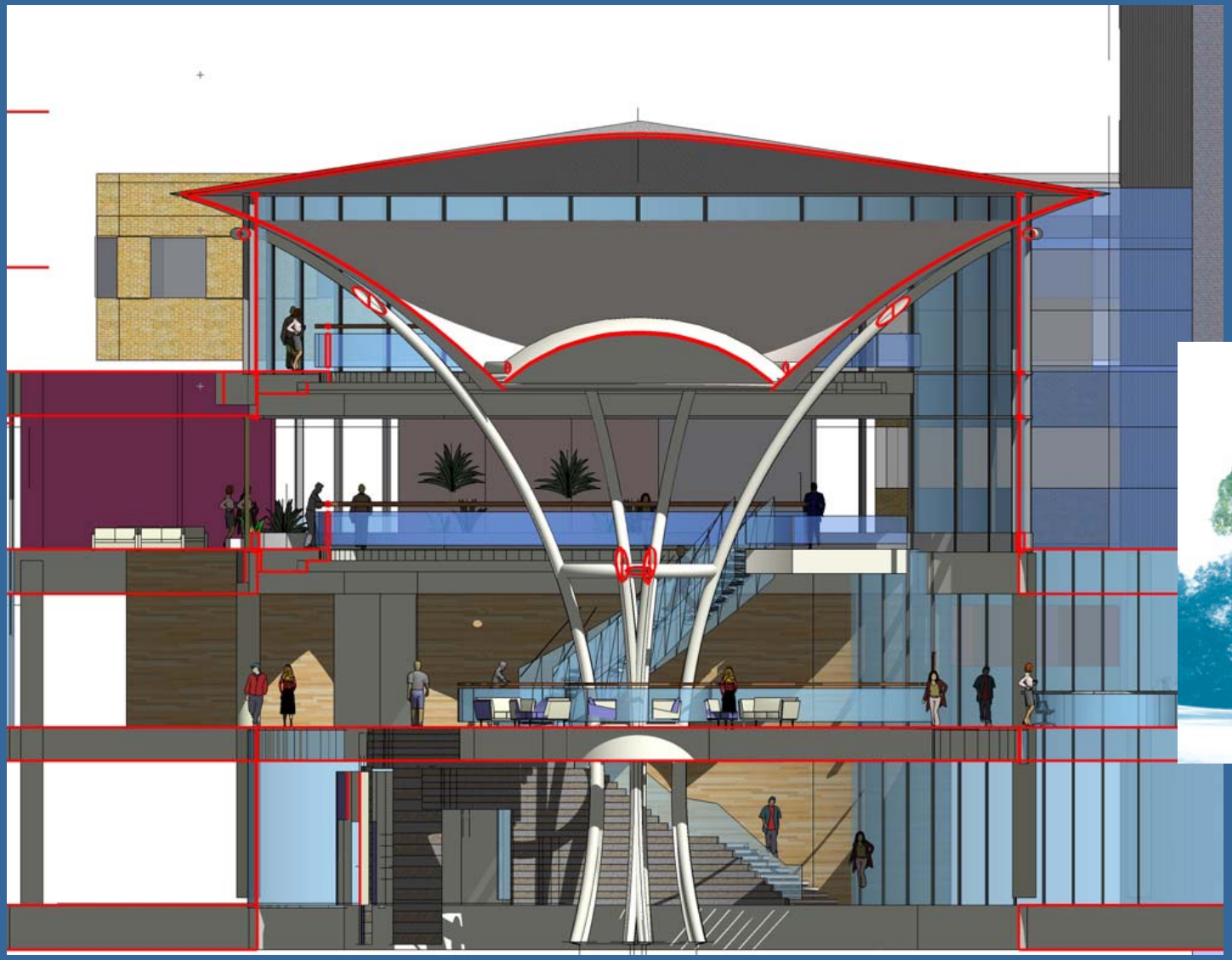

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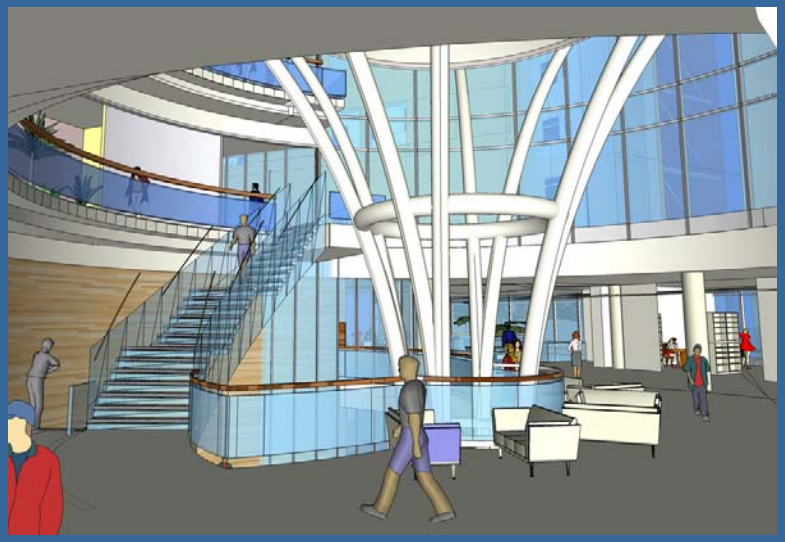
