

University of Virginia

Energy and Utilities Master Plan

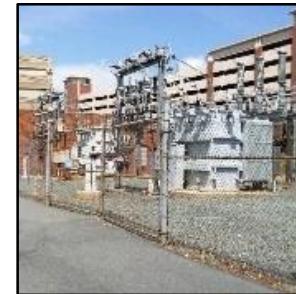
February 10, 2016

IT'S ALIVE!

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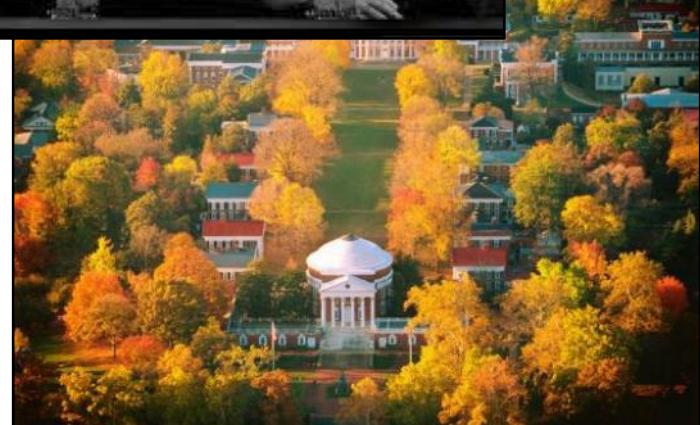
Master Plan Goals

- Assess and document deficiencies in the existing systems
 - Heating
 - Cooling
 - Electrical
 - Sanitary Sewer
 - Water
 - Stormwater
- Identify and evaluate opportunities to:
 - Reduce energy usage
 - Minimize financial and operational risks
 - Enhance reliability and service
 - Evaluate opportunities to enhance UVA's environmental stewardship



