



ASHRAE LEVEL II ENERGY AUDIT

THE CITY OF KITCHENER

ENERGY AUDIT SUMMARY

WF Project No.: 2019-0052-11

December 16, 2019

WALTERFEDY

INTRODUCTION

Objectives

WalterFedy was hired by The City of Kitchener to complete ASHRAE level II Energy Audits at 35 of their facilities located within Kitchener, ON. The purpose of this portfolio energy audit program is to review how energy and water is currently being consumed within each facility, gain an understanding of how the facility is being operated, and provide specific and actionable recommendations for cost savings and improved efficiencies.

Each report identified and explains potential energy and water conservation measures and provides economic analyses in order to estimate utility savings, greenhouse gas reductions, budget implementation costs, and simple payback periods.

The goal of the audits is to recognize EWCMs with high financial and greenhouse gas savings along with reasonable payback periods. An analysis of historical energy and water use provides insight into the consumption patterns of the facilities.

It is The City of Kitcheners intent to pair the results of this portfolio energy audit program with their multi-year capital planning strategy.

Contact information

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RECOMMENDATIONS

Recommendations - Low/no cost projects

Numerous low/no cost opportunities were reported within the energy audits. These opportunities focused on adjustments to existing building control systems (ie. equipment schedules, setpoint adjustments) or low cost equipment replacements (faucet aerators). It is understood that the City's own forces would be available to complete these projects. A summary of these opportunities are found within the table below (refer to Table 4 for a complete list of EWCMS).

Table 1: Recommendations - No/Low Cost EWCMS

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)
Bridgeport community centre	Temperature setpoint optimization	484.72	0.19
Centreville chicopee community centre	Faucet aerator upgrade	248.35	0.23
Chandler mowat community centre	Faucet aerator upgrade	313.04	0.29
Country hills community centre	HVAC schedule optimization (gym)	2,217.65	7.91
	Faucet aerator upgrade	338.54	0.32
Downtown Community Centre/WCDSB Administration	Faucet aerator upgrade	582.91	0.55
Fire station #5 Forest heights community centre	Faucet aerator upgrade	761.43	0.72
Mill countland community centre	Faucet aerator upgrade	310.72	0.29
Rockway community centre	Faucet aerator upgrade	647.35	0.60
Breithaupt Centre and Park	Pool evaporation optimization	6,752.93	33.30
Cameron Heights Collegiate Pool	Pool evaporation optimization	5,264.96	29.53
Forest Heights Swimming Pool and Library	Faucet aerator upgrade	634.85	0.54
	Pool evaporation optimization	6,275.78	29.53
Grand River Recreation Complex	Pool evaporation optimization	6,333.46	29.53
Wilson pool	Faucet aerator upgrade	216.72	0.18
Idlewood Pool	Faucet aerator upgrade	529.79	0.44
Activa Group Sportsplex	HVAC schedule optimization	18,054.96	72.29
	General energy awareness	50,386.56	41.27
	Ice thickness and temperature optimization	19,490.57	5.93
	Faucet aerator upgrade	7,460.71	5.96
Grand River Arena	Faucet aerator upgrade	1,569.32	1.49
	Booster pump removal	77.31	0.02
Lions Arena	Faucet aerator upgrade	1,658.43	1.57
Kitchener Memorial Auditorium Complex	Electricity peak demand management	50,137.82	0.03
	General energy awareness	92,488.18	102.08
	Ice thickness and temperature optimization	31,904.23	11.87
	Faucet aerator upgrade	24,614.96	23.38
Kitchener City Hall	HVAC schedule optimization	15,847.75	31.17
	General energy awareness	85,945.34	76.62
	Lighting schedule optimization	8,840.50	2.72
	Pump schedule optimization	7,086.30	2.18
Kitchener Market	General energy awareness	23,681.40	26.85
	HVAC schedule optimization	13,921.62	38.98
	Air-side free-cooling	8,124.47	2.23
	Faucet aerator upgrade	4,307.70	1.04
Kitchener Operations Facility	HVAC schedule optimization	71,013.24	183.88
	HVAC control optimization	10,578.15	34.96
	Discharge pressure setpoint optimization	4,447.67	1.36
	Irrigation water use optimization	22,380.61	0.18
	RO water treatment optimization	29,840.81	0.23
Fire Headquarters Station #1	Faucet aerator upgrade	1,497.79	1.26
Fire Station #2	Faucet aerator upgrade	44.35	0.04
Fire Station #3	Faucet aerator upgrade	378.57	0.32
Total		637,692.52	804.06

Recommendations - Top projects

To determine the *Top Project* list (excludes EWCMs listed in Table 1, refer to Table 4 for a complete list of EWCMs), the combined EWCM list from all 35 energy audits were filtered according to the following criteria and summarized below.

- The simple payback of the ECWM is < 12 years.
- The utility savings of the ECWM are > \$1,000.
- The GHG reduction of the ECWM is > 5 tonnes.

Table 2: Recommendations - Top Project EWCMs

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
Country hills community centre	Demand control ventilation (gym)	1,822.07	13.81	1,500.00	0.66	108.64
Downtown Community Centre/WCDSB Administration	Demand control ventilation (gym)	4,505.14	32.58	1,500.00	0.27	46.05
Mill countland community centre	Demand control ventilation (gym)	1,156.97	8.91	1,500.00	1.04	168.44
Victoria Hills Community Centre	Demand control ventilation (gym)	1,252.20	9.17	3,000.00	2.16	326.98
Breithaupt Centre and Park	Boiler equipment upgrade*	5,623.01	46.28	69,000.00	11.20	1,490.97
	Shower fixture upgrade	60,415.16	65.34	3,600.00	0.06	55.10
Cameron Heights Collegiate Pool	Shower fixture upgrade	16,109.25	17.23	2,400.00	0.15	139.26
Forest Heights Swimming Pool and Library	Shower fixture upgrade	5,246.70	5.68	3,000.00	0.57	528.34
Grand River Recreation Complex	Boiler equipment upgrade (pool)*	1,268.39	10.33	14,800.00	9.30	1,432.99
	Boiler equipment upgrade (heating)*	1,217.37	9.91	20,000.00	11.50	2,017.64
Harry Class Pool	Energy recovery (drainwater)	1,075.85	7.84	2,000.00	1.67	255.08
Activa Group Sportsplex	Resurfacing water de-aeration	31,931.24	54.00	50,000.00	1.03	925.87
	Ammonia heat rejection equipment upgrade	21,111.31	6.43	180,000.00	7.92	28,011.99
Don McLaren Arena	Resurfacing water de-aeration	10,989.24	19.55	50,000.00	4.06	2,557.20
Grand River Arena	Resurfacing water de-aeration	10,586.26	19.55	50,000.00	4.25	2,557.20
Lions Arena	Resurfacing water de-aeration	10,601.94	19.55	50,000.00	4.25	2,557.20
Sportsworld Arena	Resurfacing water de-aeration	27,262.68	51.58	50,000.00	1.35	969.40
	Low-e ceiling	20,590.31	6.30	163,950.00	7.35	26,023.81
Kitchener Memorial Auditorium Complex	Shower fixture upgrade	18,794.04	20.30	24,000.00	1.28	1,182.29
	Resurfacing water de-aeration	43,050.11	117.68	100,000.00	1.73	849.74
	HVAC schedule optimization	21,626.83	56.22	80,000.00	2.66	1,423.03
	Lighting upgrade	76,296.09	28.39	374,287.20	4.32	13,185.06
Kitchener City Hall	Demand control ventilation	23,521.69	177.91	60,000.00	2.49	337.24
Kitchener Operations Facility	General energy awareness	65,904.88	98.98	20,000.00	0.30	202.06
Fire Headquarters Station #1	Apparatus bay door switches	18,055.31	62.75	6,500.00	0.01	103.59
Total		500,014.04	966.27	1,381,037.20	2.76	1,429.25

Recommendations - Complete list of EWCMS

The following table provides summary metrics from all 35 energy audits combined. The figures on the following pages provide a site level comparison for the each of the categories listed in the table below.

