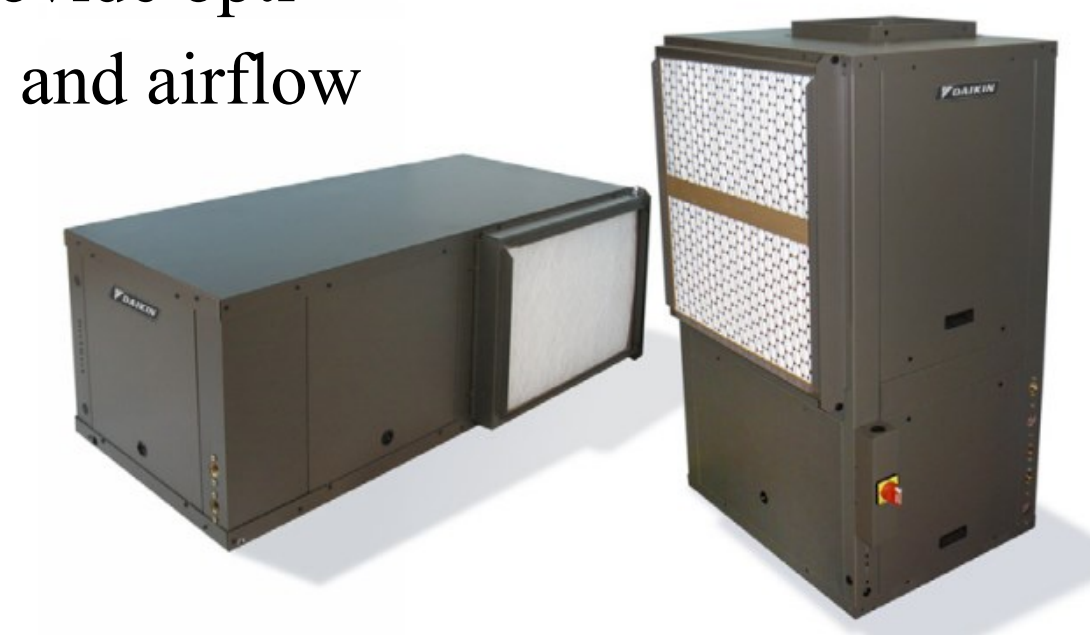


TBD ENGINEERING | EQUIPMENT SCHEDULES

WSHP Schedule									
Level	WSHP ID	Spaces Served	Unit Size	CC Capacity	HC Capacity	Refrigerant Type	GPM	CFM	Orientation
				BTU	BTU				
B	WSHP-B1	Corridor	26	26400	29300	R410A	6.5	800	Vertical
		Storage 000							
		Storage 002							
	WSHP-B2	Men's Locker Room	26	26400	29300	R410A	6.5	800	Vertical
		Women's Locker Room							
	WSHP-B3	Mechanical Room	26	26400	29300	R410A	6.5	800	Vertical
Trash									
		Elevator Mech Room							
1	WSHP-11	Mud Room	26	26400	29300	R410A	6.5	800	Horizontal
	WSHP-12	Processing	32	32500	36400	R410A	7.5	1000	Horizontal
	WSHP-13	Workshop	32	32500	36400	R410A	7.5	1000	Horizontal
	WSHP-14	Market	72	72700	88400	R410A	17.5	2160	Vertical
			72	72700	88400	R410A	17.5	2160	Vertical
	WSHP-16	Office 100A Office 100B	26	26400	29300	R410A	6.5	800	Vertical
2	WSHP-21	Gathering Space, Storage	64	64800	76100	R410A	16	2000	Vertical
			64	64800	76100	R410A	16	2000	Vertical
			49	48900	55300	R410A	12.2	1600	Vertical
			44	44400	50100	R410A	10.5	1400	Vertical
	WSHP-25	Women's Restroom Men's Restroom Elevator Lobby Mech/Elec Closet	26	26400	29300	R410A	6.5	800	Horizontal
WSHP-26	Breakout Space	49	48900	55300	R410A	12.2	1600	Horizontal	
		49	48900	55300	R410A	12.2	1600	Horizontal	
3	WSHP-31	Classroom 53	44	44400	50100	R410A	10.5	1400	Horizontal
			44	44400	50100	R410A	10.5	1400	Horizontal
	WSHP-32	Classroom 61	44	44400	50100	R410A	10.5	1400	Horizontal
	WSHP-33	Demo Kitchen 56	64	44400	50100	R410A	10.5	1400	Vertical
	WSHP-34	University Incubator	32	32500	36400	R410A	7.5	1000	Horizontal
4	WSHP-41	Collaboration Station	38	39000	44400	R410A	9	1250	Horizontal
		Employee Lounge							Horizontal
	WSHP-42	Corridor	26	26400	29300	R410A	6.5	800	Vertical
		Women's restroom							
		Men's Restroom							
		Elevator Lobby							
		Copy Room							
	Mech/Elec Closet								
	WSHP-43	Director's Office	72	72700	88400	R410A	17.5	2160	Horizontal
		Reception							
Office Space									
WSHP-44	Conference Room	44	44400	50100	R410A	10.5	1400	Horizontal	

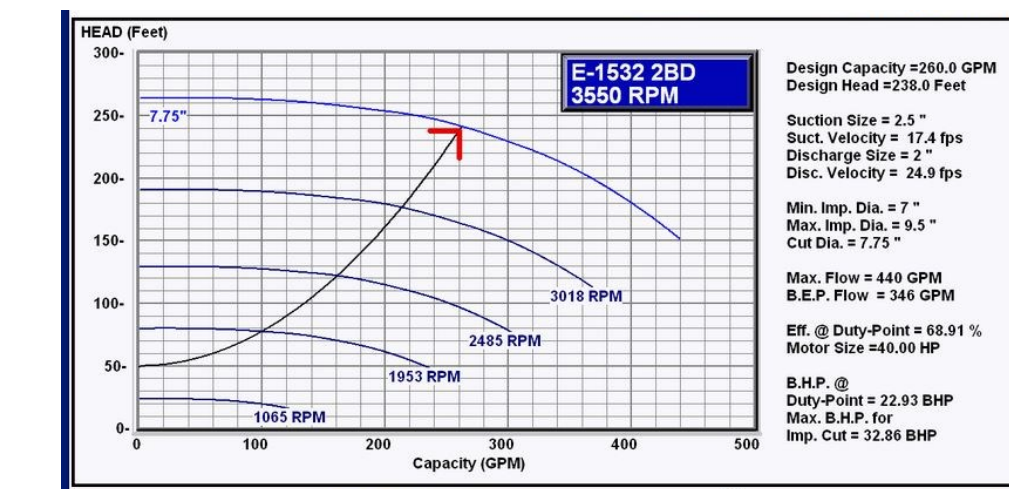
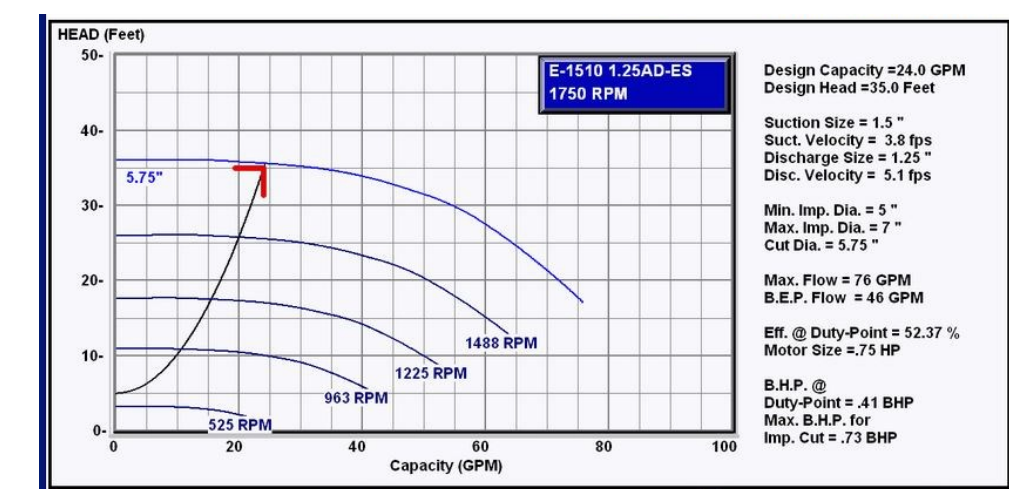
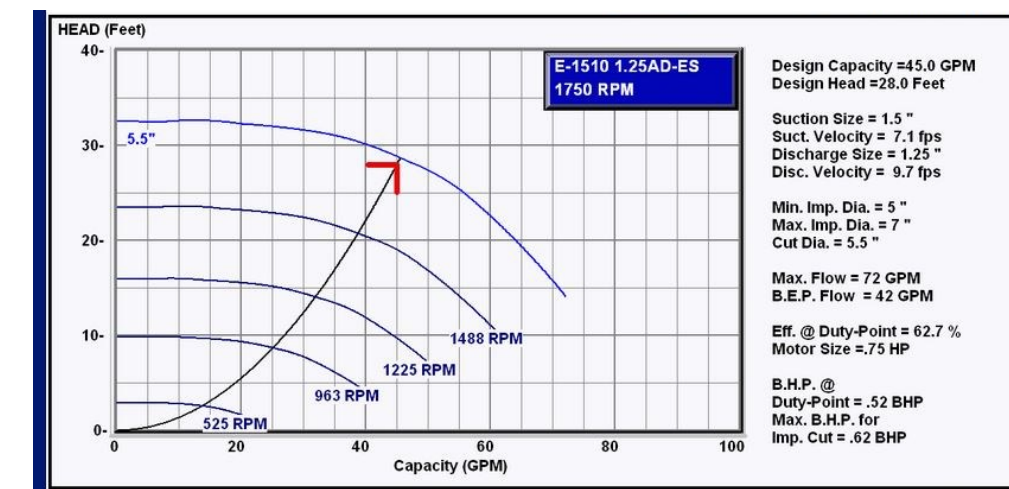
EVAPORATIVE COOLER SCHEDULE										
Description	Water Side					Air Side			Electrical Data	
	GPM	Pressure Drop (FT.)	EWT (°F)	LWT (°F)	Range (°F)	CFM	EAWT (°F)	Approach (°F)	Fan HP	Pump HP
WSHP EC	260	9.50	102.00	86.00	16.00	51,000	78.00	8.00	15.00	5.00