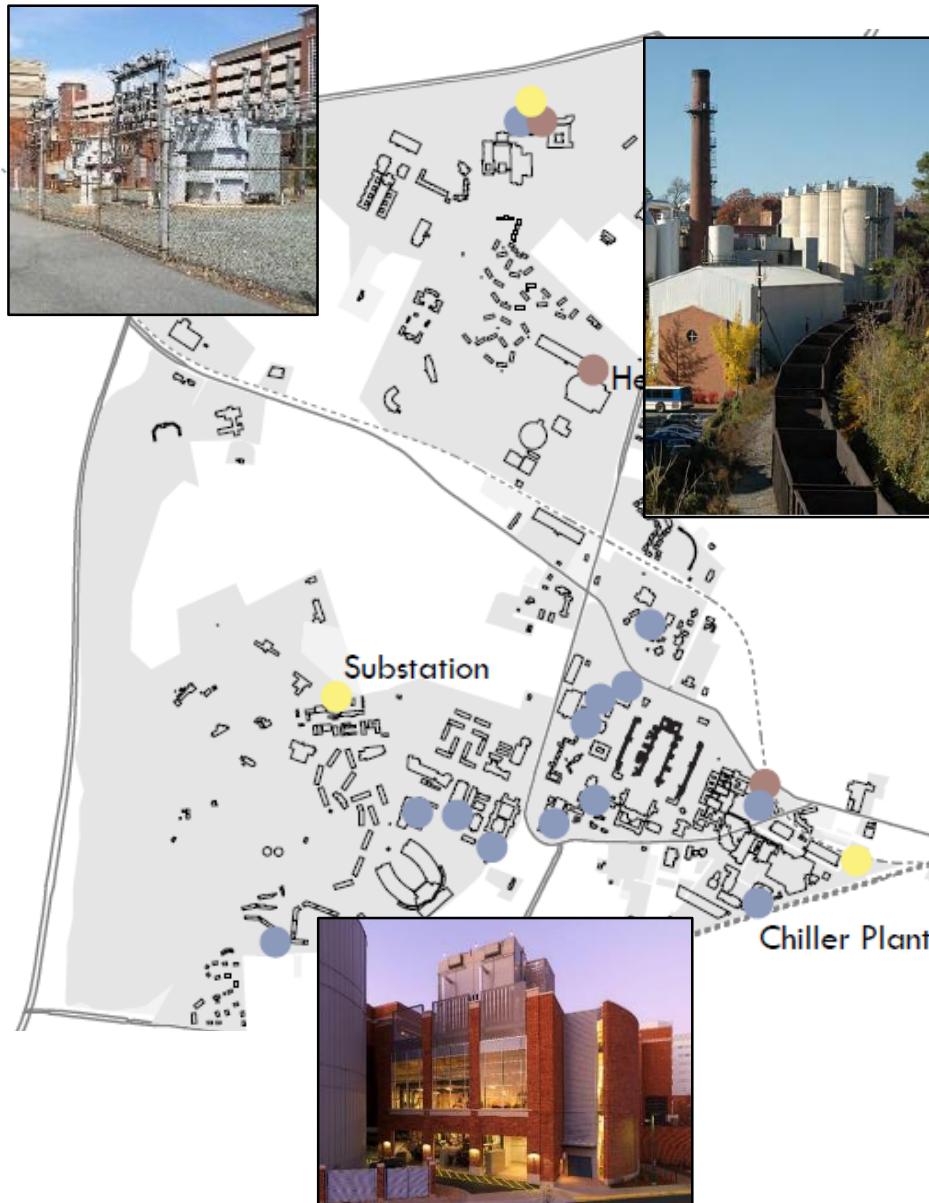
Master Plan Goals

- Plan for capital renewal and growth
 - 25 year horizon
 - 16 MM to 22 MM GSF
 - Load projections and analysis
 - Capacity additions
 - Distribution system modeling
- Create a “Roadmap”
 - Comprehensive project list
 - Budgetary costs
 - Integrate with GIS?
 - A “Living” plan



Existing Conditions

- Three district heating plants
 - 500,700 MBH / 275,000 MBH
 - Steam and MTHW
 - Coal and natural gas
- Seven main regional chilled water loops
 - 50,300 Tons / 32,800 Tons
 - Electric centrifugal chillers
- Three substations
 - 128 MVA / 61 MVA
- Good level of redundancy and reliability



Load Projection Summary



Time Frame	Heating (MBH)	Electrical (MVA)	Cooling (Tons)	Potable Water (Peak Hourly Demand - GPM)	Sanitary Sewer (Peak Day Flow - GPM)
Existing	275,013	61.2	32,754	2,712	1,868
0 - 5	304,436	66.4	39,179	3,601	2,290
6 - 10	350,621	70.3	43,561	3,953	2,490
11 - 15	377,226	72.4	48,404	4,207	2,607
16 - 20	394,207	73.6	50,533	4,362	2,717
20 - 25	433,887	77.0	55,385	4,656	2,950
25+	478,524	80.6	59,579	4,901	3,060

Increase

74%

32%

82%

81%

64%

Major Recommendations

- 13.4 MW CHP and 4.7 MW Other Power Generation
- Dedicated natural gas service and phase out of coal
- Continued conversion from steam to hot water distribution
- Install DVP “express” substation feeders to increase reliability
- Implementation of more CHW optimization and conservation strategies
- Optimization of operation and quality testing program for DCW
- Correct sanitary inflow and infiltration (I&I) deficiencies
- Develop strategies for implementation and compliance with new stormwater National Pollutant Discharge Elimination System (NPDES) regulatory requirements

Master Project List Cost Summary

Time Frame	Heating	Electrical	Cooling	Potable Water	Sanitary Sewer	Storm Water	Sub-Totals
TBD	\$ -	\$ -	\$ -	\$ -	\$ 797,000	\$ -	\$ 797,000
0 - 5	\$ 46,665,000	\$ 7,102,500	\$ 44,360,000	\$ 11,217,600	\$ 3,445,800	\$ 4,605,600	\$ 117,396,500
6 - 10	\$ 71,880,000	\$ 9,155,000	\$ 77,790,000	\$ 2,794,900	\$ 1,919,900	\$ 13,447,000	\$ 176,986,800
11 - 15	\$ 18,144,000	\$ 2,015,000	\$ 47,420,000	\$ 809,800	\$ 617,000	\$ 2,093,400	\$ 71,099,200
16 - 20	\$ 3,525,000	\$ 2,160,000	\$ 30,450,000	\$ 169,100	\$ 1,558,400	\$ 1,944,600	\$ 39,807,100
20 - 25	\$ 11,052,000	\$ 4,210,000	\$ 56,370,000	\$ 2,989,300	\$ 1,862,500	\$ 62,700	\$ 76,546,500
25+	\$ 14,465,000	\$ 3,260,000	\$ 44,660,000	\$ 1,939,300	\$ 5,820,000	\$ -	\$ 70,144,300
Sub-Totals	\$ 165,731,000	\$ 27,902,500	\$ 301,050,000	\$ 19,920,000	\$ 16,020,600	\$ 22,153,300	\$ 552,777,400