Table 3: ASHRAE level II energy audits - 35 site summary totals

Annual Electricity Savings	[kWh]	10,792,593
Annual Natural Gas Savings	[m3]	1,394,076
Annual Water Savings	[m3]	62,426
Utility Cost Savings	[\$]	2,385,688
eCO2 Savings	[tonnes]	3,186
Total Capital Costs	[\$]	22,897,083
Total Incentives	[\$]	454,690

Table 4: Recommendations - Complete list of EWCMs

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
Bridgeport community centre	Lighting upgrade (exterior - wall mounted only)	550.40	0.22	3,000.00	4.54	13,745.36
	Lighting upgrade (interior)	528.20	0.21	8,808.00	13.94	42,052.14
	Lighting controls (occupancy)	253.54	0.10	7,046.40	27.00	70,086.91
	Lighting controls (daylighting)	92.44	0.04	7,193.20	77.03	196,243.34
	Solar PV electricity generation	20,677.26	8.20	468,000.00	22.63	57,077.63
	Temperature setpoint optimization	484.72	0.19	0.00	0.00	0.00
	Water leak monitoring	236.42	0.00	1,500.00	6.34	0.00
	General energy awareness		0.37			
Centreville chicopee community centre	Demand control ventilation (gym)	960.27	7.16	1,500.00	1.25	209.47
	Lighting upgrade (exterior - wall mounted only)	325.98	0.13	1,800.00	4.60	14,224.95
	Lighting upgrade (interior)	354.09	0.14	7,368.00	17.40	53,604.93
	Toilet upgrade	189.05	0.00	3,500.00	18.51	0.00
	Lighting controls (occupancy)	276.41	0.11	10,852.65	38.49	101,144.47
	Solar PV electricity generation	15,706.56	6.10	348,000.00	22.16	57,077.63
	Faucet aerator upgrade	248.35	0.23	0.00	0.00	0.00
	General energy awareness	22,614.13	2.38			
Chandler mowat community centre	Lighting upgrade (interior)	898.42	0.36	14,320.50	13.33	40,314.45
	Lighting controls (occupancy)	431.24	0.17	11,456.40	25.78	67,190.75
	Toilet upgrade	231.72	0.00	7,000.00	30.21	0.00
	Solar PV electricity generation	682.75	0.27	15,408.00	22.57	57,077.63
	Faucet aerator upgrade	313.04	0.29	0.00	0.00	0.00
	Water leak monitoring	2,361.84	0.00	1,500.00	0.64	0.00
	General energy awareness	3,691.91	2.95			
Country hills community centre	Demand control ventilation (gym)	1,822.07	13.81	1,500.00	0.66	108.64
	Lighting upgrade (exterior - wall mounted only)	493.82	0.20	3,000.00	5.06	15,292.06
	Toilet upgrade	291.66	0.00	3,500.00	12.00	0.00
	Lighting upgrade (interior)	970.15	0.39	14,688.00	12.66	38,109.76
	Lighting controls (occupancy)	695.68	0.28	19,726.80	27.56	71,377.37
	Solar PV electricity generation	14,553.20	5.78	330,000.00	22.68	57,077.63
	HVAC schedule optimization (gym)	2,217.65	7.91	0.00	0.00	0.00
	Faucet aerator upgrade	338.54	0.32	0.00	0.00	0.00
	Water leak monitoring	306.43	0.00	1,500.00	4.90	0.00
	General energy awareness	2,788.02	4.99			
Downtown Community Centre/WCDSB Administration	Demand control ventilation (gym)	4,505.14	32.58	1,500.00	0.27	46.05
	Lighting upgrade (exterior)	438.74	0.17	3,000.00	5.70	17,230.98
	Lighting upgrade (interior)	3,957.24	1.57	54,715.50	11.56	34,843.21
	Toilet upgrade	554.60	0.00	10,500.00	18.93	0.00
	Demand control ventilation (kitchen)	2,315.47	1.40	46,500.00	19.40	33,199.25
	Lighting controls (occupancy)	2,018.19	0.80	46,508.18	22.25	58,072.01
	Faucet aerator upgrade	582.91	0.55	0.00	0.00	0.00
	Water leak monitoring	336.97	0.00	1,500.00	4.45	0.00
	General energy awareness	14,892.65	22.73			
Fire station #5 Forest heights community centre	Shower fixture upgrade	517.27	0.56	600.00	1.16	1,076.08
	Lighting upgrade (exterior)	1,833.44	0.68	14,256.00	6.96	20,904.27
	Toilet upgrade	584.53	0.00	9,800.00	16.77	0.00
	Lighting upgrade (interior)	1,099.95	0.41	24,947.25	18.96	60,975.61
	Lighting controls (occupancy)	510.60	0.19	20,623.20	39.65	108,588.09
	HVAC system upgrade (ASHP)	-1,153.12	8.40	17,000.00		2,023.60
	Energy recovery (change room)	-425.00	2.00	2,000.00		1,001.17
	Big Ass fans	-461.02	1.58	30,000.00		18,965.90
	Solar PV electricity generation	19,695.20	7.33	418,140.00	21.23	57,077.63
	Faucet aerator upgrade	761.43	0.72	0.00	0.00	0.00
	Water leak monitoring	652.27	0.00	1,500.00	2.30	0.00
	Radiant heater sensor upgrade	129.73	1.04	1,000.00	7.71	960.06
	General energy awareness	4,523.00	8.49			
Kingsdale community centre and wilson park	Demand control ventilation (gym)	961.20	7.37	1,500.00	1.25	203.60
	Lighting upgrade (exterior)	772.32	0.30	6,240.00	7.21	20,692.19

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Table 4: Recommendations - Complete list of EWCMS

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
	Lighting upgrade (interior)	1,562.51	0.61	24,801.00	13.27	40,650.41
	Lighting controls (daylighting)	390.63	0.15	14,467.25	36.26	94,850.95
	Destratification fans	-126.55	4.86	19,500.00		4,008.83
	Solar PV electricity generation	17,499.11	6.83	390,000.00	22.29	57,077.63
	Water leak monitoring	561.51	0.00	1,500.00	2.67	0.00
	General energy awareness	2,759.42	3.86			
Mill countland community centre	Demand control ventilation (gym)	1,156.97	8.91	1,500.00	1.04	168.44
	HVAC system upgrade (portable)	934.61	-1.74	5,460.00	5.84	-3,146.11
	Lighting upgrade (exterior)	511.01	0.21	4,164.00	7.22	20,281.28
	Lighting upgrade (interior)	734.52	0.30	14,995.50	17.07	50,813.01
	Toilet upgrade	230.44	0.00	4,900.00	21.26	0.00
	Lighting controls (occupancy)	264.43	0.11	8,997.30	33.22	84,688.35
	Lighting controls (daylighting)	220.35	0.09	10,496.85	46.83	118,563.69
	Solar PV electricity generation	18,233.55	7.33	418,140.00	22.93	57,077.63
	Faucet aerator upgrade	310.72	0.29	0.00	0.00	0.00
	General energy awareness	2,035.53	3.62			
Rockway community centre	Lighting upgrade (exterior)	646.44	0.25	4,776.00	6.38	18,881.58
	Lighting upgrade (interior)	4,063.42	1.59	62,047.50	12.77	39,024.39
	Toilet upgrade	535.12	0.00	9,800.00	18.31	0.00
	Lighting controls (occupancy)	1,584.73	0.62	40,330.88	24.67	65,040.65
	Faucet aerator upgrade	647.35	0.60	0.00	0.00	0.00
	Water leak monitoring	401.06	0.00	1,500.00	3.74	0.00
	General energy awareness	2,880.10	3.73			
Stanley park community centre	Lighting upgrade (exterior)	1,065.08	0.41	8,328.00	6.93	20,281.28
	Lighting upgrade (interior)	2,425.68	0.94	33,057.00	11.39	35,348.18
	Toilet upgrade	414.70	0.00	5,600.00	13.50	0.00
	Lighting controls (occupancy)	1,237.10	0.48	28,098.45	21.94	58,913.63
	Lighting controls (daylighting)	291.08	0.11	11,569.95	38.98	103,098.86
	Install solar PV system	16,359.66	6.31	360,000.00	22.01	57,077.63
	Water leak detection device	285.71	0.00	1,500.00	5.25	0.00
	General energy awareness	2,293.59	3.35			
Victoria Hills Community Centre	Demand control ventilation (gym)	1,252.20	9.17	3,000.00	2.16	326.98
	Lighting upgrade (exterior)	934.38	0.37	3,000.00	2.68	8,081.79
	Lighting upgrade (interior)	886.26	0.35	13,740.00	12.96	39,024.39
	Toilet upgrade	391.79	0.00	7,000.00	17.87	0.00
	Lighting controls (occupancy)	608.12	0.24	17,442.00	27.89	72,197.02
	Solar PV electricity generation	11,907.17	4.73	270,000.00	22.68	57,077.63
Williamsburg Community Centre	General energy awareness	2,850.04	5.10			
	Thermostat upgrade	112.37	0.27	600.00	5.34	2,245.16
	Lighting upgrade (interior)	296.32	0.10	4,423.50	12.48	43,360.43
	Lighting controls (occupancy)	237.05	0.08	3,538.80	14.24	43,360.43
	Lighting controls (daylighting)	148.16	0.05	5,160.75	34.14	101,174.35
Breithaupt Centre and Park	General energy awareness		0.21			
	Demand controlled ventilation (gym)	724.76	4.08	4,000.00	5.11	979.72
	Lighting upgrade (exterior)	1,915.94	0.57	11,700.00	5.51	20,655.19
	Boiler equipment upgrade*	5,623.01	46.28	69,000.00	11.20	1,490.97
	Lighting upgrade (interior)	3,733.12	1.10	50,235.50	12.87	45,516.02
	Destratification fans	2,046.02	23.73	30,000.00	13.98	1,264.37
	Energy recovery (main change room)	708.67	18.66	24,000.00	33.16	1,286.44
	Energy recovery (small change room)	9.94	10.93	23,000.00	2,283.38	2,103.81
	Energy recovery (exercise pool)*	-163.14	11.48	57,000.00		4,964.77
	Solar PV electricity generation	10,937.51	3.23	146,880.00	13.43	45,422.36
	Pool evaporation optimization	6,752.93	33.30	0.00	0.00	0.00
	Shower fixture upgrade	60,415.16	65.34	3,600.00	0.06	55.10
	Lighting controls (occupancy)	812.79	0.24	7,500.00	8.93	31,210.99
	General energy awareness	12,914.52	33.17			
Cameron Heights Collegiate Pool	Shower fixture upgrade	16,109.25	17.23	2,400.00	0.15	139.26

