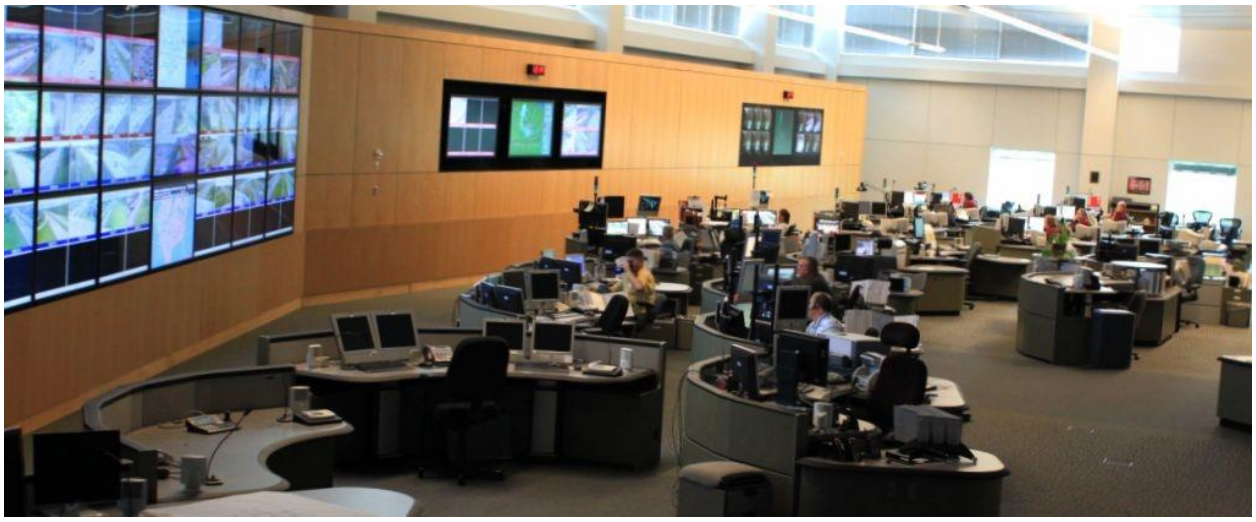
PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
DOT Waters Edge Buildings



Date: 5/9/2012

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

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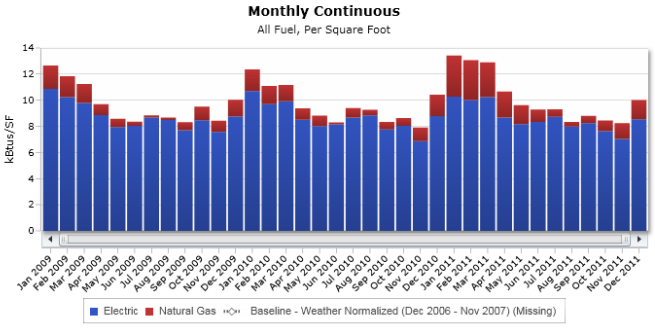
DOT Waters Edge Buildings Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of DOT Waters Edge Buildings was performed by Hammel, Green and Abrahamson, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$55,854		Total Project Cost	$115,974
Future costs including Implementation , Measurement & Verification	$60,120		Study and Administrative Cost Paid with ARRA Funds	($58,854)
Total Project Cost	$115,974		Utility Co-funding	($14,400)
			Total costs after co-funding	$42,720
Estimated Annual Total Savings ($)	$10,449		Estimated Annual Total Savings ($)	$10,449
Total Project Payback	11.0		Total Project Payback with co-funding	4.1
Electric Energy Savings (176,509 of 5,624,837 kWh (2011))	**3.1%**	**and**	**Natural Gas Savings (1,069 of 33,658 Therms (2011))**	**3.2%**



Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	184,710	21,461,611	Missing	-	-	$382,037.27	$0.02
2010	365	184,710	21,255,322	Missing	-	-	$390,508.62	$0.02
2011	365	184,710	22,557,786	Missing	-	-	$412,360.20	$0.02

DOT Waters Edge Buildings Consumption Report
Total energy use remained constant during the period of the investigation

STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

PBEEEP State Government

DOT Waters Edge Buildings	
Location	1500 West County Road B2, Roseville, MN 55113
Facility Manager	Mark Pavelich
Interior Square Footage	184,620
PBEEEP Provider	Hammel, Green and Abrahamson, Inc.
State's Project Manager	John Peters
Annual Energy Cost	$ 412,360 (2011) Source: B3
Utility Company	Xcel Energy (Electric and Natural Gas)
Site Energy Use Index (EUI)	121 kBtu/ft^2 (at start of study) 115kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	109 kBtu/ft^2

Building Name	Area (Square Feet)	Year Built
Waters Edge	130,090	1981
Regional Traffic Management Center	54,620	2003

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Building Automation System (Automated Logic)
2	Buildings
9	Air Handlers (5, 4)
186	VAV Boxes (119, 67)
10	Exhaust Fans (5, 5)
1	Electric Unit Heaters (1,0)
4	Chillers (1,3)
4	Dry Coolers / Cooling Towers (1, 3)
5	Modular Cooling Units (1, 4)
3	Hot Water Boilers (0, 3)
15	Pumps (HW, CHW, etc) (6, 9)
2	Humidifiers (2, 0)
4	Fan Coil Units (2, 2)
2,490	Point available on the BAS (1,400, 1090)
993	Minimum Points for Trending (543, 450)

Implementation Information			
Estimated Annual Total Savings ($)			$10,449
Total Estimated Implementation Cost ($)			$57,120
GHG Avoided in U.S Tons (CO2e)			157
Electric Energy Savings (kWh) 3.1 % Savings 2011 Electric Usage 5,624,837 kWh (from B3)			176,509
Electric Demand Savings (Peak kW) 0 % Savings			0
Natural Gas Savings 3.2% Savings 2011 Natural Gas Usage 33,658Thermsfrom B3			1,069
Statistics			
Number of Measures identified			7
Number of Measures with payback < 3 years			3
Screening Start Date	1/25/2011	Screening End Date	5/3/2011
Investigation Start Date	8/11/2011	Investigation End Date	4/23/2011
Final Report	5/10//2012		

DOT Waters Edge Buildings Cost Information			
Phase		**To date**	**Estimated**
Screening		$3,985	
Investigation [Provider]		$45,900	
Investigation [CEE]		$5,968	$1,000
Implementation			$57,120
Implementation [CEE]			$1,000
Measurement & Verification		0	$1,000
Total		$55,854	$60,120

Co-funding Summary	
Study and Administrative Cost	$58,854
Utility Co-Funding - Estimated Total ($)	$14,400
Total Co-funding ($)	$73,254

Facility Overview

The energy investigation identified 3.1% of total energy savings at DOT Waters Edge Buildings with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at DOT Waters Edge Buildings are based on adjusting the schedule of equipment to match actual building occupancy hours, and adjusting the chiller to operate with a higher temperature drop. The total cost of implementing all the measures is $57,120.

Implementing all these measures can save the facility approximately $10,449 a year with a combined payback period of 5.5 years before rebates based on the implementation cost only (excluding study and administrative costs). After rebates the site will have a cost of $42,720, which reduces the payback to 4.1 years. These measures will produce 3.1 % electrical savings and 3.2 9% natural gas savings. The building is currently performing at 5% above the Minnesota Benchmarking and Beyond database (B3) benchmark.

The primary energy intensive systems at DOT Waters Edge Buildings are described here:

The DOT Facility in Roseville serves as the region's headquarters and as the Regional Traffic Management Center (RTMC) where DOT and State Highway Patrol manage traffic flow and events. It is comprised of two buildings totaling 184,710 square feet. The large building is the Waters Edge (1981) where the majority of offices and the cafeteria reside. The smaller RTMC houses more offices and the operations room, a single large room with dispatch personnel from three different entities working together to achieve optimal traffic flow. The room has a large wall with projected screens of traffic cameras and other important traffic information (see cover page picture). The personnel have desks with computers and the Johnson Controls' Personal Environments system which controls airflow and temperature at each desk using small desk-mounted diffusers and a radiant panel under the desk. The RMTC was built in 2003 as a standalone building next to the Waters Edge building. The Waters Edge Building was originally a commercial office building which was purchased by the state of Minnesota approximately 15 years after it was built.