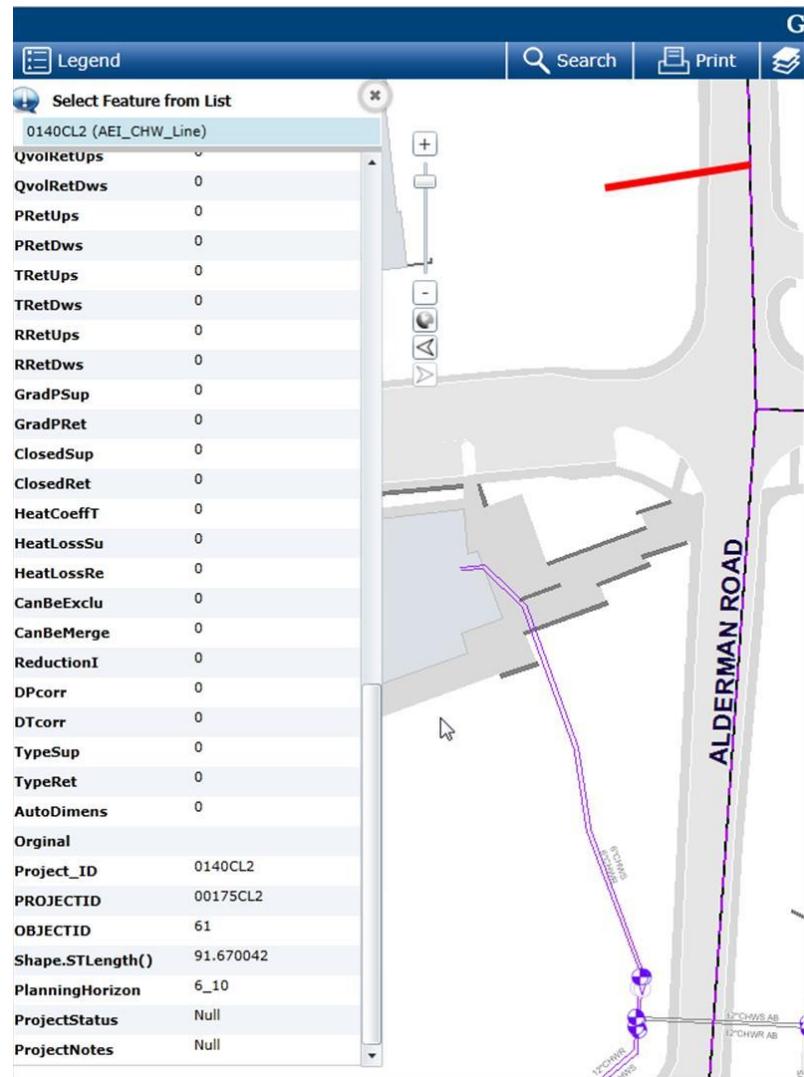
“Living” Distribution Modeling

- Systems and Software
 - Heating – KY Pipe
 - Cooling – Termis*
 - Sanitary Sewer – Innovyze InfoSewer*
 - Water – Innovyze InfoWater*
 - Stormwater – Innovyze InfoSWMM*
- GIS Integration
 - Compatibility with UVA’s GIS Programs
 - Direct import of mapping and attributes
 - “Automatic” updates to GIS
- UVA Owns and Maintains Models