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Table 4: Recommendations - Complete list of EWCMS

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
	Faucet aerator upgrade	1,045.19	0.87	1,800.00	1.72	2,057.97
	Lighting upgrade (underwater)	2,685.82	0.96	7,200.00	2.43	7,506.10
	Lighting upgrade (interior)	729.98	0.26	12,069.75	15.63	46,296.30
	Boiler equipment upgrade	92.61	0.70	24,000.00	242.96	34,103.31
	Energy recovery (change room)	-783.84	10.44	23,000.00		2,203.06
	Destratification fans	-401.23	2.16	30,000.00		13,919.68
	Solar PV electricity generation	9,731.68	3.48	166,406.40	17.10	47,878.47
	Pool evaporation optimization	5,264.96	29.53	0.00	0.00	0.00
	Lighting controls (occupancy)	370.44	0.13	5,250.00	13.82	39,682.54
	Energy recovery (pool room)	-1,277.26	6.69	1,000.00		149.47
	General energy awareness	5,460.85	14.02			
	Forest Heights Swimming Pool and Library	Faucet aerator upgrade	634.85	0.54	0.00	0.00
Shower fixture upgrade		5,246.70	5.68	3,000.00	0.57	528.34
Lighting upgrade (interior)		3,186.95	0.94	34,074.25	10.11	36,412.82
Boiler equipment upgrade		1,033.98	8.56	15,000.00	13.06	1,753.28
Demand controlled ventilation (meeting room)		242.45	0.75	4,000.00	15.26	5,367.43
Energy recovery (change room)		1,040.35	14.60	23,000.00	21.73	1,575.13
Destratification fans		-53.41	6.53	30,000.00		4,591.61
Solar PV electricity generation		15,065.84	4.42	246,528.00	16.36	55,728.28
Pool evaporation optimization		6,275.78	29.53	0.00	0.00	0.00
Lighting controls (occupancy)		491.03	0.14	4,500.00	8.87	31,210.99
General energy awareness		13,521.84	36.19			
Grand River Recreation Complex		Shower fixture upgrade	2,767.26	2.99	3,000.00	1.08
	Lighting upgrade (exterior)	1,348.06	0.41	8,100.00	5.29	19,949.46
	Boiler equipment upgrade (pool)*	1,268.39	10.33	14,800.00	9.30	1,432.99
	Lighting upgrade (interior)	4,076.22	1.23	42,782.25	9.92	34,846.67
	Boiler equipment upgrade (heating)*	1,217.37	9.91	20,000.00	11.50	2,017.64
	Demand controlled ventilation (multipurpose room)	431.56	0.40	6,000.00	13.21	15,113.78
	Energy recovery (change room)	1,350.90	23.44	24,000.00	17.30	1,023.91
	Destratification fans	986.00	14.71	30,000.00	29.01	2,039.38
	Solar PV electricity generation	2,525.29	0.76	43,142.40	17.08	56,721.54
	Pool evaporation optimization	6,333.46	29.53	0.00	0.00	0.00
	Lighting controls (occupancy)	416.84	0.13	3,750.00	8.70	29,868.58
	General energy awareness	14,040.19	28.48			
Wilson pool	Faucet aerator upgrade	216.72	0.18	0.00	0.00	0.00
	Lighting upgrade (exterior)	108.47	0.04	3,000.00	23.74	73,792.02
	Lighting upgrade (interior)	41.38	0.02	3,052.50	68.01	196,837.99
	Boiler equipment upgrade	81.25	0.54	15,000.00	166.16	27,591.53
	Lighting controls (occupancy)	20.98	0.01	1,950.00	92.58	248,015.87
	General energy awareness	378.12	1.14			
	Envelope sealing	75.99	0.22			
Harry Class Pool	Energy recovery (drainwater)	1,075.85	7.84	2,000.00	1.67	255.08
	Lighting upgrade (interior)	153.10	0.06	6,261.00	37.70	110,894.64
	Boiler equipment upgrade	1,059.90	7.72	108,000.00	96.24	13,981.34
	Lighting controls (daylighting)	81.51	0.03	1,400.00	16.81	46,575.75
	General energy awareness	2,178.94	10.38			
Envelope sealing	260.78	0.10				
Idlewood Pool	Faucet aerator upgrade	529.79	0.44	0.00	0.00	0.00
	Lighting upgrade (exterior)	139.02	0.05	3,900.00	24.46	77,089.12
	Lighting upgrade (interior)	49.31	0.02	3,532.50	66.04	196,837.99
	Lighting controls (occupancy)	19.94	0.01	1,800.00	89.89	248,015.87
	General energy awareness	369.38	1.26			
	Envelope sealing	55.57	0.17			
Activa Group Sportsplex	Resurfacing water de-aeration	31,931.24	54.00	50,000.00	1.03	925.87
	Shower fixture upgrade	4,545.05	4.14	13,200.00	2.90	3,190.06
	Pump speed controls (ice)	9,657.07	2.94	40,000.00	3.53	13,608.22
	Ammonia heat rejection equipment upgrade	21,111.31	6.43	180,000.00	7.92	28,011.99