Waters Edge

The Waters Edge has four VAV AHUs and one constant volume. The two large AHUs share an electric resistance heating element and chilled water coil. Both of these AHUs also have humidifiers. There are two smaller, identical AHUs located outside which serve the basement; these two AHUs have natural gas heat and DX Cooling. The small AHU located in the Radio room is cooling only and serves a small data center for radio communications.

The building's heat is provided by electric resistance, there are no boilers. The chilled water is produced by a single 500 Ton centrifugal chiller with a cooling tower on the roof. There is also a 5 Ton Liebert unit for a data center on the third floor.

Regional Traffic Management Center

There are two large AHUs at the RTMC. One (AHU-2) serves the second floor only, the Operations Room, and the other (AHU-1) serves the rest of the building. This was done to allow AHU-1 to run fewer hours since the Operations Room is operated 8,760 hours per year. Both AHUs are VAV systems and have humidifiers. There are two very small constant volume AHUs that serve the chiller room and the boiler room.

The VAV boxes have hot water reheats and most of the perimeter is served by additional hot water radiation. The hot water heat comes from three identical boilers. The three AHUs have booster pumps to ensure required flow.

The chilled water is supplied by three identical three-stage scroll chillers whenever the temperature outside is above 40°F. The chillers are turned off and the dry coolers become water-side economizers below 40°F. The chillers are by-passed and two smaller pumps are used to pump the water to the dry coolers on the roof. The large data center (3,155 sq ft) is cooled year around. The original design used three Liebert units using chilled water. An additional large Liebert (20 Tons) was installed for redundancy after the building was built, but is run all the time together with the three small units.

Controls and Trending

The equipment at both buildings of the DOT Facility is controlled by an Automated Logic WebCtrl system, which is web based and remotely accessible. The BAS can trend points, and automatically collect, process and send the file in an email at set intervals. Almost the entire campus has DDC actuation and control. Some large valves and dampers have pneumatic actuation.

Lighting

The majority of the interior lighting is 32W T8 fixtures. Most spaces have motion detectors to control the lighting, but some spaces have been switched back to manual operation because the lights would turn off when people were working in the spaces.

Metering

There are two electric meters and three gas meters. The Waters Edge Building has one electric meter and one natural gas meter. The gas meter is for domestic hot water heating only. The RTMC has an electric meter and two gas meters, one of which has very little use.

Documentation

There is mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals available on-site for the RTMC, but not the Waters Edge. The plans are located at the facility management office and in good order and condition. The Waters Edge documentation is very limited. The building was purchased by the DOT after it was built, and the documentation was not transferred from the old owner.

Findings Summary

Site: DOT Waters Edge

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
4	Waters Edge	AC-1 runtime	$1,000	$2,963	0.34	$0	0.34	47
5	Waters Edge	HVAC-1 and 2 run 24/7	$1,000	$627	1.60	$0	1.60	10
3	Regional Traffic Management Center	Reduce operational hours at AHU-3	$2,015	$950	2.12	$0	2.12	8
1	Regional Traffic Management Center	FCU 1 and FCU 2 over cool the skyways.	$250	$59	4.22	$0	4.22	1
2	Waters Edge	Garage MAU and EF3 run continuously	$8,265	$1,950	4.24	$0	4.24	31
2	Regional Traffic Management Center	Reduce operational hours at AHU1 using CO2 sensor and occupancy override panel	$20,600	$2,033	10.13	$0	10.13	31
1	Waters Edge	Chiller low delta T	$23,990	$1,867	12.85	$3,750	10.84	29
		Total for Findings with Payback 3 years or less:	**$4,015**	**$4,540**	**0.88**	**$0**	**0.88**	**65**
		Total for all Findings:	**$57,120**	**$10,449**	**5.47**	**$3,750**	**5.11**	**157**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

DOT

Finding Type Number	Finding Type	Relevant Findings	Looked for, Not found	Not relevant
a.1 (1)	Time of Day enabling is excessive	2		
a.2 (2)	Equipment is enabled regardless of need, or such enabling is	2		
a.3 (3)	Lighting is on more hours than necessary.		2	
a.4 (4)	OTHER_Equipment Scheduling/Enabling	1	1	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not		2	
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design	2		
b.3 (7)	OTHER_Economizer/OA Loads		2	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive		2	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding,		2	
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of		2	
c.4 (11)	OTHER_Controls	1	1	
d.1 (12)	Daylighting controls or occupancy sensors need optimization.		2	
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-		1	1
d.3 (14)	Fan Speed Doesn't Vary Sufficiently	1	1	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently	1	1	
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary		1	1
d.6 (17)	Other_Controls (Setpoint Changes)		2	
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-		2	
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-	1	1	
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-		2	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is		2	
e.5 (21)	Condenser Water Temperature Reset is not implemented or is	1	1	
e.6 (22)	Other_Controls (Reset Schedules)		2	
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		2	
f.2 (24)	Pump Discharge Throttled		2	
f.3 (25)	Over-Pumping		2	
f.4 (26)	Equipment is oversized for load.	1	1	
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction		2	
g.1 (28)	VFD Retrofit - Fans	1	1	
g.2 (29)	VFD Retrofit - Pumps	1	1	
g.3 (30)	VFD Retrofit - Motors (process)		2	
g.4 (31)	OTHER_VFD		2	
h.1 (32)	Retrofit - Motors		2	
h.2 (33)	Retrofit - Chillers		2	
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged		2	
h.4 (35)	Retrofit - Boilers		2	
h.5 (36)	Retrofit - Packaged Gas fired heating		2	
h.6 (37)	Retrofit - Heat Pumps		2	
h.7 (38)	Retrofit - Equipment (custom)		2	
h.8 (39)	Retrofit - Pumping distribution method		2	

h.9 (40)	Retrofit - Energy/Heat Recovery		2	
h.10 (41)	Retrofit - System (custom)		2	
h.11 (42)	Retrofit - Efficient Lighting		2	
h.12 (43)	Retrofit - Building Envelope		2	
h.13 (44)	Retrofit - Alternative Energy		2	
h.14 (45)	OTHER_Retrofit		2	
i.1 (46)	Differed Maintenance from Recommended/Standard		2	
i.2 (47)	Impurity/Contamination_		2	
i.3 ( )	Leaky/Stuck Damper		2	
i.4 ( )	Leaky/Stuck Valve		2	
i.5 (48)	OTHER_Maintenance		2	
j.1 (49)	OTHER		2	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Waters Edge
Site: DOT Waters Edge

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
4	AC-1 runtime	$1,000	$2,963	0.34	$0	0.34	47
5	HVAC-1 and 2 run 24/7	$1,000	$627	1.60	$0	1.60	10
2	Garage MAU and EF3 run continuously	$8,265	$1,950	4.24	$0	4.24	31
1	Chiller low delta T	$23,990	$1,867	12.85	$3,750	10.84	29
	Total for Findings with Payback 3 years or less:	**$2,000**	**$3,590**	**0.56**	**$0**	**0.56**	**57**
	Total for all Findings:	**$34,255**	**$7,407**	**4.62**	**$3,750**	**4.12**	**117**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Waters Edge

FWB Number:	15001	Eco Number:	1
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	Chiller low delta T	Date Identified:	1/1/2012
Description of Finding:	CHW dT varies from 1 to 7 F at maximum OAT. Chiller was designed for 14 F delta T. Varying primary chilled water flow is not an option as flow matched to maximum load is approximately equal to minimum evaporator flow of 353 gpm. Chilled water temp reset not used but is available in control sequence. Cooling towers are controlling to 85F setpoint rather than to allow temp to drop with OAT, where chiller efficiency is greatly improved with lower CWR temps. 5 HP fan at cooling tower not functioning, so cooling tower is operating with only the 15 HP fan at full speed, cycling rapidly.		
Equipment or System(s):	Chiller Plant	Finding Category:	Controls (Reset Schedules)
Finding Type:	CHW Supply Temperature Reset is not implemented or is sub-optimal		

Implementer:	Controls contractor, TAB contractor
Benefits:	Improved efficiency, reduced chiller cycling.
Baseline Documentation Method:	Trended cooling tower discharge temp, chiller amps, CHW S and R temps, CW pump amps and CHW pump amps. Cooling tower fan data not available on BAS. Observation that 5 HP motor does not operate in Hand position.
Measure:	reduce flow through chiller to evaporator minimum (353 gpm) plus small safety factor (=400 gpm), use CHW and CW reset schedule currently available in controls program
Recommendation for Implementation:	Rebalance hyronic system, add VFD to Cooling Tower, add VFD to CHW pumps.
Evidence of Implementation Method:	Trend chiller amps, CW supply and return temperatures, CHW supply and return temps, CHW pump amps for cooling season.

