

MEMORANDUM



DATE September 20, 2022 FROM Electra Coonjah & Jeremy Clowes
TO Clarke Kruiswyk FILE 1179.0109.01
CC Kevin Trottier SUBJECT RDCO Backup Power Review_rev.3

1.0 INTRODUCTION

The Regional District of Central Okanagan (RDCO) requested that Urban Systems Ltd. (Urban) review adding backup power to five water facilities located in the Killiney Beach and Westshore Estates water systems. The facilities that were reviewed are identified in the table below.

Table 1-1: Reviewed Sites

Water System	Facility Name	Address
Killiney Beach	Killiney Beach Intake	9335 Hodges Road
	Killarney Way Reservoir	9375 Westside Road
	Udell Reservoir	584 Udell Road
Westshore Estates	Westshore Intake	10403 Westside Road
	Mountain Reservoir	492 Mountain Drive

The intent of this review was to:

- Identify order of magnitude costs for adding backup power to the above sites considering both permanent and trailered generator units,
- Identify a potential location for adding a permanent generator at each site,
- Estimate annual operation & maintenance effort and costs for operating the generators,
- Review ability to increase storage as alternative to providing backup power,
- Consider integration with the Killiney Beach & Westshore Estates Water Systems Study preferred option, and,
- Provide a recommendation based on findings from above tasks which will be one of the following:
 - Do nothing or defer decision,
 - Add permanent or trailered generator(s) for providing backup power, or,
 - Increase water storage within each system.

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Our findings related to each of the above tasks are provided below. The most recent site information was obtained from a site visit completed on 21-Jul-2022 with RDCO (Clarke Kruiswyk and Kevin Trottier) and Urban (Electra Coonjah & Jeremy Clowes) staff. Proposed generator locations were discussed during this visit. Using Google Earth, along with the RDCO mapping and GIS web-based system, proposed generator locations are outlined in red in figures below for each site.

2.0 SITE REVIEW SUMMARY

Below we have summarized our review of each site that included:

- Confirming the motor sizes of the main equipment,
- Identifying a potential location for adding a permanent generator, and,
- Identifies an assumed generator size for the cost review.

2.1 KILLINEY BEACH SITE REVIEW

The sites reviewed within the Killiney Beach water system include Killiney Beach Intake, Killarney Way Reservoir and the Udell Reservoir as summarized below.

2.1.1 Killiney Beach Intake at 9335 Hodges Rd

This site's main equipment includes two vertical turbine pumps that convey water from the Killiney Beach Intake to the Killarney Reservoir. Both pumps have 22.5 kW motors (30 HP). We have assumed that two pumps are able to operate at time with a total power requirement of 45 kW (60 HP).

- Generator Type -
 - Capacity: 100 kW
 - Proposed site location:

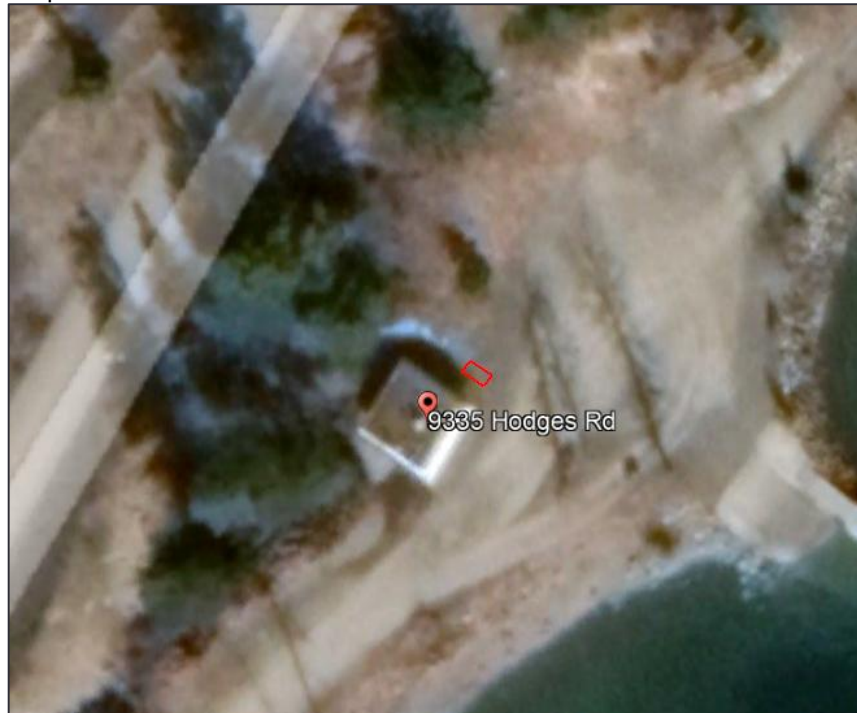


Figure 1: Killiney Beach Intake Generator Location

2.1.2 Killarney Way Reservoir at 9375 Westside Rd

This site's main equipment includes two submersible pumps that convey water from Killarney Reservoir to the Udell Reservoir. Both pumps have 11 kW motors (15 HP), totalling to a power requirement of 22 kW (30 HP).

- Generator Type -
 - Capacity: 60 kW
 - Proposed site location:

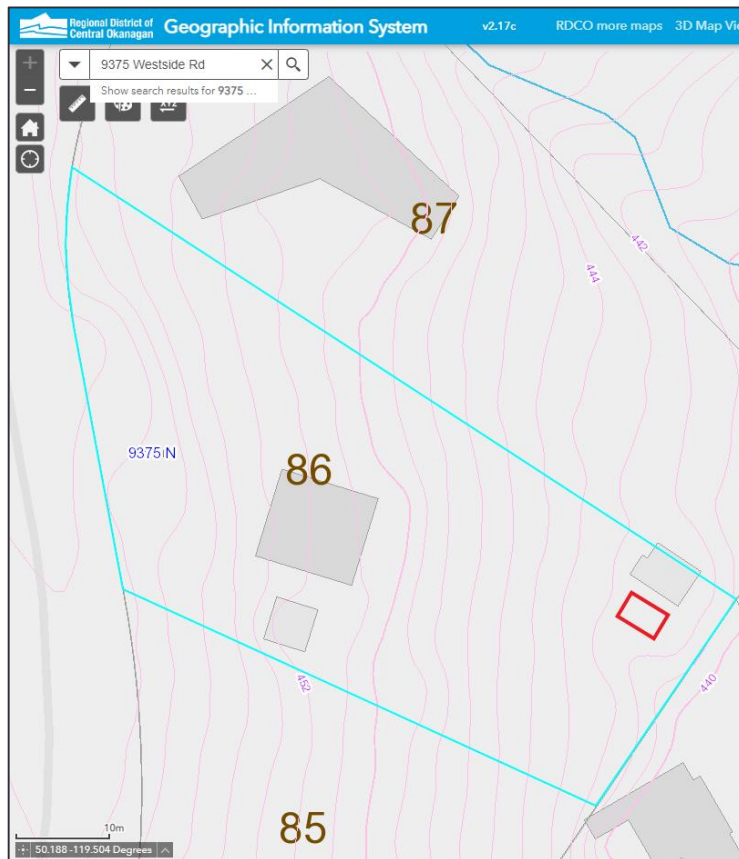


Figure 2: Killarney Way Reservoir Generator Location

2.1.3 Udell Reservoir at 584 Udell Rd

This site's main equipment includes two submersible pumps that convey water from Udell Reservoir to the Winchester Reservoir. Both pumps have 7.5 kW motors (10 HP), totalling to a power requirement of 15 kW (20 HP).