* GIS compatible software

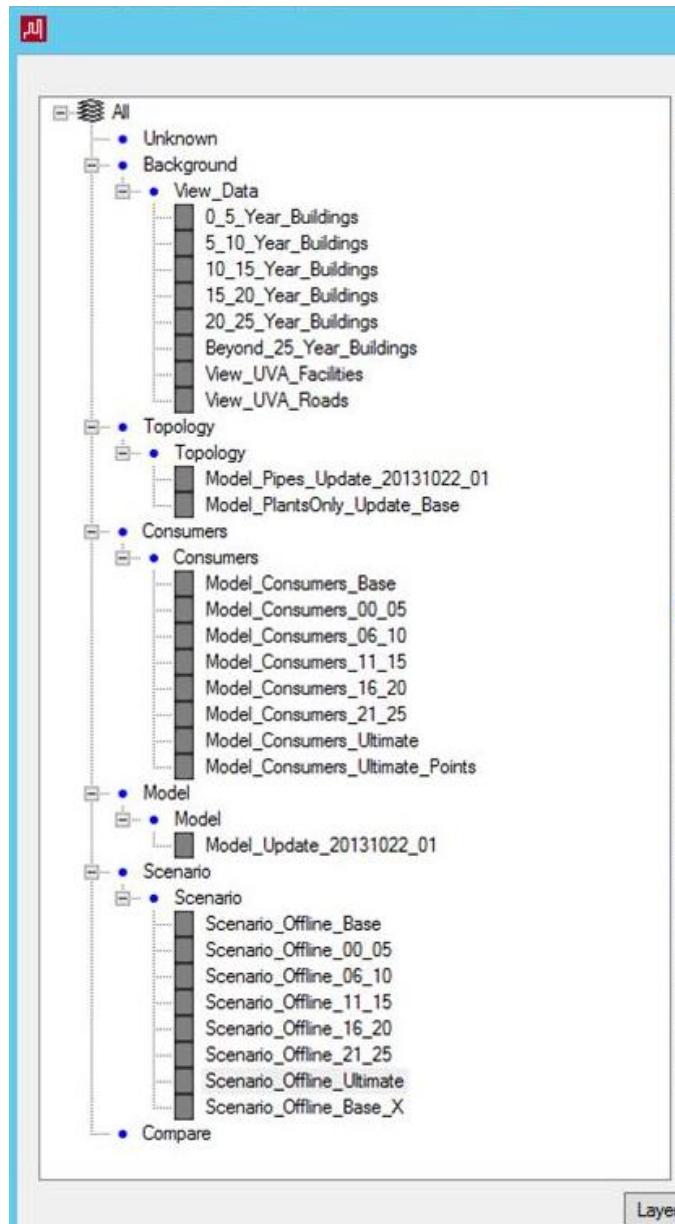
“Living” Distribution Modeling – CHW Example

- UVA “cleaned-up” the existing CHW GIS for use with hydraulic modeling
 - GIS pipe routing/size reviewed
 - Attributes to GIS model for pipe properties (material and analysis outputs)
 - Modeling effort validated GIS accuracy
- Performed “test runs” of existing CHW model and compared to metered data
 - Small adjustments and corrections made to align with measurements



“Living” Distribution Modeling – CHW Example

- Utilizing the layer function in Hydraulic Model program to separate piping into different time horizons
 - First built “Beyond 25 Year” model
 - Removed pipes and loads to step backwards through time
 - Program has functionality to automatically size pipes based on velocity/differential pressure parameters



“Living” Distribution Modeling – CHW Example



Current Scenario

- Model results for pipeline upgrades/ additions for each timeframe imported into GIS model



25+ Year Scenario



“Living” Master Project List

- Complete Master Plan Project List compiled
- Nearly 500 individual projects identified
- Project information and cost
- Synergy reviews / groupings
- Linked to GIS



Project Number	Main Project ID	Sub Project ID	Project Timeframe	System	Capacity / Distribution	Project Description	Project Cost (in 2014 Dollars)
1001CL1	1001	CL1	0-5 Years	Cooling	Distribution	Extend McCormick Loops System Piping to McCormick Dorms	\$ 2,120,000
1001HT1	1001	HT1	0-5 Years	Heating	Distribution	12" MTHW Main Piping Tunnel from Chemistry to Leake (Main Campus)	\$ 7,443,800
1002CL1	1002	CL1	0-5 Years	Cooling	Distribution	Interconnect New Newcomb Road Chiller Plant to McCormick Loop with System Piping	\$ 2,020,000
1003CL1	1003	CL1	0-5 Years	Cooling	Capacity	Remove five existing 1,200 ton Chillers in the North Chiller Plant, as they have reached their useful life.	\$ 420,000
1004CL1	1004	CL1	0-5 Years	Cooling	Capacity	Remove Existing R22 Chillers from Gooch/Dillard and Hereford Plants.	\$ 140,000
1004CL2	1004	CL2	0-5 Years	Cooling	Distribution	Extend McCormick Road System Piping to Gooch/Dillard and Hereford.	\$ 2,630,000
1005CL1	1005	CL1	0-5 Years	Cooling	Capacity	Add one 1,200 ton chiller to Massie Road Plant.	\$ 3,360,000
1006CL1	1006	CL1	0-5 Years	Cooling	Capacity	Add one 1,200 ton chiller to North Grounds Plant	\$ 3,360,000
1006CL2	1006	CL2	0-5 Years	Cooling	Distribution	Extend System Piping to Monsanto Development Area and Falkner House.	\$ 2,830,000
1007CL1	1007	CL1	0-5 Years	Cooling	Capacity	Add two 2,000 ton chillers to East Chiller Plant. This represents the full build out of current plant shell.	\$ 9,520,000
1008HT1	1008	HT1	0-5 Years	Heating	Capacity	New Fontaine Redevelopment Zone Heating Plant - (2) 10,000 MBH Boilers	\$ 2,912,000
1008HT2	1008	HT2	0-5 Years	Heating	Distribution	6" to 10" HW Direct Buried Distribution Mains (Fontaine Redevelopment Zone)	\$ 1,393,000
1008CL1	1008	CL1	0-5 Years	Cooling	Capacity	New Future B Chiller Plant. 5,400 Tons Ultimate Capacity. Two 1,200 ton and one 400 ton chillers initial.	\$ 24,480,000
1008CL2	1008	CL2	0-5 Years	Cooling	Distribution	Extend System Piping to Master Plan Building 48, 49 and 50, and to Ray C. Hunt Drive 560	\$ 1,520,000
1008EL1	1008	EL1	0-5 Years	Electric	Capacity	Install new Fontaine Substation.	\$ 1,500,000
1008EL2	1008	EL2	0-5 Years	Electric	Distribution	Electrical Service to Future Chiller Plant B	\$ 225,000

