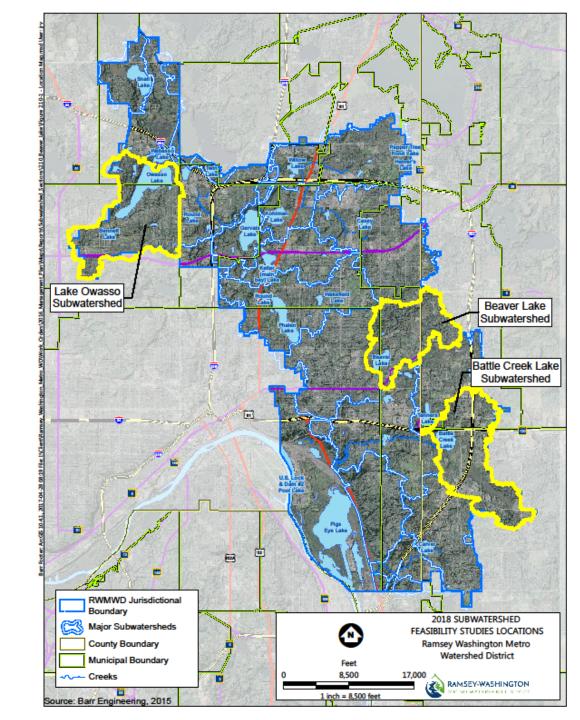
2018 Subwatershed Feasibility Studies

Beaver Lake

Lake Owasso

Battle Creek Lake





Completed subwatershed feasibility studies

- Purpose: to identify cost effective best management practices (BMPs) in the these subwatersheds that will slow the degradation process in lakes that are considered "at risk"
- RWMWD has done subwatershed feasibility studies for a number of impaired water bodies and creeks
- Impaired* Lakes
 - ✓ Kohlman (likely to be delisted soon)
 - ✓ Wakefield
 - ✓ Bennett

- Impaired* Creeks
 - ✓ Battle Creek (TSS)
 - ✓ Fish Creek (E. Coli)

- At Risk* Lakes
 - **✓** Emily
 - Beaver (2018)
 - Owasso (2018)
 - Battle Creek (2018)



* The terms "impaired" and "at risk" refer to nutrient, sediment and E. Coli levels



Subwatersheds of water bodies that have <u>not</u> been studied recently (but have been studied in the past)

- At Risk* Lakes
 - Carver
 - Round (Little Canada)

- At Risk* Creeks
 - Fish Creek
 - Gervais Creek
 - Kohlman Creek

- Stable Lakes
 - Keller Lake
 - Snail Lake
 - Wabasso Lake
 - Lake Phalen
 - Gervais Lake
 - Tanners Lake
 - Round Lake (in Maplewood)
 - Twin Lake
 - Willow Lake

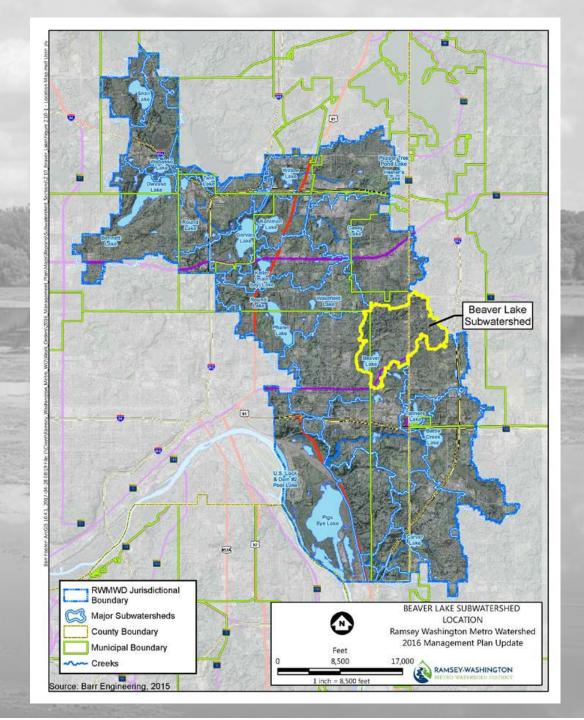




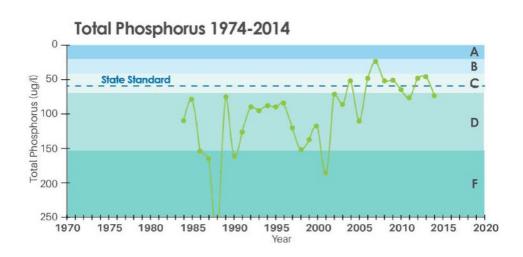
^{*} The term "impaired" and "at risk" refer to nutrient, sediment and E. Coli levels

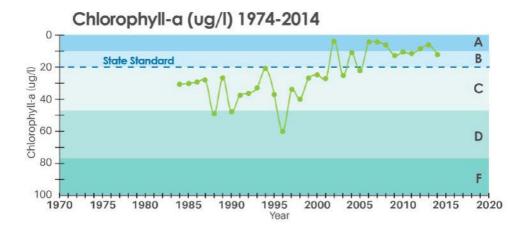
Beaver Lake

- Tributary area = 1,935 acres
- 87-acre lake
- Maximum depth = 11 feet
- Average depth = 4 feet
- Primarily used for canoeing, fishing, picnicking, wildlife habitat and aesthetic viewing.
- A Ramsey County park occupies most of the north and west shoreline.
- There is no public boat access, although there is a fishing pier on the west shoreline within the county park.