Continued on next page

Table 4: Recommendations - Complete list of EWCMs

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
	Demand control ventilation	501.49	3.58	8,000.00	15.68	2,235.97
	Toilet upgrade	1,676.52	0.00	28,000.00	16.70	0.00
	MAU equipment upgrade	2,800.89	8.63	50,000.00	17.38	5,791.31
	HVAC schedule optimization	18,054.96	72.29	0.00	0.00	0.00
	General energy awareness	50,386.56	41.27	0.00	0.00	0.00
	Ice thickness and temperature optimization	19,490.57	5.93	0.00	0.00	0.00
	Faucet aerator upgrade	7,460.71	5.96	0.00	0.00	0.00
Don McLaren Arena	Shower fixture upgrade	1,580.98	1.71	3,000.00	1.90	1,757.78
	Resurfacing water de-aeration	10,989.24	19.55	50,000.00	4.06	2,557.20
	Pump speed controls (ice)	3,952.39	1.10	20,000.00	4.50	18,130.34
	Lighting upgrade (interior)	808.48	0.23	7,543.50	8.43	33,430.28
	Toilet upgrade	588.10	0.00	7,000.00	11.90	0.00
	Low-e ceiling	5,549.56	1.55	79,402.50	13.75	51,263.83
	Dehumidifier upgrade	6,365.36	1.78	120,000.00	18.85	67,545.07
	Desuperheater	691.91	5.62	20,000.00	28.91	3,560.47
	DHW heater equipment upgrade	507.31	4.12	39,000.00	74.51	9,469.37
	Solar PV electricity generation	79,748.66	22.26	1,270,440.00	15.93	57,077.63
Grand River Arena	Shower fixture upgrade	4,472.25	4.83	3,000.00	0.67	621.65
	Resurfacing water de-aeration	10,586.26	19.55	50,000.00	4.25	2,557.20
	Lighting upgrade (exterior)	848.80	0.25	4,488.00	4.49	18,071.56
	Pump speed controls (ice)	3,770.25	1.10	20,000.00	4.72	18,130.34
	Lighting upgrade (interior)	1,221.74	0.36	9,093.00	6.73	25,437.53
	Low-e ceiling	5,293.82	1.55	80,190.00	14.56	51,772.26
	Toilet upgrade	415.73	0.00	7,000.00	16.84	0.00
	Desuperheater	694.06	5.62	20,000.00	28.82	3,560.47
	Energy recovery (change room)	967.17	19.18	57,000.00	58.40	2,971.50
	DHW heater equipment upgrade	609.11	4.93	39,000.00	62.06	7,911.11
	Solar PV electricity generation	75,732.38	22.16	1,264,740.00	16.70	57,077.63
	Faucet aerator upgrade	1,569.32	1.49	0.00	0.00	0.00
	Booster pump removal	77.31	0.02	0.00	0.00	0.00
Lions Arena	Shower fixture upgrade	2,363.39	2.55	3,000.00	1.27	1,177.51
	Resurfacing water de-aeration	10,601.94	19.55	50,000.00	4.25	2,557.20
	Pump speed controls (ice)	3,770.25	1.10	20,000.00	4.72	18,130.34
	Lighting upgrade (interior)	1,915.55	0.56	16,275.00	7.68	29,038.53
	Toilet upgrade	877.91	0.00	7,000.00	7.97	0.00
	Low-e ceiling	5,293.82	1.55	80,190.00	14.56	51,772.26
	Lighting upgrade (exterior)	6,697.59	1.96	130,388.00	19.09	66,537.35
	Dehumidifier upgrade	3,036.01	0.89	60,000.00	19.76	67,545.07
	Desuperheater	699.21	5.62	20,000.00	28.60	3,560.47
	DHW heater equipment upgrade	699.86	5.62	39,000.00	54.01	6,936.55
	Solar PV electricity generation	76,828.18	22.48	1,283,040.00	16.70	57,077.63
	Faucet aerator upgrade	1,658.43	1.57	0.00	0.00	0.00
	Booster pump removal	67.72	0.02	270.00	3.99	13,626.34
Sportsworld Arena	Resurfacing water de-aeration	27,262.68	51.58	50,000.00	1.35	969.40
	Shower fixture upgrade	4,400.00	4.69	6,000.00	1.36	1,280.16
	Pump speed controls (ice)	9,606.85	2.94	40,000.00	3.55	13,608.22
	Low-e ceiling	20,590.31	6.30	163,950.00	7.35	26,023.81
	DHW boiler equipment upgrade	4,554.65	36.27	60,000.00	12.91	1,654.29
	Toilet upgrade	1,635.22	0.00	23,100.00	14.13	0.00
	Solar PV electricity generation	187,757.70	57.45	3,279,000.00	17.46	57,077.63
	Water leak monitoring	6,244.86	0.00	1,500.00	0.24	0.00
Queensmount Arena	Lighting upgrade (exterior)	476.46	0.17	3,000.00	5.25	17,230.98
	Lighting upgrade (interior)	3,332.74	1.22	49,789.25	12.42	40,884.03
	DHW heater equipment upgrade	934.93	7.50	19,500.00	20.22	2,600.66
	Toilet upgrade	94.41	0.00	5,600.00	59.32	0.00
	Solar PV electricity generation	21,575.75	7.88	450,000.00	20.86	57,077.63
	Water leak monitoring	248.44	0.00	1,500.00	6.04	0.00

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Table 4: Recommendations - Complete list of EWCMS

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)	
Kitchener Memorial Auditorium Complex	Shower fixture upgrade	18,794.04	20.30	24,000.00	1.28	1,182.29	
	Resurfacing water de-aeration	43,050.11	117.68	100,000.00	1.73	849.74	
	HVAC schedule optimization	21,626.83	56.22	80,000.00	2.66	1,423.03	
	Air-side free-cooling (atrium)	3,650.29	1.36	14,000.00	3.84	10,308.15	
	Lighting upgrade	76,296.09	28.39	374,287.20	4.32	13,185.06	
	Pump speed controls (ice)	7,900.20	2.94	60,000.00	6.85	20,412.33	
	Toilet upgrade	14,756.38	0.00	140,000.00	9.49	0.00	
	Low-e ceiling	12,824.93	4.77	170,625.00	12.56	35,757.51	
	Electricity peak demand management	50,137.82	0.03	0.00	0.00	0.00	
	General energy awareness	92,488.18	102.08	0.00	0.00	0.00	
	Ice thickness and temperature optimization	31,904.23	11.87	0.00	0.00	0.00	
	Faucet aerator upgrade	24,614.96	23.38	0.00	0.00	0.00	
	Water fixture control optimization	10,059.38	0.00	8,400.00	0.84	0.00	
	Kitchener City Hall	Demand control ventilation	23,521.69	177.91	60,000.00	2.49	337.24
		Pump speed controls (HVAC)	7,640.61	2.35	34,500.00	3.90	14,669.67
AHU configuration upgrade		3,001.17	13.87	45,000.00	14.71	3,244.04	
Lighting controls		31,218.59	9.61	568,779.75	17.91	59,191.61	
Lighting upgrade		35,551.81	10.94	1,022,223.00	21.22	93,414.27	
Chiller equipment upgrade		5,771.08	1.78	296,000.00	50.67	166,633.99	
Condensing water filter upgrade		69.69	0.00	47,600.00	683.00	0.00	
HVAC schedule optimization		15,847.75	31.17	0.00	0.00	0.00	
General energy awareness		85,945.34	76.62	0.00	0.00	0.00	
Lighting schedule optimization		8,840.50	2.72	0.00	0.00	0.00	
Pump schedule optimization		7,086.30	2.18	0.00	0.00	0.00	
Kitchener Market		Toilet upgrade	2,084.62	0.00	14,000.00	6.72	0.00
		Lighting upgrade and controls	22,407.61	6.15	283,822.67	12.39	46,157.19
	Demand control ventilation (kitchen)	5,873.45	16.54	275,000.00	46.82	16,630.99	
	Exterior door upgrade	989.71	8.01	136,500.00	137.71	17,042.62	
	Solar PV electricity generation	30,645.25	8.41	480,000.00	15.66	57,077.63	
	General energy awareness	23,681.40	26.85	0.00	0.00	0.00	
	HVAC schedule optimization	13,921.62	38.98	0.00	0.00	0.00	
	Air-side free-cooling	8,124.47	2.23	0.00	0.00	0.00	
	Faucet aerator upgrade	4,307.70	1.04	0.00	0.00	0.00	
	Kitchener Operations Facility	Pump speed controls upgrade	2,981.36	0.91	10,000.00	2.74	10,998.11
Lighting fixture upgrade		57,202.65	17.45	962,921.30	16.53	55,195.95	
Lighting controls upgrade		21,527.42	6.57	919,152.15	42.36	140,000.00	
GSHP system application		-25,235.54	316.74	10,000.00		31.57	
HVAC schedule optimization		71,013.24	183.88	0.00	0.00	0.00	
HVAC control optimization		10,578.15	34.96	0.00	0.00	0.00	
Discharge pressure setpoint optimization		4,447.67	1.36	0.00	0.00	0.00	
Irrigation water use optimization		22,380.61	0.18	0.00	0.00	0.00	
RO water treatment optimization		29,840.81	0.23	0.00	0.00	0.00	
General energy awareness		65,904.88	98.98	20,000.00	0.30	202.06	
Shower head upgrade		5,837.92	0.00	6,000.00	1.03	0.00	
Fire Headquarters Station #1		Lighting upgrade (interior)	8,753.81	2.60	72,311.75	7.58	27,822.29
	Lighting upgrade (exterior)	1,530.54	0.45	17,700.00	10.18	38,950.32	
	HVAC system upgrade (ASHP)	8,629.93	85.23	936,000.00	108.46	10,982.52	
	De-stratification fans	-166.14	5.29	30,000.00		5,667.26	
	Faucet aerator upgrade	1,497.79	1.26	0.00	0.00	0.00	
	Apparatus bay door switches	18,055.31	62.75	6,500.00	0.01	103.59	
	Shower fixture upgrade	1,154.91	1.24	600.00	0.52	482.62	
	Radiant heater sensor upgrade	243.73	1.94	1,000.00	4.10	516.18	
	General energy awareness	10,330.71	14.17				
Fire Station #2	Lighting upgrade (interior)	865.16	0.35	12,313.00	13.30	34,777.87	
	Lighting upgrade (exterior)	502.78	0.21	8,700.00	15.31	42,284.22	
	HVAC system upgrade (ASHP)	-1,407.62	12.92	17,000.00		1,315.85	
	Energy recovery (change room)	-376.43	1.82	2,000.00		1,098.42	