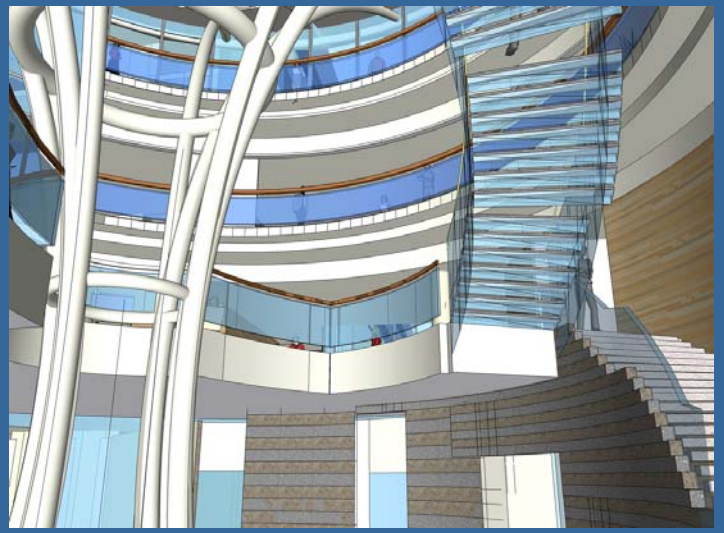
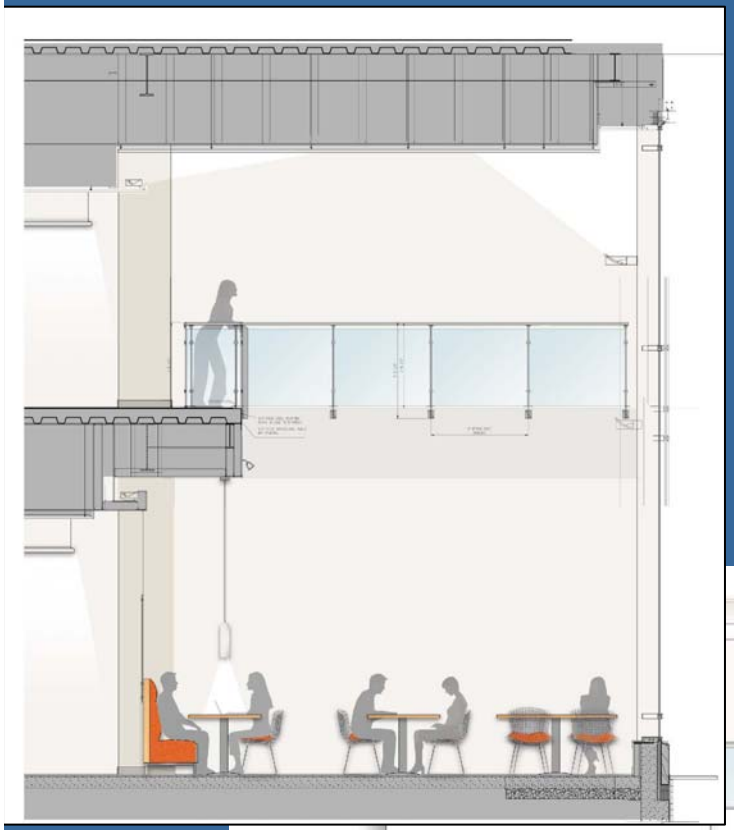
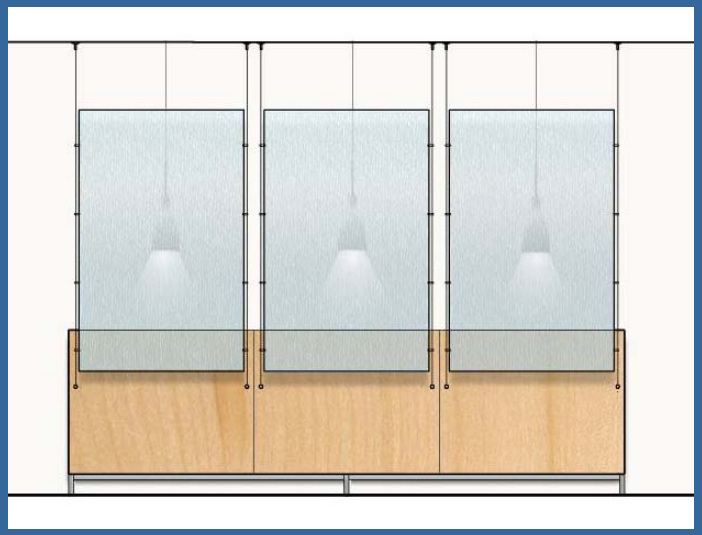