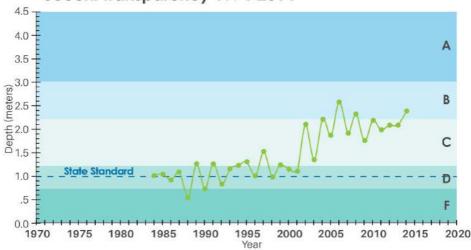
Beaver Lake Water Quality Monitoring





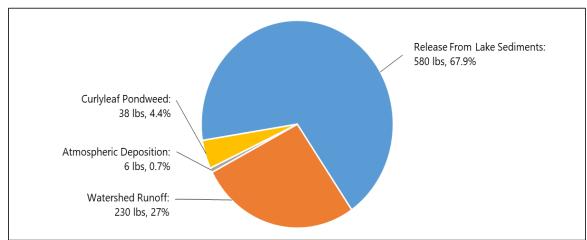
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Secchi Transparency 1974-2014

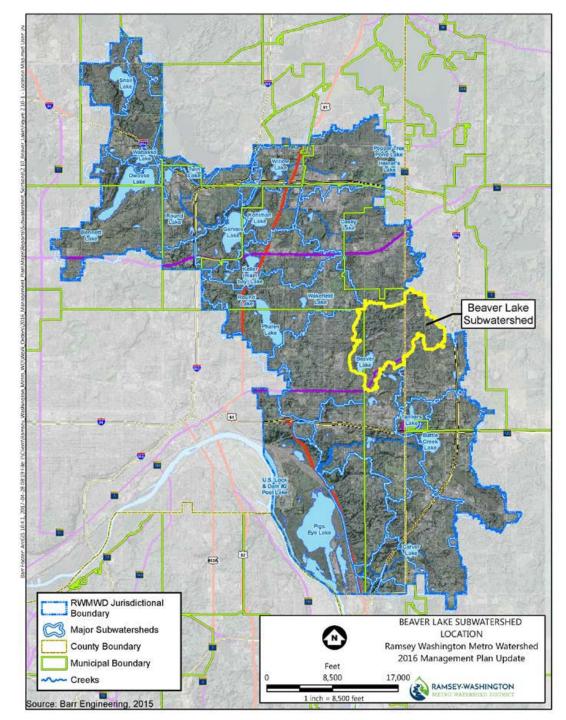


Beaver Lake Subwatershed

- Beaver Lake: "at risk" for impairment
- Shallow lake (<15 feet deep)
- Phosphorus loading:



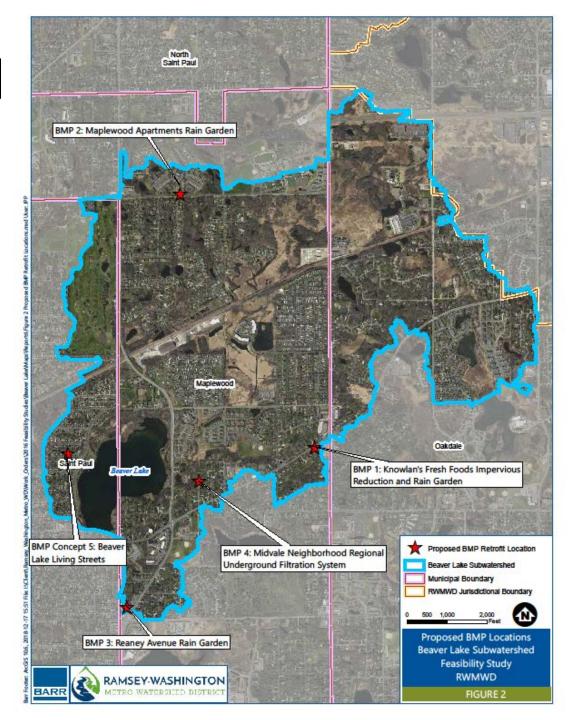




Beaver Lake Subwatershed Site Selection for BMPs

- Desktop Analysis
 - 56 sites identified
- Site Investigation
 - Eight sites prioritized and visited
- Conceptual Design Development
 - Five sites selected
 - 3 rain gardens
 - 1 impervious surface reduction
 - 1 neighborhood filtration
 - 1 living streets project





North Saint Paul BMP 2: Maplewood Apartments Rain Garden Oakdale Saliit Paul BMP 1: Knowlan's Fresh Foods Impervious Reduction and Rain Garden BMP Concept 5: Beave Proposed BMP Retrofit Location BMP 4: Midvale Neighborhood Regional Lake Living Streets Underground Filtration System Beaver Lake Subwatershed Municipal Boundary RWMWD Jurisdictional Boundary Proposed BMP Locations BMP 3: Reaney Avenue Rain Garden Beaver Lake Subwatershed Feasibility Study RWMWD RAMSEY-WASHINGTON FIGURE 2