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Table 4: Recommendations - Complete list of EWCMS

Facility	ECM description	Savings (\$)	eCO2 savings (tonnes)	Capital cost (\$)	Payback (years)	Cost/eCO2 savings (\$/eCO2 tonnes)
	Destratification fans	-265.80	2.58	30,000.00		11,643.66
	Solar PV electricity generation	4,666.58	1.91	87,360.00	18.72	45,745.41
	Faucet aerator upgrade	44.35	0.04	0.00	0.00	0.00
	Shower fixture upgrade	211.39	0.23	600.00	2.84	2,641.72
	Water leak monitoring	431.11	0.00	1,500.00	3.48	0.00
	Radiant heater sensor upgrade	181.61	1.42	1,000.00	5.51	702.31
	General energy awareness	1,800.87	4.01			
Fire Station #3	Lighting upgrade (interior)	941.00	0.39	13,616.75	13.52	34,777.87
	Lighting upgrade (exterior)	579.23	0.24	10,200.00	15.58	42,321.98
	HVAC system upgrade (ASHP)	-2,181.15	20.50	17,000.00		829.41
	Energy recovery (change room)	-341.00	2.04	2,000.00		979.71
	Destratification fans	-104.22	3.81	30,000.00		7,878.59
	Solar PV electricity generation	5,769.29	2.40	144,000.00	24.96	59,987.50
	Faucet aerator upgrade	378.57	0.32	0.00	0.00	0.00
	Shower fixture upgrade	211.06	0.23	600.00	2.84	2,641.72
	Radiant heater sensor upgrade	284.90	2.26	1,000.00	3.51	442.68
	Water leak monitoring	372.77	0.00	1,500.00	4.02	0.00
	General energy awareness	2,052.90	5.50			
Fire Station #4	Lighting upgrade (interior)	856.64	0.35	12,251.75	13.36	34,777.87
	Lighting upgrade (exterior)	557.83	0.23	9,600.00	15.28	41,847.84
	Destratification fans	-334.21	1.97	30,000.00		15,237.09
	HVAC system upgrade (ASHP)	-1,057.81	10.10	17,000.00		1,683.49
	Energy recovery (change room)	-369.00	1.81	2,000.00		1,104.70
	Solar PV electricity generation	6,657.26	2.74	162,240.00	24.37	59,260.34
	Shower fixture upgrade	636.00	0.68	600.00	0.94	880.57
	Water leak monitoring	287.93	0.00	1,500.00	5.21	0.00
	Radiant heater sensor upgrade	144.96	1.11	1,000.00	6.90	898.53
	General energy awareness	1,515.56	3.23			
Fire Station #6	Lighting upgrade (interior)	855.11	0.35	12,206.25	13.33	34,777.87
	Lighting upgrade (exterior)	443.66	0.18	7,800.00	15.50	42,833.96
	Destratification fans	-240.45	2.74	30,000.00		10,950.60
	HVAC system upgrade (ASHP)	-1,452.31	13.54	17,000.00		1,255.12
	Energy recovery (change room)	-374.97	1.80	2,000.00		1,109.42
	Solar PV electricity generation	6,406.46	2.63	149,760.00	23.38	56,953.79
	Shower fixture upgrade	1,035.68	1.11	600.00	0.58	539.71
	Water leak monitoring	384.14	0.00	1,500.00	3.90	0.00
	Radiant heater sensor upgrade	191.74	1.49	1,000.00	5.22	669.90
	General energy awareness	1,735.02	3.81			
Fire Station #7	Lighting upgrade (interior)	843.60	0.35	12,206.25	13.52	34,777.87
	Lighting upgrade (exterior)	650.08	0.27	11,400.00	15.54	42,149.63
	Destratification fans	-273.40	2.43	30,000.00		12,355.68
	Solar PV electricity generation	6,281.47	2.61	149,760.00	23.84	57,304.66
	Shower fixture upgrade	422.95	0.45	600.00	1.42	1,320.86
	Water leak monitoring	322.56	0.00	1,500.00	4.65	0.00
	Radiant heater sensor upgrade	171.13	1.34	1,000.00	5.84	747.64
	General energy awareness	1,721.52	3.95			

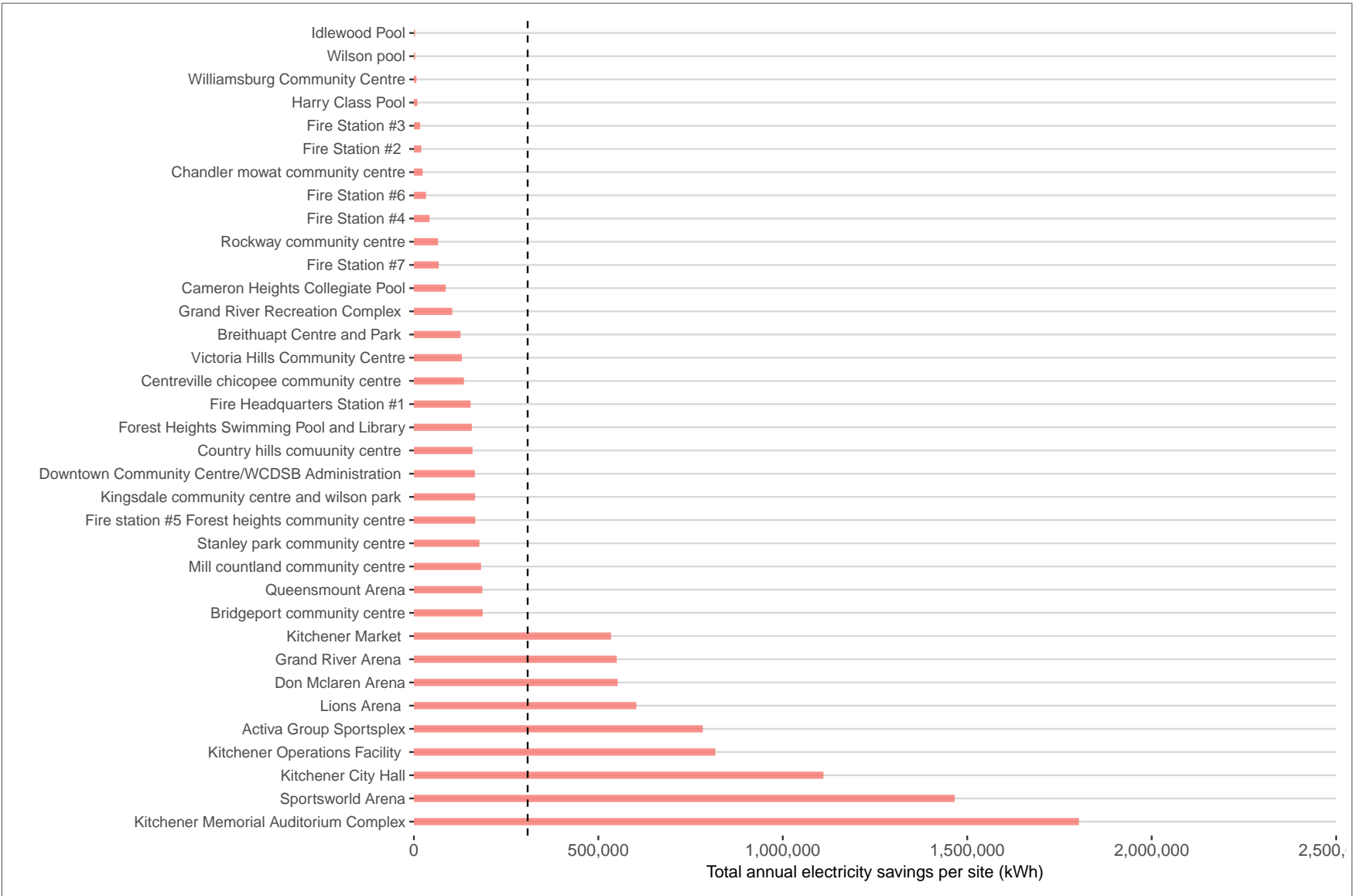


Figure 1: Summary of total electrical savings (kWh) per site. Dashed line = average savings.