“Living” Master Project List

2015 1118 UVA EU Master Plan Projects List All Utilities - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER ADD-INS ACROBAT POWERPIVOT DESIGN George Howe

Cut Copy Format Painter Clipboard Font Alignment Number Styles Cells Editing

Normal 3 Normal Conditional Formatting Table Insert Delete Format AutoSum Fill Sort & Find & Filter Clear

H2 Replace Lateral - Lateral from MH SAUV60100 to North Chiller Plant

Main Proj	Project Number	Project Timeframe	System	Capacity / Distribution / I&I / Repair	Project Description	Project Cost (in 2014 Dollars)	Priority	E&U Filter
1	0001	001SS1	TBD	Sanitary Sewer	I&I - East Precinct	Replace Lateral - Lateral from MH SAUV60100 to North Chiller Plant	\$9,100	Normal Yes
2	0002	002SS1	TBD	Sanitary Sewer	I&I - East Precinct	Point Repairs - Lateral from MH SAUV60105 to Hospital Link (forecemain per GIS)	\$22,120	Normal Yes
3	0003	003SS1	TBD	Sanitary Sewer	I&I - East Precinct	Install Cleanout - Lateral from MH SAUV60135 to Health Sciences Library	\$4,620	Normal Yes
4	0004	004SS1	TBD	Sanitary Sewer	I&I - East Precinct	Point Repair - MH SAUV60076 to MH SAUV60075	\$9,240	Normal Yes
5	0005	005SS1	TBD	Sanitary Sewer	I&I - East Precinct	Pipe Rehabilitation - MH SAUV60104 to MH SAUV60105	\$15,400	Normal Yes
6	0006	006SS1	TBD	Sanitary Sewer	I&I - East Precinct	Pipe Rehabilitation - MH SAUV60105 to MH SAUV60150	\$15,400	Normal Yes
7	0007	007SS1	TBD	Sanitary Sewer	I&I - East Precinct	Point Repair/Pipe and Manhole Rehabilitation - MH SAUV60125 to MH SAUV60130	\$34,580	Normal Yes
8	0008	008SS1	TBD	Sanitary Sewer	I&I - East Precinct	Pipe Rehabilitation - MH SAUV60150 to MH SAUV60145	\$2,940	Normal Yes
9	0009	009SS1	TBD	Sanitary Sewer	I&I - East Precinct	Flush Pipe/Install Cleanout/Pipe Rehabilitation - MH SAUV60106 to Medical School Building	\$19,180	Normal Yes
10	0010	0010SS1	TBD	Sanitary Sewer	I&I - East Precinct	Install Cleanout - MH SAUV60106 to MH SAUV60102	\$6,440	Normal Yes
11	0011	0011SS1	TBD	Sanitary Sewer	I&I - East Precinct	Pipe And Manhole Rehabilitation/Replacement - Central Grounds	\$40,600	Normal Yes
12	0012	0012SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Replace Cleanout Frame - Cleanout between MH SAUV40445 and North Grounds Rec Center	\$1,820	Normal Yes
13	0013	0013SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Replace Cleanout Cover - Cleanout for Abbot House	\$980	Normal Yes
14	0014	0014SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Elevate Manhole Frame and Cover - MH SAUV00165	\$980	Normal Yes
15	0015	0015SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Seal Riser Extension - MH SAUV40375	\$2,800	Normal Yes
16	0016	0016SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Pipe and Manhole Rehabilitation - MH SAUV40445 to MH SA100	\$320,180	Normal Yes
17	0017	0017SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Pipe and Manhole Rehabilitation - Rugby Faculty Apts.	\$65,660	Normal Yes
18	0018	0018SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Replace Cleanout Cover- Cleanout between MH SAUV40595 and Copeley Apartments #22	\$980	Normal Yes
19	0019	0019SS1	TBD	Sanitary Sewer	I&I - Meadow Creek	Re-route downspout to storm sewer - Downspout between PAV V & PAV VII	\$27,160	High Yes