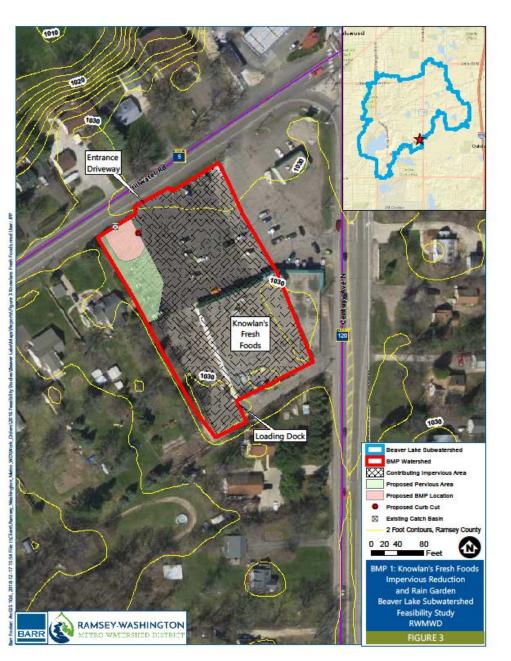
Beaver Lake Subwatershed BMPs

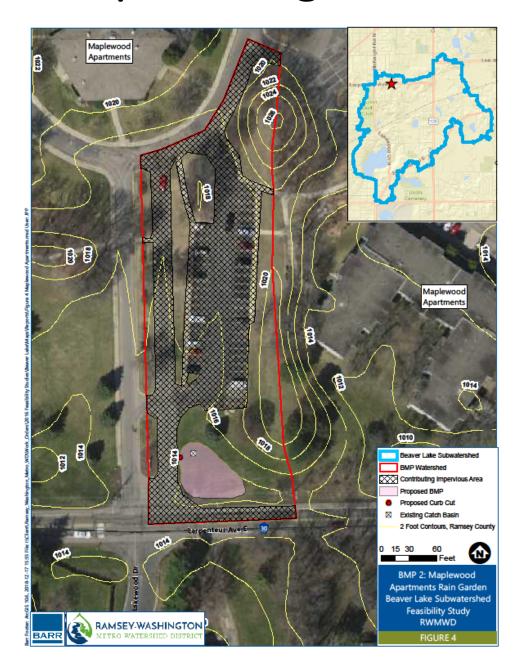
Proposed BMP	Estimated annual TP reduction (lb/year)
1. Knowlan's Fresh Foods impervious reduction	1.46
and rain garden	
2. Maplewood Apartments rain garden	1.73
3. Reaney Avenue rain garden	0.37
4. Midvale neighborhood regional underground	14.51
filtration system	
5. Beaver Lake living streets	11.54

Proposed BMP	planning-level opinion	estimated	total project cost
	of cost ^{1,2}	engineering cost ³	
1. Knowlan's Fresh Foods	\$209,000	\$83,500	\$292,500
impervious reduction and rain	(\$146,000-\$313,000)		(\$229,500-\$396,500)
garden			
2. Maplewood Apartments rain	\$55,500	\$22,200	\$77,200
garden	(\$38,900-\$83,300)		(\$61,100-\$105,500)
3. Reaney Avenue rain garden	\$46,600	\$18,600	\$65,200
	(\$32,600-\$70,000)		(\$45,600-\$97,900)
4. Midvale neighborhood regional	\$394,000	\$157,600	\$551,600
underground filtration system	(\$275,300-\$590,000)		(\$385,600-\$826,400)
5. Beaver Lake living streets ⁴	\$4,730,000	\$1,890,000	\$6,620,000
	(\$3,300,000-\$7,100,000)		(\$5,190,000-\$8,990,000)

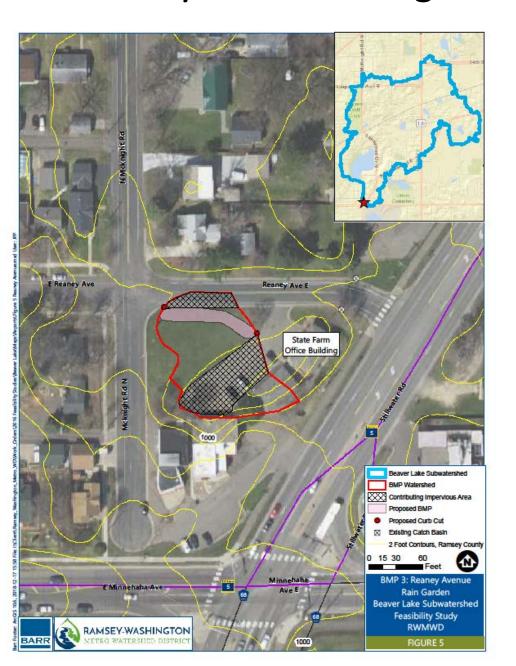
Proposed BMP	Annual cost per pound of TP removed (\$/lb.) ¹
1. Knowlan's Fresh Foods impervious reduction and rain garden	\$12,100-\$16,100
2. Maplewood Apartments rain garden	\$3,900-\$4,800
3. Reaney Avenue rain garden	\$12,700-\$16,200
4. Midvale neighborhood regional underground filtration system	\$3,200-\$4,100
5. Beaver Lake living streets	\$3,200-\$4,000 (\$22,800-\$30,900) ²

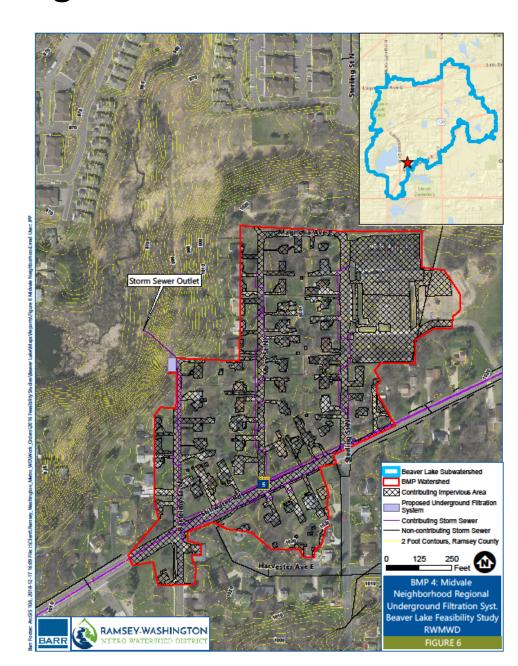
Knowlan's Fresh Foods and Maplewood Apts. rain gardens +