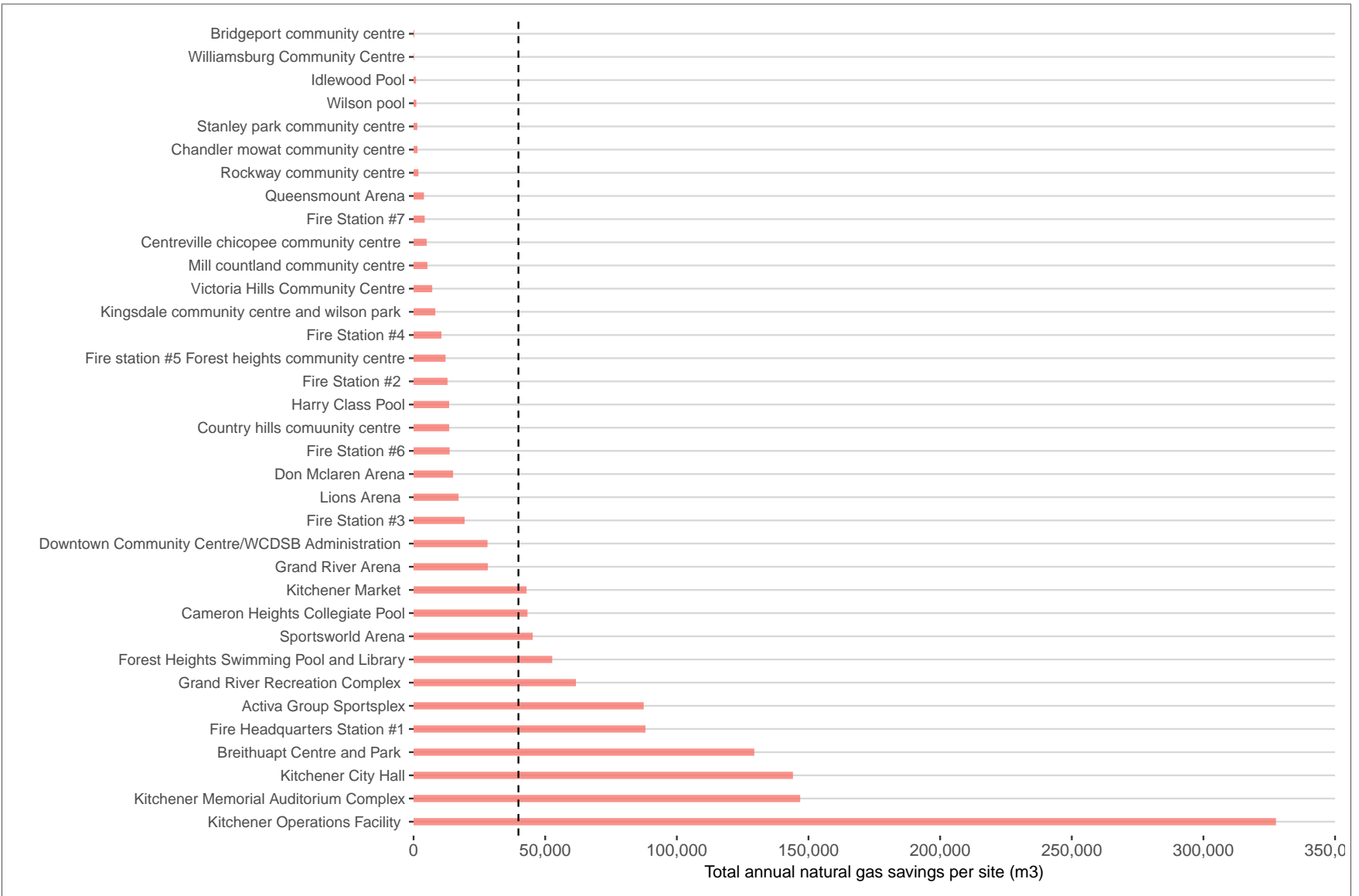


Figure 2: Summary of total natural gas savings (m3) per site. Dashed line = average savings.



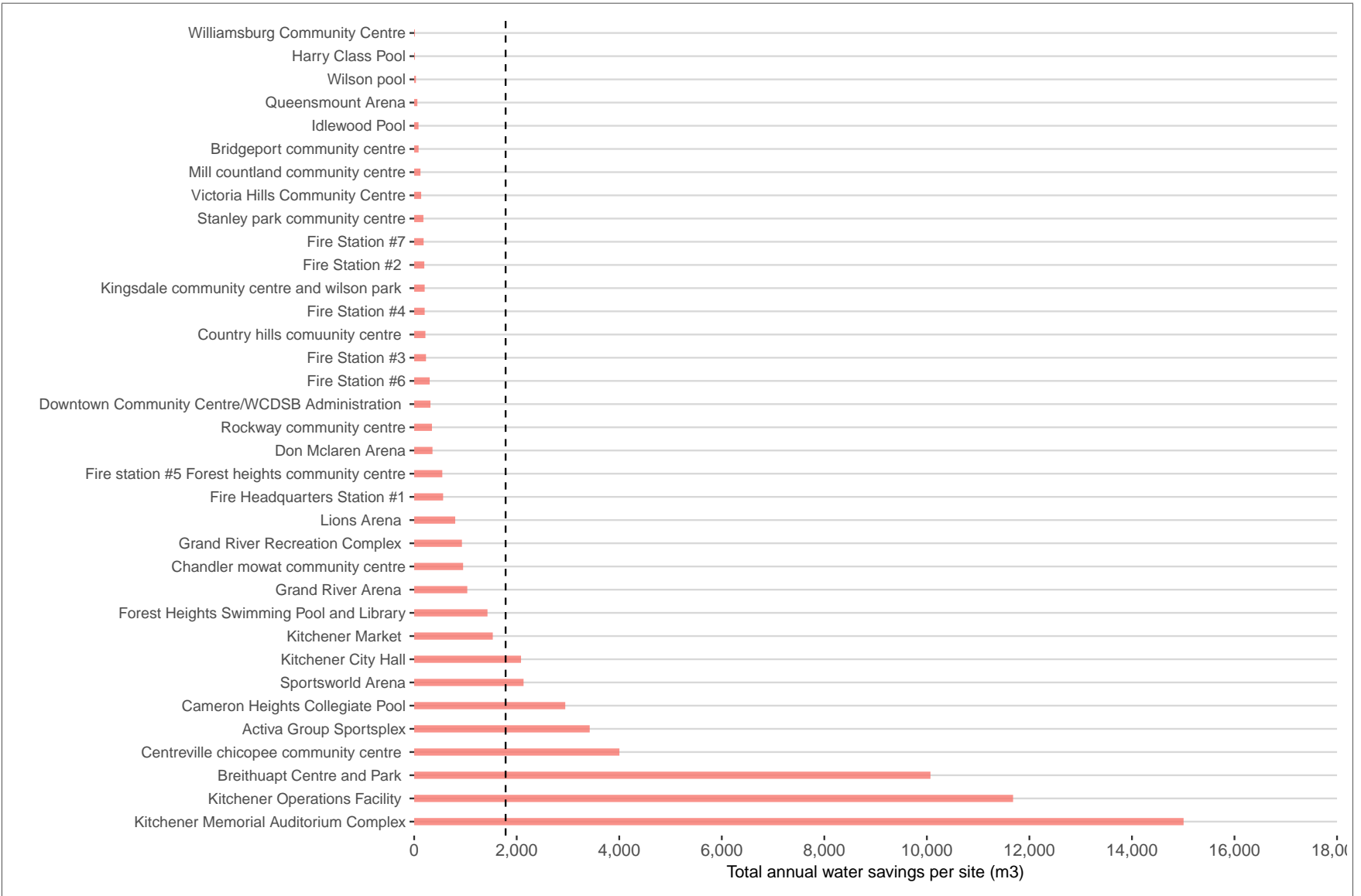


Figure 3: Summary of total water gas savings (m3) per site. Dashed line = average savings.