Annual Electric Savings (kWh):	34,301	Contractor Cost ($):	$18,790
Estimated Annual kWh Savings ($):	$1,867	PBEEEP Provider Cost for Implementation Assistance ($):	$5,200
		Total Estimated Implementation Cost ($):	$23,990

Estimated Annual Total Savings ($):	$1,867	Utility Co-Funding for kWh ($):	$3,750
Initial Simple Payback (years):	12.85	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	10.84	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	29	Utility Co-Funding - Estimated Total ($):	$3,750

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	17.9%	Percent of Implementation Costs:	42.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Waters Edge

FWB Number:	15001	Eco Number:	2
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	Garage MAU and EF3 run continuously	Date Identified:	1/1/2012
Description of Finding:	Fan amp trends show constant run times with a few random hours of downtime which do not correspond to OAT or CO readings. CO sensors not reading accurately. CO reading does not rise when fan shuts off or during heavier use periods. Fan switches to summer mode at OAT=37F and it seems that unit is trying to heat to summer cooling setpoint. There is no cooling coil. Heating coil has been disabled by operator.		
Equipment or System(s):	AHU with heating only	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor and Facility Operator	Benefits:	Reduced runtime
Baseline Documentation Method:	Trended Amps at MAU and EF fan motors, garage temps, existing CO sensor trended data.		
Measure:	Replace CO sensors and provide controls.		
Recommendation for Implementation:	Replace CO sensors. Implement regular testing and calibration of CO sensors. Change heating setpoint to minimum required to protect sprinkler system.		
Evidence of Implementation Method:	Trend fan amps, CO readings, garage temps.		

Annual Electric Savings (kWh):	35,840	Contractor Cost ($):	$5,765
Estimated Annual kWh Savings ($):	$1,950	PBEEEP Provider Cost for Implementation Assistance ($):	$2,500
		Total Estimated Implementation Cost ($):	$8,265

Estimated Annual Total Savings ($):	$1,950	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.24	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.24	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	31	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	18.7%	Percent of Implementation Costs:	14.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Waters Edge

FWB Number:	15001	Eco Number:	4
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	AC-1 runtime	Date Identified:	1/1/2012
Description of Finding:	Built up AHU runs 24/7 with no night setback space temperatures or CFMs.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Facility Operator	Benefits:	Reduced runtime
Baseline Documentation Method:	Trended Fan amps show only one supply fan modulates with load. The second supply fan, and two return fans, operated at roughly constant speed. There is no balance info or CFM data available for this unit. VAVs on this system do not report cfm.		
Measure:	Provide occupancy schedule. For this calculation, occ hours assumed 6 am to 10 pm.		
Recommendation for Implementation:	Implement an internal program to schedule overtime when facility is occupied past 10 pm. Include 4 hours per week of internal facility staff time to implement scheduling weekly.		
Evidence of Implementation Method:	Trend fan amps and zone temps		

Annual Electric Savings (kWh):	54,438	Contractor Cost ($):	$400
Estimated Annual kWh Savings ($):	$2,963	PBEEEP Provider Cost for Implementation Assistance ($):	$600
		Total Estimated Implementation Cost ($):	$1,000

Estimated Annual Total Savings ($):	$2,963	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.34	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.34	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	47	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	28.4%	Percent of Implementation Costs:	1.8%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Waters Edge

FWB Number:	15001	Eco Number:	5
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	HVAC-1 and 2 run 24/7	Date Identified:	1/1/2012
Description of Finding:	Units run 24/7 although time-of-day scheduling is available in controls sequence.		
Equipment or System(s):	Packaged cooling with gas heat	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Facility Operator	Benefits:	Reduced runtime
Baseline Documentation Method:	Unit amps not available on BAS. DAT trend shows unit is cooling 24/7. Seven of the 13 VAVs on this unit are trendable and are locked in a minimum cfm position.		
Measure:	Provide occupancy schedule. For this calculation, occ hours assumed 6 am to 10 pm.		
Recommendation for Implementation:	Implement an internal program to schedule overtime when facility is occupied past 10 pm.		
Evidence of Implementation Method:	Trend fan amps and zone temps		

Annual Electric Savings (kWh):	11,518	Contractor Cost ($):	$400
Estimated Annual kWh Savings ($):	$627	PBEEEP Provider Cost for Implementation Assistance ($):	$600
		Total Estimated Implementation Cost ($):	$1,000

Estimated Annual Total Savings ($):	$627	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.60	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.60	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	10	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.0%	Percent of Implementation Costs:	1.8%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Regional Traffic Management Center

Site: DOT Waters Edge

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	Reduce operational hours at AHU-3	$2,015	$950	2.12	$0	2.12	8
1	FCU 1 and FCU 2 over cool the skyways.	$250	$59	4.22	$0	4.22	1
2	Reduce operational hours at AHU1 using CO2 sensor and occupancy override panel	$20,600	$2,033	10.13	$0	10.13	31
	Total for Findings with Payback 3 years or less:	**$2,015**	**$950**	**2.12**	**$0**	**2.12**	**8**
	Total for all Findings:	**$22,865**	**$3,042**	**7.52**	**$0**	**7.52**	**41**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Regional Traffic Management Center

FWB Number:	15002	Eco Number:	1
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	FCU 1 and FCU 2 over cool the skyways.	Date Identified:	1/1/2012
Description of Finding:	Skyway temperatures average 69 degrees all summer.		
Equipment or System(s):	Packaged cooling with electric heat	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Other_Controls (Setpoint Changes)		

Implementer:	controls contractor (edit by CEE)	Benefits:	Energy Savings
Baseline Documentation Method:	Trended fancoil unit operation, on/off, heating and cooling, and zone temperatures		
Measure:	Simply change setpoints in existing control program		
Recommendation for Implementation:	Change cooling Setpoint to 75F from current 69F		
Evidence of Implementation Method:	Trend space temps when warm and cold outside to make sure the heating and cooling temperature setpointsare controlled to.		

Annual Electric Savings (kWh):	1,088	Contractor Cost ($):	$200
Estimated Annual kWh Savings ($):	$59	PBEEEP Provider Cost for Implementation Assistance ($):	$50
		Total Estimated Implementation Cost ($):	$250

Estimated Annual Total Savings ($):	$59	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.22	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.22	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.6%	Percent of Implementation Costs:	0.4%

Findings Details

Building: Regional Traffic Management Center

FWB Number:	15002	Eco Number:	2
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	Reduce operational hours at AHU1 using CO2 sensor and occupancy override panel	Date Identified:	1/1/2012
Description of Finding:	Air handling unit operates 24/7 because offices are sometimes occupied during off hours. Recommendation is to add an occupancy override switch to schedule reduced operating hours but allow workers to start AHU from an occupancy over ride switch. Calculation assuems that building is occupied from 5 am to 10 pm, 7 days a week.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	controls contractor	Benefits:	Energy Savings
Baseline Documentation Method:	Trended AHU operation, MAT, RAT, OAT, associated VAVs showing constant cfm.		
Measure:	Add occupancy override for users.		
Recommendation for Implementation:	Add one occupancy override button at per floor served. Any occupancy botton activated would bring on entire AHU for 4 (adjustable) hours.		
Evidence of Implementation Method:	Trend MAT, RAT, DAT, OAT, SF Status, SF Speed, CO2 levels. Look for no overnight run time unless button is pushed. Make sure the CO2 levels do not exceed requierd levels when occupied.		