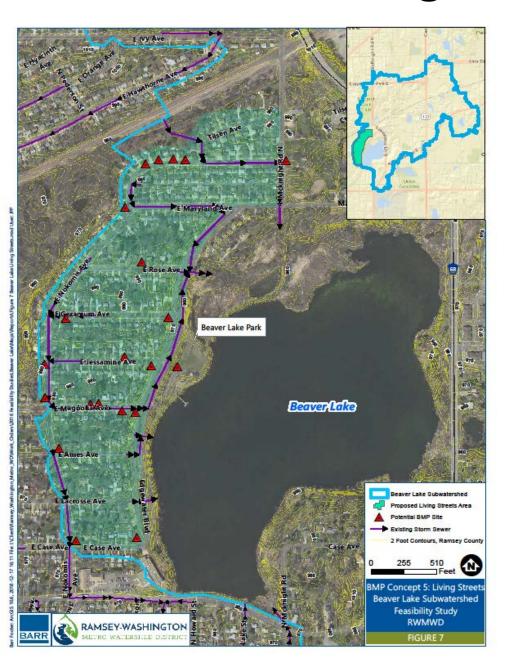


Reany Avenue rain garden and Midvale Neighborhood infiltration



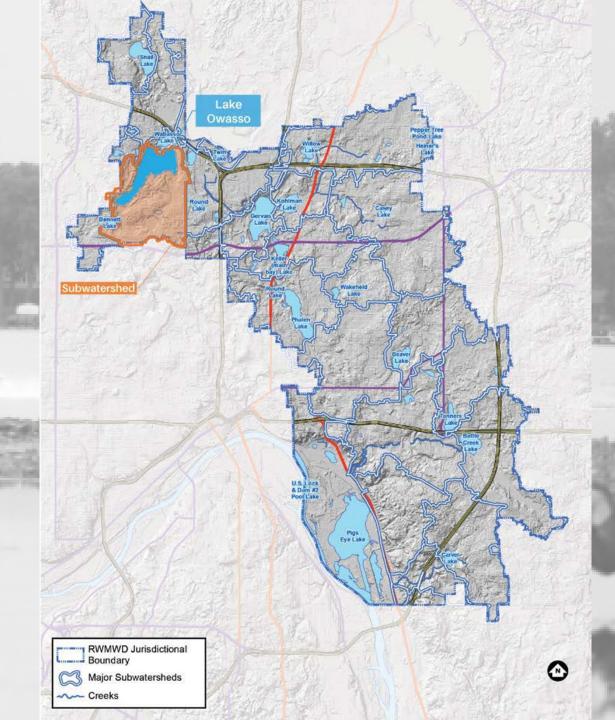


Living Streets (approx. 2 miles)

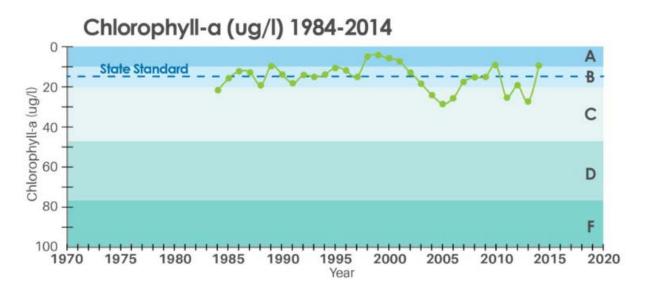


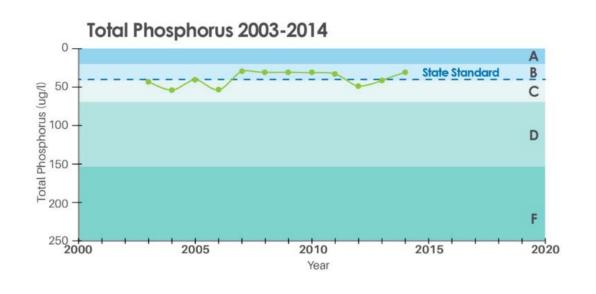
Lake Owasso

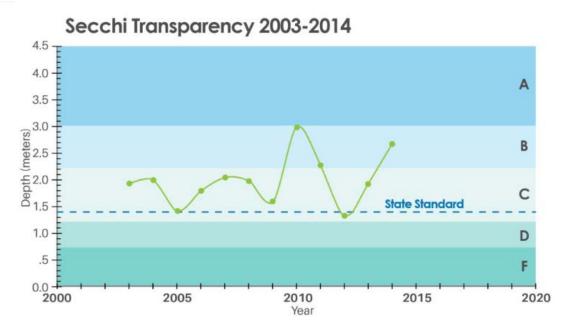
- Tributary area = 2,175 acres
- 375-acre lake
- Maximum depth = 37 feet
- Average depth = 11 feet
- Major regional recreational resource used for fishing, boating, waterskiing and swimming.
- Roseville's Central Park North (along the south shore of the lake) and Owasso County Park in the city of Shoreview (on the north side) provide two public access points including a boat launch and a public swimming beach.
- Lake Owasso receives water from Bennett Lake and Lake Emily.



Lake Owasso Water Quality Monitoring

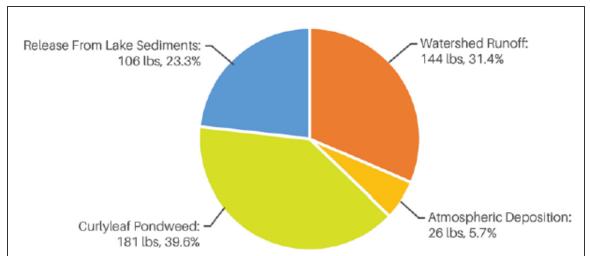




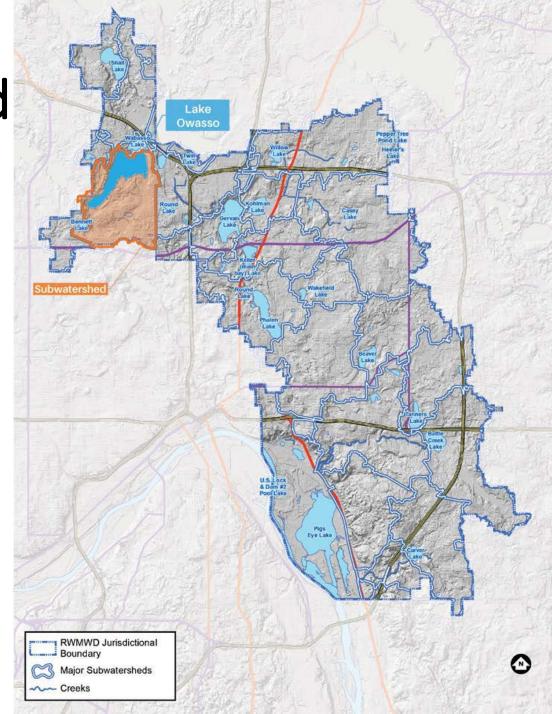


Lake Owasso Subwatershed

- Lake Owasso "at risk" for impairment
- Deep lake (>15 feet deep)
- Phosphorus Loading:







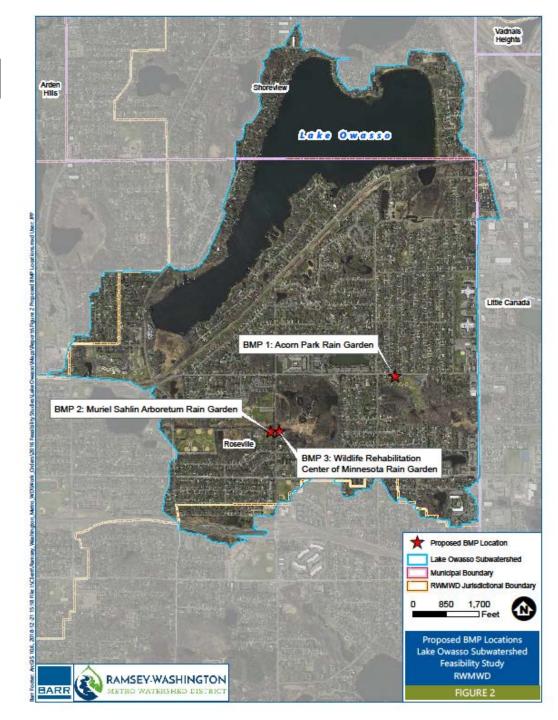
Lake Owasso Subwatershed Site Selection for BMPs

- Desktop Analysis
 - 41 sites identified

- Site Investigation
 - 10 sites prioritized and visited

- Conceptual Design Development
 - Three sites selected for rain gardens





North Saint Paul BMP 2: Maplewood Apartments Rain Garden Oakdale Saint Paul BMP 1: Knowlan's Fresh Foods Impervious Reduction and Rain Garden BMP Concept 5: Beave Proposed BMP Retrofit Location BMP 4: Midvale Neighborhood Regional Lake Living Streets Underground Filtration System Beaver Lake Subwatershed Municipal Boundary RWMWD Jurisdictional Boundary Proposed BMP Locations BMP 3: Reaney Avenue Rain Garden Beaver Lake Subwatershed Feasibility Study RWMWD RAMSEY-WASHINGTON FIGURE 2

Lake Owasso Subwatershed BMPs

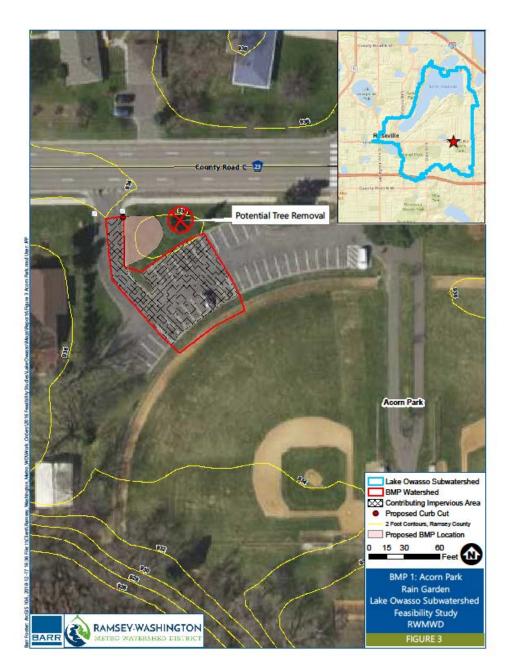
Proposed BMP	Estimated annual TP reduction (lb/year)
1. Acorn Park rain garden	0.49
2. Muriel Sahlin Arboretum rain garden	0.64
3. Wildlife Rehabilitation Center of Minnesota rain garden	1.05

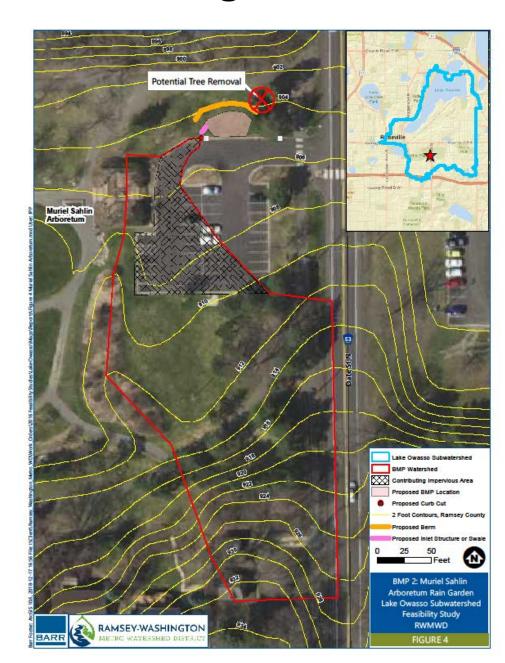
Proposed BMP	Planning-level opinion of cost ^{1,2}	Estimated engineering cost ³	Total
1. Acorn Park rain garden	\$44,100	\$14,100	\$58,200
	(\$30,800-\$66,200)	\$14,100	(\$44,900-\$80,300)
2. Muriel Sahlin Arboretum rain	\$43,800	\$14,000	\$57,800
garden	(\$30,600-\$65,600)	\$ 14,000	(\$44,600-\$79,600)
3. Wildlife Rehabilitation Center	\$55,300	\$17,700	\$73,000
of Minnesota rain garden	(\$38,700-\$82,900)	\$17,700	(\$56,400-\$100,600)

Proposed BMP	Annual cost per pound of TP removed (\$/lb) ¹
1. Acorn Park rain garden	\$7,268-\$9,644
2. Muriel Sahlin Arboretum rain garden	\$5,520-\$7,325
3. Wildlife Rehabilitation Center of Minnesota rain garden	\$4,249-\$5,638

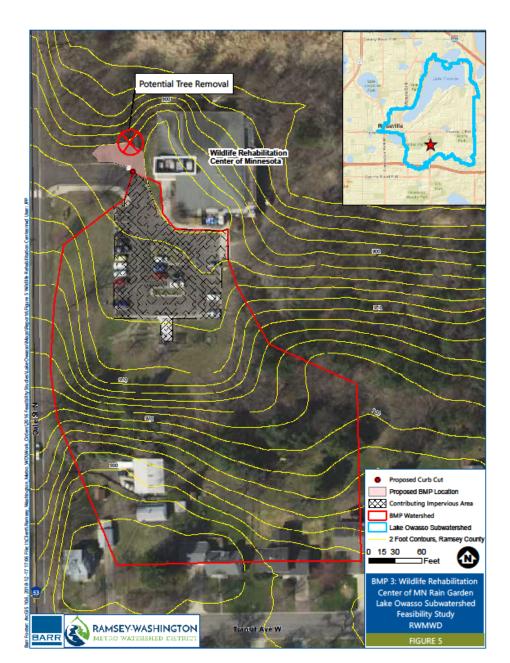


Acorn Park and Muriel Sahlin Arboretum rain gardens



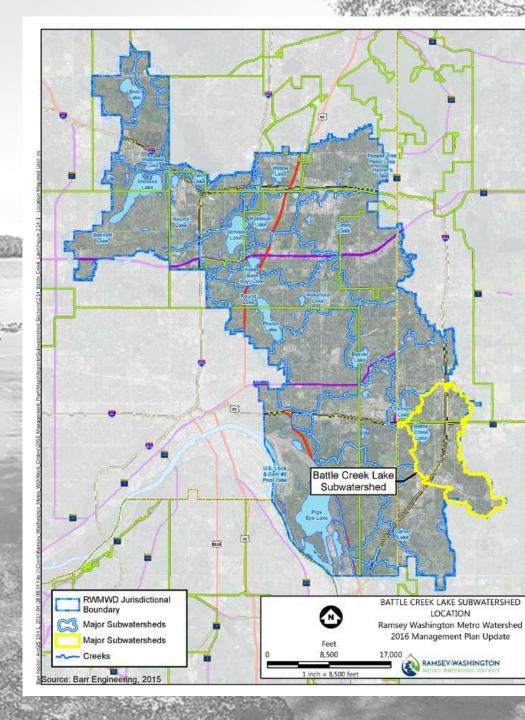


Wildlife Rehabilitation Center of Minnesota rain garden

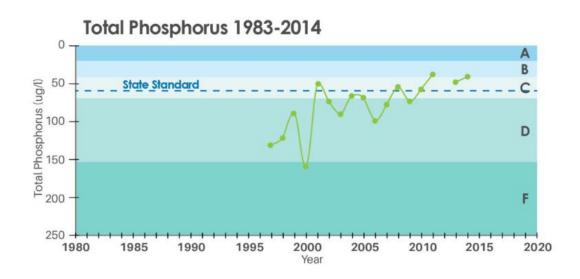


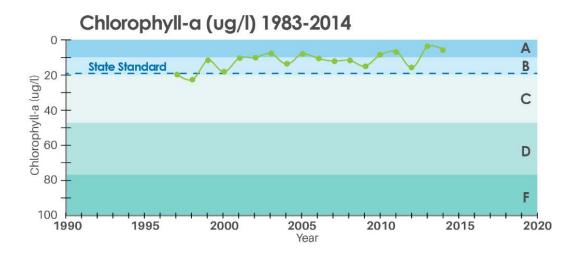
Battle Creek Lake

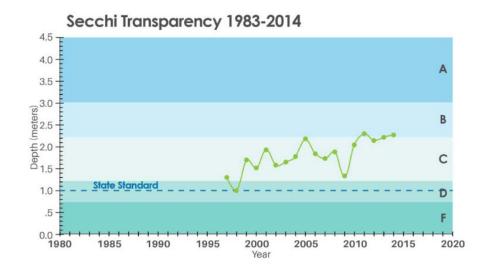
- Tributary area = 2,638 acres
- Downstream waterbody: Battle Creek
- 103-acre lake
- Maximum depth = 15 feet
- Average depth = 4 feet
- Removed from the impaired waters list in 2014
- Used for a variety of recreational purposes, including motor boating, canoeing, fishing, picnicking and viewing.
- There is a public boat access at the southeast corner of the lake in Shawnee Park.



Battle Creek Lake Water Quality Monitoring

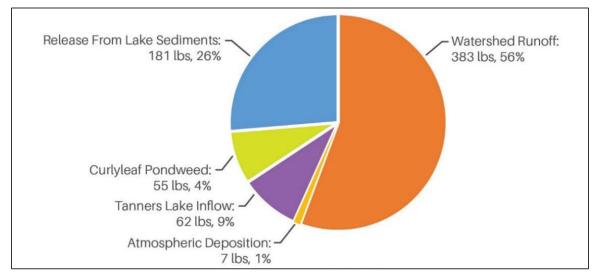




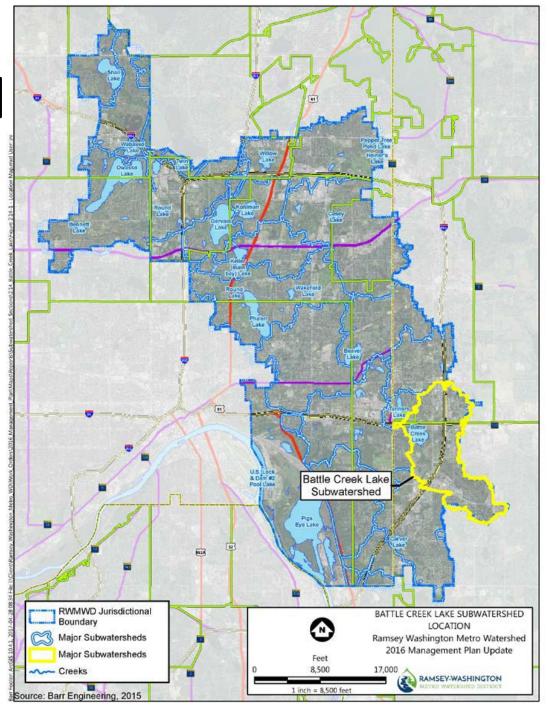


Battle Creek Lake Subwatershed

- Battle Creek Lake "at risk" for impairment
- Shallow lake (<15 feet deep)
- Phosphorus Loading:



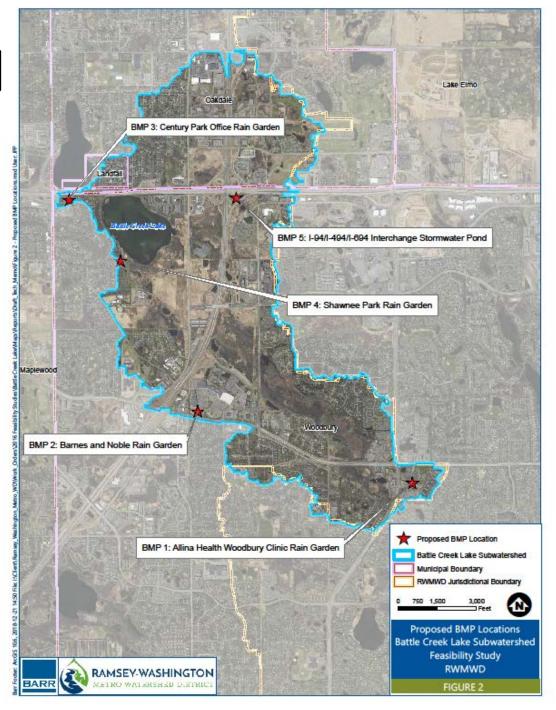




Battle Creek Lake Subwatershed Site Selection for BMPs

- Desktop Analysis
 - 50 sites identified
- Site Investigation
 - 12 sites prioritized and visited
- Conceptual Design Development
 - Five sites selected
 - 4 rain gardens
 - 1 regional treatment system





Lake Elmo BMP 3: Century Park Office Rain Garden BMP 5: I-94/I-494/I-694 Interchange Stormwater Pond BMP 4: Shawnee Park Rain Garden Maplewood BMP 2: Barnes and Noble Rain Garden Proposed BMP Location BMP 1: Allina Health Woodbury Clinic Rain Garden Battle Creek Lake Subwatershed Municipal Boundary RWMWD Jurisdictional Boundary Proposed BMP Locations Battle Creek Lake Subwatershed Feasibility Study RWMWD RAMSEY-WASHINGTON FIGURE 2

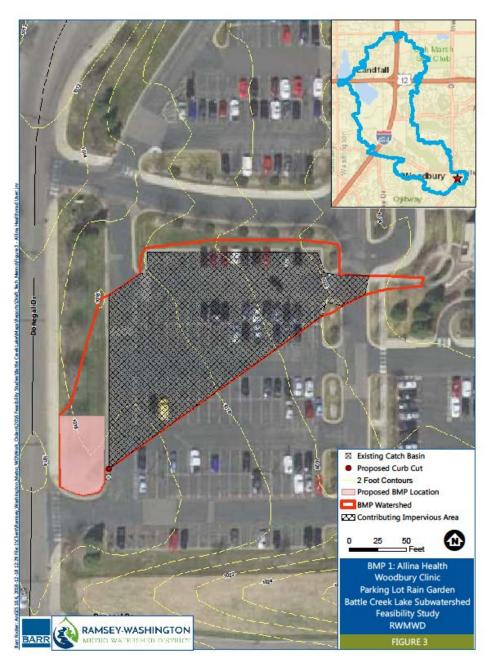
Battle Creek Lake Subwatershed BMPs

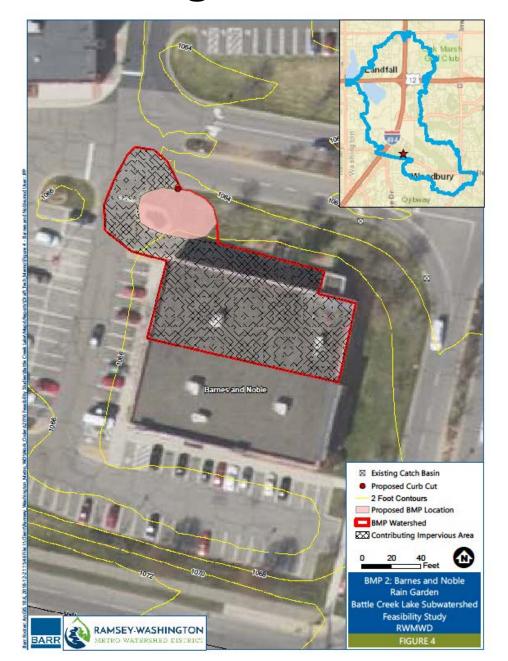
Proposed BMP	Estimated annual TP reduction (lb/year)
1. Allina Health Woodbury Clinic rain garden	1.00
2. Barnes and Noble rain garden	0.44
3. Century Office Park rain garden	1.12
4. Shawnee Park rain garden	0.50
5. I-94/I-494/I-694 Interchange stormwater pond	36.3

Proposed BMP	Planning-level opinion	Estimated	Total opinion of cost
	of construction cost ¹	engineering cost ²	
Allina Health Clinic Woodbury	\$63,900	\$20,400	\$84,300
rain garden	(\$44,70-\$95,900)		(\$65,100-\$116,300)
Barnes and Noble rain garden	\$28,700	\$9,100	\$37,800
	(\$20,100-\$43,000)		(\$29,200-\$52,100)
Century Office Park rain	\$40,000	\$12,800	\$52,800
garden	(\$28,000-\$60,000)		(\$40,800-\$72,800)
Shawnee Park rain garden	\$21,800	\$7,000	\$28,800
	(\$15,300-\$32,700)		(\$22,300-\$39,700)
I-94/I-494/I-694 Interchange	\$295,000	\$118,000	\$413,500
stormwater pond	(\$258,200-\$553,200)		(\$376,200-\$671,200)

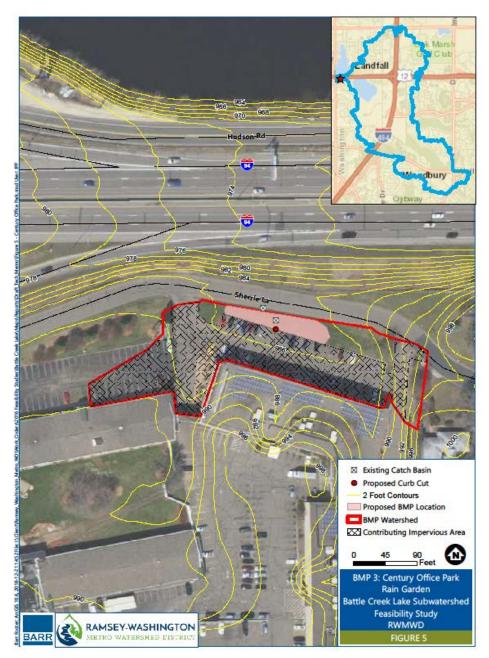
Proposed BMP	Annual cost per pound of TP removed (\$/lb.) ¹
Allina Health Clinic Woodbury rain garden	\$5,500-\$7,200
Barnes and Noble rain garden	\$6,800-\$8,500
Century Office Park rain garden	\$3,400-\$4,400
Shawnee Park rain garden	\$5,100 - \$6,200
I-94/I-494/I-694 Interchange stormwater pond	\$530 - \$690

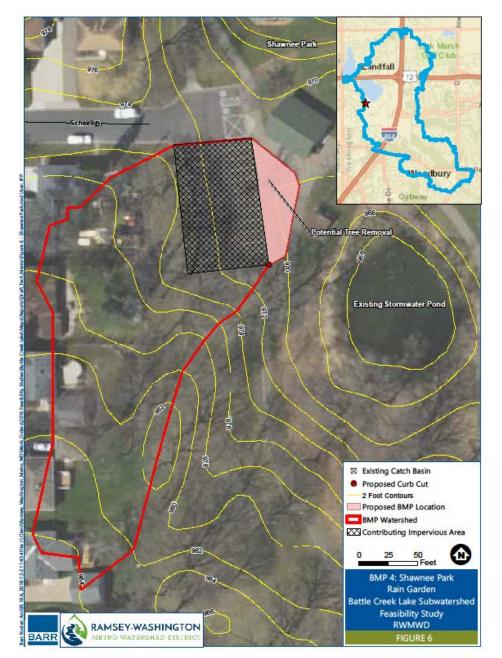
Allina Health and Barnes & Noble rain gardens



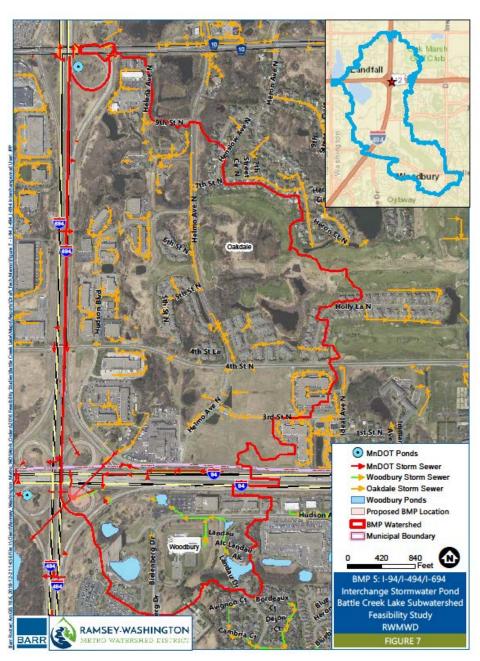


Century Office Park and Shawnee Park rain gardens





I – 694/494/94 intersection regional treatment



Recommendations

- Consider pursuing regional BMPs in coming years, including:
 - Midvale neighborhood underground filtration system
 - I-94/I-494/I-694 interchange stormwater pond

- Develop guidelines for cost considerations
 - \$/lb
 - \$ for community engagement and educational opportunities
- Continue to work with local cities, Ramsey and Washington Counties, and others to partner on water quality projects tied with other proposed work





Recommendations (cont.)

- Investigate and pursue opportunities to address internal loading
 - Carp management
 - Macrophyte harvesting
 - Iron aggregate pond application research project
 - Spent lime pond application project