READY Combined Projects Removed Project List

“Living Master Plan” in GIS

- Project Elements Illustrated – GIS “Objects”
- Project Information – GIS “Attributes”
- Project “Attributes” created from project list
- Other “Elements” and “Attributes” linked to modeling software
- Existing and future facilities incorporated
- All broken down into 5 year planning time frames can be viewed individually or collectively
- Live Demonstration

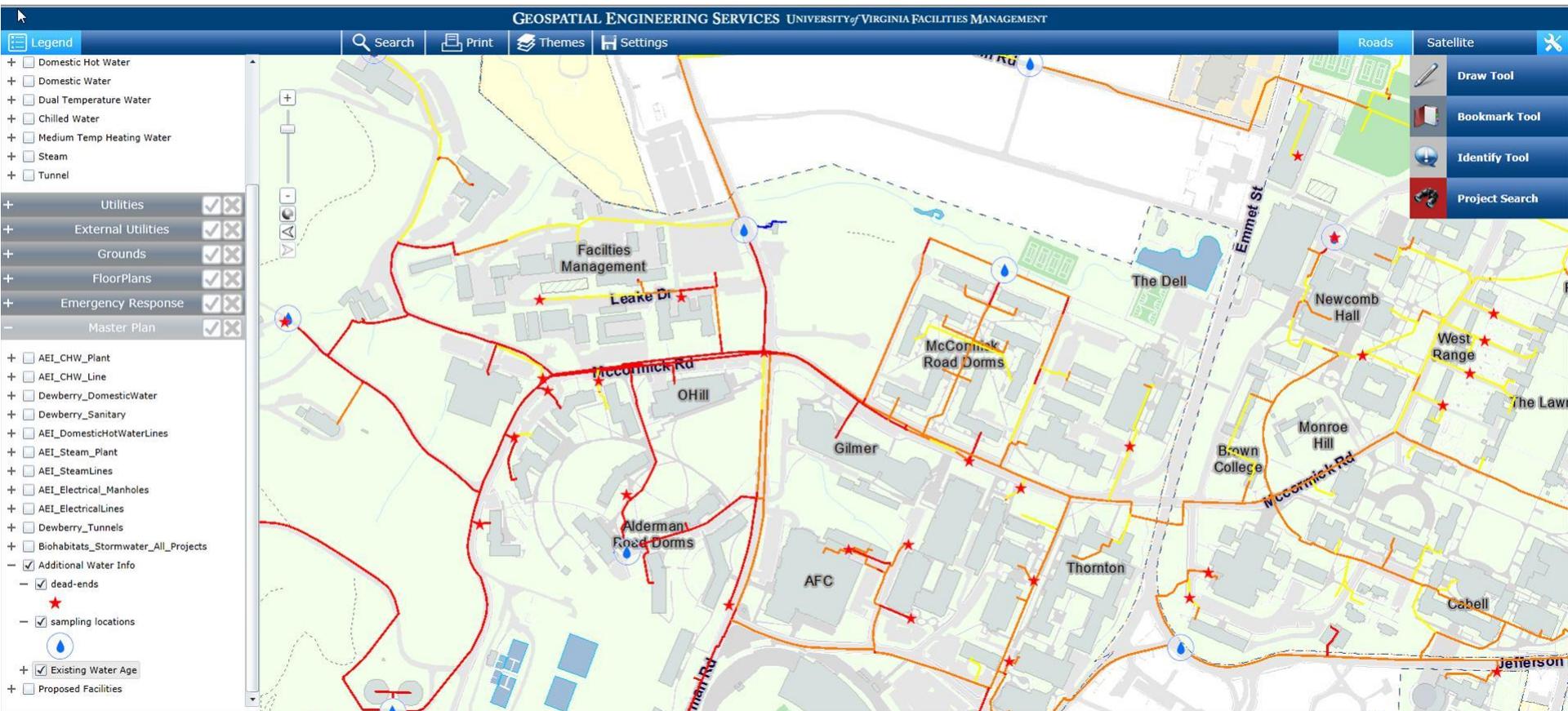


“Living Master Plan” in GIS – Live Demonstration



In lieu of Live Demonstration, see slides 16 though 20

“Living Master Plan” in GIS -



“Living Master Plan” in GIS

GEOSPATIAL ENGINEERING SERVICES UNIVERSITY OF VIRGINIA FACILITIES MANAGEMENT

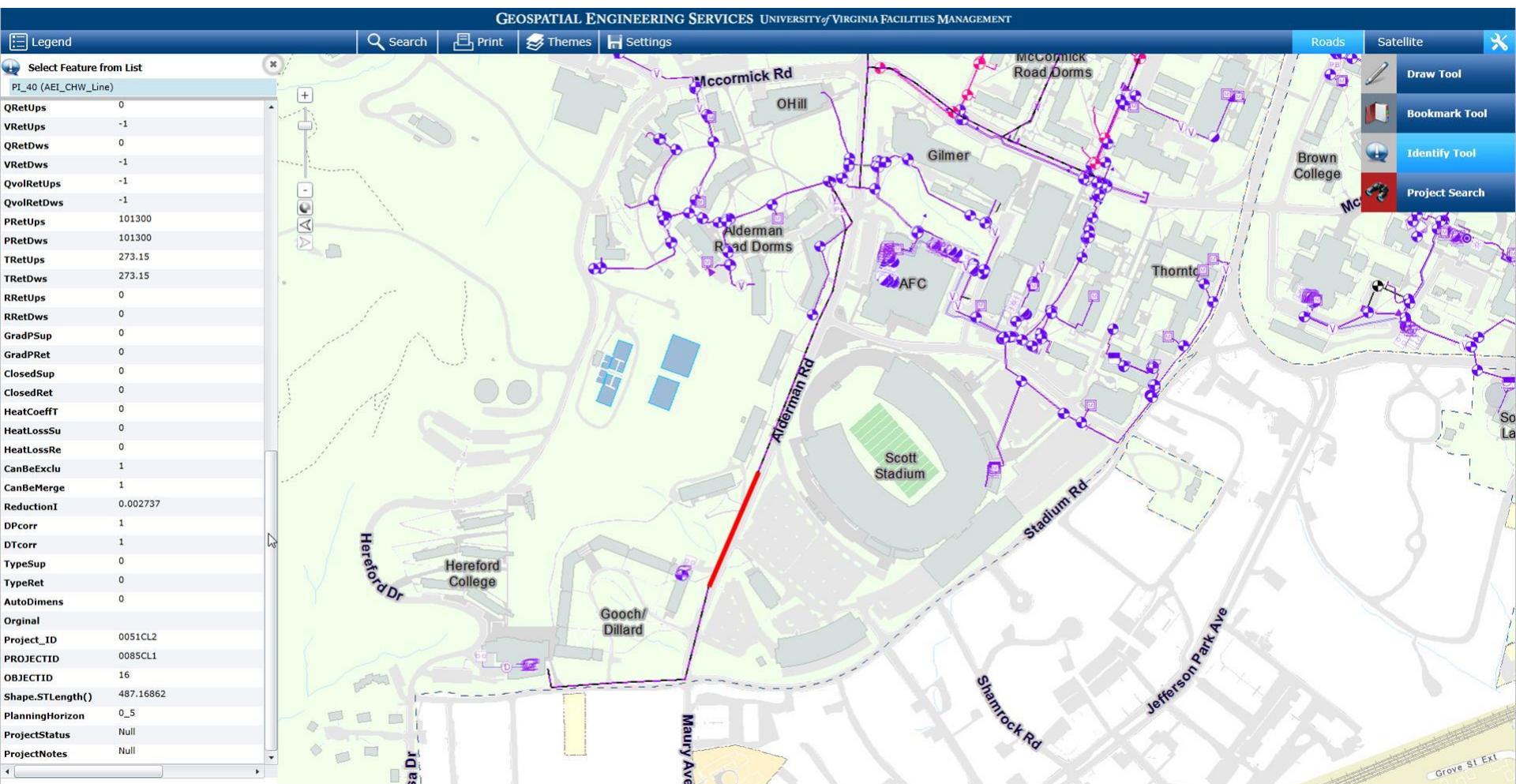
Legend | Search | Print | Themes | Settings | Roads | Satellite | Draw Tool | Bookmark Tool | Identify Tool | Project Search