Annual Electric Savings (kWh):	35,601	Annual Natural Gas Savings (therms):	121
Estimated Annual kWh Savings ($):	$1,937	Estimated Annual Natural Gas Savings ($):	$95
Contractor Cost ($):	$15,200		
PBEEEP Provider Cost for Implementation Assistance ($):	$5,400		
Total Estimated Implementation Cost ($):	$20,600		

Estimated Annual Total Savings ($):	$2,033	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	10.13	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	10.13	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	31	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	19.5%	Percent of Implementation Costs:	36.1%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Regional Traffic Management Center

FWB Number:	15002	Eco Number:	3
Site:	DOT Waters Edge	Date/Time Created:	4/26/2012

Investigation Finding:	Reduce operational hours at AHU-3	Date Identified:	1/1/2012
Description of Finding:	Air handling unit operates 24/7 although it serves an unoccupied space. Recommendation is to add operate unit only during building occupied hours, 6 am to 6 pm. Change setpoints to 60-80 rather than constant 72F. Savings calculated from heating and cooling minimum OA from OAT to room temeprature. Motor savings from shutting unit off during unoccupied hours or when OAT is < 20 or > 80. REbalance minimum OA form current 600 cfm to code minimum 200 cfm.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	controls contractor, TAB contractor	Benefits:	energy Savings
Baseline Documentation Method:	Trended AHU operation, MAT, RAT, OAT, fan run time.		
Measure:	Rebalance minimum OA to code minimum 200 cfm. Change room temp setpoints. Add occupancy schedule.		
Recommendation for Implementation:	Add one CO2 sensor in chiller room and control to 1100ppm CO2 and rebalance the min OA flow to 200cfm.		
Evidence of Implementation Method:	Trend MAT, RAT, DAT, OAT, SF Status,, CO2 levels. Make sure the CO2 levels do not exceed requierd levels when occupied.		

Annual Electric Savings (kWh):	3,723	Annual Natural Gas Savings (therms):	948
Estimated Annual kWh Savings ($):	$203	Estimated Annual Natural Gas Savings ($):	$748
Contractor Cost ($):	$1,565		
PBEEEP Provider Cost for Implementation Assistance ($):	$450		
Total Estimated Implementation Cost ($):	$2,015		

Estimated Annual Total Savings ($):	$950	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.12	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.12	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	8	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	9.1%	Percent of Implementation Costs:	3.5%

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15001 - Waters Edge

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	All AHUs and EFs run 24/7	All AHUs		
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	MAU-1/EF-3	WE Garage		non-existant or out of calibration CO sensors
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	most areas have occ sensors. In open office areas these have been disabled by the user.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling				
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)				
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.				
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive				
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement				
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.				
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.				
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently				
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently				
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary				
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal				
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal				
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal				
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal				
	e.6 (22)	Other_Controls (Reset Schedules)				
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit				
	f.2 (24)	Pump Discharge Throttled				
	f.3 (25)	Over-Pumping				
	f.4 (26)	Equipment is oversized for load.				
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction				
	g.1 (28)	VFD Retrofit - Fans				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15001 - Waters Edge

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.2 (29)	VFD Retrofit - Pumps				
	g.3 (30)	VFD Retrofit - Motors (process)				
	g.4 (31)	OTHER_VFD				
h. Retrofits:	h.1 (32)	Retrofit - Motors				
	h.2 (33)	Retrofit - Chillers				
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating				
	h.6 (37)	Retrofit - Heat Pumps				
	h.7 (38)	Retrofit - Equipment (custom)				
	h.8 (39)	Retrofit - Pumping distribution method				
	h.9 (40)	Retrofit - Energy/Heat Recovery				
	h.10 (41)	Retrofit - System (custom)				
	h.11 (42)	Retrofit - Efficient Lighting				
	h.12 (43)	Retrofit - Building Envelope				
	h.13 (44)	Retrofit - Alternative Energy				
	h.14 (45)	OTHER_Retrofit				
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard				
	i.2 (47)	Impurity/Contamination				
	i.3 ( )	Leaky/Stuck Damper				
	i.4 ( )	Leaky/Stuck Valve				
	i.5 (48)	OTHER_Maintenance				
j. OTHER	j.1 (49)	OTHER				

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15002 - Regional Traffic Management Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	AHU-3 runs 24/7			Ahu-1 and Ahu-2 serve areas occupied 24/7. FCUs serving computer room loads can't be shut down and have no OA so no savings available.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	FCU-1 and FCU-2 setpoints too low.			Skyways overcooled (T=69F). AHU1 and 3 enabled 24/7.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	Most lighting is on occupancy sensors. Where occ sensors not used they were removed because they were not effective
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	AHU-3 min OA=30%			Serves unoccupied boiler and cihller room. OA could be closed until CO sensors require OA. Comb air provided separately. Refrigerant detection and exhaust fan exist in Chiler room. AHU-1 min oa = 15%. AHU-2 min OA shows zero %OA at minimum damper posn. MA sensor not well placed, but unit is economizing.
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Not cost-effective to investigate	AHU-2 MAT sensor not accurate but unit is economizing around OAT=78
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	HWPs on boiler system not on VFDs		Not cost-effective to investigate	heating water pumps are 3 HP
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	HW reset is used		Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	CHW reset is used		Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	DAT at AHUs = 60F		Investigation looked for, but did not find this issue.	Operator keeps DAT at 60F throughout summer, doesn't need to reset to 55 to meet load
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	AHU 1 SP setpoint = 0.8" AHU 2 SP setoint = 1". Not excessive.
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	CWT reset is effective, see graphs vs OAT
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	interior lighting not excessive. Parking lighting levels are not excessive.
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	staging at HW and CHW is good
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

15002 - Regional Traffic Management Center

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	all motors over 7.5 HP have VFDs
	g.2 (29)	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	all motors over 7.5 HP have VFDs
	g.3 (30)	VFD Retrofit - Motors (process)			Investigation looked for, but did not find this issue.	
	g.4 (31)	OTHER_VFD			Investigation looked for, but did not find this issue.	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Investigation looked for, but did not find this issue.	
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Investigation looked for, but did not find this issue.	Equipment is new circa 2000, high eff
	h.4 (35)	Retrofit - Boilers			Investigation looked for, but did not find this issue.	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Investigation looked for, but did not find this issue.	
	h.6 (37)	Retrofit - Heat Pumps			Investigation looked for, but did not find this issue.	
	h.7 (38)	Retrofit - Equipment (custom)			Investigation looked for, but did not find this issue.	
	h.8 (39)	Retrofit - Pumping distribution method			Investigation looked for, but did not find this issue.	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Investigation looked for, but did not find this issue.	
	h.10 (41)	Retrofit - System (custom)			Investigation looked for, but did not find this issue.	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	
	h.12 (43)	Retrofit - Building Envelope			Investigation looked for, but did not find this issue.	
	h.13 (44)	Retrofit - Alternative Energy			Investigation looked for, but did not find this issue.	
	h.14 (45)	OTHER_Retrofit			Investigation looked for, but did not find this issue.	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	j.1 (49)	OTHER			Investigation looked for, but did not find this issue.	