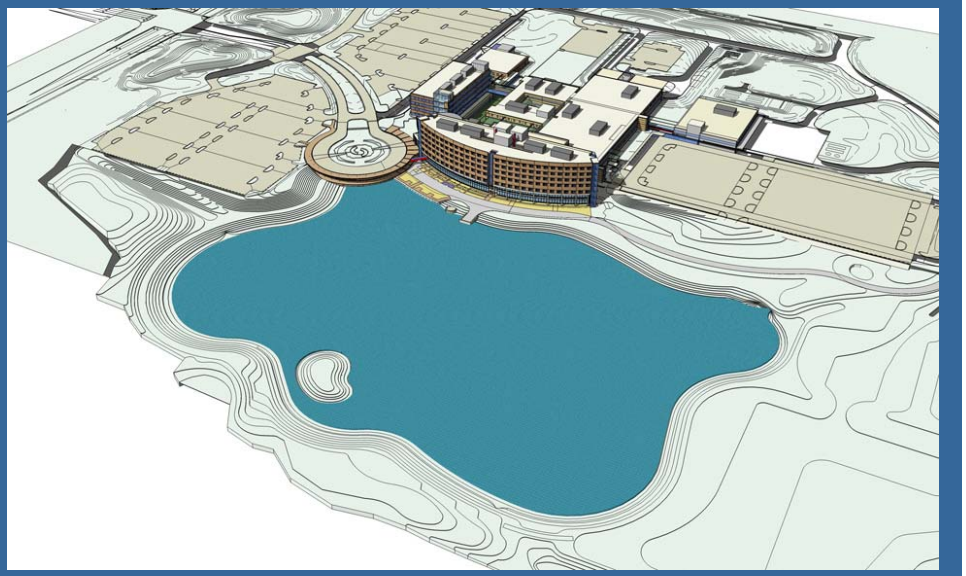
Healing Environment: Public Realm





Healing Environment: Geothermal System

- Lake serves multiple purposes
  - thermal source
  - therapeutic healing environment
  - storm water retention
- Excavated fill used to raise building pad 10’ for greater presence
- Irrigation system will use water from lake rather than city
- Manifold Room educates public about clean renewable energy



Lake Excavation: Progress

Lake Excavation: Progress

October 7, 2006

Questions and Answers

Sherman Health Replacement Hospital

People-focused Safe Innovative Efficient Environmentally-friendly Flexible

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