Select Feature from List
HDPE (Chilled Water Lines)
HDPE 2634 (Chilled Water Lines)

OBJECTID: 2633
Material: HDPE
Notes: Tracer wire
Diameter: 12
Status: Active
IsInsulated: Null
Source: Null
SupplyReturn: Return
Type: Chilled
System: Null
UtilityInfrastructureID: 7264
LabelConc: Null
Test: 0
SystemType: Main
Project: Alderman 6
Installed: 4/1/2015
RuleID: Chilled, Active
T_InModel: No
T_Rough: Null
T_HeatXfer: Null
InnerDiameter: 12.4
Placement: Underground
Volume_Gal: Null
Shape.STLength(): 111.559642

McCormick Rd
OHill
Gilmer
McCormick Road Doms
Alderman Road Doms
AFC
Scott Stadium
Stadium Rd
Jefferson Park Ave
Shamrock Rd
Maury Ave
Gooch/Dillard
Hereford College
Hereford Dr
McCormick Rd
OHill
Gilmer
McCormick Road Doms
Alderman Road Doms
AFC
Scott Stadium
Stadium Rd
Jefferson Park Ave
Shamrock Rd
Maury Ave
Gooch/Dillard
Hereford College
Hereford Dr

“Living Master Plan” in GIS



“Living Master Plan” in GIS

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Legend | Search | Print | Themes | Settings | Roads | Satellite | X

Select Feature from List
DI (Chilled Water Lines)
DI 2231 (Chilled Water Lines)

OBJECTID: 2228
Material: DI
Notes: Null
Diameter: 12
Status: Active
IsInsulated: No
Source: Null
SupplyReturn: Supply
Type: Chilled
System: Chilled Water
UtilityInfrastructureID: 7268
LabelConc: inch
Test: 0
SystemType: Main
Project: South Chiller Plant Expansion Phase 3 Construction
Installed: 6/1/2010
RuleID: Chilled, Active
T_InModel: Yes
T_Rough: 0.000001
T_HeatXfer: 0.000001
InnerDiameter: 12.4
Placement: Underground
Volume_Gal: 571,571.247
Shape.STLength(): 35.289941

Draw Tool
Bookmark Tool
Identify Tool
Project Search

The map displays the University of Virginia's medical campus with a focus on chilled water lines. The network of purple lines is overlaid on a street map showing Main Street, 13th Street, 12 1/2 Street, 12th Street, 11th Street, 10th Street, 9th Street, and Lee Street. Key buildings labeled include the Medical School Bldg, Complex, Stacey Hall, UVA Clinical Laboratory, East Parking Garage, Emergency Department Expansion Under Construction, MRI Relocation Under Construction, and the University Hospital. Construction projects shown as grey areas include the Health System Education Resource Center Under Construction, the Jefferson Park Medical Office Building, and the Emergency Department Expansion Under Construction. Other buildings visible are the Claude Moore Health Sciences Library, Jordan Hall, Primary Care Center, and the Biomed. Eng. & Medical Sci. Bld. (MR-5). A red line highlights a specific section of the chilled water network along Lee Street.

“Living Master Plan” in GIS

GEOSPATIAL ENGINEERING SERVICES UNIVERSITY OF VIRGINIA FACILITIES MANAGEMENT

Legend | Search | Print | Themes | Settings | Roads | Satellite | X

Select Feature from List
0240CL2 (AEI_CHW_Line)

QRetUps 0
VRetUps 0
QRetDws 0
VRetDws 0
QvolRetUps 0
QvolRetDws 0
PRetUps 0
PRetDws 0
TRetUps 0
TRetDws 0
RRetUps 0
RRetDws 0
GradSup 0
GradPret 0
ClosedSup 0
ClosedRet 0
HeatCoeffT 0
HeatLossSu 0
HeatLossRe 0
CanBeExclu 0
CanBeMerge 0
ReductionI 0
DPcorr 0
DTcorr 0
TypeSup 0
TypeRet 0
AutoDimens 0
Orginal
Project_ID 0240CL2
PROJECTID 00195CL2
OBJECTID 40
Shape.STLength() 524.749714
PlanningHorizon 11_15
ProjectStatus Null
ProjectNotes Null

Draw Tool
Bookmark Tool
Identify Tool
Project Search

“Living Master Plan” in GIS

- Readily accessible for UVA staff
- One place to see it all – future big picture view with key details
- Easy to update
- Simplified coordination
- Powerful planning tool



Questions?

- Justin Callihan – UVA – jhc4h@eservices.virginia.edu
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