Department of Transportation Summary of Findings

Waters Edge Building

Chiller low delta T:

The chiller is oversized for the load. Chiller was designed for 14F delta T on a design day. Maximum dT experienced during the 2011 cooling season was only 7F, or about 175 tons. The design chiller output is 340 tons. The recommendation is to rebalance the flow to the minimum evaporator flow, and to use the CHWS temperature reset which is already available in the chiller sequence.

It was also discovered that the cooling tower 5 HP fan was not operational. The control sequence calls for the 5 HP fan to run until it cannot meet the load, then switch to the 15 HP fan. Instead, the 15 HP fan was cycling to maintain 85F condenser water temperature, even when a much lower CW temperature is attainable. A lower CW temperature would result in more efficient chiller operation. The recommendation is ato add a VFD to the 15HP fan and allow the CW temperature to drop at lower outside air temperatures.

The factory efficiency data was used to compare theoretical chiller efficiency at current operation, with theoretical chiller efficiency at recommended operating conditions. The percent increase in efficiency at varying chiller loading was applied to actual chiller kW/tons calculated using trended data.

The costs associated with this finding are a new VFD for the cooling tower, for which there is a rebate from Xcel Energy and the cost to rebalance the chilled water pumps to 400 gpm using new VFDs on chilled water pumps. The current control logic allows for CHWS temperature reset but the reset is currently programmed for constant 42F chilled water temperature.

Garage: Make up air unit MAU-1 and EF-3:

Summer trends show the make up air unit and exhaust fan running nearly continuously. During winter hours, the fans run only sporadically. There seems to be no correlation to the fan status and the readings on the two CO sensors which are always in normal range. What I found in the logic is that the systems changes from summer to winter mode at OAT < 37F. The only difference between summer and winter mode is the setpoints. This unit has only a gas heating coil, no cooling coil.

There is a summer cooling setpoint of 80F in the logic, however. It seems that the system may be trying to HEAT to 80 in the summer, but the gas at the heating unit has been manually shut off. I suggest that the summer and winter setpoints be changed to 40F, and the fan operation trended once OAT is consistently higher than 37F. If that does not solve the problem then a controls contractor may need to take a closer look at the sequence to see what is triggering the fan status to ON nearly all summer. The CO sensors have not been recalibrated since installation.

The fan running hours have been logged since the controls upgrade, 9/30/2008, showing that the fans have run 84% of all hours since then.

The heating setpoint of 40F should be maintained, as the garage has a wet sprinkler system which needs protecting. Winter trends show that the garage temperature never falls below 55F because computer room exhaust fans dump conditioned air into this space.

AC-1 Runtime:

This built-up AHU has a large bank of electric heating coils which would probably dim the lights at Rosedale Mall if they were ever fired. They have been disabled since 2008 according to the operator. The humidifiers have also been disabled. A minimum 60 F mixed air temperature is maintained by allowing the OA dampers to close. This means that on a design cold day, the %OA would be reduced to 11%. The unit is operated 24/7 although the spaces are not always occupied. This calculation assumes that the unit could be scheduled to shut down from 10 pm until 6 am. The calculation did not include turning the unit off during weekends.

HVAC-1 and HVAC-2:

These units were replaced last year, and full trending capability has not yet been implemented. The VAV boxes have not been balanced, and are operating at 50% flow. The outside air dampers were closed during the winter season by the operator. The fans operate 24/7 although the spaces are not occupied at night. Because the OA dampers have been closed and the system is not balanced, I included only the fan energy savings in this calculation.

Regional Transportation Management Center (RTMC):

This building houses the Operations Center which has 24/7 cooling needs. Chiller and boiler trends show supply temperature reset based on OAT. Dry coolers are used for chilled water needs during cold months. Dry coolers stage on as needed to meet load. Condenser water pumps have VFDs and stage on with dry coolers.

AHU-2 is required 24/7 to cool the loads in the Operations Center. The only opportunities for saving energy are in the other AHUs. AHU-1 serves the support areas which are often occupied during evening hours. The calculation assumes that the AHU could be reduced 30% by shutting down at 10 pm each night. The installation cost provides for a CO sensor at each level for trending only, and an occupancy override switch at each level that the unit serves.

AHU-3 operates 24/7 in the chiller room. It is maintaining constant space temperature of 75F. ASHRAE 62 recommends 200 cfm OA for this space during occupied hours. This room is occupied only when servicing the chiller and can be considered an unoccupied space. The calculation provides for constant operation during the hours of 6 am to 6 pm, reduces the OA from 600 cfm to 200 cfm, and provides a wider space temperature deadband (60 F to 80 F.) OA cfm would be controlled by a CO2 sensor and would be less than 200 cfm in actual operation as the space is unoccupied.

Skyways are cooled using two chilled water fan coil units. Summer trending showed that the space temperature is maintained at 69F. Trane TRACE was used to model the skyway to show savings available by cooling to 75F rather than 69F.

September 14, 2011

Mark Pavelich
MNDOT Waters Edge & RTMC
1500 W County Rd B2
Roseville, MN 55113

Dear Mark:

Thank you for participating in Xcel Energy's Recommissioning program. We have reviewed your study application and proposal and have preapproved your study. The following outlines your rebate and project information:

Building Address	**1500 W County Rd B2, Roseville, MN 55113**		
Study Cost	$45,900	Study Number	**RM1709**
Preapproved study rebate*	**$10,650**		
* Your rebate was based on the study cost provided. If the final study cost is lower, your rebate will be adjusted accordingly.			
Study Provider	**HGA**		
Account manager	**Barb Jerhoff** Phone **651-229-5565**		

Here's a quick review of the Recommissioning program process:

- Once your study is complete, your study provider will send a draft copy to us for review.
- After we complete our review and approve the study, we will send you a confirmation letter noting our approval.
- Your study provider will schedule a wrap-up meeting with you and your Xcel Energy account manager to go over the results of the study.
- You pay the study provider for the full cost of the study.
- You submit the Recommissioning Study Rebate Application, along with a copy of the invoice and your Customer Implementation Plan, to us within 3 months of your report presentation. Please work with your account manager to complete the Customer Implementation Plan.
- We'll send your study rebate check to you.

Please note that we need to approve the final study in order to receive your study rebate.

This study pre-approval is valid for **3 months** from the date of this letter. If your study will take longer than that, please let us know. If you have any questions or comments, please call your assigned Xcel Energy account manager. Thanks again for participating in our Recommissioning program.