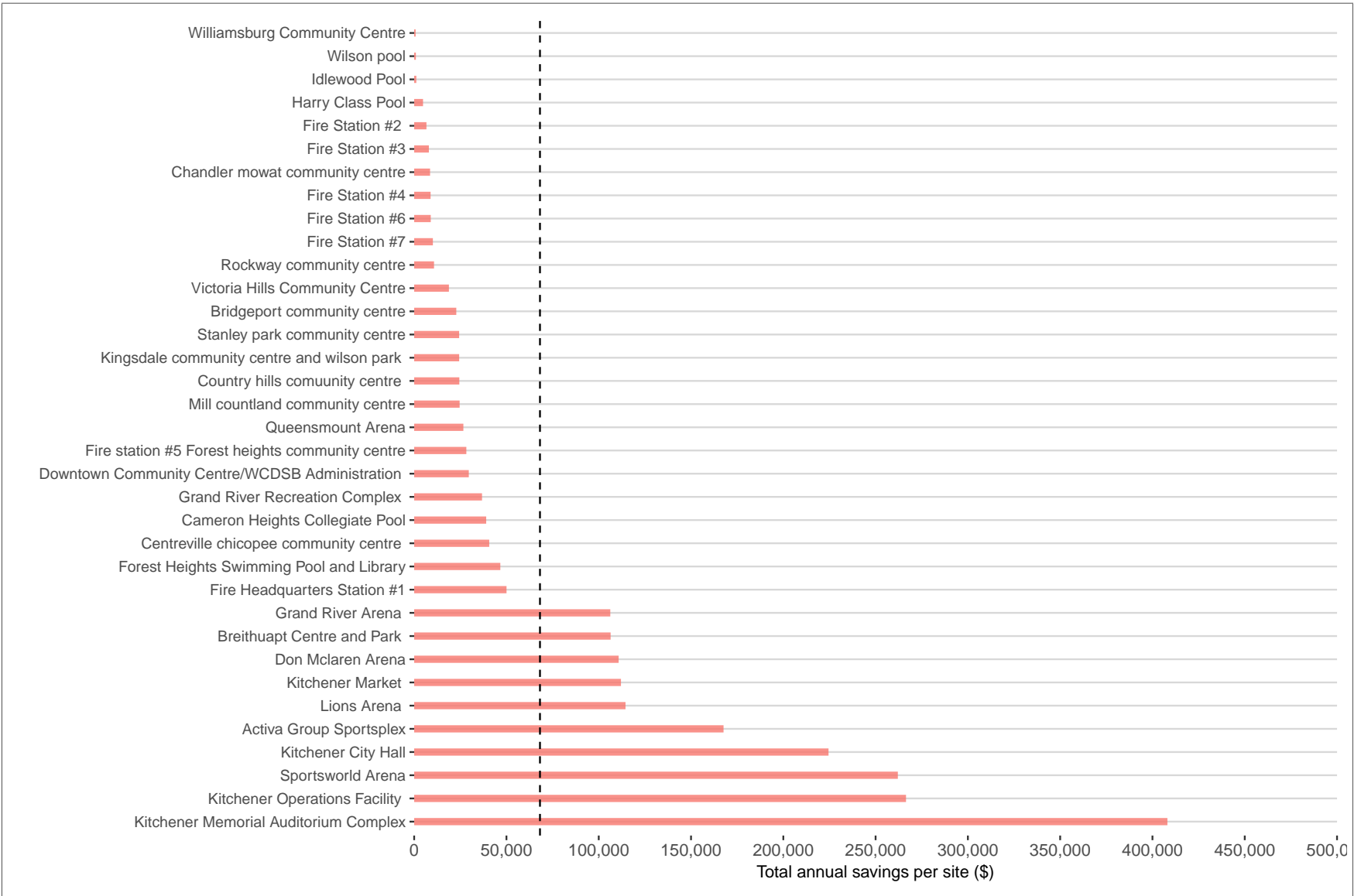


Figure 4: Summary of total cost savings (\$) per site. Dashed line = average savings.



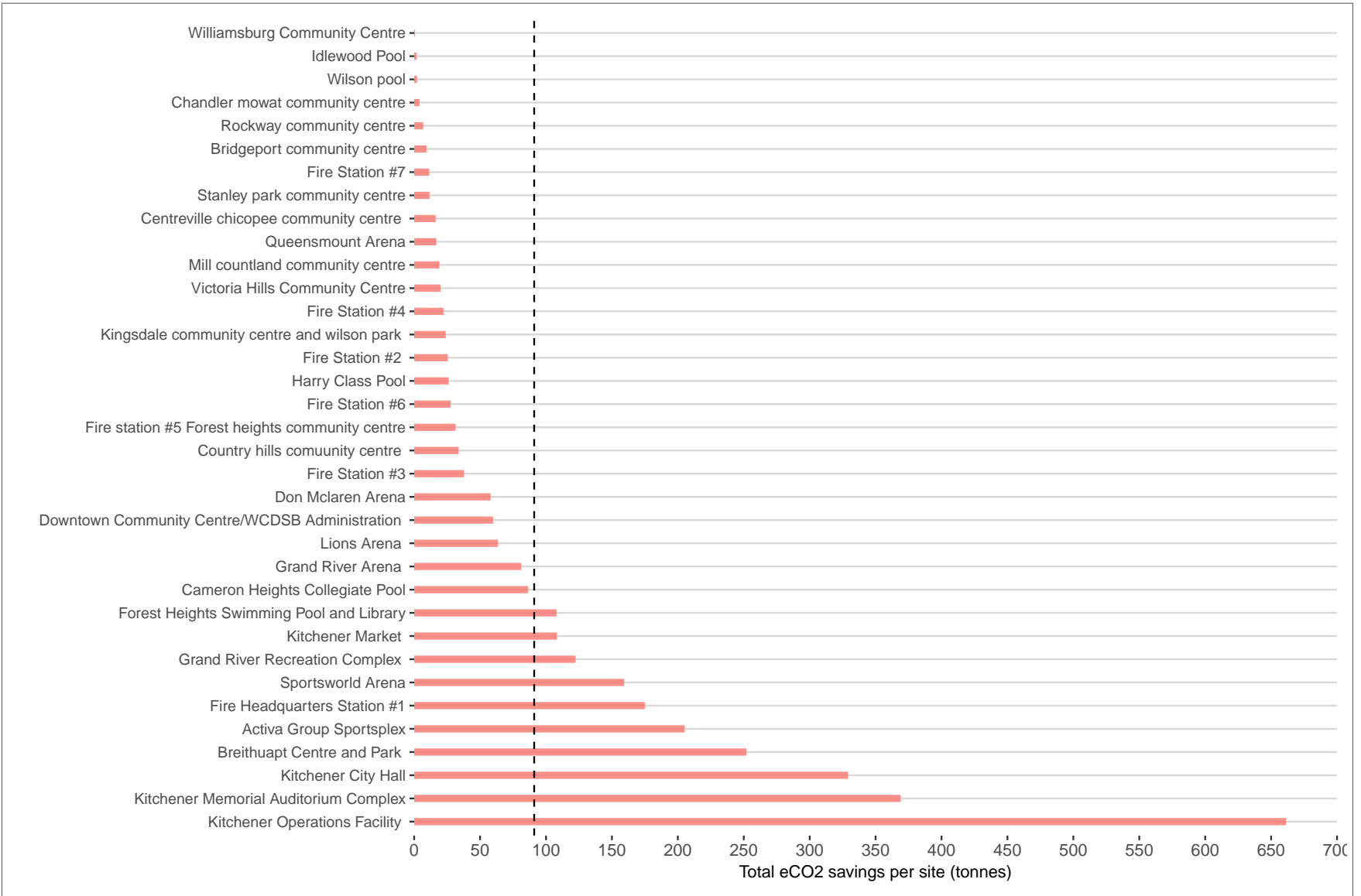


Figure 5: Summary of total eCO2 savings (tonnes) per site. Dashed line = average savings.