- Generator Type -
 - Capacity: 60 kW
 - Proposed site location:

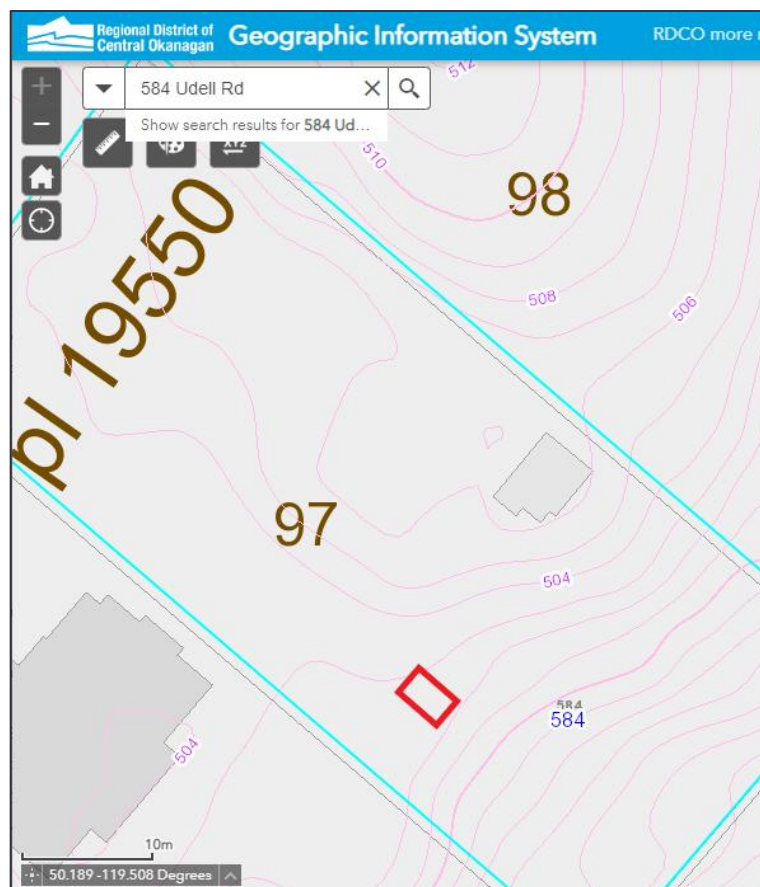


Figure 3: Udell Reservoir Generator Location

2.2 WESTSHORE ESTATES SITE REVIEW

The sites reviewed within the Westshore Estates water system include Westshore Intake and Mountain Reservoir as summarized below.

2.1.2 Westshore Intake at 10403 Westside Rd

This site's main equipment includes two vertical turbine pumps that convey water from the Westshore Intake to the Mountain Reservoir. Both pumps have 37.5 kW motors (50 HP). We assumed only one pump operates at a time for sizing the generator.

- Generator Type -
 - Capacity: 100 kW
 - Proposed site location

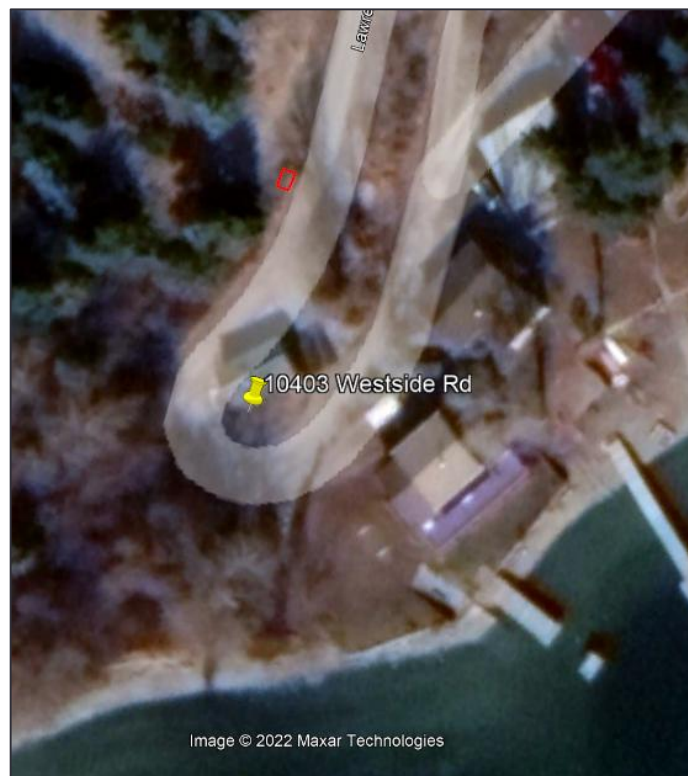


Figure 4: Westshore Intake Generator Location

2.2.2 Mountain Reservoir at 492 Mountain Dr

This site's main equipment includes two vertical turbine pumps that convey water from the Westshore Intake to the Mountain Reservoir. Both pumps have 45 kW motors (50 HP). We assumed only one pump operates at a time for sizing the generator.