Sincerely,

Jon Packer
Marketing Assistant, Recommissioning

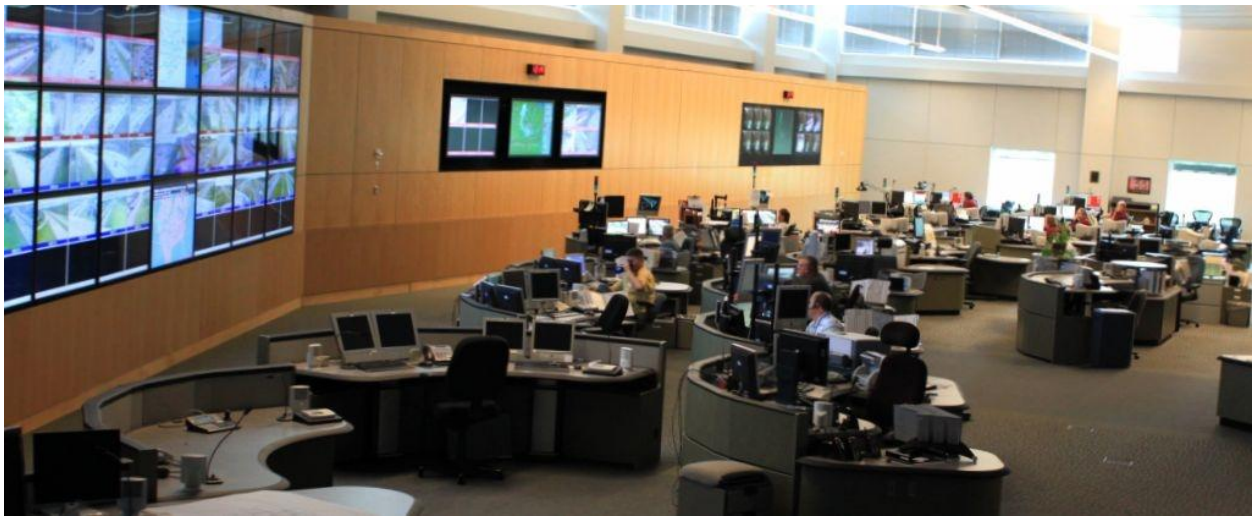
Attachment

CC: Barb Jerhoff - Xcel Energy
Sherryl Volkert - Xcel Energy
Kate Zwicky - HGA

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR DOT ROSEVILLE: WATERS EDGE AND REGIONAL TRAFFIC MANAGEMENT CENTER



May 3, 2011

Campus Overview

DOT Roseville: Waters Edge and Regional Traffic Management Center	
Location	1500 West County Road B2. Roseville, MN
Facility Manager	Mark Pavelich
Number of Buildings	2
Interior Square Footage	184,710
PBEEEP Provider	Center for Energy and Environment (Gustav Brändström)
Date Visited	January 25, 2011
Annual Energy Cost	$375,693 (from 2010 utility data in B3)
Utility Company	Electric and Natural Gas: Xcel Energy
Site Energy Use Index (EUI)	121.1 kBtu/sq ft (from 2010 utility data)
Benchmark EUI (from B3)	110.1 kBtu/sq ft

The DOT Facility in Roseville serves as the region's headquarters and as the Regional Traffic Management Center (RTMC) where DOT and State Highway Patrol manage traffic flow and events. It is comprised of two buildings totaling 184,710 square feet. The large building is the Waters Edge (1981), where the majority of offices and the cafeteria reside. The smaller RTMC houses more offices and the operations room, a single large room with dispatch personnel from three different entities working together to achieve optimal traffic flow. The room has a large wall with projected screens of traffic cameras and other important traffic information (see cover page picture). The personnel have desks with computers and the Johnson Controls' *Personal Environments* system which controls airflow and temperature at each desk using small desk-mounted diffusers and a radiant panel under the desk. The RMTC was built in 2003 as a standalone building next to the Waters Edge building. The Waters Edge Building was originally a commercial office building which was purchased by the state of Minnesota approximately 15 years after it was built.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of the DOT Facility was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on January 25, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Recommendation

A detailed investigation of the energy usage and energy savings opportunities of the two buildings listed below is recommended at this time. The floor areas listed in the table have not been verified.

Building Name	Area (sq ft)	Year Built
Waters Edge	130,090	1981
Regional Traffic Management Center	54,620	2003
Total	184,710	

There are many factors that are part of the decision to recommend an energy investigation of a building; at the Department Of Transportation (DOT) Facility, some of the characteristics that were taken into account during the building selection process include:

- Potential energy savings opportunities observed during screening phase
- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation

Recommended Buildings Descriptions

The main building at DOT Facility is made up of two skyway connected buildings that were built in 1981 and 2003. Each building has its own dedicated heating and cooling system. Details obtained through the screening process regarding the recommended buildings are included below:

Mechanical Equipment Summary Table	
1	Building Automation System (Automated Logic)
2	Buildings
184,710	Interior Square Feet
9	Air Handlers (5, 4)
186	VAV Boxes (119, 67)
10	Exhaust Fans (5, 5)
1	Electric Unit Heaters (1,0)
4	Chillers (1,3)
4	Dry Coolers / Cooling Towers (1, 3)
5	Modular Cooling Units (1, 4)
3	Hot Water Boilers (0, 3)
15	Pumps (HW, CHW, etc) (6, 9)
2	Humidifiers (2, 0)
4	Fan Coil Units (2, 2)
2,490	Point available on the BAS (1,400, 1090)
993	Minimum Points for Trending (543, 450)
0	Loggers required

(Numbers in parentheses break down the pieces of equipment by building)

Mechanical Equipment

Waters Edge

The Waters Edge has four VAV AHUs and one constant volume. The two large AHUs share an electric resistance heating element and chilled water coil. Both of these AHUs also have humidifiers. There are two smaller, identical AHUs located outside which serve the basement; these two AHUs have natural gas heat and DX Cooling. The small AHU located in the Radio room is cooling only and serves a small data center for radio communications.

The building's heat is provided by electric resistance, there are no boilers. The chilled water is produced by a single 500 Ton centrifugal chiller with a cooling tower on the roof. There is also a 5 Ton Liebert unit for a data center on the third floor.

Regional Traffic Management Center

There are two large AHUs at the RTMC. One (AHU-2) serves the second floor only, the Operations Room, and the other (AHU-1) serves the rest of the building. This was done to allow AHU-1 to run fewer hours since the Operations Room is operated 8,760 hours per year. Both AHUs are VAV systems and have humidifiers. There are two very small constant volume AHUs that serve the chiller room and the boiler room.

The VAV boxes have hot water reheats and most of the perimeter is served by additional hot water radiation. The hot water heat comes from three identical boilers. The three AHUs have booster pumps to ensure required flow.

The chilled water is supplied by three identical three-stage scroll chillers whenever the temperature outside is above 40°F. The chillers are turned off and the dry coolers become water-side economizers below 40°F. The chillers are by-passed and two smaller pumps are used to pump the water to the dry coolers on the roof. The large data center (3,155 sq ft) is cooled year around. The original design used three Liebert units using chilled water. An additional large Liebert (20 Tons) was installed for redundancy after the building was built, but is run all the time together with the three small units.

Controls and Trending

The equipment at both buildings of the DOT Facility is controlled by an AutoMatrix WebCtrl system, which is web based and remotely accessible. The BAS can trend points, and automatically collect, process and send the file in an email at set intervals. Almost the entire campus has DDC actuation and control. Some large valves and dampers have pneumatic actuation.

Lighting

The majority of the interior lighting is 32W T8 fixtures. Most spaces have motion detectors to control the lighting, but some spaces have been switched back to manual operation because the lights would turn off when people were working in the spaces.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) for the two buildings combined is 121.1 kBtu/sq ft, which is 10% higher than the B3 Benchmark of 110.1 kBtu/sq ft. The Waters Edge building's EUI is 102.6 kBtu/sq ft, which is 3% higher than its benchmark of 99.3 kBtu/sq ft. The Regional Transportation Management Center's EUI is 165.1 kBtu/sq ft, which is 21% higher than its benchmark of 135.9 kBtu/sq ft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average.

Metering

There are two electric meters and three gas meters. The Waters Edge Building has one electric meter and one natural gas meter. The gas meter is for domestic hot water heating only. The RTMC has an electric meter and two gas meters, one of which has very little use.

Documentation

There is mechanical documentation, including building plans, equipment schedules, operations and maintenance manuals available on-site for the RTMC, but not the Waters Edge. The plans are located at the facility management office and in good order and condition. The Waters Edge documentation is very limited. The building was purchased by the DOT after it was built, and the documentation was not transferred from the old owner.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff, building walk-through, automation system screen-captures, and equipment documentation. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge. The buildings below are those being recommended for investigation.

Waters Edge					
Area (sq ft)	130,090	Year Built	1981	Occupancy (hrs/yr)	5,148

HVAC Equipment

Air Handlers (5 Total)

Description	Type	Size	Notes
AHU 1 – East	VAV with VFDs on SF and Relief Fan	SF: 60 hp SF RF: 45,000cfm 20 hp	CHW and 2,100kW (shared with AHU 2) electric heating (rarely used), serves VAV boxes on the east side of the building
AHU 2 – West	VAV with VFDs on SFs and Relief Fan	SF: 60 hp SF RF: 45,000cfm 20 hp	CHW and 2,100kW (shared with AHU 1) electric heating (rarely used), serves VAV boxes on the east side of the building
AHU-1	VIGV VAV System with SF	SF: 7.5 hp, 25 Ton DX, 324kBtu/h Nat Gas Heat	One year old Trane unit serving basement. Located outside.
AHU-2	VIGV VAV System with SF	SF: 7.5 hp, 25 Ton DX, 324kBtu/h Nat Gas Heat	One year old Trane unit serving basement. Located outside.
Radio Room	AHU	5hp, 8000cfm*	Estimated from Manufacturer Manual Cooling Only.