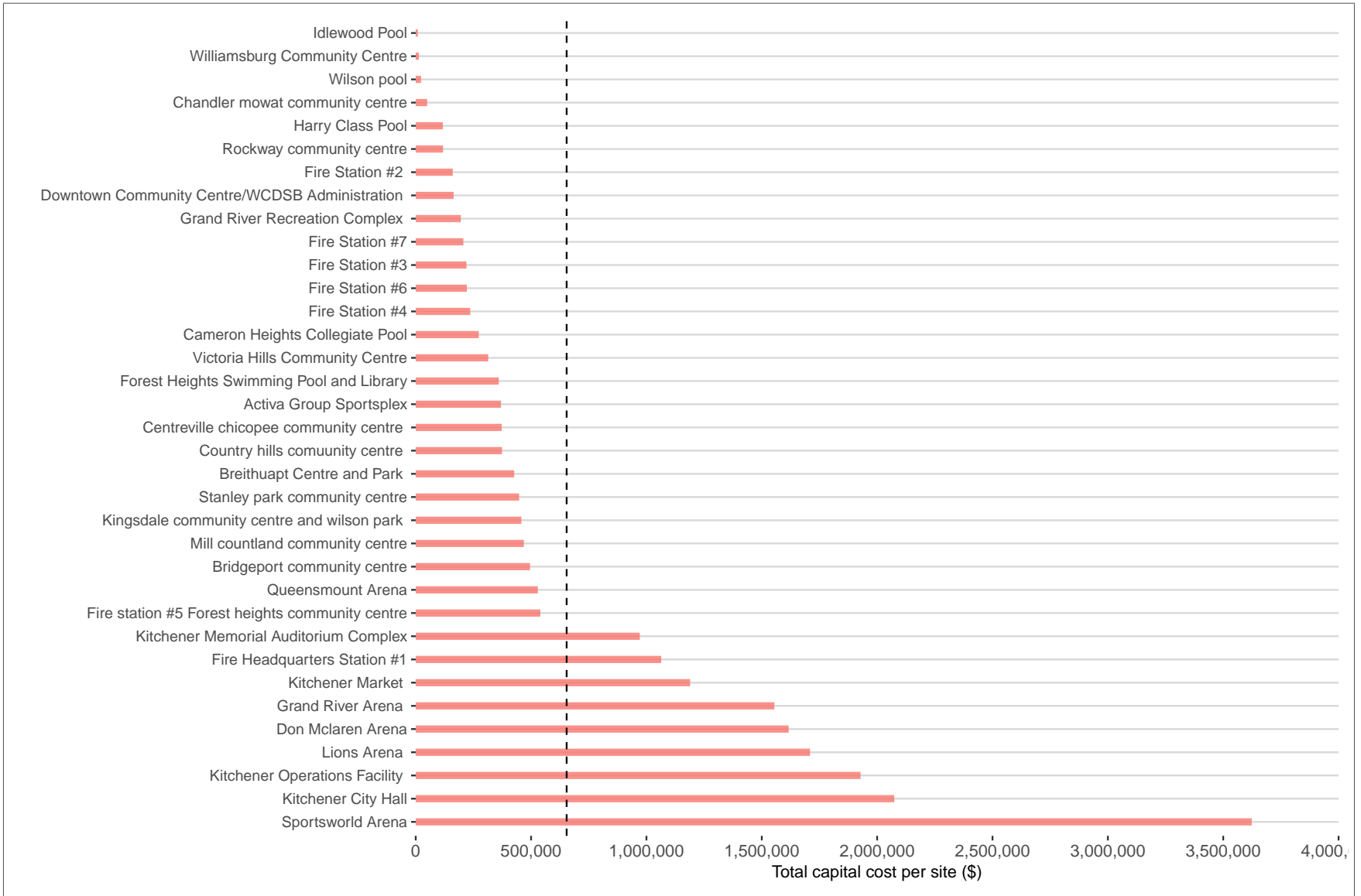


Figure 6: Summary of total capital cost (\$) per site. Dashed line = average savings.

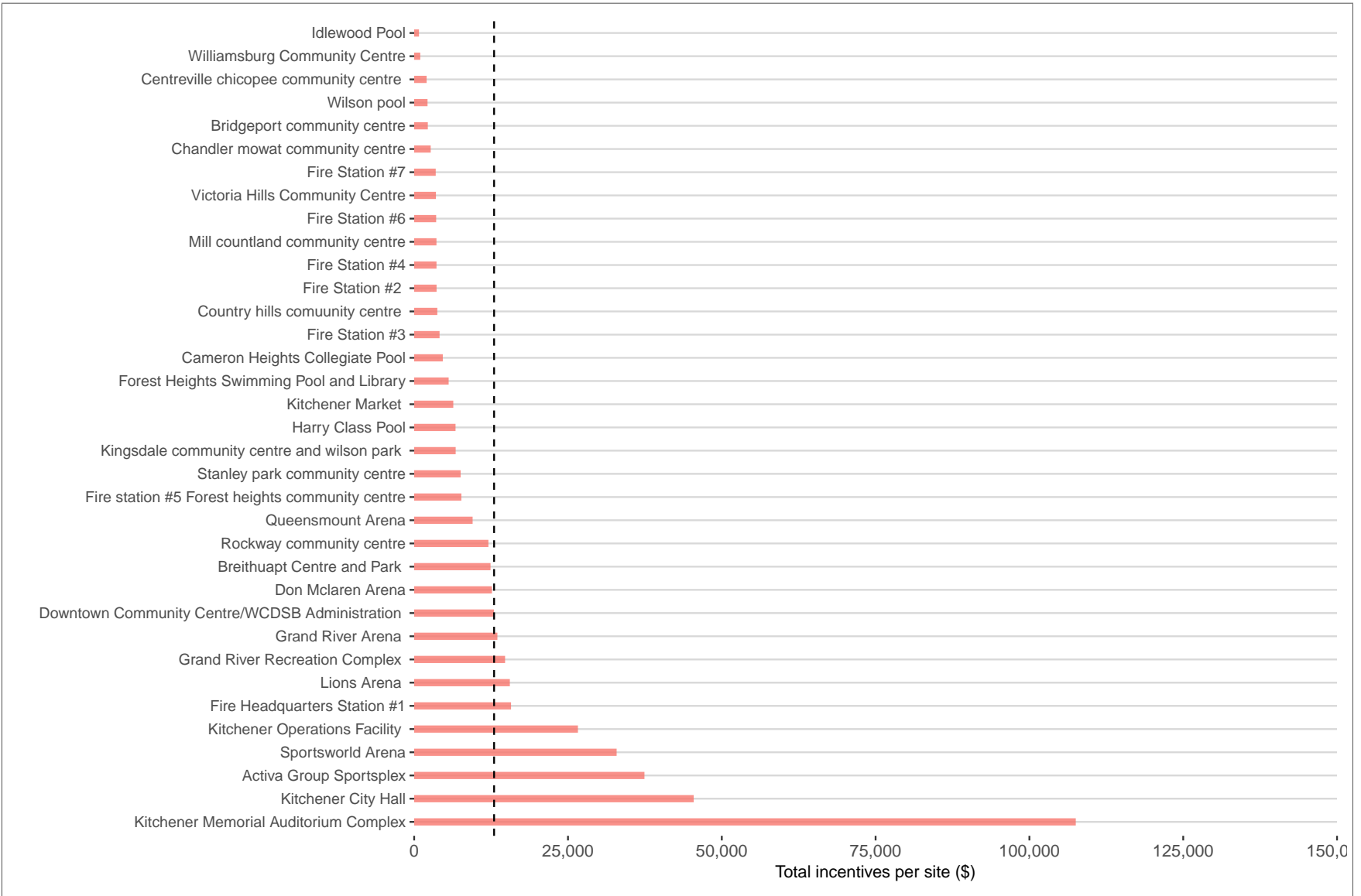


Figure 7: Summary of total incentives (\$) per site. Dashed line = average savings.



WALTERFEDY - COMPANY PROFILE

Overview

WalterFedy is a dynamic, integrated design firm delivering creative solutions and practical built environments. Since our inception in 1951, we have continued to learn, adapt, and evolve to best serve our clients. In 1970, we became one of Canada's first integrated design firms in order to deliver a level of coordination and team commitment not served by the traditional project model.

Today, our expertise includes energy management; architecture; mechanical, electrical, structural, and civil engineering; asset and facilities management; project management; and construction management through our sister company, AEC Developments. The value of our integrated nature shines through our modern team structure, which allows us to share lessons learned and discuss project challenges organically.

We view each project to be an opportunity to build a relationship. We value the creative process, and spend the time to work with you to understand your objectives. Our collaborative spirit is furthered by our ability to quickly solicit feedback. Going beyond scheduled meetings with specific agendas, this continuous state of collaboration enables designers to seek discipline-specific input on a moment's notice. These impromptu meetings provide our designers with a variety of perspectives, and allow us to offer all-inclusive and comprehensive solutions to meet our customers' needs.

We have developed our team to envision the project as a whole. Coordination is facilitated from design through construction, as project leaders have quick and easy access to all design disciplines, and team members interact continuously. This is the benefit of being in an integrated practice: we routinely think about how each design element impacts all aspects of the project.

Energy Management

In the Energy Management Solutions (EMS) team, we base project success on the value and experience our clients have obtained through the project journey. We understand the impact we can have on our clients and global community is long term, and we take that sincerely. Taking our core value of environmental sustainability to heart, we are passionate about the opportunities we uncover, and are always proud to see each of our projects implemented. EMS was founded on the principals of understanding our clients, developing practical solutions to achieve desired energy and greenhouse gas outcomes, and supporting through implementation. We see ourselves as primary drivers to supporting the parallel global climate goal initiatives and economic growth.