- Generator Type -
 - Capacity: 100 kW
 - Proposed site location

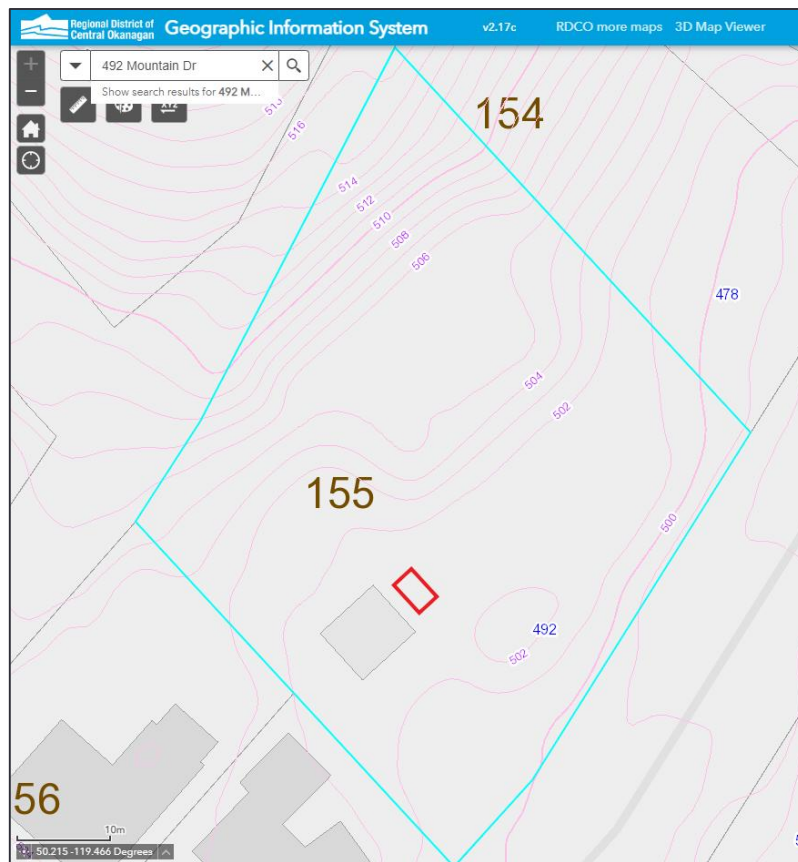


Figure 5: Mountain Reservoir Generator Location

2.3 SUMMARY OF SITE VISIT

The table below summarizes our site visit and assumptions for the cost review.

Table 2-1: Summary of Site Review

Water System	Facility	Minimum Power Supply Requirement (kW)*	Generator Size Selected for Cost Review (kW)**
Killiney Beach	Killiney Beach Intake	55	100
	Killarney Way Reservoir	32	60
	Udell Reservoir	25	60
Westshore Estates	Westshore Intake	47.5	100
	Mountain Reservoir	55	100

*Assumed building electrical load for lighting, receptacles, and heating of up to 10 kW was added to each site's minimum power requirement. Note that each site contains at least one 4 kW electrical unit heater.

**Generator size selected for the costing review was determined by reviewing the minimum power requirement for each site and selecting a common generator size that exceeds the minimum power requirement.

3.0 OPTIONS EVALUATION WITH COSTING

The following options have been considered for improving the reliability of the water supply for the Killiney Beach and Westshore Estates water systems including: 1) Do nothing or defer decision, 2A) Add permanent backup power, 2B) purchase a trailered generator(s), 3) rent trailered generator(s), or 4) Increase water storage.

We evaluated each option using a common assumption for the annual power failure frequency and durations. We assumed that three power failures occur annually that required a temporary power supply to be in service for 24 hours under each occurrence. This assumption is expected to be conservative and can be checked against actual power loss data from BC Hydro. We submitted a request for this data but were unable to obtain it at the time this memorandum was issued.

Other important assumptions regarding the option evaluation are listed below:

- Generator design life = 25 years
- Reservoir design life = 75 years

3.1 OPTION 1 – DO NOTHING OR DEFER DECISION

We reviewed the existing storage capacity in the Killiney Beach and Westshore Estate systems to identify if there is existing surplus storage that can be used for emergency purposes. Refer to Appendix A which includes four tables summarizing the available storage for emergencies within the Killiney Beach and Westshore Estate systems under existing and buildout conditions.

The storage was evaluated as whole for each system under the following assumptions:

- Water system is intended to supply drinking water and rural fire flows only (excess capacity for fighting forest fires has not been considered),
- Only one fire occurs at a time,
- The maximum fire flow to be supplied equals 60 L/s for a duration of 1.5 hours,
- Fire storage can be located at the highest reservoir and conveyed to lower pressure zones as required, and
- Minimum required reservoir storage = A + B + C
 - A = Fire Storage = 324 m³
 - B = Equalization Storage = 25% of the Maximum Day Demand (MDD)
 - C = Emergency Storage = 25% (A+B).

Based on above, we considered the emergency storage component as available for supplying water under a power failure. We do not recommend considering fire or equalization storage for emergency purposes as reservoir levels are intended to fluctuate and these volumes may not be available when an emergency occurs.

Table 3-1: Available Emergency Storage

Site	Existing Available Emergency Storage (m ³)	Max Duration of Water Supply under Ex/ MDD (hrs)	Buildout Available Emergency Storage (m ³)	Max Duration of Water Supply under Buildout MDD (hrs)
Killiney	691	11.2	481	5.0
Westshore	878	12.9	575	4.9

Notes:

1. Killiney Beach existing and buildout MDDs are 17.1 L/s and 26.8 L/s, respectively.
2. Westshore Estates existing and buildout MDDs are 18.9 L/s and 32.9 L/s, respectively.

Under the do nothing or defer option, we expect that the existing storage capacity to be sufficient to provide at least 11 hours of emergency storage for the Killiney Beach system and at least 12 hours of emergency storage for Westshore Estates under the existing MDD.

3.2 OPTION 2A- PERMANENT BACK-UP POWER WITH AUTOMATIC TRANSFER SWITCHES

To provide a permanent back-up power solution, generators can be installed at each site with automatic transfer switches. The intent would be to add pad mounted generators that come with an acoustical & insulated enclosure. This solution includes purchasing and installing three 100 kW and two 60 kW capacity generators with automatic transfer switches to supply backup power to all reviewed sites. Generators would be placed on a cast-in-place concrete pad in the locations identified in Section 3, and automatic transfer switches may be placed in each existing building or can be installed in a small kiosk.

Table 3-2: Permanent Back-up Power - Generator Cost Summary

Item	Description	Quantity	Unit	Supply \$/Unit	Install \$/Unit	Extended \$/Unit
1	Killiney Beach Intake 100 kW	1	ls	\$70,000	\$55,000	\$105,000
2	Killarney Way Reservoir 60 kW	1	ls	\$55,000	\$27,500	\$82,500
3	Udell Reservoir 60 kW	1	ls	\$55,000	\$27,500	\$82,500
4	Westshore Intake 100 kW	1	ls	\$70,000	\$55,000	\$105,000
5	Mountain Reservoir 100 kW	1	ls	\$70,000	\$55,000	\$105,000
Subtotal						\$ 480,000
Engineering + Contingency (50%)						\$ 240,000
Rounded Total						\$ 720,000

Maintenance Considerations & Cost Allowance

Operational and maintenance costs for each generator must allow for routine inspections, troubleshooting issues, and purchasing & replacing parts all in accordance with the manufacturer's instructions and other relevant design standards (e.g., NFPA 110 and CSA C282). This would entail the routine items below as a minimum:

- A weekly inspection of the unit and transfer switch,
- A monthly operational test for 30 mins, and,
- An annual inspection and load test.

RDCO has multiple existing backup generators located at other sites. RDCO staff and a contractor (Total Power) maintain and test the existing generators. The existing generators annual O&M cost is broken down as follows:

- Annual testing = \$600/unit,

- Fuel = \$500/unit,
- Spare parts = \$600/unit,
- Troubleshooting = \$1500/unit,
- Estimated additional RDCO staff time = 50% FTE hours (assumed value for 50% FTE = \$60k/yr) and,
- Truck Allowance for Inspections (\$150/day, 104 days per year used, and annual allowance of \$15.6k/yr)

Based on the above, we have considered an annual O&M cost of \$20,000/unit (rounded value) or a total of \$100,000/yr for all five proposed generators.

Replacement costs for the generator are also incorporated into the Net Present Value Analysis. The estimated asset renewal cost for this option is \$28.8k/yr.

3.3 OPTION 2B – PURCHASE TRAIERED GENERATOR WITH MANUAL TRANSFER SWITCHES

Option 2B considered purchasing a backup generator that is mounted on a trailer. Under this option, we have assumed that a 100-kW trailered generator would be purchased for the Killiney Beach System and a second would be purchased for the Westshore Estates System. In the event of a power outage, operations staff could trailer the generator to each site that has lost power to convey water to next highest reservoir. This would require extensive effort to move the generator from site to site and we would expect interruptions in services to occur with this type of arrangement. We estimate the supply of a 100 kW trailered generator to cost \$140,000 + GST. The total estimated cost for the supply of two trailered generators and equipping each site with manual transfer switch is estimated to be \$500,000 based on allowance of \$7.5k/site for the installation of a manual transfer switch, purchase of two 100 kW trailered units at \$280k, plus engineering and contingency.

Maintenance Considerations & Cost Allowance

We have allowed for annual O&M budget of \$21,000/unit based on increasing the above estimate by \$1,000 for annual trailer maintenance. This option carries an annual O&M budget of \$42,000. A ½ -ton truck is expected to be capable of towing a 100 kW trailered unit but the steep terrain at the water sites may warrant using a larger ¾ ton truck.

In addition, there will be additional labour and material costs to transport, operate & rotate the trailered generators between sites. An allowance of \$5,000 per 24 hour power failure is assumed for operating the system and minimizing service interruptions or \$15,000 annually.

The total O&M allowance for Option 2B equals \$57,000/yr. Replacement costs for the generator are also incorporated into the Net Present Value Analysis. The estimated asset renewal cost for this option is \$20K/yr.

3.4 OPTION 3 – RENT TRAILERED GENERATOR(S) WITH MANUAL TRANSFER SWITCH

We reached out to suppliers to inquire about rental options and found suitable units at United Rentals. The minimum lead time generally ranges from 24 to 48 hours, once a unit is available for either 60 kW or 200 kW rental sizes. A 100 kW generator could be considered in lieu of 200 kW model but a suitable unit was not available when we enquired to rental stores. Availability of rental generators cannot be guaranteed. Rental rates are summarized in the table below for info but we do not recommend this option given the uncertainty around availability of generator units and the level of effort required to implement this option each time there is a power outage. If RDCO selected Option 1 (Do Nothing or Defer Decision), Option 3 could still be considered for extended power outages that may occur for any reason.

Table 3-2: Trailered System - Rental Back-up Power Costing

Supplier	United Rentals	
Model/Capacity	60 kW, Diesel	200 kW, Diesel
Daily Pricing	\$978	\$1,100
Weekly Pricing	\$1,950	\$2,250
Monthly Pricing	\$5,852	\$6,750
Deliver to Jobsite	\$1,656	\$5,520
Pickup/Return	\$1,656	\$5,520
Environmental Fee	\$39	\$130
Lead Time	If available, 24-48 hours	If available, 24-48 hours

For comparison, we have evaluated a scenario where RDCO would rent two 200 kW trailered generators each time there is a power outage. The 200 kW was used for estimating costs to implement this option but a 100 kW can be considered if available. The reduced generator size is not expected to lower cost significantly (e.g., compare above rates for 60 kW and 200 kW units) but would be easier to tow to site. A capital budget of \$60k is allowed under this option to install manual transfer switches at each site and establish a cleared area where the trailered unit can be situated at each site.

Maintenance Considerations & Cost Allowance

We have allowed for a budget of \$32,000 per year which includes rental fees and estimated labour cost to operate the rented equipment for three separate power outages each lasting 24 hours. Replacement costs are not applicable for this option under the Net Present Value Analysis.

A ¾-ton truck is necessary to tow the 200 kW trailered unit.

3.5 OPTION 4 – INCREASE WATER STORAGE

Increasing water storage was discussed as a potential alternative to adding a backup generator to each of the reviewed sites that would increase system reliability. We considered this and evaluated an alternative storage option as described in this section.

In this option, excess storage would be constructed at an elevated level in each system that would be accessible to the full extents of each water system in a power outage—Upper site for Westshore Estates and a site near the same level as the Winchester reservoir for Killiney Beach. The excess storage would be sufficient to provide at least 24 hours of max day demand without impacting the existing amount of available fire flow and balancing volumes stored within each system. To implement this option, the piping in each station would need to be modified to allow for return flows from the next highest reservoir which could be automated or manually operated. We believe this would be a preferable concept over trying to expand storage at each individual site which have limited available space and access.

Based on last year’s data, the maximum day demand was reported as 17.3 L/s and 15.2 L/s for Killiney Beach and Westshore Estates, respectively. This equates to a minimum storage volume of 1,500 m³ for Killiney Beach and 1,350 m³ for Westshore Estates. The total additional storage required equals 1,794 m³ which would be divided between the Killiney Beach and Westshore Estate water systems. The existing emergency storage volume significantly reduces the additional volume needed to sustain operations for 24 hours without power. We suggest allowing a total of \$2.5M for the capital cost of the reservoir expansion at both sites based on adding up to 1,794 m³ of storage capacity.

Table 3-3: Options Summary

Site	Required Emergency Storage for 24 hr Supply at MDD (m ³)	Buildout Available Emergency Storage (m ³)	Min Storage to be Added for 24 Hour Supply (m ³)
Killiney	1500	481	1,019
Westshore	1350	575	775
		Total	1,794

Maintenance Considerations & Cost Allowance

Annual maintenance costs for option 4 would be comparable to other water storage sites RDCO maintains. Adding excess storage will likely require a re-chlorination system to be implemented at each expanded site as well. We have allowed for 30% of a Full Time Equivalent employee to operate and maintain the added infrastructure (assumed value of 30% FTE = \$36k/yr)

The estimated asset renewal cost for this option is \$33k/yr.

4.0 OPTION SUMMARY

We have summarized the reviewed options in the table below. A net present value analysis is presented for each option below as well.

Table 4-1: Options Summary

Option	Description	Capital Cost Estimate (Class D)	Annual O&M Cost Estimate	75 Year NPV*	Ability to Minimize Service Interruptions
1	Do Nothing or Defer	n/a	n/a	n/a	n/a
2A	Add permanent generators with automatic transfer switches	\$720k	\$100k	\$4.8M	High
2B	Purchase two trailered 100 kW generators and manual transfer switches	\$500k	\$57k	\$2.9M	Medium
3	Rent generator(s)	\$60k	\$32k	\$1.2M	Low
4	Increase storage to provide 24 hours storage	\$2.5M	\$36k	\$3.9M	Medium

*NPV analysis is based on the following inputs:

- Inflation rate of 1.5% and interest rate of 4.15%,
- Option 2A & 2B have an assumed 25-year service life,
- Option 4 has an assumed 75-year service life,
- Generator replacements are included for Option 2A and 2B at years 25, 50 and 75 in the NPV calculation,
- Reservoir replacement costs are included in Option 4 at year 75 in the NPV calculation, and
- Annual O&M costing allows for three power failures to occur with each incident requiring backup power for 24 hours.

**RDCO can consider the available funding sources when evaluating options (e.g., Option 3 may be funded by Emergency Management BC (EMBC)). The funding source does not change our recommendations provided in Section 6.

5.0 FUTURE INTEGRATION WITH WATER STUDY

Urban Systems is working on a study with RDCO to improve water quality in the Killiney Beach and Westshore Estate systems. The report is expected to advance in 2023 and the scope may overlap with the recommendations included in this memorandum. We recommend reviewing and updating this memorandum after RDCO has selected a preferred option to improve water quality. There is potential that the primary water source for the area could be sourced from the Fintry aquifer which could eliminate the need for backup power at the Killiney Beach and Westshore intake sites.

6.0 CONCLUSION AND RECOMMENDATIONS

We have reviewed four options for improving the reliability of the Killiney Beach and Westshore Estate systems which included: 1) Do Nothing or Defer Decision, 2A) Add Permanent Generators with automatic transfer switches, 2B) Purchase two trailered generators with manual transfer switches, 3) Rent Generators or 4) Increase Water Storage.

We recommend the following:

- Obtain and review BC Hydro power loss data to inform RDCOs decision prior to advancing any option. Complete the following based on the data:
 - If the power interruptions are on average less than 12 hours per event, we recommend Option 1,
 - If the power interruptions are equal to or greater than our assumption (up to 3 power failures per year, each requiring backup power for 24 hours per event), we recommend Option 2A as it will provide the greatest ability to minimize service interruptions and starts automatically, or,
 - If the power interruptions fall between the above scenarios (i.e., average duration of power failure per event is between 12 and 24 hours), we recommend Option 1 as the existing emergency storage exceeds minimum requirements.
- Update plan after a preferred water quality improvement solution is selected for Killiney Beach and Westshore Estates (potential to reduce number of sites requiring backup power), and,
- Engage an electrical engineer to complete detailed design of the backup power generators and integration to each site.

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7.0 CLOSURE

Thank you for the opportunity to assist on this project. We enjoy working with RDCOs staff and appreciate this opportunity. If you have any questions, please contact the undersigned.

Sincerely,
URBAN SYSTEMS LTD.

A handwritten signature in blue ink, appearing to be "Jeremy Clowes".

Jeremy Clowes, P.Eng.
Principal, Water & Wastewater Engineer

cc: Kevin Trottier - RDCO
/ec
Enclosure

file://usl.urban-systems.com/projects/Projects_KEL/1179/0109/01/R-Reports-Studies-Documents/R1-Reports/Generator%20Costing%20Memo/2022-08-09%20Generator%20Costing%20Summary%20Memo_EC.docx

Appendix A – Storage Calculations

Killiney Beach - Buildout

Site	Available Storage (m3)	Required Storage			Min Required Total Storage (m3)	Available Storage for Emergencies (m3)
		A - Fire Storage (m3)	B - Balancing Storage (m3)	C- Emergency Storage (m3)		
Killarney	76	0	95	0	95	-19
Udell	383	0	127	0	127	256
Winchester	925	324	356	226	906	245
Total	1384	324	579	226	1129	481

Killiney Beach - Existing

Site	Available Storage (m3)	Required Storage			Min Required Total Storage (m3)	Available Storage for Emergencies (m3)
		A - Fire Storage (m3)	B - Balancing Storage (m3)	C- Emergency Storage (m3)		
Killarney	76	0	69	0	69	7
Udell	383	0	104	0	104	279
Winchester	925	324	197	173	693.9	404
Total	1384	324	369	173	867	691

Westshore Estates - Buildout

Site	Available Storage (m3)	Required Storage			Min Required Total Storage (m3)	Available Storage for Emergencies (m3)
		A - Fire Storage (m3)	B - Balancing Storage (m3)	C- Emergency Storage (m3)		
Mountain	510	0	270	0	270	240
Upper	1100	324	441	259	1023	335
Total	1610	324	711	259	1293	575

Westshore Estates - Existing

Site	Available Storage (m3)	Required Storage			Min Required Total Storage (m3)	Available Storage for Emergencies (m3)
		A - Fire Storage (m3)	B - Balancing Storage (m3)	C- Emergency Storage (m3)		
Mountain	510	0	158	0	158	352
Upper	1100	324	251	183	758	525
Total	1610	324	408	183	915	878