Water Source Heat Pump Sizing
 The Water Source Heat Pumps in the Growing Power Vertical Farm were selected to meet the cooling coil capacity output from Trane TRACE 700 for each zone. From these capacities it was determined that these WSHP units would sufficiently provide optimal cooling, heating, and airflow within each zone.



Evaporative Cooler Sizing
 The evaporative cooler for the WSHP water loop was sized based on the peak load of the system. Marley cooling tower selection software was used to make the selection based on an appropriate approach and range.

PUMP SCHEDULE						
Description	Type	Head (FT.)	GPM	Manufacturer Reference	Water Loop	
					Temp. Supply (°F)	Temp Return (°F)
WSHP LOOP	End Suction	235	260	Bell and Gossett e-1532	86	68
GREENHOUSE HW	End Suction	25	45	Bell and Gossett e-1510	140	100
AUXILIARY HW LOOP	End Suction	35	24	Bell and Gossett e-1510	140	100



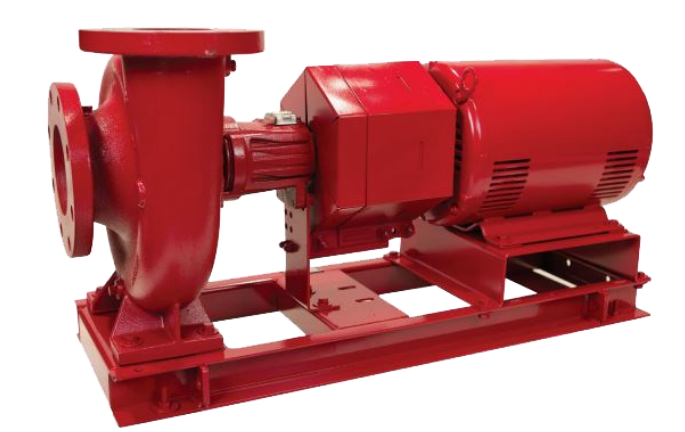
Greenhouse Hot Water Loop

Auxiliary Hot Water Loop

WSHP Water Loop

Pump Selection

Pumps that serve the main HVAC water loops of the building were sized based on the total friction head loss seen by the closed system as well as the maxim GPM flow of the loop. Selection software provided by Bell and Gossett was used to determine the performance curves of the pumps at variable speed.



TBD ENGINEERING | EQUIPMENT SCHEDULES

CONDENSING BOILER SCHEDULE

Description	Nominal Capacity (MBH)	Natural Gas Input (FT ³ /Hr)	Output (MBH)	Max Operation Temp (°F)	Flue Gas (lb/Hr)	Fan Motor (kW)
Clever Brooks Condensing	2,500	2,500	2,175	194	2,783	1.2

Condensing Boiler Sizing

The auxiliary backup boiler was selected based on the peak heating load seen by the building. Condensing Boiler sizes were provided by the Clever Brooks website.



Internal Combustion Engine

Description	Number of Cylinders	Electrical (kW)	Thermal (kW)	Gas Input (kW)
Viessmann BM-55/88	R6	55	88	165
Viessmann BM-55/88	R6	55	88	165

Internal Combustion Engine Sizing

The internal combustion engines used for CHP were sized based on the site thermal and electric demand. The Viessmann Group provided information online about their IC engine efficiencies.



Heat Exchanger Schedule

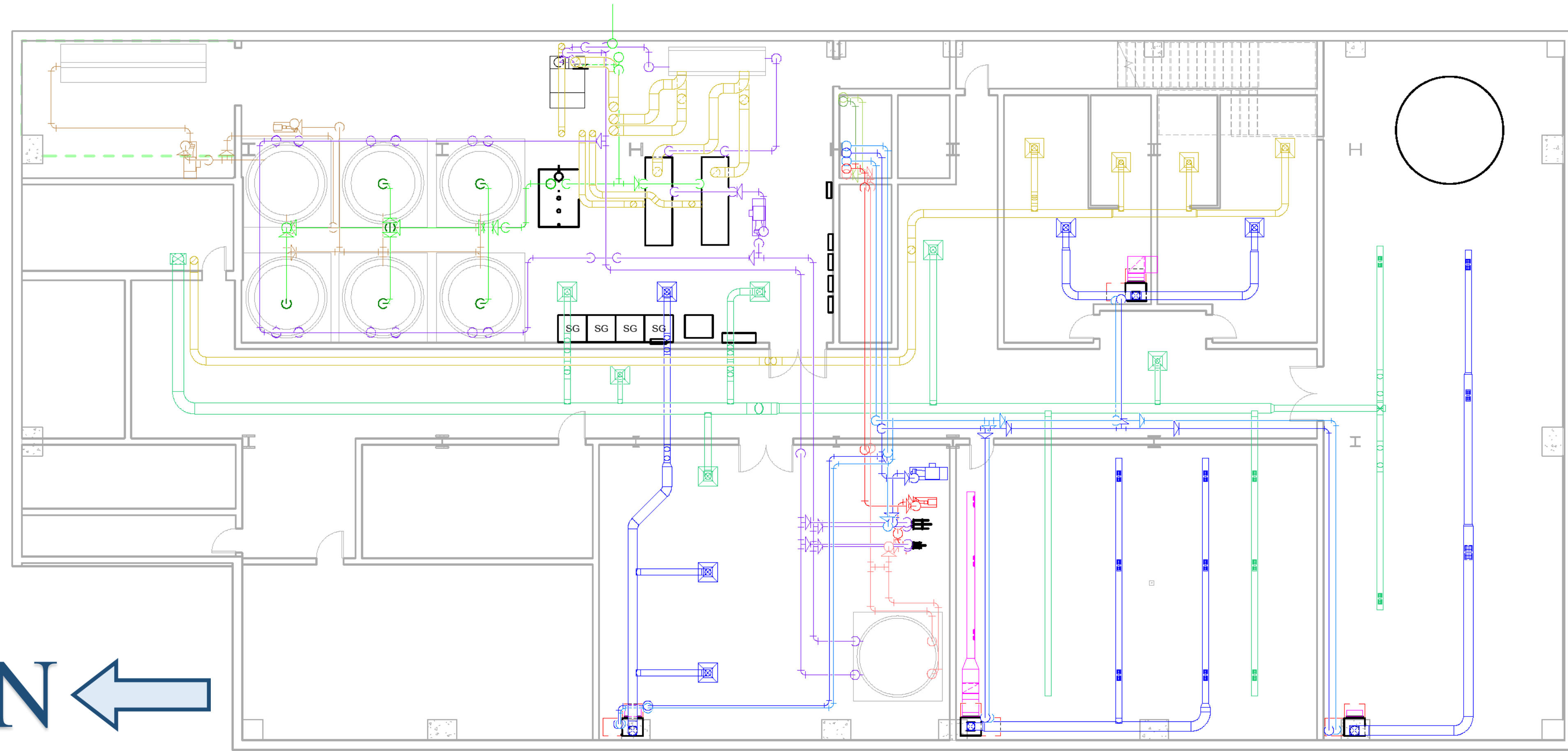
Description	Hot Side				Cold Side			
	GPM	EWT	LWT	Pressure Drop	GPM	EWT	LWT	Pressure Drop
HX WSHP Water Loop	92.0	200.0	160.0	2.4	200.0	68.0	86.0	9.9
HX Auxiliary Heating Loop	35.0	200.0	160.0	7.6	35.0	100.0	140.0	6.4
HX Greenhouse Heating Loop	25.0	200.0	160.0	7.8	25.0	100.0	140.0	6.1

Heat Exchanger Sizing

The heat exchangers serving the CHP heat rejection loop were sized base on the heat rejection of the system and the heat demand of the building. Xylem ESP Thermal selection software was utilized to size the heat exchangers.

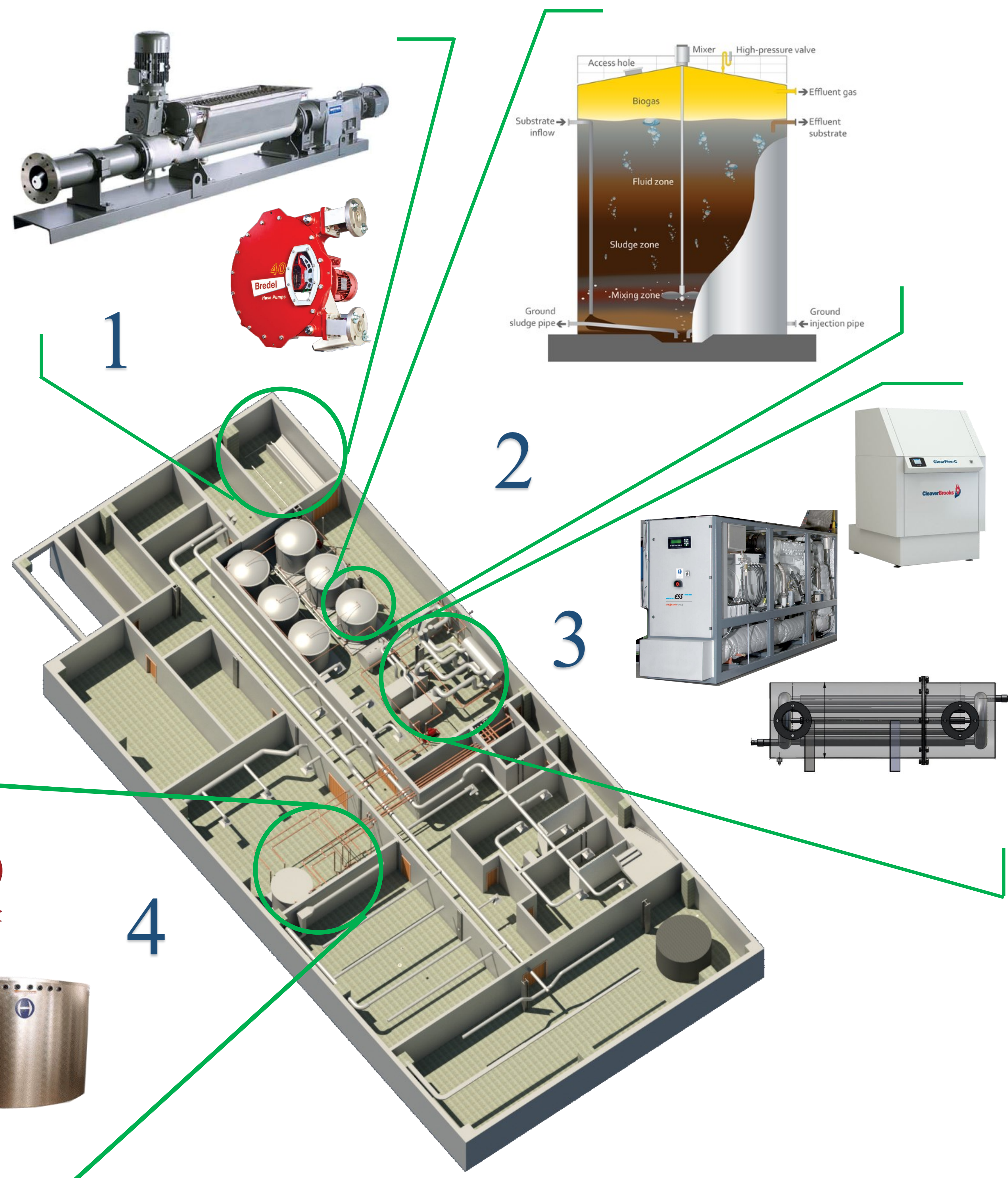


TBD ENGINEERING | MECHANICAL ROOM LAYOUT



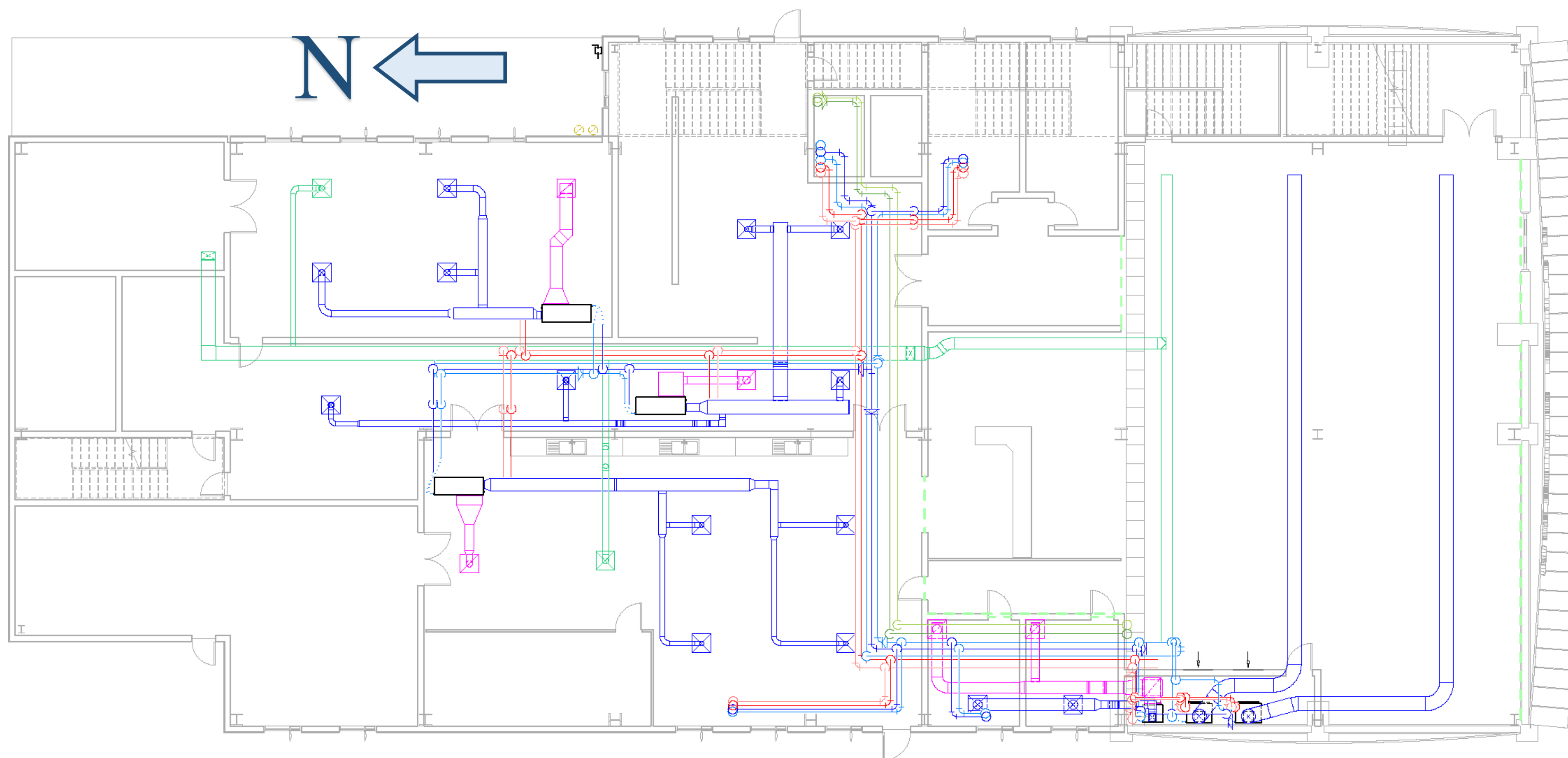
1 BASEMENT FLOOR PLAN
D3 SCALE: 1/8" = 1'-0"

- 1 Waste Grinder and Waste Pump for anaerobic digestion preprocessing. Images courtesy of Moyno Chopper Hopper⁽¹⁴⁾ waster grinder and Marlow Watson hose pump.⁽¹⁴⁾
- 2 Anaerobic Digestion tank with agitator.⁽¹⁴⁾
- 3 Internal combustion engine coupled with heat recovery silencer. An auxiliary boiler is included to meet peak heating demands. Images courtesy of Viessmann Group⁽¹⁴⁾, Maxim Heat Recovery Silencers⁽¹⁴⁾, and Clever Brookes Boilers.⁽¹⁴⁾
- 4 Hot water storage tank and distribution pumps to building loads. Images courtesy of Hydroflex Systems⁽¹⁴⁾ and Bell and Gossett Pumps.⁽¹⁴⁾

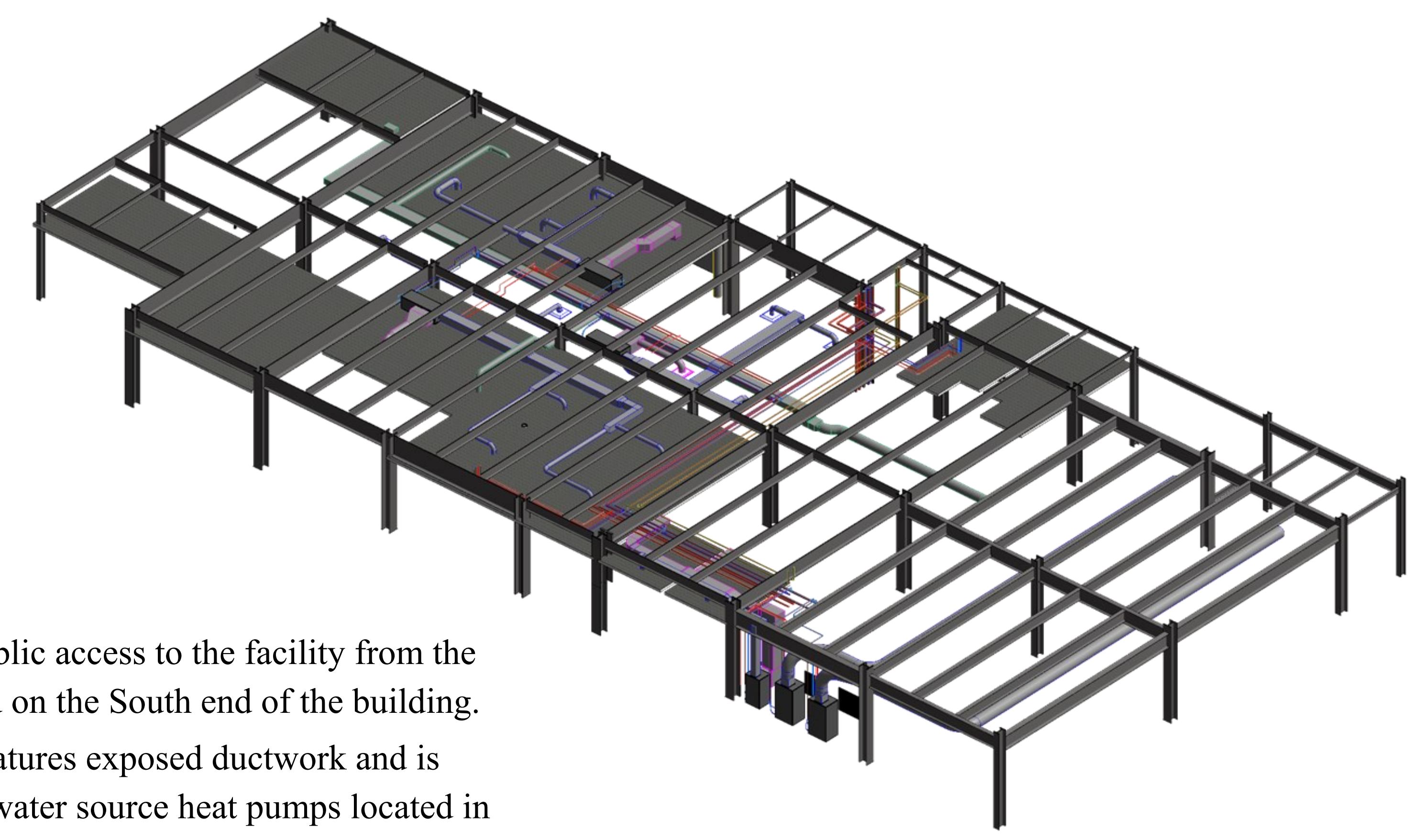


2 BASEMENT 3D COORDINATION VIEW
D3

TBD ENGINEERING | FIRST AND SECOND FLOOR PLANS

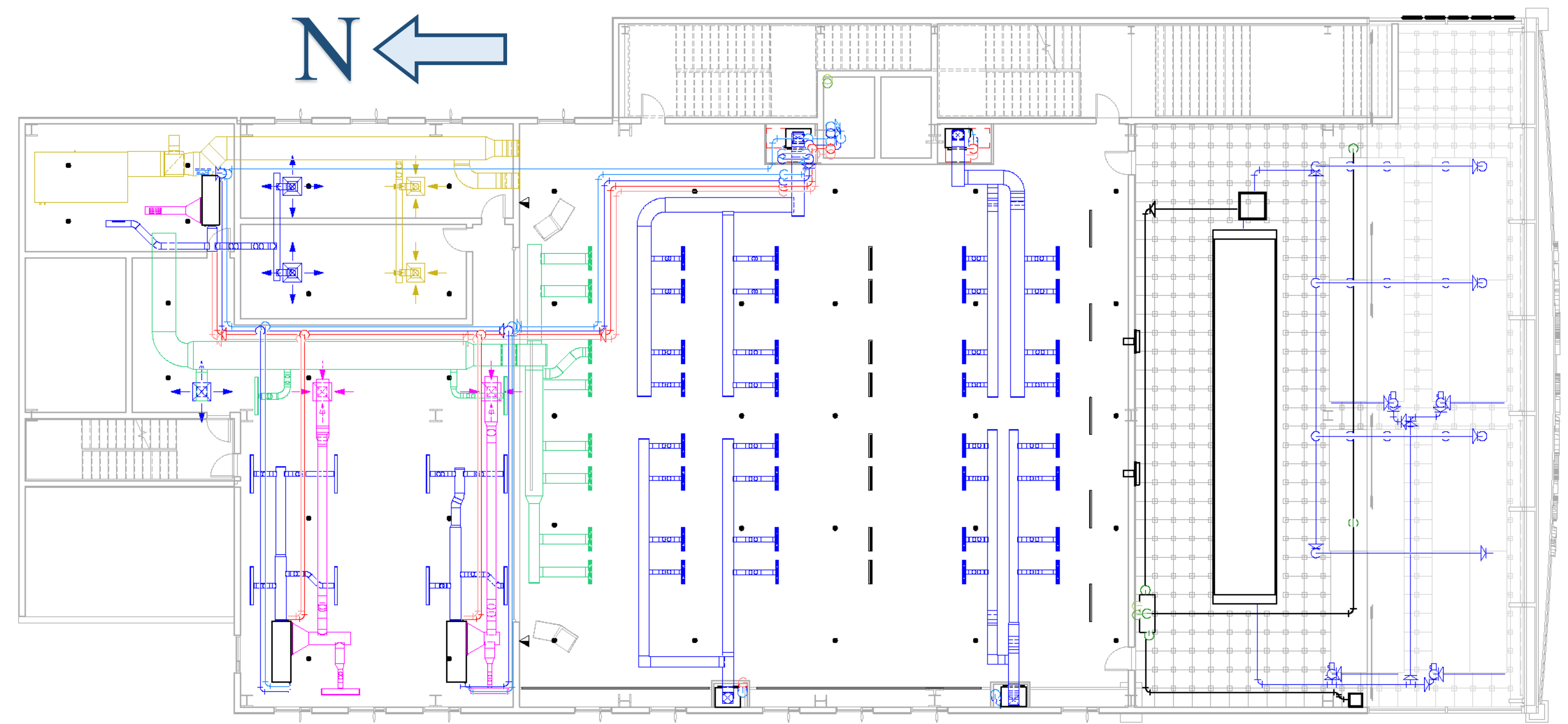


1 LEVEL 1 FLOOR PLAN
D4 SCALE: 1/8" = 1'-0"

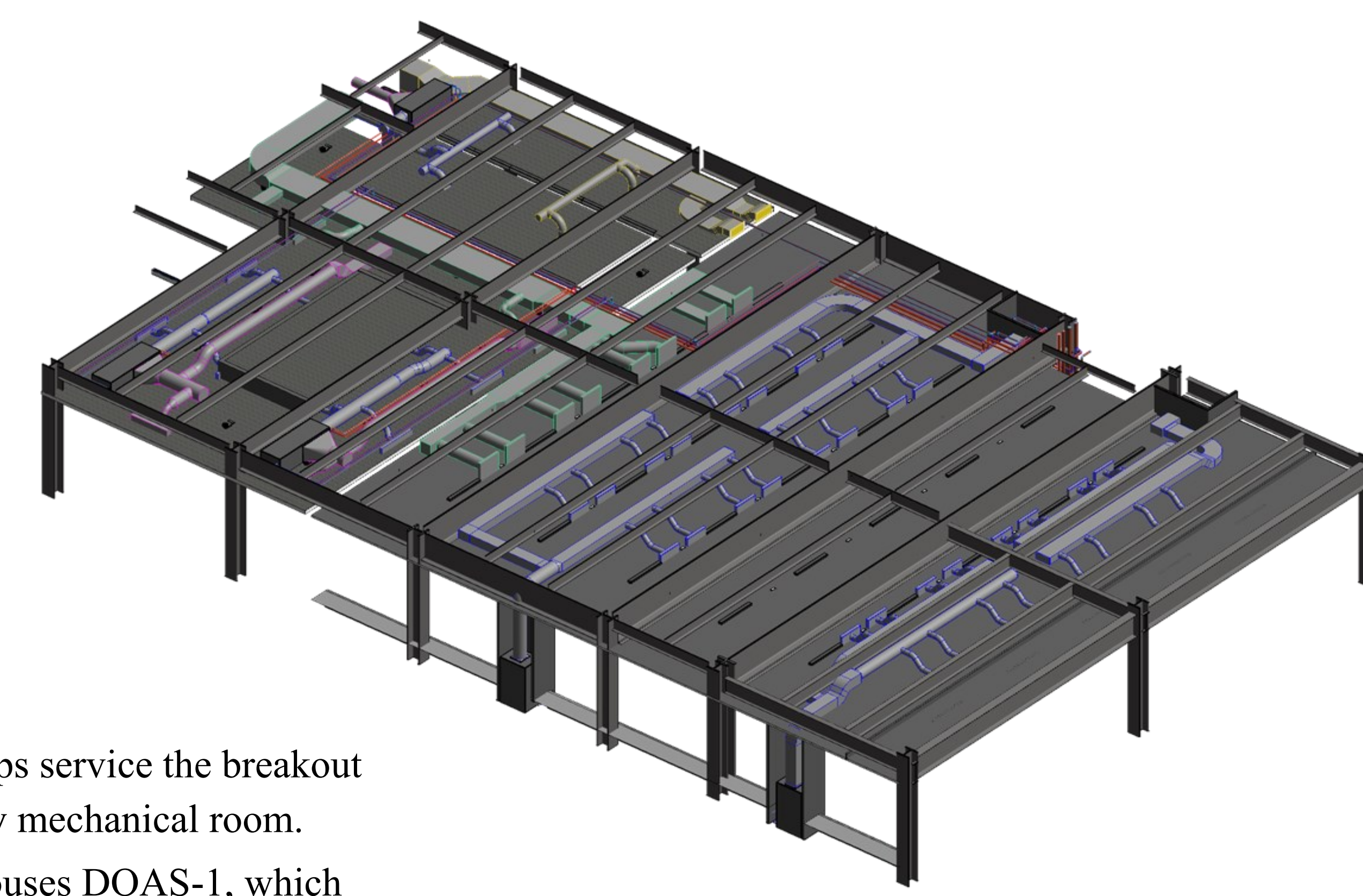


2 LEVEL 1 3D COORDINATION VIEW
D4

Level 1 gives the public access to the facility from the market space located on the South end of the building. The market space features exposed ductwork and is conditioned by two water source heat pumps located in closets along the West wall. To the north of the market space, areas are designated for food processing, coolers, mud room, restrooms, as well as loading and shipping.



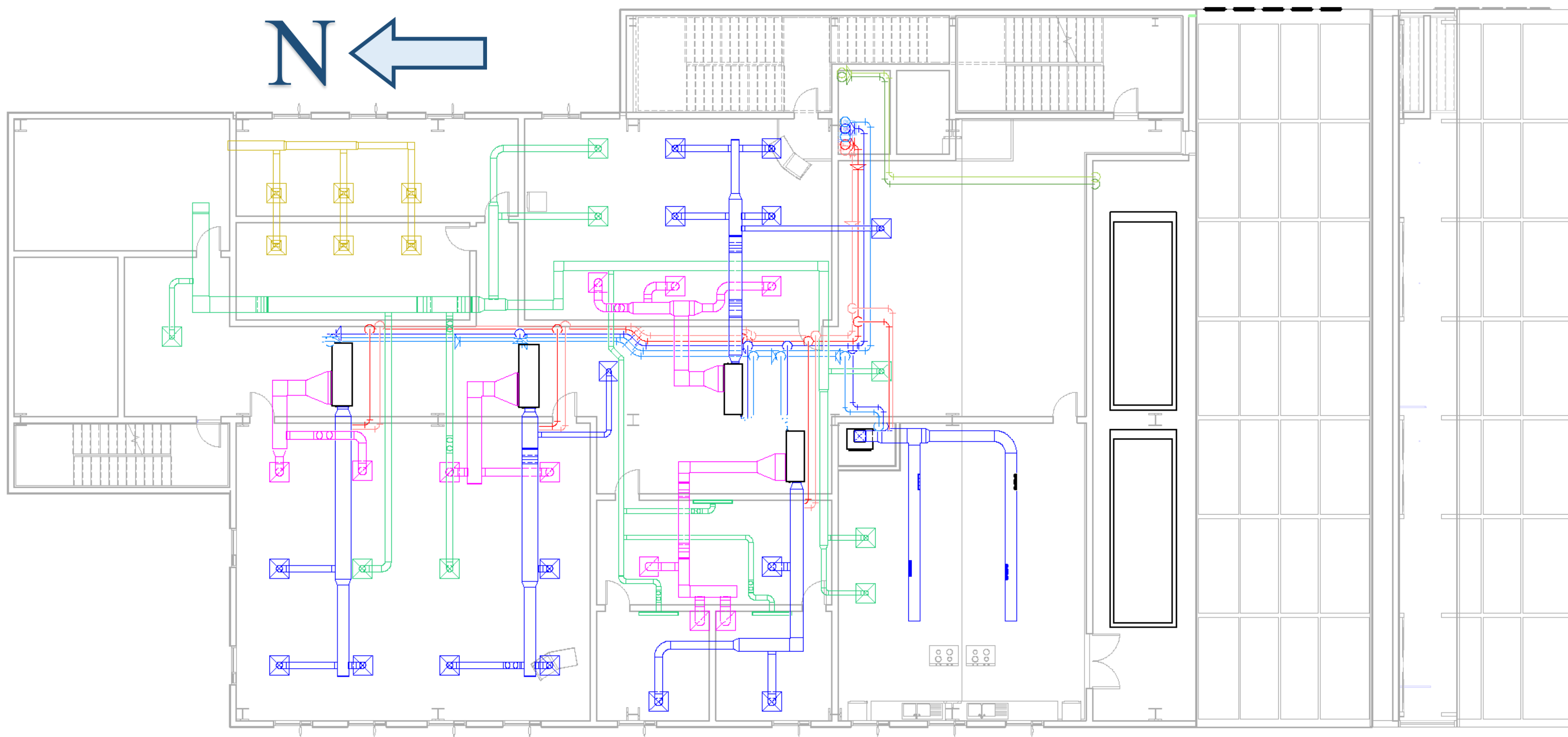
3 LEVEL 2 FLOOR PLAN
D4 SCALE: 1/8" = 1'-0"



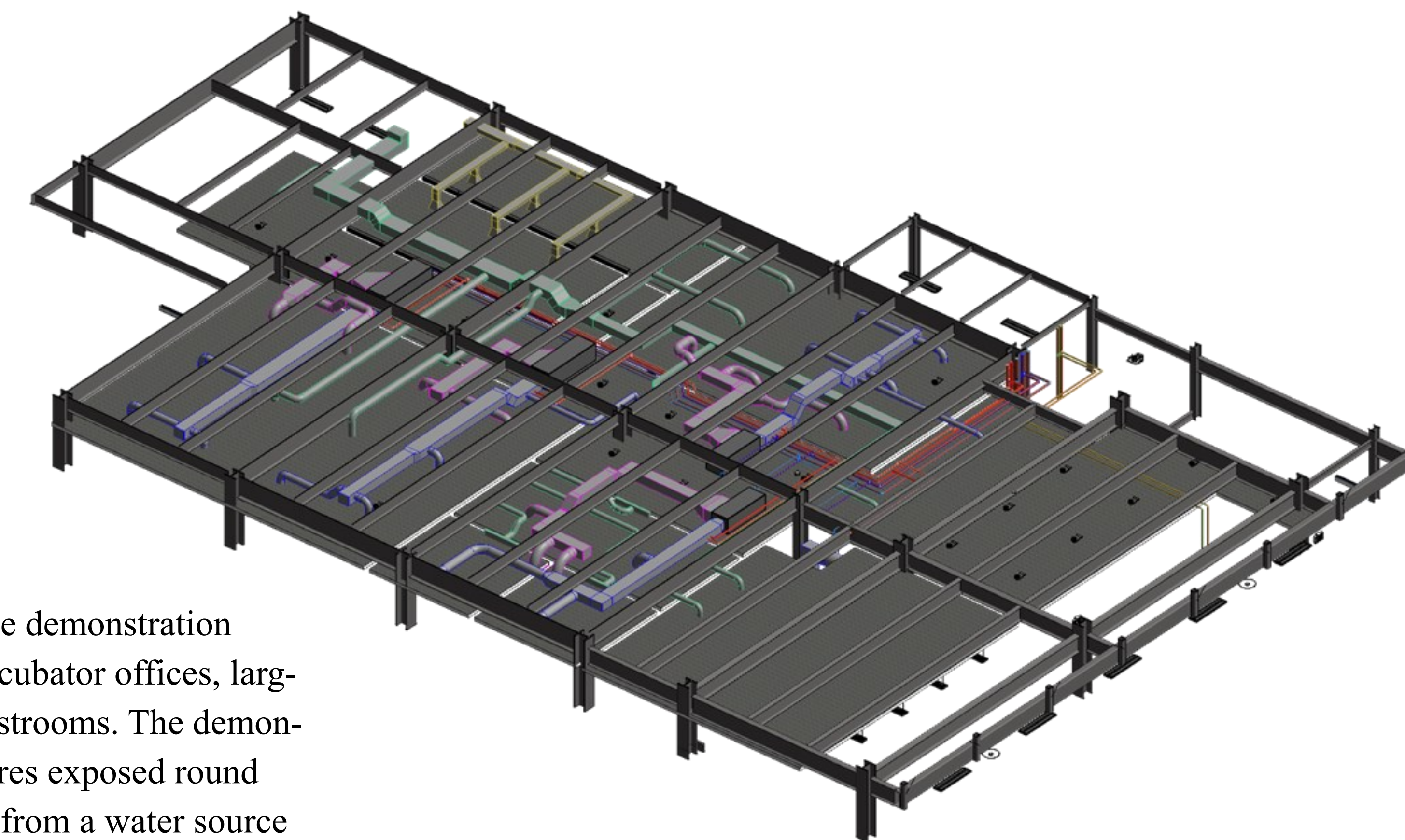
4 LEVEL 2 3D COORDINATION VIEW
D4

Level 2 includes the gathering space in which four water source heat pumps in individual closets serve the space. Linear diffusers align with the lighting fixtures in the ceiling. Additional water source heat pumps service the breakout space, restrooms, and the auxiliary mechanical room. The auxiliary mechanical room houses DOAS-1, which provides the minimum ventilation air as specified by ASHRAE 62.1 to the basement, level 1, and level 2.

TBD ENGINEERING | THIRD AND FOURTH FLOOR PLANS



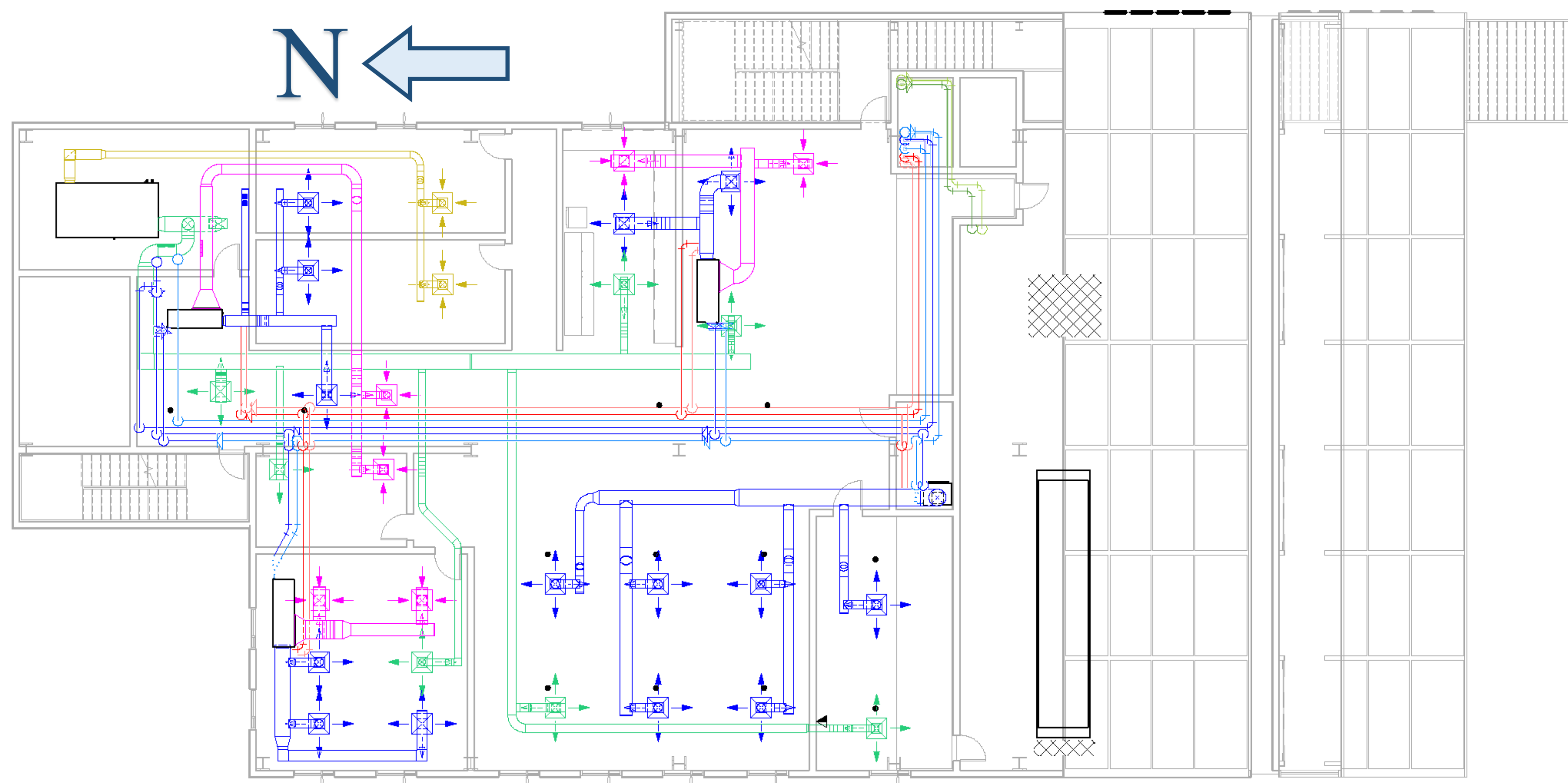
1 LEVEL 3 FLOOR PLAN
D5 SCALE: 1/8" = 1'-0"



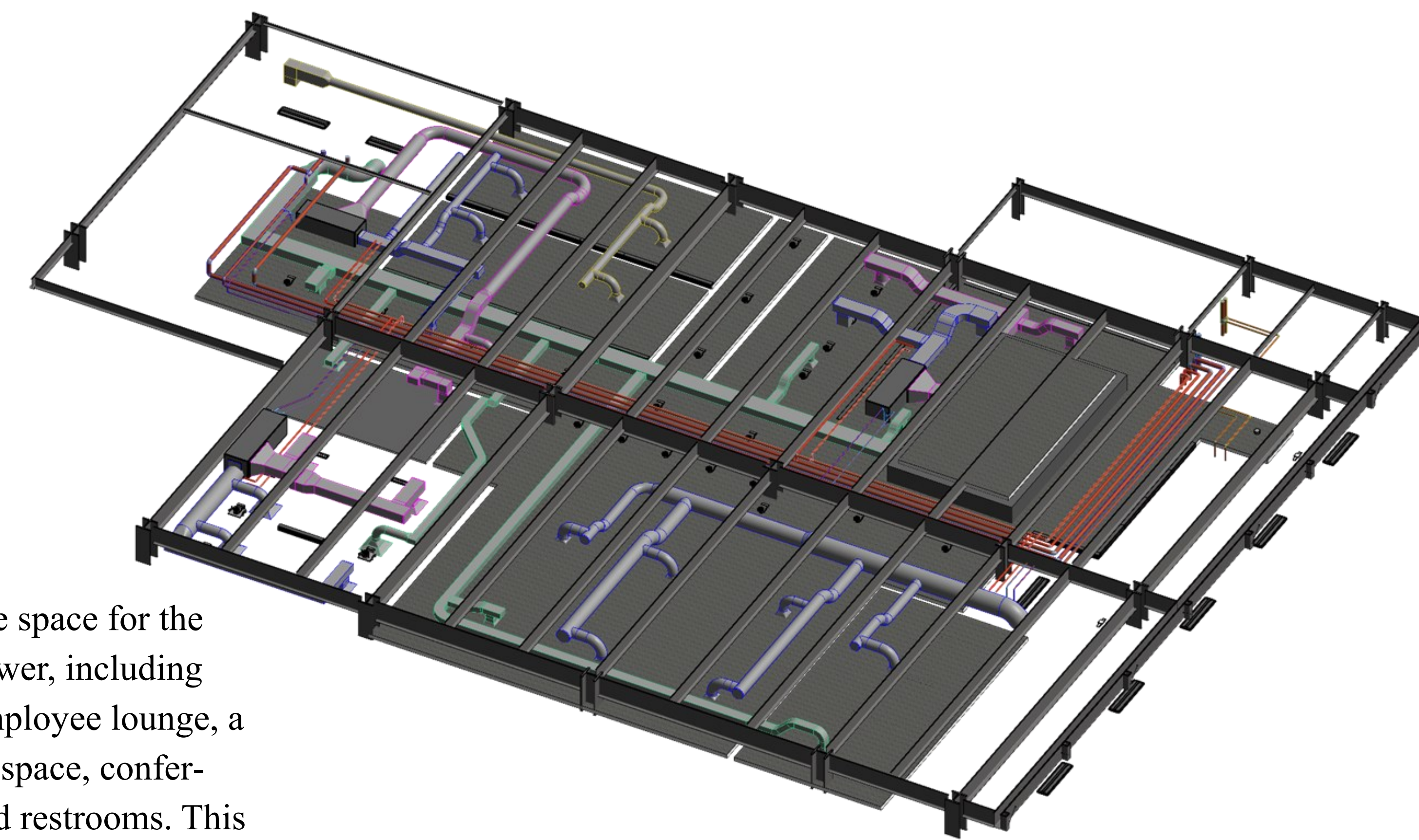
2 LEVEL 3 3D COORDINATION VIEW
D5

Level 3 consists of the demonstration kitchen, university incubator offices, larger classrooms, and restrooms. The demonstration kitchen features exposed round ductwork distributed from a water source heat pump in the space.

Four additional water source heat pumps service Level 3, for a total of five units on this level.



3 LEVEL 4 FLOOR PLAN
D5 SCALE: 1/8" = 1'-0"



4 LEVEL 4 3D COORDINATION VIEW
D5

Level 4 composes of office space for the employees of Growing Power, including the director's office, an employee lounge, a coffee station, open office space, conference room, copy room, and restrooms. This level contains an auxiliary mechanical room where DOAS-2 provides ventilation air to levels 3 and 4.

TBD ENGINEERING | VENTILATION CALCULATIONS

VENTILATION CALCULATIONS FOR DOAS-1											
Level	Room No.	Room Name	Space Type	# persons	Floor Area, Az	OA required per person, Rp	OA required per unit area, Ra	OA at Breathing Zone, Vbz	Zone Air Distribution Effectiveness, Ez	Zone Outdoor Airflow, Voz	Zone Supply OA
Basement	B000	STORAGE	Storage room	4	1838	5	0.06	130.28	1	130.28	140
	B001	CER	Science Laboratories	4	1162	10	0.18	249.16	1	249.16	250
	B002	STORAGE	Storage room	4	1128	5	0.06	87.68	1	87.68	90
	B003	COOLERS	Refrig machinery rooms	1	671	10	0	10	1	10	10
	B004	COOLERS	Refrig machinery rooms	1	285	10	0	10	1	10	10
	B005	STAIRS	Stairwells	1	250	0	0	0	1	0	0
	B009	ELEV MACHINE ROOM	Elevator Machine Rooms	1	199	10	0.12	33.88	1	33.88	40
	B010	TRASH	trash rooms	1	318	5	0.06	24.08	1	24.08	30
	B011	MECH ROOM	Main Mechanical Room	4	1946	10	0.12	273.52	1	273.52	280
	B015	STAIR	Stairwells	2	189	0	0	0	1	0	0
	B016	W LOCKER	Locker rooms	4	373	0	0	0	1	0	0
	B017	M LOCKER	Locker rooms	4	406	0	0	0	1	0	0
	B018	CORRIDOR	Corridors	2	1524	0	0.06	91.44	1	91.44	100
	100	MARKET CHECKOUT	Supermarket	10	1350	7.5	0.06	156	1	156	160
	100	MARKET PROCESSING	Food preparation center	6	500	7.5	0.06	126	1	126	130
	100	MARKET RETAIL	Supermarket	40	1290	7.5	0.06	330	1	330	330
	100A	MARKET OFFICE	Office space	2	111	5	0.06	87.4	1	87.4	90
	100B	MARKET OFFICE	Office space	2	111	5	0.06	16.66	1	16.66	20
101	COOLERS	Refrig machinery rooms	2	240	10	0	20	1	20	20	
101	PROCESSING	Food preparation center	6	1382	7.5	0.06	59.4	1	59.4	60	
102	LOADING	Loading Dock	4	470	10	0.12	205.84	1	205.84	210	
103	SHIP/RECEIVE	Shipping/Receiving	4	313	10	0.12	96.4	1	96.4	100	
104	STAIR	Stairwells	2	150	0	0	0	1	0	0	
107	LOADING	Loading Dock	4	305	10	0.12	58	1	58	60	
108	WORKSHOP	wood/metal shop	10	850	10	0.18	154.9	1	154.9	160	
109	MUD ROOM	Janitor's closet	1	207	5	0.06	56	1	56	60	
110	VOLUNTEER SPACE	Reception areas	8	452	5	0.06	52.42	1	52.42	60	
113	STORAGE	Storage room	1	58	5	0.06	32.12	1	32.12	40	
114	RESTROOM	Toilets	6	370	0	0	0	1	0	0	
116	CORRIDOR	Corridors	1	220	0	0.06	22.2	1	22.2	30	
117	STAIR	Stairwells	2	420	0	0	0	1	0	0	
118	CORRIDOR	Corridors	1	1260	0	0.06	25.2	1	25.2	30	
200	GREENHOUSE	Greenhouse	10	2750	0	0	0	1	0	0	
201	GATHERING SPACE EXT	Multipurpose assembly	24	961	5	0.06	177.66	1	177.66	180	
201	GATHERING SPACE INT	Multipurpose assembly	359	3029	5	0.06	1976.74	1	1976.74	1980	
202	BREAKOUT SPACE EXT	Multipurpose assembly	35	426	5	0.06	200.56	1	200.56	210	
202	BREAKOUT SPACE INT	Multipurpose assembly	35	818	5	0.06	224.08	1	224.08	230	
203	STAIR	Stairwells	2	150	0	0	0	1	0	0	
205	CORRIDOR	Corridor	3	180	0	0.06	10.8	1	10.8	20	
206	MECH ROOM	Aux Mechanical Room	2	305	10	0.12	56.6	1	56.6	60	
208	RESTROOM	Toilet room	7	540	0	0	0	1	0	0	
209	STORAGE	Storage room	2	273	5	0.06	26.38	1	26.38	30	
212	STAIR	Stairwells	2	472	0	0	0	1	0	0	

100% OA Intake Flow [cfm] 5220

VENTILATION CALCULATIONS FOR DOAS-2											
Level	Room No.	Room Name	Space Type	# persons	Floor Area, Az	OA required per person, Rp	OA required per unit area, Ra	OA at Breathing Zone, Vbz	Zone Air Distribution Effectiveness, Ez	Zone Outdoor Airflow, Voz	Zone Supply OA
Level 3	300	GREENHOUSE	Greenhouse	10	1920	0	0	0	1	0	0
	301	DEMO KITCHEN	Kitchen (cooking)	38	787	7.5	0.12	379.44	1	379.44	380
	302	UNIV RECEPTION	Reception areas	2	264	5	0.06	25.84	1	25.84	30
	302A	UNIV INCUBATOR	Office space	2	136	5	0.06	18.16	1	18.16	20
	303	CLASSROOM	Lecture Classroom	40	1130	7.5	0.06	367.8	1	367.8	370
	303	STAIRS	Stairwells	2	150	0	0	0	1	0	0
	303B	UNIV INCUBATOR	Office space	2	136	5	0.06	18.16	1	18.16	20
	306	TELECOM ROOM	Aux Mechanical Room	2	305	10	0.12	56.6	1	56.6	60
	308	CORRIDOR	Corridors	2	1800	0	0.06	108	1	108	110
	308	RESTROOM	Toilets	7	540	0	0	0	1	0	0
	310	CLASSROOM	Lecture Classroom	40	663	7.5	0.06	339.78	1	339.78	340
	310A	STORAGE	Storage room	2	265	5	0.06	25.9	1	25.9	30
	313	STAIRS	Stairwells	2	233	0	0	0	1	0	0
	400	GREENHOUSE	Greenhouse	10	1665	0	0	0	1	0	0
	401	DIRECTOR'S OFFICE	Office space	2	329	5	0.06	29.74	1	29.74	30
	402	RECEPTION	Reception areas	6	186	5	0.06	41.16	1	41.16	50
	403	OPEN OFFICE	Office space	7	805	5	0.06	83.3	1	83.3	90
	403	STAIRS	Stairwells	2	150	0	0	0	1	0	0
404	COPY ROOM	Computer (not printing)	2	134	5	0.06	18.04	1	18.04	20	
405	CONFERENCE ROOM	Conference/meeting	14	418	5	0.06	95.08	1	95.08	100	
406	MECH ROOM	Aux Mechanical Room	2	305	10	0.12	56.6	1	56.6	60	
408	CORRIDOR	Corridors	1	1240	0	0.06	74.4	1	74.4	80	
408	RESTROOM	Toilets	4	540	0	0	0	1	0	0	
413	EMPLOYEE LOUNGE	Coffee stations	5	231	5	0.06	38.86	1	38.86	40	
414	COLLABORATION	Break rooms	8	362	5	0.06	61.72	1	61.72	70	
415	STAIRS	Stairwells	2	273	0	0	0	1	0	0	
500	GREENHOUSE	Greenhouse	10	4625	0	0	0	1	0	0	
503	STAIRS	Stairwells	2	150	0	0	0	1	0	0	

100% OA Intake Flow [cfm] 1900

Ventilation Calculations

Ventilation calculations were performed according to ASHRAE Standard 62.1 2013 to determine the Outdoor Air required for the DOAS units.

EXHAUST CALCULATIONS				Floor Area, Az	Exhaust rate	Units Requiring	Exhaust Rate	Zone
Level	Room No.	Room Name	Space Type	SF	CFM/unit	# units	CFM/SF	CFM
Basement	B000	STORAGE	Storage room	1838	0	0	0	0
	B001	CER	Science Laboratories	1162	0	0	0	0
	B002	STORAGE	Storage room	1128	0	0	0	0
	B003	COOLERS	Refrig machinery rooms	671	0	0	0	0
	B004	COOLERS	Refrig machinery rooms	285	0	0	0	0
	B005	STAIRS	Stairwells	250	0	0	0	0
	B009	ELEV MACHINE ROOM	Elevator Machine Rooms	199	0	0	0	0
	B010	TRASH	trash rooms	318	0	0	1	320
	B011	MECH ROOM	Main Mechanical Room	1946	0	0	0	0
	B015	STAIR	Stairwells	189	0	0	0	0
	B016	W LOCKER	Locker rooms	373	0	0	0.25	100
	B017	M LOCKER	Locker rooms	406	0	0	0.25	110
	B018	CORRIDOR	Corridors	1524	0	0	0	0
	100	MARKET CHECKOUT	Supermarket	1350	0	0	0	0
	100	MARKET PROCESSING	Food preparation center	500	0	0	0.3	150
	100	MARKET RETAIL	Supermarket	1290	0	0	0	0
	100A	MARKET OFFICE	Office space	111	0	0	0	0
	100B	MARKET OFFICE	Office space	111	0	0	0	0
101	COOLERS	Refrig machinery rooms	240	0	0	0	0	
101	PROCESSING	Food preparation center	1382	0	0	0.3	420	
102	LOADING	Loading Dock	470	0	0	0	0	
103	SHIP/RECEIVE	Shipping/Receiving	313	0	0	0	0	
104	STAIR	Stairwells	150	0	0	0	0	
107	LOADING	Loading Dock	305	0	0	0	0	
108	WORKSHOP	wood/metal shop	850	0	0	0.5	430	
109	MUD ROOM	Janitor's closet	207	0	0	1	210	
110	VOLUNTEER SPACE	Reception areas	452	0	0	0	0	
113	STORAGE	Storage room	58	0	0	0	0	
114	RESTROOM	Toilets	370	25	4	0	100	
116	CORRIDOR	Corridors	220	0	0	0	0	
117	STAIR	Stairwells	420	0	0	0	0	
118	CORRIDOR	Corridors	1260	0	0	0	0	
200	GREENHOUSE	Greenhouse	2750	0	0	0	0	
201	GATHERING SPACE EXT	Multipurpose assembly	961	0	0	0	0	
201	GATHERING SPACE INT	Multipurpose assembly	3029	0	0	0	0	
202	BREAKOUT SPACE EXT	Multipurpose assembly	426	0	0	0	0	
202	BREAKOUT SPACE INT	Multipurpose assembly	818	0	0	0	0	
203	STAIR	Stairwells	150	0	0	0	0	
205	CORRIDOR	Corridor	180	0	0	0	0	
206	MECH ROOM	Aux Mechanical Room	305	0	0	0	0	
208	RESTROOM	Toilet room	540	25	7	0	180	
209	STORAGE	Storage room	273	0	0	0	0	
212	STAIR	Stairwells	472	0	0	0	0	
300	GREENHOUSE	Greenhouse	1920	0	0	0	0	
301	DEMO KITCHEN	Kitchen (cooking)	787	0	0	0.7	560	
302	UNIV RECEPTION	Reception areas	264	0	0	0	0	
302A	UNIV INCUBATOR	Office space	136	0	0	0	0	
303	CLASSROOM	Lecture Classroom	1130	0	0	0	0	
303	STAIRS	Stairwells	150	0	0	0	0	
303B	UNIV INCUBATOR	Office space	136	0	0	0	0	
306	TELECOM ROOM	Aux Mechanical Room	305	0	0	0	0	
308	CORRIDOR	Corridors	1800	0	0	0	0	
308	RESTROOM	Toilets	540	25	7	0	180	
310	CLASSROOM	Lecture Classroom	663	0	0	0	0	
310A	STORAGE	Storage room	265	0	0	0	0	
313	STAIRS	Stairwells	233	0	0	0	0	
400	GREENHOUSE	Greenhouse	1665	0	0	0	0	
401	DIRECTOR'S OFFICE	Office space	329	0	0	0	0	
402	RECEPTION	Reception areas	186	0	0	0	0	
403	OPEN OFFICE	Office space	805	0	0	0	0	
403	STAIRS							