Make-up Air Unit

Description	Type	Size	Notes
MAU 1	Constant Volume	10 hp SF.	HW, serves Garage. Linked to Garage EF.

VAV Boxes (119 Total)

Description	Type	Size	Notes
VAV boxes		119 Units. Varying sizes.	Electric reheat

Fan Coil Unit

Description	Type	Size	Notes
	Fan Coil unit	2000cfm, 0.75hp SF 5Ton	Serves Old Patrol. Mounted in ceiling. Has electric heat, may be up to 20kW.
	Fan Coil unit	2000cfm, 0.75hp SF 5Ton	Serves old Hwy Dispatch. Mounted in ceiling. Has electric heat, may be up to 20kW.

Waters Edge (cont.)
HVAC Equipment (cont.)

Cooling System

Description	Type	Size	Notes
CH-1	Water Cooled	500 Tons	
CHWP-1	Pump	600 gpm, 15 HP	CHW Pump
CHWP-2	Pump	600 gpm, 15 HP	CHW Pump
Cooling Tower			Unknown size
CWP-1	Pump	1,000 gpm, 25 HP	CW Pump
CWP-2	Pump	1,000 gpm, 25 HP	CW Pump

Exhaust Fans

Description	Type	Size	Notes
Garage EF		3hp Prop Fan	Controlled to CO levels in garage. Tied to the MAU.
4th Flr Electrical		0.5hp, 1000-1800cfm*	Estimated from manuf. reference table
1st Floor North Electrical Room		0.5hp, 1500-2000cfm*	Estimated from Fan Curve
1st Floor South Electrical Room		0.5hp, 1500-2000cfm*	Estimated from Fan Curve
Basement		0.5hp, 1500-2000cfm*	Estimated from Fan Curve
Mechanical Room		0.75hp	Propeller Exhaust Fan

Modular Cooling Units

Description	Type	Size	Notes
MCU-1		5 Tons	Serves computer room on 3rd Floor.

Unit Heaters (1 Total)

Description	Type	Size	Notes
UH	Electric Unit Heaters	15kW	

Waters Edge(cont.)

Points on BAS

Air Handlers

Description	Points
AHU 1 – Eas & West (most are common points)	RAT, MAT, DAT, MinOA Damper Position, MinOA Fan Status, Economizer Damper Position, Heating Stage Status (4X), Humidifier Stage Status (2X), RF1-S and Speed, RF2-S and Speed, Plenum Static Pressure, 1st Floor Static Pressure, SF1-S and Amps, SF2-S and Amps, CHW Valve 1 Position, CHW Valve 2 Position, DSP1, DSP2,
AHU 1 & 2	MAT, DAT, RAT, VIGV Position, DSP, SF-S and Amps, OAD Position, Gas Heat Status, DX Cooling Status
MAU 1	SF-S and Amps, Gas Heat Status, Summer/Winter Mode, ZN-T and Setpoint, North CO Sensor, South CO Sensor, EF-3 Status and Amps
Radio Room AHU	MAT, DAT, RAT, DSP, SF-S, OAD Position, DX Cooling Status, PRV Damper Position, ZN-T

VAV Boxes

Description	Points
Each Unit	Airflow (cfm), Airflow setpoint (cfm), Cooling Max, Heating Max, Occupied Min, and Unoccupied Min Flow Setpoints, Cooling temperature setpoint, Heating airflow and temperature setpoint, Heating valve, Zone temp, Damper Pos, Radiation Valve Position

Cooling System

Description	Points
	Chiller Status, Chiller Amps, Chiller %Reset, CHWST, CHWRT, OAT, OARH, CHWP 1 & 2 Status and Amps, CWP 1 & 2 Status and Amps, Cooling Tower Status, CWST, CWRT,

Exhaust Fans

Description	Points
All EFs	EF status

Regional Traffic Management Center					
Area (sq ft)	54,620	Year Built	2003	Occupancy (hrs/yr)	8760 / ?

HVAC Equipment

Air Handlers (3 Total)

Description	Type	Size	Notes
AHU-1	VAV	SF 30,000 cfm, 40hp RF 22,500cfm, 10hp	Serves entire building except Operations Room. 45 VAVs. Has humidifier.
AHU-2	VAV	SF 10,000 cfm, 15hp RF 8,700cfm, 5hp	Serves only the Operations Room. 22 VAVs. Has humidifier.
AHU-3	CV	SF 2,000cfm, 2hp	Serves Chiller Room.

VAV Boxes (67 Total)

Description	Type	Size	Notes
VAV Boxes	HW reheat	120 to 2,800 cfm max each	5 VAVs do not have reheat.

Heating System

Description	Type	Size	Notes
Boiler 1-3	Boiler	1,200 kBtu/h	Three identical boilers, each 1,200kBtu/h.
HWP 1-3	CV Pump	80 gpm, 3hp	HW Loop. Each boiler has a pump.
HWP 4	Booster Pump	40 gpm, 1/3hp	HW Pump on AHU-1
HWP 5	Booster Pump	15 gpm, 1/4hp	HW Pump on AHU-2
HWP 6	Booster Pump	3 gpm, 1/20hp	HW Pump on AHU-3

Cooling System

Description	Type	Size	Notes
Chiller 1-3	Water cooled Scroll	60 Tons	4 Stages.
CHWP 1-3	CV Pump	95 gpm, 5hp	CHW Loop.
CWP 1-3	CV Pump	180 gpm, 7.5hp	Condenser Water Pump for Summer use.
CWP 4-5	CV Pump	60 gpm, 5hp	Condenser Water Pump for Winter use.
DC-1-3	Dry Cooler/Cooling Tower	1,880gpm, 87,800cfm, 8hp	3 Units. Used as cooling towers in summer and for free cooling in the winter. The water can be bypassed the chillers and used for cooling.

Fan Coil Units (2 Total)

Description	Type	Size	Notes
FC-1 and 2	Fan Coil Unit	1,500 cfm, 40.5 kBtu/h heat	Serves skyways.

Modular Cooling Units (5 Total)

Description	Type	Size	Notes
MCU-1-3	Liebert Unit	Cool: 76.3 kBtu/h (CHW)	Serves Computer Room.
MCU-4	Liebert Unit	Cool: 20.3 kBtu/h (CHW)	Serves Electrical Room
MCU-5	Liebert Unit	Cool: 240 kBtu/h (CHW)	Serves Computer Room. Added after construction.

Exhaust Fans (4 Total)

Description	Type	Size	Notes
EF 1	Exhaust Fan	2,500/5,020 cfm, 2.5hp	2-speed Fan. Serves WCs.
EF 2	Exhaust Fan	1,030/2,070 cfm, 1hp	2-speed Fan. Serves WCs in Operations Room.
EF 3	Exhaust Fan	2,300 cfm, 0.75hp	Serves Chiller Room.
EF 4	Exhaust Fan	500 cfm, 0.25hp	Serves Chiller Room.

Regional Traffic Management Center (cont)

Points on BAS

Air Handlers

Description	Points
AHU-1 AHU-2	DAT, DA-RH, DSP, SF-S, Amperage, and Speed, RF-S, Amperage, and Speed, RAT, EF-S and Amperage, MinOA Damper Position and cfm, Economizer Damper Position, Relief Damper Position, Return Air Damper Position, MAT, HTG Valve Pos, HTG Pump Status and Amps, CHW Valve Pos, Humidifier Status and Modulation, Return Duct Static Pressure, Space Static Pressure, Mixing Box Static Pressure, SF cfm, RF cfm, ZN-T, ZN-RH (AHU-2 does not have air flow points)
AHU-3	DAT, SF-S, DSP, HTG Valve Position, HTG Pump Status and Amperage, MAT, MA Pressure, RAT, OA Damper Position, RA Damper Position, ZN-T with Heating and Cooling Setpoints, ZN-RH, Space Static Pressure

VAV Boxes

Description	Points
Each Unit	Airflow (cfm), Airflow setpoint (cfm), Cooling Max, Heating Max, Occupied Min, and Unoccupied Min Flow Setpoints, Cooling temperature setpoint, Heating airflow and temperature setpoint, Heating valve, Zone temp, Damper Pos, Radiation Valve Position

Heating System

Description	Points
	HWST, HWRT, For all three boilers: Boiler Status, Flame Rate, Setpoint, Supply Temp, HWP Status and Amperage

Cooling System

Description	Points
	For all three chillers: Chiller Status, Compressor (1-4) Amperage, Supply Temp, Cond Temp, Setpoint Reset. For all three dry coolers (DC-1-3): Stage 1-4 Status, Amperage, Exit Temp, Status. Valve pair 1/2, 3/6, 4/7, and 5/8 Control, Dry Cooler Supply and Return Temperature, CHWP-1-3 Status and Amperage, CWP 1-5 Status and Amperage, CHWST, CHWRT, CHW Flow Rate, Condenser Flow Rate.

MCUs

Description	Points
MCU-1-4	ZN-T and Heating and Cooling setpoint, Status

Floor Plan

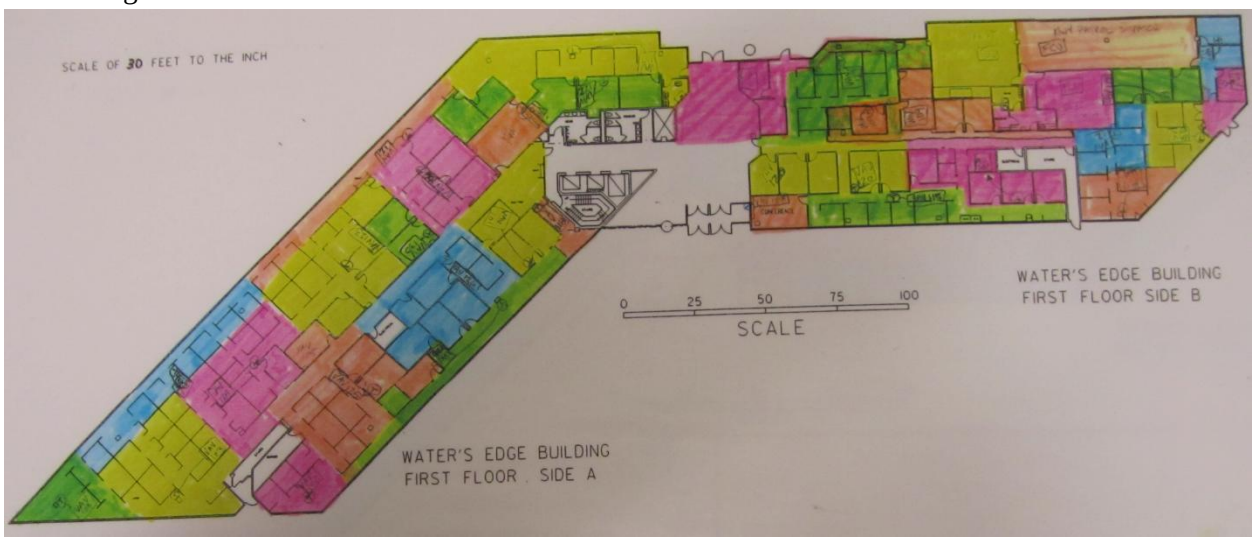
Description	Points
	Floor Baffle Position and Actuator Feedback (3X),

Exhaust Fans

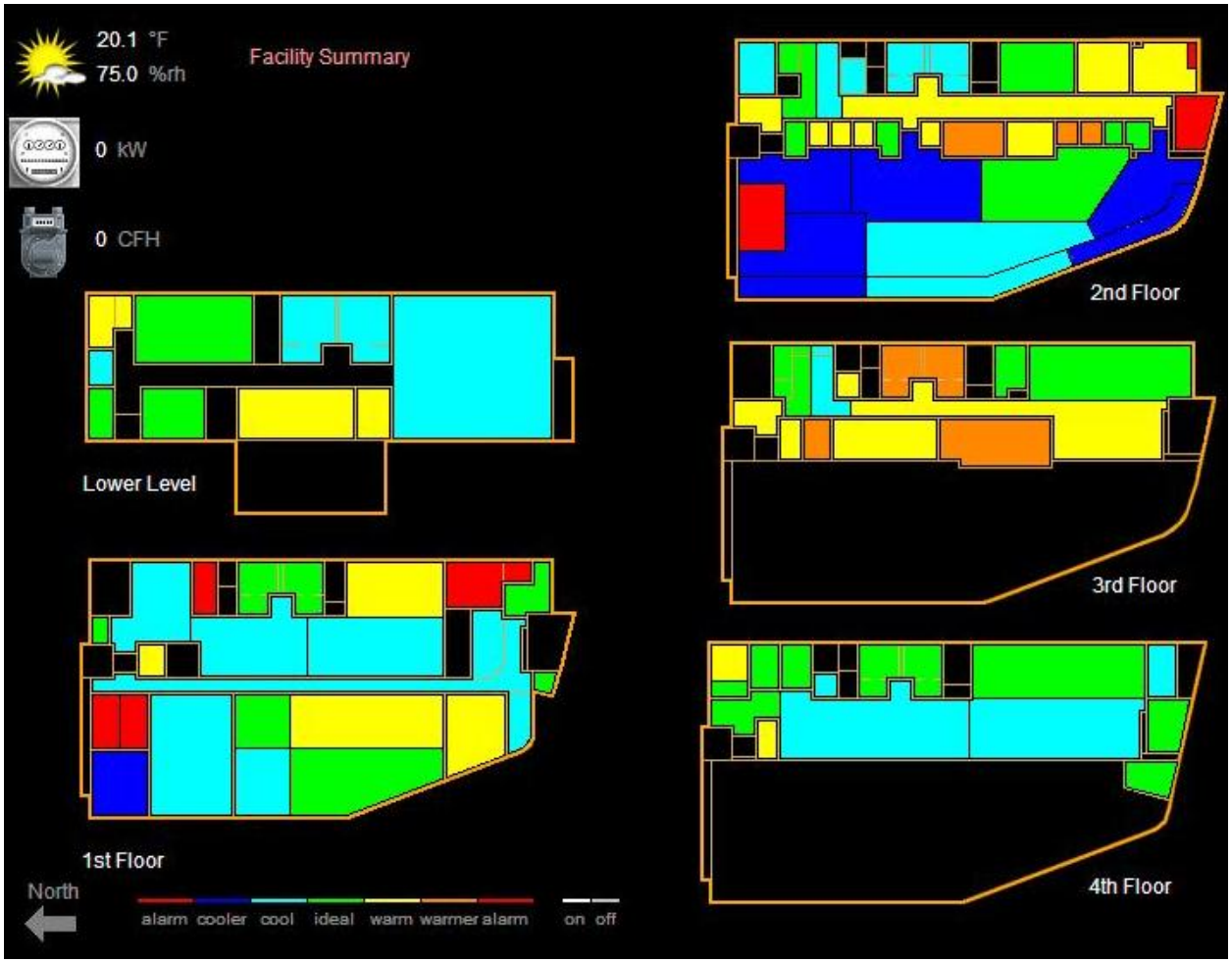
Description	Points
EF-1, 2	Toiler EF Low Status, Toilet EF High Status, EF VFD Speed
EF-3	EF-S, Damper Control, Fan Static Pressure, Amps
EF-4	EF status, Damper Position, Amps

Building Floor Plans

Waters Edge



Regional Transportation Management Center



PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH