Water Reuse and Conservation in the City of Rosemount

Prepared by

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On behalf of

The City of Rosemount

With support from

The Resilient Communities Project

Resilient Communities Project

UNIVERSITY OF MINNESOTA
Driven to Discover℠

This project was supported by the Resilient Communities Project (RCP), a program at the University of Minnesota that convenes the wide-ranging expertise of U of M faculty and students to address strategic local projects that advance community resilience and sustainability. RCP is a program of the Center for Urban and Regional Affairs (CURA).

This publication may be available in alternate formats upon request.

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Introduction

This report is a compilation of work produced by students in PUBH 6132: Air, Water, and Health, taught by Dr. Matt Simcik during fall semester 2014 at the University of Minnesota. The project was part of the 2014–2015 Resilient Communities Project–City of Rosemount partnership, which included work on 29 community-identified projects.

For this project, the City of Rosemount was interested in viable solutions for reuse of intermittent storm water flow and treated effluent from the Metropolitan Council Environmental Services (MCES) Empire Wastewater Treatment Facility. Groups of students in PUBH 6132 were asked to research options for water reuse that addressed some or all of the following issues:

- opportunities for reuse of storm water and treated effluent at both the community and individual household scale (e.g., irrigation, toilets, industrial water usage, etc.)
- community-scale efforts elsewhere in Minnesota or the United States to reuse stormwater or treated effluent
- public acceptance of water reuse, as well as ideas for a public education and information campaign
- public health implications of water reuse
- tertiary treatment options for stormwater and treated effluent for various uses
- regulatory barriers to water reuse

The goal of the project was to identify reasonable, cost-effective, and publicly acceptable reuse options for storm water or treated effluent, taking into account existing regulatory and other barriers.

Regulatory Assessment

Lindsey Englar, Christina Schultz, Charlotte Wood

PubH 6132
Air, Water and Health
University of Minnesota

Jurisdiction

MINNESOTA DEPARTMENT OF LABOR & INDUSTRY

Mission: *Ensure Minnesota's work and living environments are equitable, healthy, and safe*

- Administers the plumbing code
- Stormwater conveyance systems to any "point of disposal"

Current MN Plumbing Code

Specific regulations regarding water supply (MN326B.43 subd. 2c)

(2) ensure that there is no physical connection between water supply systems that are safe for domestic use and those that are unsafe for domestic use; and
(3) ensure that there is no apparatus through which unsafe water may be discharged or drawn into a safe water supply system;

https://www.revisor.mn.gov/statutes/?id=326B&format=pdf

Current MN Plumbing Code

4715.1910 IDENTIFICATION OF POTABLE AND NONPOTABLE WATER.

- Potable water = green pipes
- Nonpotable water = yellow pipes
  - Can also use metal tags to ID potable/ nonpotable

(Department of Labor and Industry [DLI], 2012)

Proposed Amendments

Sets requirements for interior rainwater piping materials

Includes provisions for personal rain catchment systems
~ No direct connections allowed
~ Underground: Pipes cannot be laid in same trench as potable water

(Department of Labor and Industry [DLI], 2014)

Proposed Amendments

Measure	Limit
Turbidity (NTU)	<1
E. coli (MPN/ 100mL)	2.2
Odor	Non-offensive
Temperature (degrees C)	MR
Color	MR
pH	MR

MR = Measure and record

MINIMUM TREATMENT REQUIREMENTS:
5 micron absolute filter
0.5 log inactivation of viruses

Also includes minimum maintenance, testing and inspection frequency

(Department of Labor and Industry [DLI], 2014)

Jurisdiction

Mission: *Protecting, maintaining and improving the health of all Minnesotans*

- Provide guidance for stormwater management within wellhead protection areas
- Concerned with human exposure to pathogens

Jurisdiction

Mission: *Working to protect and improve our environment and enhance human health.*

- Governs Minnesota's stormwater program as required by the CWA
- Responsible for water quality standards of various application types
- Uses the California Water Reuse code as a model for Minnesota

Classification & Treatment

Types of reuse	Reuse permit limits	Minimum level of treatment
Irrigation of residential yards, playgrounds, parks and golf courses	2.2 MPN/100 mL total coliform 2 NTU (daily avg.); 10 NTU (daily max turbidity)	Tertiary Disinfected Secondary Filtration/Disinfection
Cleaning roads, sidewalks and outdoor work areas	23 MPN/100 mL total coliform	Disinfected Secondary 23 Secondary Disinfection
Food crops not for direct human consumption	200 MPN/100 mL fecal coliform	Disinfected secondary 200 Secondary disinfection

(MPCA, 2010)

Jurisdiction

Mission: *Work with citizens to conserve and manage the state's natural resources*

- Issue water appropriation permits for water withdrawals
    - *This applies to water withdrawals from stormwater ponds*

Case Studies

Target Field

Rainwater/stormwater collection from ballpark; Recycled irrigation water

Use: Irrigation and washing of spectator areas

St Anthony Village

Stormwater runoff (incl. snowmelt); Filtered backwash from WTP

Use: Irrigation (20 acres)

Feasibility

Yes, it is feasible

BUT…

Dependent on:

Working group findings/analysis

Feasibility of expansion would be dependent on potential code amendments

Points of Contact

NAME/AGENCY	TITLE	PHONE/EMAIL	JOB SUMMARY
Don Sivigny, DLI	construction code representative	(651) 284-5874 **Don.Sivigny@state.mn.us**	rules, code development residential energy code info
Mark Schmitt, MPCA	Municipal Division Director	(651) 757-2698 **Mark.Schmitt@state.mn.us**	Municipal division works with cities and towns to properly manage wastewater and stormwater, and to protect the citizens and environment.
Princesa VanBuren Hansen, MnDNR	Water Use Program Consultant	(651)259-5731 **Princesa.hansen@state.mn.us**	Water appropriation permits.
Randy Ellingboe, MDH	Drinking Water Protection Director	(651)201-4647 **randy.ellingboe@state.mn.us**	The program provides wellhead protection, source water assessments, surface water intakes protection, and general technical information.
Jim Hilgendorf, UMN	Building Code Division, Building Official	(612)625-5973 **Jhilgend@umn.edu**	Assist with permits and inspections of University of Minnesota property.
Alan Strand, City of Rosemount	Building Official	(651) 322-2036	

References

[DLI] Minnesota Department of Labor and Industry Construction Codes and Licensing Division. 2012. Minnesota Plumbing Code Chapter 4715. [Accessed online 2014 October 14] Available from http://www.dli.mn.gov/ccld/PDF/pe_code.pdf

[DLI] Minnesota Department of Labor and Industry Construction Codes and Licensing Division. 2014. Proposed Amendment to Rules Governing the Plumbing Code and Adopting the 2012 Uniform Plumbing Code, with Amendments. [Accessed 2014 October 14] Available from http://www.dli.mn.gov/PDF/docket/4715rule.pdf

[MPCA] Minnesota Pollution Control Agency. 2010. Municipal Wastewater Reuse - Minnesota Pollution Control. [Accessed 2014 December 10] Available from http://www.pca.state.mn.us/index.php/view-document.html?gid=13496

The Office of the Reservoir of Statues. 2014. Chapter 326B Construction Codes and Licensing. [Accessed 2014 October 14] Available from https://www.revisor.mn.gov/statutes/?id=326B

REGULATORY AGENCY JURISDICTION

At the state level, there are a number of agencies that have jurisdiction over water reuse in Minnesota. The following section provides a brief description of the interests of each agency involved with water reuse policy as well as their specific jurisdiction over a potential water reuse project.

Minnesota Department of Labor Industry (DLI)

Mission Statement: The Department of Labor and Industry's (DLI) mission is to ensure Minnesota's work and living environments are equitable, healthy and safe. The department serves employees and employers by regulating workplaces through education and enforcement.[1]

Jurisdiction

In regards to water reuse, the DLI is responsible for administering the plumbing code. The Minnesota plumbing board, which operates under the DLI, is the entity which holds the rule making authority over the plumbing code. If stormwater is being collected on or within buildings, regulation of scuppers, gutters, and downspouts is regulated under the building code, not the plumbing code. However, the plumbing code does outline the requirements of interior roof drain systems.

The DLI's main regulatory authority in relation to water reuse is related to stormwater conveyance systems. This can include both interior and exterior storm piping. The DLI's jurisdiction over stormwater conveyance system is primarily over any conveyance to an approved point of disposal. A point of disposal is defined differently depending on the property boundaries involved. As UMORE park is a large area of land with the holding ponds likely within the property boundary, these ponds would be defined as the point of disposal. However, if the water body where the water is directed to lies outside of the property boundary, then the property boundary serves as the point of disposal. Once beyond this point of disposal, the MPCA typically holds jurisdiction

If water is being reused from a stormwater pond for irrigation, the DLI has jurisdiction over the conveyance system to the point where it discharges into the stormwater pond; however, the DLI would not have jurisdiction over the stormwater pond or the irrigation system taking water from the pond and would typically not review those components.

[1] "Mission - Minnesota Department of Labor and Industry." 2009. 10 Dec. 2014 <http://www.doli.state.mn.us/Mission.asp>

The DLI does not have jurisdiction over water quality standards, however, they recommend that water should be treated and have issued suggested fecal coliform and Total Suspended Solids limits

Minnesota Pollution Control Agency (MPCA)

Mission Statement: The Minnesota Pollution Control Agency's mission is to protect and improve the environment and enhance human health.[2]

Jurisdiction

The MPCA's jurisdiction is primarily related to the quality of water reaching other water bodies waters in order to protect the water quality of lakes, streams, and groundwater. The permitting system for wastewater reuse has been modelled on the State of California's regulations.[3] In regards to stormwater management, the MPCA's jurisdiction typically applies to construction sites which are disturbing more than one acre of soil, industrial sites that an industrial stormwater permit, or Municipal Separate Storm Sewer System (MS4) operators who are trying to meet the requirements of their permits, These MS4s can include Total Maximum Daily Load (TMDL) wasteload allocations.

The MPCA has established a set of water quality guidelines for water reuse based on the intended application. When reusing wastewater, the MPCA requires both monthly and annual reports entailing where the wastewater was reused, the volume of water used at each location, and a summary of monitoring results.[4] The guidelines for wastewater reuse, based on application, be seen in Figure 1.

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[2] "Agency strategy - Minnesota Pollution Control Agency." 2013. 10 Dec. 2014 <http://www.pca.state.mn.us/index.php/about-mpca/mpca-overview/agency-strategy/index.html>

[3] "Municipal Wastewater Reuse - Minnesota Pollution Control ..." 2010. 10 Dec. 2014 <http://www.pca.state.mn.us/index.php/view-document.html?gid=13496>

[4] "Municipal Wastewater Reuse - Minnesota Pollution Control ..." 2010. 10 Dec. 2014 <http://www.pca.state.mn.us/index.php/view-document.html?gid=13496>

Treatment Limits

Types of reuse	Reuse permit limits	Minimum level of treatment
• Food crops where the recycled water contacts the edible portion of the crop, including root crops • Irrigation of residential landscape, parks, playgrounds, school yards, golf courses • Toilet flushing • Decorative fountains • Artificial snow making, structural fire fighting • Backfill consolidation around potable water pipe • Industrial process water that may come in contact with workers • Industrial or commercial cooling or air conditioning involving cooling towers, evaporative condensers, or spray that creates mist	2.2 MPN/100 ml. Total Coliform 2 NTU daily average; 10 NTU daily maximum turbidity	**Disinfected** **Tertiary** secondary, filtration, disinfection
• Cemeteries • Roadway landscaping • Ornamental nursery stock and sod farms with restricted access • Pasture for animals producing milk for human consumption • Nonstructural fire fighting • Backfill consolidation around nonpotable water pipe • Soil compaction, mixing concrete, dust control on roads and streets • Cleaning roads, sidewalks, and outdoor work areas • Industrial process water that will not come into contact with workers • Industrial boiler feed • Industrial or commercial cooling or air conditioning not involving cooling towers, evaporative condenser, or spray that creates mist	23 MPN/100 ml. Total Coliform	**Disinfected Secondary 23** Secondary, disinfection
• Fodder,fiber, and seed crops • Food crops not for direct human consumption • Orchards and vineyards with no contact between edible portion • Non food bearing trees, such as Christmas trees, nursery stock and sod farms not irrigated less than 14 days before harvest • In Minnesota, this is commonly called "spray irrigation"	200 MPN/100 ml. Fecal Coliform	**Disinfected secondary 200** Secondary, disinfection (stabilization pond systems with 210 days of storage do not need a separate disinfection process)

Figure 1: MPCA Guidelines for water reuse

Minnesota Department of Natural Resources (DNR)

Mission Statement: The mission of the Minnesota Department of Natural Resources (DNR) is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.[5]

Jurisdiction

The DNR has jurisdiction over water appropriation permits for any water withdrawals over 10,000 gallons per day or 1 million gallons a year from any waters of the state, including stormwater ponds. These permits are required regardless of how the water will be used. In general, if water is pumped out of a stormwater basin, an appropriation permit will be required. One exception to this is if the water is temporarily drained out of the basin via an operable outlet structure. In this case, an appropriation permit is not required.

Minnesota Department of Health (MDH)

Mission Statement: The mission of the Minnesota Department of health is protecting, maintaining and improving the health of all Minnesotans.[6]

Jurisdiction

The MDH has a somewhat limited jurisdiction over the systems related to stormwater collection and reuse for irrigation. The MDH has no regulatory authority over most routine handling of stormwater; however, they administer the Wellhead Protection Program which can be related to wastewater reuse. Staff from the MDH Source Water Protection Unit provide guidance on implementing stormwater management within wellhead protection areas.[7]

The MDH is also concerned with the potential for exposure to pathogens in the environment. This area is largely unregulated, however, the MDH is currently reviewing the EPA/USDA Microbial Risk Assessment Guideline in order to assist with establishing a strategy for nonpotable water reuse applications which takes into consideration potential exposure to pathogens.

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[5] Mlecoch, C. "Mission statement: Minnesota DNR." 1998. <http://www.dnr.state.mn.us/aboutdnr/mission.html>

[6] Stieger, J. "MDH Mission, Vision and Values - Minnesota Dept. of Health." 2005. <http://www.health.state.mn.us/about/mission.html>

[7] "Wellhead Protection - EH: Minnesota Department of Health." 2003. 10 Dec. 2014 <http://www.health.state.mn.us/divs/eh/water/swp/whp/>

Water Reuse Case Studies

Below are a selection of Minnesota water reuse projects, sourced from the Minnesota Stormwater Manual.[8] These case study are supplemented by Figure 2 which provides a more detailed breakdown of a selection of water reuse case studies.

Outdoor Use

The **City of St. Anthony Village** water reuse facility collects stormwater runoff from a county road, city hall, local streets and backwash water from the City's water treatment plant in a half million gallon reservoir located underground. Water stored in the reservoir is recycled to irrigate a 20 acre site that includes a municipal park and St. Anthony's City Hall campus. For more information, watch the City of St. Anthony video

The **Oneka Ridge Golf Course** project in the City of Hugo, collects and stores stormwater runoff from nearly 1,000 acres of land upstream of Bald Eagle Lake and uses it, instead of pumped groundwater, to irrigate 116 acres with the golf course. For more information, go to the Rice Creek Watershed District web page

Target Field, home of the Minnesota Twins, collects stormwater in a 200,000 gallon cistern. This water is treated and used to irrigate the ball field, reducing city water use by 2 millions gallons per year.

The **Eagle Valley** and **Prestwick Golf Courses** in Woodbury are installing two large scale water re-use systems that will capture urban runoff and excess nutrients that would otherwise flow into Colby and Bailey Lakes and use it for irrigation. This project was funded in 2013 with a Clean Water Fund grant.

The **Minnesota National Guard Facility** in Arden Hills has an extensive water-collection system that stores rainwater in a 25,000-gallon underground cistern for reuse in wash bays with a second 20,000-gallon tank to filter rainwater for irrigation.

Maplewood Mall has a 5,700 gallon cistern that catches roof runoff.

Carver County has five sites where stormwater is being to irrigate balllfields and turf. They are Beise Addition, Chevalle, Club West, Copper Hills and Waconia School

[8] "Stormwater re-use and rainwater harvesting - Minnesota ..." 2013. 10 Dec. 2014 <http://stormwater.pca.state.mn.us/index.php/Stormwater_re-use_and_rainwater_harvesting>

District. Carver County Watershed Management Organization also has stormwater Reuse Guidelines.

Indoor Use

The **University of Minnesota** received a $300,000 grant from the Environment and Natural Resources Trust Fund for a rainwater reuse and valuation investigation. Funds will be used to design, install and monitor a rainwater reuse system for use in evaporative chiller systems and identify other potential applications for rainwater reuse systems.

The **City of St. Paul's Lowertown Ball Park** project will be using rainwater for toilet flushing and for irrigation of the ballpark. Installation is expected to take place in November, 2014 and will be operational when the ballpark opens in the spring of 2015. For more information, contact Wes Saunders-Pearce/Water Resources Coordinator at 651- 266-9112 or Wes.Saunders-Pearce@ci.stpaul.mn.us. Information about the project is also available on Capitol Region Watershed District's web site. On October 17, Wes Saunders-Pearce gave a detailed presentation at the Mississippi River Forum.

Great River Energy in Maple Grove: Rainwater from the rooftop is collected in a 20,000-gallon cistern, treated with ultraviolet light, and used for toilet and urinal flushing.

The new **Target Field Station** (The Interchange) features the first-ever, year-round snowmelt and stormwater runoff capture and reuse system in Minnesota. Snowmelt or stormwater is collected in cisterns and then pumped to the Hennepin Energy Recovery Center (HERC), a nearby waste-to-energy facility that burns municipal waste to generate energy. The HERC facility uses the water in a variety of industrial processes, thereby reducing the facility's dependence on the municipal water supply. In total, the stormwater system will direct approximately 1 million gallons of stormwater runoff per year toward the HERC facility for reuse.

Schaar's Bluff Gathering Center in Dakota County utilizes rainwater harvesting for toilet flushing.

Feasibility & Future

There is currently a Water Reuse Interagency Work Group meeting which is composed of staff from MDH, MPCA, DNR and the Metropolitan Council, along with the Department of Labor and Industry and the Minnesota Plumbing Board. The most represented agency within this group is the MPCA. The work group is investigating the options for formalizing and synchronizing the Minnesota state rules related to the use of stormwater and harvested rainwater, as well as the reuse of greywater. It was expected that research and policy analysis would be available late 2014, with information focused on the safety of water used for different applications and on the permitting and performance standards required to encourage and manage water utilization and reuse.

Additionally, if there were to be future expansion into the established portions of Rosemount, attention should be given to potential changes in residential building and plumbing codes. Currently, the MN plumbing code is going through a review process, and amendments may occur in the near future. The most current amendment proposal document was created July 17, 2014.

Project	Permits	Source Water	Use
MINNESOTA			
Saint Anthony Village Water Reuse Facility; City of Saint Anthony Village, Minnesota	Water treatment facility general permit (MPCA)	Stormwater runoff including snowmelt; filter backwash water from the City's water treatment plant	Outdoor: Irrigation og a 20acre site which includes a municipal park and St. Anthony's City Hall campus
	NPDES/SDS Permit (MPCA) for water treatment plant discharge		
	NPDES general stormwater for construction activity (MPCA) for site construction		
	Sanitary Sewer Extension Permit (MPCA/Metropolitan Council) for discharge to sanitary sewer from storage reservoir		
	Rice Creek Watershed District permit for construction activity		
	Rice Creek Watershed District Rules and the City's Ordinances		
	Minnesota Department of Health (MDH) did not require a permit for the project		
Target Field Rainwater Recycling Sytem; Target Field, Minneapolis, MN	Standard electrical permits and standard construction (plumbing) permits	Rainwater/stormwater form the ball park (field and stadium seating); recyled irrigation water on the ballpoark field	Outdoor: Irrigation go the ball field and washing of the spectators seating areas
OTHER STATES			
Santa Monica Urban Runoff Recycling Facility (SMURRF); Santa Monica, California	Approval required from the California Coastal Commission	Urban stormwater runoff	Outdoor: Landscape irrigation throughout Santa Monica
	Approval required through California Environmental Quality Act (CEQA)		
	Building and Safety Permit required		
	State of California Regional Water Quality Board required a monitoring plan in lieu of a NPDES permit beacause SMURRF was classified as a Best Management Practice		
Stephen Epler Hall Rainwater Reclamation System Portland State University and Oregon University	Standard building permits as required by city hall	Rooftop rainwater from the 10,000 sq. ft. roof and from a portion of the roof of the neighborhood King Albert Hall	Indoor/Outdoor: On-site irrigation and toilet flushing
Information attained from: The Metropolitan Council Stormwater Reuse Guide; Fall 2011 http://rfcd.pima.gov/pdd/lid/pdfs/31-mn-metropolitan-council-stormwater-reuse-guide-2011.pdf			

Figure 2: Water resuse case studies

Points of contact

Below are the titles and contact information for key people within each of the key state agency's related to water reuse. The positions and contact information is current as of 12/10/2014

NAME/AGENCY	TITLE	PHONE/EMAIL	JOB SUMMARY
Don Sivigny, DLI	construction code representative	(651) 284-5874 **Don.Sivigny@state.mn.us**	rules, code development residential energy code info
Mark Schmitt, MPCA	Municipal Division Director	(651) 757-2698 **Mark.Schmitt@state.mn.us**	Municipal division works with cities and towns to properly manage wastewater and stormwater, and to protect the citizens and environment.
Princesa VanBuren Hansen, MnDNR	Water Use Program Consultant	(651)259-5731 **Princesa.hansen@state.mn.us**	Water appropriation permits.
Randy Ellingboe, MDH	Drinking Water Protection Director	(651)201-4647 **randy.ellingboe@state.mn.us**	The program provides wellhead protection, source water assessments, surface water intakes protection, and general technical information.
Jim Hilgendorf, University of Minnesota	Building Code Division, Building Official	(612)625-5973 **Jhilgend@umn.edu**	Assist with permits and inspections of University of Minnesota property.
Alan Strand, City of Rosemount	Building Official	(651) 322-2036	

Engineering

Matthew Bechle, Ethan Lipscomb, Shiyue Zhang

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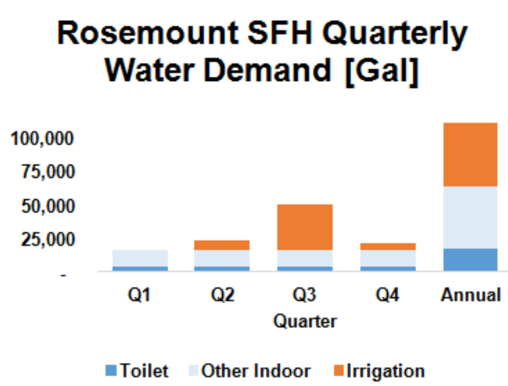
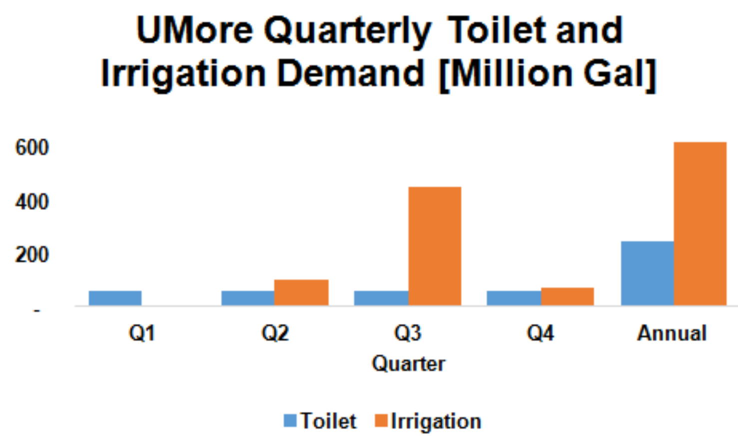
Air, Water and Health
University of Minnesota

UMore Water Demand

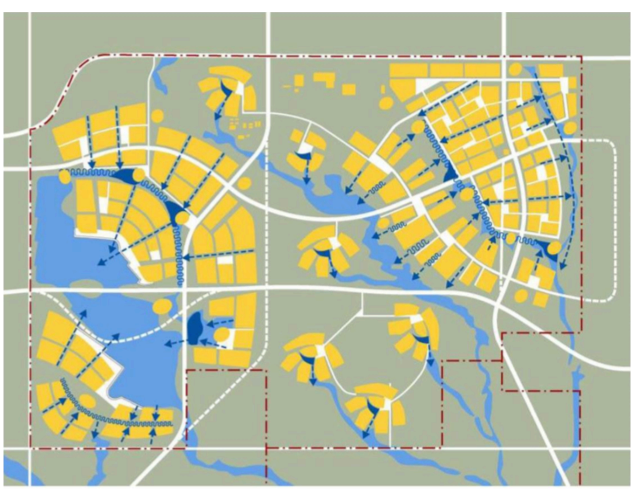
- Assume water usage in Q1 was 100% indoors; difference in other quarters was irrigation
- 27% of indoor usage from toilets (based on U.S. EPA)
- Extrapolate to the expected 13000 SFHs at UMore



UMore Water Demand



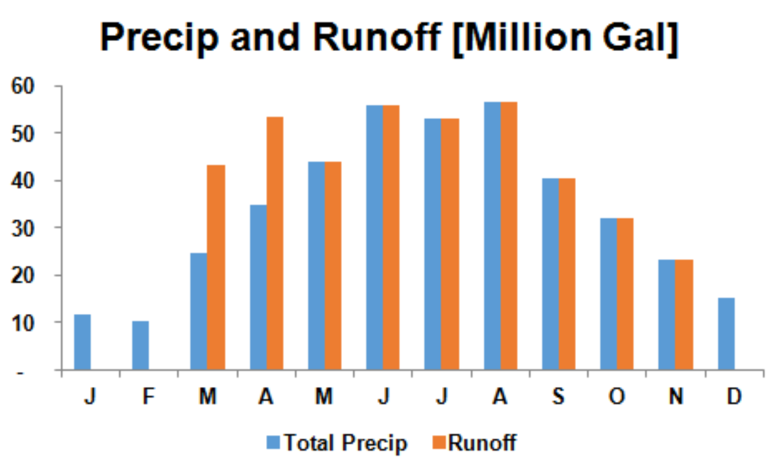
Stormwater Potential



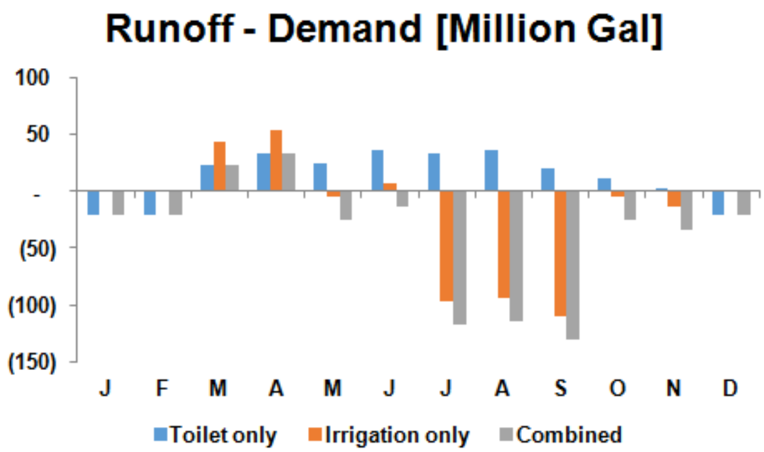
Stormwater Potential

- ~⅓ of UMore area drains to lake
- 30% of all precipitation is runoff
- Winter precipitation becomes runoff in spring

Stormwater Potential



Meeting Demand



Treatment Levels

<u>Environmental Reuse</u>:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform

Treatment Levels

Environmental Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform

Urban Restricted Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform; pH = 6-9; 1 mg/L Cl_2 residual

Treatment Levels

Environmental Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform

Urban Restricted Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform; pH = 6-9; 1 mg/L Cl_2 residual

Urban Unrestricted Reuse:

- ≤ 10 mg/L BOD; ≤ 30 mg/L TSS; no fecal coliform; ≤ 2 NTU; pH = 6-9

Treatment Levels

Environmental Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform

Urban Restricted Reuse:

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform; pH = 6-9; 1 mg/L Cl_2 residual

Urban Unrestricted Reuse:

- ≤ 10 mg/L BOD; ≤ 30 mg/L TSS; no fecal coliform; ≤ 2 NTU; pH = 6-9

Empire WWTP Average Reclaimed Water Levels:

- 3 mg/L BOD; 4 mg/L TSS; 15 #/100mL fecal coliform; 4 NTU; pH = 7

Case Study: Tucson, AZ

- 700+ SFH use reclaimed water for outdoor landscaping.
- 15 million gallons of surface storage
- Average daily delivery: 13.5 MGD; summer peak delivery : 31 MGD

- Process:
  1) Secondary effluent from WWTP goes to additional filtration and disinfection at a water filtration plant
  2) Secondary effluent from WWTP is recharged into a river basin then taken back again and disinfected
  3) Tertiary effluent from another WWTP

Case Study: Florida

- Reclaimed water system for landscape irrigation of:
  - ~10,000 residential lawns
  - 61 schools
  - 111 parks, and 6 golf courses.

- Process:
  - grit removal, mechanical aeration, clarification, filtration in deep-bed multimedia filters, high-level disinfection with Cl, and storage.

- One of the most widely known reuse systems in the world.

Summary

- Stormwater runoff enough for toilet use

- Irrigation and/or combined demand needs to be supplemented with tap water or reclaimed water from the Empire WWTP.

- Reclaimed water from Empire WWTP meets recommended environmental and urban restricted reuse levels.

Recommendations

Recommended treatment option 1:

- Microfiltration + disinfection at UMore for stormwater + reclaimed WW
- Reclaimed water may be:
  - routed through lake for additional pre-treatment
  - used throughout UMore restricted irrigation

Recommended treatment option 2:

- Microfiltration at Empire WWTP prior to UV disinfection
- Use reclaimed WW for toilet and irrigation
- Use minimally treated lake water for restricted reuse.

Water Reuse Case Studies

General Treatment Methods/Requirements:
In general, nonpotable water to be reused for irrigation can be treated with sand or dual-media filtration after secondary treatment (Miller, 2006). Secondary treatment, filtration, and disinfection appear to be the main treatment methods for water to be reused for 'unrestricted urban use' such as toilet flushing and landscape irrigation (table from Mujeriego, 1999; originally from US EPA 1992 and Asano and Levine, 1998).

Tucson, AZ

http://water.tucsonaz.gov/water/reclaimed-general

- treated wastewater for reuse

-"More than 700 single-family homes use reclaimed water for outdoor landscaping.

-"Using reclaimed water instead of drinking water for irrigation saves enough water every year for more than 60,000 families.

-"There are 160 miles of pipe in the reclaimed water system and 15 million gallons of surface storage in enclosed reservoirs.

Tucson - From EPA Source Case Studies (Dotson, 2006)

-more than 160 miles of pipeline in the reclaimed water distribution system

-15 million gallons of surface storage

-average daily delivery of reclaimed water : 13.5 MGD

-summer peak delivery : 31 MGD

-Reclaimed water comes from:

1) 2ndry effluent from waste water treatmnet plant in Pima Cnty and goes through additional filtration and disinfection at a water filtration plant in Tucson
2) 2ndry effluent from Pima Cnty waste water treatment plant that is recharged into a river basin then taken back again and disinfected
3) Tertiary effluent from a Pima Cnty park waste water treatment plant

Apopka, FL

http://www.apopka.net/departments/public-services/water-resource-management/storm-water/collection-and-reuse-of-stormwater.html

-problem: increasing demand, drought, contamination of gw

-developed idea of stormwater reuse in 2006

-collects water from impervious areas to be used as landscape irrigation

-constructed 120 MG reservoir and pump station

-reservoir is equipped with a built-in filtration system for removing PM and turbidity

-storage pond is stocked with grass carp to maintain vegetation

Sidewall Friends School (Washington D.C.)

From EPA document, Case Study

-central courtyard contains a rain garden, pond, and treatment wetland

-wastewater is processed through the courtyard 3 to 5 days, enters storage tank in basement of the school building, passes through 10 to 100 microfilters and is UV disinfected

-project costed $4 million

-treatment includes multi-step system, terraced subsurface-flow wetland cells, recirculating sand filter, trickling filter. Subsurface flow is advantageous in that it removes hazard of contact and odor.

-runoff from the building is conveyed into the pond

-stormwater is NOT combined with treated wastewater for use in the buildings

St Petersburg, FL

-first major city to use reclaimed water for large-scale irrigation (Miller, 2006)

-treatment process at four main plants in 1970s include: grit removal, mechanical aeration, clarification, filtration in deep-bed multimedia filters, high-level disinfection with Cl, storage.

-In this case, treating the water to be used as reclaimed water was cheaper than treating the water to meet standards for flowing into the Tampa Bay and Gulf of Mexico (Okun, 1996).

-“Highly treated reclaimed water is made available in a separate piping system for landscape irrigation, including the irrigation of more than 9,992 residential lawns, 61 schools, 111 parks, and 6 golf courses. This is one of the most widely known reuse systems in the world. The system has been in operation since 1977. An average of about 17.7 mgd of reclaimed water was reused in 2003 to irrigate the spring training grounds of a major league baseball team, and in cooling towers at the Tropicana Dome." (http://www.dep.state.fl.us/water/reuse/project.htm)

<u>Canada – cost assessment of stormwater reuse for flushing and irrigation</u>

-site-level stormwater reuse system that reuses captured commercial site runoff to be used for toilet flushing and lawn irrigation at commercial units on the site (Nanos 2013).

-outlet from an existing stormwater management pond channels stormwater to an on-site treatment facility, then transports water to be stored in a reclaimed tank. Water from the reclaimed tank will be transported to buildings onsite for toilet flushing and irrigation.

-**focuses on uses on-site; avoids city-wide piping infrastructure construction

-this is a hypothetical study that focuses on stormwater reuse potential in Vancouver, Edmonton, Saskatoon, Regina, Toronto, and Quebec. Runoff modeling performed for these cities

-payback periods: 3.7 to 72 years, Saskatoon to Quebec; Saskatoon has high municipal potable water fees. Skewed results account for huge value for Quebec, canadian land tax based on property value.

<u>Gilbert, AZ</u>

From EPA document Case Study (Carpenter, 2006)

-pop. 208,453

-operates two water reclamation facilities

1) Greenfield WRF - capacity 16MGD with 8 MGD supplied to Gilbert
2) Neely WRF - capacity 11MGD

-now has 60 miles of reclaimed water mains in distribution system and 37 users

-reclaimed water that is not used in the distribution system is used to recharge aquifer

-reclaimed water is pressurized and distributed out of non-recreational lakes and used in a park for spray irrigation in first phase of the project

Sydney Australia

Harvesting surface runoff at :

1) regional scale: wetland, The wetland and filtering system treats stormwater from surrounding residential, industrial and commercial areas to remove litter, nutrients, heavy metals and sediments. Stormwater enters the wetland near an island that slows down the flow of the water.

2) rainwater tank scale: Harvesting for reuse:

The Kogarah Town Square Redevelopment Project provides a best practice example of rainwater collection, treatment and reuse by:

a. collecting rainwater and re-using it for low quality uses such as toilet flushing and car washing;
b. reducing the demand of mains water through water conservation and efficiency; and
c. managing the quantity and quality of stormwater through capture, re-use and treatment within the landscaped areas.

Alberta Canada

Divide the area into 3 parts, find out the issues and decide for water reuse strategy.

SouthGrow Regional Initiative

Issue: Water scarcity and climate change limiting growth

Stormwater, Irrigation canal water and municipal effluent use for:

•Irrigation

•Food processing

•Recreation

Rocky View County and Western Irrigation District

Issue: Basin over-allocation limiting new development

Stormwater, Irrigation canal water use for:

•Aquifer storage and recovery

•Gravel washing

•Energy extraction processes

•Constructed wetlands and wetland renewal

Regional Municipality of Wood Buffalo Issue: Significant and rapid industrial and municipal development Snow, stormwater, and municipal wastewater effluent use for:

- •Residential developments
- •Industrial applications (i.e. truck cleaning)
- •Energy sector operations

Engineering Water Reuse at UMore Park

All data, calculations, and figures can be found in the appended document titled "UMore Park -- Water Reuse Design Calcs.xlsx"

The goals of the engineering team were to:

1. Quantify the water demand for irrigation and toilet use in the UMore Park development.
2. Quantify available stormwater runoff that could be utilized for reuse.
3. Determine if stormwater reuse is sufficient to meet demand for these uses, and to what extent reclaimed water from the Empire WWTP may be needed to meet this demand.
4. Utilize recommended treatment levels and case studies to suggest possible treatment options for stormwater and/or reclaimed water reuse at the UMore Park development.

Water Demand

Typical quarterly single family home (SFH) water usage was determined from year-2013 Rosemount data.

Assumptions:

- Winter time water usage is representative of typical year-round indoor demand.
- 27% of indoor usage is attributed to toilet use (U.S. EPA).
- Additional water usage is representative of irrigation demand.
- SFH irrigation is only irrigation considered.
- 5,155 SFH in Rosemount (Rosemount city website).
- 30,000 planned UMore Park residents, of which 3,000 will reside in multi-family units; 13,000 planned SFH in Umore Park (Concept Master Plan).

Findings:

- Irrigation is predominant water usage (annual demand ~620 MG, vs. 250 MG for toilet).
- Toilet water usage using SFH estimate is consistent with estimates employing per capita water usage (30,000 residents at ~20 gpcd).
- Toilet water usage could be approx. halved using more efficient toilets (~10 gpcd).

Stormwater Runoff

Typical monthly stormwater runoff to the western lake (see appended charts and figures) was determined based on 30-year climatological average precipitation.

Assumptions:

- ~⅓ of UMore Park land area drains to main lake.
- Area of the main lake is ~160 acres.
- 30% of precipitation becomes runoff (based on dry swale scenario of Stormwater Management Plan).
- Precipitation in winter months (DJF) does not become runoff until spring, averaged evenly over the months of March and April (based in part on Oberts, 1994).

Meeting the Demand

Monthly runoff supply was matched with demand in order to determine runoff surplus and reclaimed water needs

Assumptions:

- Quarterly toilet demand was evenly distributed to corresponding months.
- Summer quarterly irrigation demand evenly distributed to corresponding months, spring and fall quarterly irrigation demand evenly distributed to the two months adjacent to summer quarter (i.e., irrigation season is April-October)
- Lake will act as temporary holding of runoff (based on ~160 lake acre area, a single month of runoff would raise lake levels by <1 ft).

Findings:

- Scenario 1 -- meeting toilet demand only
    - Total annual runoff volume meets annual toilet demand volume.
    - 3 winter months (DJF) operate in deficit (demand without incoming runoff).

- Storage needed to meet winter demand (20% oversized) is 75 MG.
- Scenario 2 -- meeting irrigation demand only
  - Total annual runoff volume does not meet annual irrigation demand volume.
  - 5 months operate in runoff deficit; total reclaimed water need is 220 MG.
  - Storage needed for runoff in consecutive spring surplus months is 120 MG.
- Scenario 3 -- meeting combined toilet and irrigation demand
  - Total annual runoff volume does not meet annual combined demand volume.
  - 10 months operate in runoff deficit; total reclaimed water need is 470 MG.
  - Storage needed for runoff in consecutive spring surplus months is 70 MG.

Treatment Levels

Recommended Environmental Reuse (e.g., discharge to lake):

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform

Recommended Urban Restricted Reuse (i.e., areas with signed or controlled public access):

- ≤ 30 mg/L BOD; ≤ 30 mg/L TSS; ≤ 200 #/100mL fecal coliform; pH = 6-9; 1 mg/L Cl_2 resid

Recommended Urban Unrestricted Reuse (e.g., toilets, household irrigation):

- ≤ 10 mg/L BOD; ≤ 30 mg/L TSS; no fecal coliform; ≤ 2 NTU; pH = 6-9

Empire WWTP Average Reclaimed Water Levels:

- 3 mg/L BOD; 4 mg/L TSS; 15 #/100mL fecal coliform; 4 NTU; pH = 7

Selected Case Studies

Tucson, AZ

- 700+ SFH use reclaimed water for outdoor landscaping.
- 15 million gallons of surface storage
- Average daily delivery: 13.5 MGD; summer peak delivery : 31 MGD
- Process:
  1) 2ndry effluent from WWTP in Pima County goes through additional filtration and disinfection at a water filtration plant in Tucson
  2) 2ndry effluent from Pima County WWTP that is recharged into a river basin then taken back again and disinfected
  3) Tertiary effluent from a Pima County park WWTP

St Petersburg, FL

- Reclaimed water is made available in a separate piping system for landscape irrigation, including the irrigation of more than 9,992 residential lawns, 61 schools, 111 parks, and 6 golf courses.
- Process: grit removal, mechanical aeration, clarification, filtration in deep-bed multimedia filters, high-level disinfection with Cl, storage.
- One of the most widely known reuse systems in the world.

Summary and Recommendations

- Stormwater runoff meets UMore Park demand for toilet use, but not irrigation needs; flow needs to be supplemented with tap water or reclaimed water from Empire WWTP.
- Reclaimed water from Empire WWTP meets recommended environmental and urban restricted reuse levels.
- Recommended treatment option 1: Microfiltration and disinfection at UMore Park to treat stormwater and reclaimed water; reclaimed water could be routed through lake for additional pre-treatment and used throughout UMore park for urban restricted reuse.
- Recommended treatment option 2: Microfiltration at Empire WWTP prior to UV disinfection, use this reclaimed water for toilet and urban restricted reuse, use minimally treated lake water for restricted reuse.

Additional Resources

MPCA stormwater calculator:
http://stormwater.pca.state.mn.us/index.php/Calculator

EPA Water Reuse Guide (includes recommended treatment levels for various uses and 300+ case studies of US and international implementation):
http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf

EPA Rainwater Use Guide:
http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_harvesting.pdf

City of Rosemount profile:
http://www.ci.rosemount.mn.us/index.aspx?nid=406

US EPA water usage estimates:
http://www.epa.gov/WaterSense/docs/app_b508.pdf

Tucson:
http://water.tucsonaz.gov/water/reclaimed

California Recycled Water Treatment Technologies:
http://www.cdph.ca.gov/certlic/drinkingwater/Documents/DWdocuments/treatmenttechnology.pdf

MN DNR: MSP Climatological Normals:
http://files.dnr.state.mn.us/natural_resources/climate/summaries_and_publications/msp_normals_means_extremes_page3.pdf

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Greywater, Gray Water, or Grey Water?

We prefer greywater.

Julie Kebisek, Shannon Sullivan, and Teegan Wydra

PubH 6132
Air, Water and Health
University of Minnesota

What is Greywater?

"the urban wastewater that includes water from baths, showers, hand basins, washing machines, dishwashers, and kitchen sinks, but excludes streams from toilets*" and <u>cannot contain</u> detergents, bleaches, or antibacterial soaps

*Li 2009

What is Greywater?

Light greywater:

- Bathroom sinks, showers, tubs, and clothes washing machines.
- Low levels of pathogens, chemicals, fats, oils, and grease

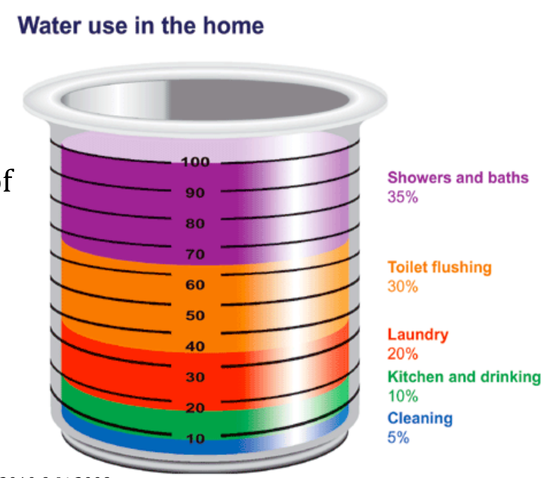
Dark greywater:

- Non-laundry utility sinks, kitchen sinks and dishwashers
- Contains more pathogens, chemicals, fats, oils, and grease

As opposed to black water: waste water from toilets that contain feces and urine that is unsafe for reuse

Did you know Greywater...?

- Accounts for up to 80% of household wastewater
  - One person creates 40 gallons of greywater per day
  - Family of four uses up to 400 gallons of water per day
    - 70% of that water is used indoors
- Contains low concentrations of organic compounds, nutrients, and pathogens (compared to black water)
- Systems are usually cheaper and easier to install during new construction



Leal 2010 & Li 2009

Various Uses for Greywater

- Can be treated and reused on-site
- Landscape irrigation
  - cannot use directly on vegetable crops
- Toilet Flushing
- Constructed Wetlands and Groundwater Recharge
- Public Use
  - Cemeteries, public fountains, public gardens, reflective ponds, etc.

➔ Madison, WI public fountain

Standards for non-potable greywater uses and applications

Table 4
The standards for non-potable grey water reuses and applications.

Categories		Treatments goals	Applications
Recreational impoundments, lakes	Unrestricted reuses	BOD_5: ≤10 mg/l TN: ≤1.0 mg/l TP: ≤0.05 mg/l Turbidity: ≤2 NTU pH: 6–9 Faecal coliform: ≤10/ml Total coliforms ≤100/ml	Ornamental fountains; recreational impoundments, lakes and ponds for swimming
	Restricted reuses	BOD_5: ≤30 mg/l TN: ≤1.0 mg/l TP: ≤0.05 mg/l TSS: ≤30 mg/l pH: 6–9 Faecal coliforms ≤10/ml Total coliforms ≤100/ ml	Lakes and ponds for recreational without body contact

Li 2009

Standards for non-potable greywater uses and applications

Urban reuses and agricultural irrigation	Unrestricted reuses	BOD_5: ≤10 mg/l Turbidity: ≤2 NTU pH: 6–9 Faecal coliform: ≤10 / ml Total coliforms ≤100/ ml Residual chlorine: ≤1 mg/l	Toilet flushing; laundry; air conditioning, process water; landscape irrigation; fire protection; construction; surface irrigation of food crops and vegetables (consumed uncooked) and street washing
	Restricted reuses	BOD_5: ≤30 mg/l Deterge t (anionic): ≤1 mg/l TSS: ≤30 mg/l pH: 6–9 Faecal coliforms ≤10/ml Total coliforms ≤100/ml Residual chlorine: ≤1 mg/l	Landscape irrigation, where public access is infrequent and controlled; subsurface irrigation of non-food crops and food crops and vegetables (consumed after processing)

Li 2009

Treatment Methods

- Membrane Bioreactor (MBR)
- Coagulation and membrane filtration
- Filter
- Biological
- Chemical
- Personal treatment
- Constructed Wetlands

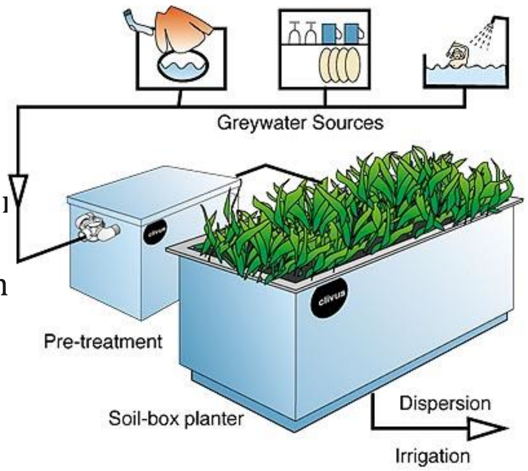
Li 2009

Table 2
Microbial nutrient requirements and the concentrations present in different grey waters.

Nutrient	Reported requirements (mg/l)[a]	Real grey water[d] (mg/l)	Real grey water[e] (mg/l)	Real Grey water[f] (mg/l)	Synthetic grey water[g] (mg/l)
N	15[b]	9.68	17.2–47.78	5.00	5.00
P	3[b]	7.53	4.17	1.37	0.047
S	1[b]	23.7	19.00	16.3	17.5
Ca	0.1–1.4	33.8	60.79	47.9	47.0
K	0.8 to >3.0	8.10	11.2–23.28	5.79	3.96
Fe	0.1–0.4	0.36	0.11	0.017	0.009
Mg	0.4–5.0	5.74	6.15	5.29	5.02
Mn	0.01–0.5	0.0121	<0.05	0.04	0.02
Cu	0.01–0.5	0.0618	0.08	0.006	0
Al	0.01–0.5	2.44	0.49	0.003	0
Zn	0.1–0.5	0.0644	0	0.03	0
Mo	0.2–0.5	–	<0.05	0	0
Co	0.1–5.0[c]	0.00136	<0.05	0	0

Biological Treatment

- Aerobic Treatment
  - Removes 90% COD and 97% of anionic surfactants
- Anaerobic Treatment
  - Removes 51% COD and 24% (poor of anionic surfactants
- Combined anaerobic-aerobic treatmen
  - Did not give an advantage over aerobic in removal of COD (89%)



Leal 2010

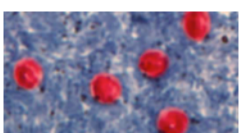
Image source: greywater.com

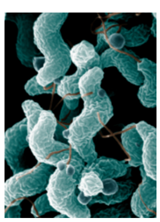
Chemical Treatment

- Used with other methods
- Better for large applications
- One study of greywater: 68 to 100% organic pollutants removed
- Good for low organic strength greywater or when lower standards required
- Not as effective for high fluctuating usage of greywater
- Coagulation and adsorption more effective for organic pollution

Constructed Wetlands

Public Health Considerations





No incidences of illness linked to greywater reuse have been reported

Winward 2008

Environmental Health Impact

- Lower freshwater extraction from rivers and aquifers
  - Groundwater recharge
  - Increased plant growth
- Topsoil nutrification
  - Reclamation of nutrients
- Reduced energy use and chemical pollution from treatment
- Less impact from septic tank and treatment plant infrastructures

Roses are well suited for greywater irrigation in Minnesota

Washington Department of Health

Case Study

Hennepin County Public Works Facility: Medina, MN

- Not connected to sanitary sewer system
  - On-site leech field
  - Internal greywater treatment plant
- Costs approx $3000/month includes:
  - Weekly inspections/maintenance
  - 24 hour on-call service
  - state DMR report
- All stormwater run-off caught by sedimentation ponds and the greywater system
- Greywater recycling system designed to reclaim water and reduce consumption by 75%

Carmody 2004

Case Study
Long Beach, CA "Laundry to Landscape" Program

- 2011 Long Beach, CA pilot program for residents to conserve water by diverting greywater from washing machines into mulch basins for use in irrigation of landscape
- Benefits include:
  - reduced water consumption, natural purification of greywater, and reduced stress on sewage system
- Average total installation cost (including materials, labor, and plumber) = **$1,248.53**

Milkweed can jazz up a Californian garden

If interested, contact:

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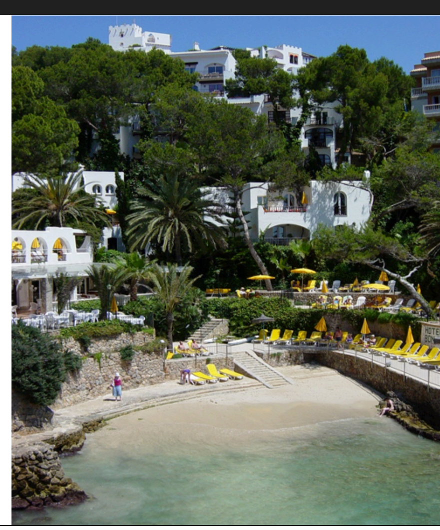
Case Study
Hotel on Mallorca Island, Spain

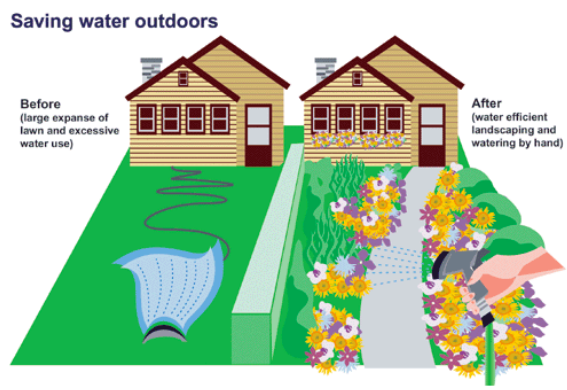
- 81 rooms (63 with a kitchen) and nine floors
- Indoor greywater recycling system to flush toilets
  - Used filtration, sedimentation, and disinfection treatments using sodium hypochlorite
- 23% of water consumption from greywater reuse
- Calculations of total cost of the system vs. savings from water use found a 14-year simple payback

March 2004



Other Methods to Reduce Water Consumption

- Installation of low-flow showerheads
  - Conventional showerheads have flow rates up to 4-5.28 gallons/min
  - Low-flow showerhead can reduce flow by half
- Installation of ultra-low volume toilets
  - Conventional toilet uses 4.75 gallons/flush
  - ULV toilets only use 1.5 gallons/ flush
- Harvest rainwater
- Plant water-efficient landscapes



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Review of Greywater Reuse Treatment Methods and Case Studies

Julie Kebisek, Shannon Sullivan, and Teegan Wydra
PubH 6132 Air, Water, and Health

In addition to reusing stormwater in an effort to reduce groundwater withdrawal in the city of Rosemount, we recommend considering greywater reuse as a supplementary resource for water conservation. Greywater constitutes roughly 50-80% of every household's water outflow, and with the right tools and knowledge, its reuse can substantially reduce overall water consumption (Li 2009). In this memo we will summarize exactly what greywater is, how to treat it, and alternative methods to reducing water consumption. We will also provide case studies of implemented greywater reuse systems, as well as a list of applicable resources.

What is Greywater?

Greywater is of lesser quality than tap water, but generally of higher quality than water from sewage systems. There are two classifications for greywater, which include light- and dark-greywater. Light-greywater is from bathroom sinks, showers, and washing machines that have relatively low levels of pathogens, chemicals, fats, oils, and grease. Dark greywater is from non-laundry utility sinks and the kitchen, including sinks and dishwashers, which typically contain more of these contaminants (Li 2009). All types of greywater exhibit high biodegradability in terms of the chemical oxygen demand (COD) and biochemical oxygen demand (BOD) ratios (Li 2009). When considering the reuse of greywater, the ratio of nitrogen and phosphorus must be low and cannot contain any bleaches, antibacterial soaps, or detergents.

Why Reuse Greywater?

Greywater makes up the largest portion of wastewater from the home; just one member of a household creates up to forty gallons of greywater per day, depending on their lifestyle. Some sources estimate the average American family of four uses up to four hundred gallons of water per day, and on average, approximately seventy percent of that water is used indoors, with the bathrooms being the largest consumer (Li 2009). One toilet alone can require up to twenty-seven percent of total water usage (EPA). Nationwide, landscape irrigation is estimated to account for nearly one-third of all residential water use, totaling nearly nine billion gallons per day.

Depending on the treatment method used, reusing greywater may offer financial savings to an already overburdened municipal sewage treatment system, though few studies have been done that might give a precise amount in savings for a large-scale project.

Greywater can be reused in a variety of ways; the most common use of greywater is for toilet flushing, though they do not require potable water but use it anyway. Other uses include irrigation (including for cemeteries or public gardens, but excluding lawns and root vegetables), public fountains, constructed wetlands, or rain gardens. The city of Madison, WI has used greywater for their public fountain for over eight years and have not encountered any issues thus far (though a sign is clearly posted to deter people from interacting with the water). The possibilities for greywater have yet to be fully explored, yet social acceptance of greywater reuse is growing internationally (Domenech 2010, March 2004, Gallup 2011).

Treatment Methods

There are multiple treatment methods that will satisfy the four main criteria of concern - hygienic safety, aesthetics, environmental tolerance, and economic feasibility (Li 2009). Of main concern are biological agents like bacteria or viruses that can pose a risk to public health and the environment. To date, there are no such reported incidences of illness linked to greywater reuse (Winward 2008), though the potential for fecal contamination is possible if water is not treated properly.

Chemical and Physical Treatment (Pidou 2008, Leal 2010, Li 2009)

Some of the most widely used treatment methods include biological processes. These processes are often used in large buildings but when used at a smaller scale, the effectiveness is reduced from feed source variability and potential shock loading. These are reduced or avoided with physical processes such as cartridge filters and depth filtration beds. However, with these methods, the physical pollution is removed but it does not work as well to remove organic pollution. To remove the dissolved organic pollution in greywater, chemical processes such as coagulation and adsorption are more effective methods. Coagulation utilizing metal salts, is one of the main processes for removal of high concentrations of dissolved organic carbon. Magnetic ion exchange resin has also been used to reduce organic loads so less coagulation is required. In one study from 2008 analyzing chemical solutions for greywater recycling, authors found that using both coagulation and ion exchange removed about 68 to 100% of organic pollutants from the mixed greywater. The level of organic removal was sufficient to meet the most stringent standards for reuse. However, these systems were most effective when the raw water strength was low. When the water strength was medium to high, chemical treatment solutions with coagulants and ion exchange resin were somewhat more limited for greywater reuse in an urban environment.

Overall, chemical treatment of greywater is most often paired with other physical or physiochemical processes such as coagulation and magnetic ion exchange resin. Physical processes alone are not sufficient to guarantee an adequate reduction of the organics, nutrients, and surfactants, and therefore, are not recommended alone for greywater recycling. If higher usage of greywater is required, chemical treatment methods may not be as effective over other methods. However, chemical treatments could potentially be an option for greywater reuse in low organic strength greywater or when lower standards are required, as it can efficiently remove the suspended solids, organic materials, and surfactants in the low strength greywater.

Use of Constructed Wetlands as Treatment (Jokerst 2012)

If you produce more greywater than needed for local irrigation, a constructed wetland can be incorporated into your system to ecologically dispose of greywater. Constructed wetlands are a secondary household treatment that uses plants to absorb nutrients and filter particles from greywater by a biofiltration system. The greywater is filtered through both a mechanical and biological process by the plants and the microbes that live around the plant. EPA water quality studies have shown that constructed wetlands substantially reduce organics, solids, nutrients, pathogens and surfactants. In particular, BOD removal rates averaged 91% and removal rates for nutrients (TN and TP) were 84% and 77%, respectively (Jokerst 2012). If you live near a natural waterway, a wetland can protect the water from nutrient pollution such as nitrogen and phosphate, that untreated greywater would provide.

Case Study: Hennepin Public Works Facility in Medina, MN (Carmody 2004)

The Hennepin Public Works Facility installed a greywater treatment system from Zenon Environmental Inc. that is not connected to a municipal sanitary water system, but instead to an on-site leech field. The facility is the first of its kind in the Midwest to have a state-of-the-art greywater plant and on-site sewage treatment system. The greywater recycling system is designed to reclaim water and reduce water consumption by 75%, resulting in the total effluent collected and reused to equal about 6 to 8 residential homes.

The greywater treatment costs (totaling just under $3000/month or $10.70/person/month) include weekly inspections and maintenance, 24-hour on call service, and a state DMR report. Water is collected in tanks from car washes and hauled off site when needed by a septic service company, averaging just over $900/month. Total sewer costs equal just under $4000/month due to vehicle washing at the facility but there is no associated sewer connection. The total water treated by the greywater system equals over 22,000 gallons per month, and the car wash station waste water equals over 18,000 gallons per month, according to the bills for that service. The system was designed to contain all fuel spills in the facility and salt stormwater runoff.

A ten thousand gallon storage tank was installed to collect the water from the washing of the vehicles. Then water from the tank is picked up from a vendor when the tank is full and sent to a facility that is connected to the public sewer system. The toilet greywater system, as opposed to the exterior greywater system, operates well but requires more maintenance than a regular system. In general, the water systems have been perceived by the maintenance staff as a "major headache," but perhaps an easier system based off of this method could be improved and utilized elsewhere.

Case Study: Long Beach 'Laundry to Landscape' Backyard Irrigation Pilot Program (City of Long Beach Office of Sustainability 2013)

The City of Long Beach, California, implemented a city-wide 'Laundry to Landscape' Backyard irrigation pilot program, which required no inspections or permits. They reused water from washing machines, bathtubs, and sinks, and diverted any water to the sewer system when using bleach or harsh chemicals. The usable greywater was used for outdoor trees and plants (for health reasons, it could not be used for lawns and root vegetables). The benefits of this program included reduced consumption of potable water, reduced load on sewage infrastructure, and the replenishment of natural groundwater resources in a region where drought is a common threat.

During the program, participants were surveyed regarding their opinion and satisfaction with the reuse of their greywater. Seventy-six percent of participants reported that the greywater system had improved the health of their garden and landscaping, and the rest were unsure. In the follow-up, most trees and plants showed noticeable signs of growth and improved health. Findings from interviews with homeowners found that participants were likely to receive positive reactions from others regarding the installation and use of a greywater system, and were likely to recommend the system to others. None of the participants expressed concern that the installation of the greywater system posed any risks to the surrounding community. Despite expectations and functionality of the systems, the water useage for homes with greywater systems did not decrease.

The average cost of total installation included materials, labor and contracted plumbers of the greywater irrigation system was just over $1,200 per installation.

Case Study: Mallorca, Spain Hotel Greywater Program (March 2004)

A three-star hotel aparthotel located on the first line of Palma Beach in Spain participated in a program that reused greywater to flush their toilets. Palma Beach, located on the island of Mallorca, where water scarcity was provisionally solved for many years by ship water transportation from the Ebro River on the main island. Some time later, desalination was adopted as a solution to their water scarcity. Due to financial constraints, the region refocused their efforts on water reuse from an environmental and economical point of view, and more emphasis was given on greywater reuse.

The participating hotel has 81 rooms, 63 of which include a kitchen, and nine floors. The greywater system was based on filtration, sedimentation, and disinfection treatments using sodium hypochlorite as the disinfecting agent. Due to the uncontrolled residence time (though typically guests stay 1-2 weeks), they monitored the daily consumption and adjusted the system capacity to compensate for high residence times to avoid a loss of residual chlorine concentration.

The calculation of the cost of the system along with savings from its use found a forteen-year simple payback, given the average occupancy of 85%, and operation of the hotel of only seven months of the year. A survey was conducted to gauge customer acceptance of the greywater reuse system, and found positive feedback and an understanding of reasons for greywater reuse. Therefore, social acceptance of reuse of greywater can be found when consumers are given adequate information.

The program confirmed that toilet flushing can be carried out with non-potable water for saving water resources. The authors of the study found that "the system can be considered clearly sustainable when considering energy consumption, land requirements, and waste production," (March 2004). The system worked for one year without significant problems, and fluctuations in the greywater composition did not affect the maintenance program.

Other Recommendations for Sustainable Water Systems (Water Sense EPA 2013)

If the treatment and installation of greywater systems is not feasible or the benefits are not worth the installation costs and public health risks, there are multiple alternatives for reducing overall water consumption. UMore Park has potential for improved water-efficient equipment, such as ultra low-volume toilets and low-flow showerheads. The average toilet uses 4.75 gallons per flush, whereas an ultra-low-volume toilet uses only 1.5 gallons per flush. Conventional showerheads have flow rates up to 4-5.28 gallons per minute, whereas a properly installed low-flow showerhead can reduce flow by half while still providing proper shower performance. These water efficient installations can save the consumer a considerable amount of money as well: a standard shower can cost up to $160/year, as opposed to a low-flow showerhead that costs just $80/year (for daily twelve minute showers). For homes that cannot afford new installations in the city of Rosemount, encouraging toilet dams and displacement bags can save up to 1.32 gallons per flush and cost as low as $10.

In addition to installing water conserving systems we recommend the usage of rain gardens and pervious surfaces to address issues with stormwater runoff. If much of the stormwater runoff is unable to be utilized for other uses, increasing groundwater infiltration alleviates much of the wear on a storm sewer system, increases recharge of local and regional aquifers, protects against flooding, and protects streams and lakes from harmful pollutants such as fertilizers, pesticides and oil (Bannerman 2003). Consider rain gardens as an alternative to traditional methods of removing excess stormwater or other temporary storage solutions such as holding ponds. In addition to increasing collection and infiltration of stormwater, rain gardens contribute to the total amount of pervious surface in an area. Alternatives to impervious surfaces such as roads, parking lots, sidewalks, and rooftops have been more frequently adopted in municipal water sustainability plans.

Conclusions

Any efforts towards reducing wasted water consumption the city of Rosemount and the UMore Park project initiate may receive national attention, therefore we recommend consideration of greywater reuse. Given the range of possible uses for greywater, various case studies that provide ample information towards implementation, and likelihood that reuse of water is inevitable in the future, we recommend installation of greywater systems while UMore Park is being constructed. Whether it be for irrigation, flushing toilets, decorative public fountains, or constructed wetlands, any reuse of non-potable water will alleviate stress on the sewage system and also help to conserve potable water.

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“Laundry to Landscape” Graywater Pilot Program Report

City of Long Beach
Office of Sustainability
July 2013

Summary

On August 23, 2011 the City of Long Beach unveiled a pilot program for residents to conserve resources by using water from their washing machines for simple irrigation systems for trees, shrubs and gardens. Through a lottery, 33 homes were selected to have a graywater system installed that diverts water from the clothes washing machine into mulch basins where it irrigates the landscape. A typical washing machine uses 15 gallons of water a day per person. Water discharged from washing machines, bathtubs and sinks is considered graywater, dirtier than potable water but cleaner than sewage water or "black" water. Graywater irrigation systems are safe for watering most vegetable gardens, though are not recommended for root vegetables such as potatoes and carrots.

Initially, the program’s goal was to install 36 graywater systems, 4 in each of the 9 City Council districts. Upon pre-install assessment however, 21 of the homes selected were deemed unsuitable or installation was cancelled for various reasons. The installations in approved homes were performed by Office of Sustainability Staff and a contracted plumber, with the help of Workforce Job Trainees between February 2012 and June 2013.

The “Laundry to Landscape” program joined other Long Beach sustainability initiatives, including the Rain Barrel Program, Mulch Home Delivery Program and Lawn to Garden program. Intended benefits include the reduced consumption of potable water, a reduced load on our sewage infrastructure and the replenishment of natural groundwater sources. This report includes findings from follow-up evaluations, interviews with participants and utility billing records to determine the effectiveness of the systems and the level of satisfaction of program participants.

Evaluation

The Office of Sustainability scheduled follow-up evaluations for each program participant during which staff visited the installation site, performed a test of the system, interviewed the participant and examined the state of the landscape irrigated by the graywater. The evaluation consists of 26 of the 33 program participants, including only those systems installed at least 6 months before the time of evaluation, excepting the more recently installed systems. Copies of the interviews and photographs of the installation site can be found in the report. Also included in the report are individual write-ups for each evaluated site including the system design and information about the overall functioning of the system.

Findings

The follow-up interviews and evaluations found a high level of satisfaction with the systems and found that an overwhelming majority of systems were in perfect working order. 15 of the 26 participating homeowners scored their level of satisfaction with the overall functioning of the system as 5/5, or “very satisfied.” 8 reported being “satisfied,” (4/5), and 3 reported being “neutral,” scoring their level of satisfaction as 3/5. No participating homeowner reported being “dissatisfied” or “very dissatisfied.”

The most common issue found during the evaluations and interviews was an unequal distribution of water to the discharge points located in the mulch basins. This problem was easily remedied by adjusting the valves on the discharge points to more evenly distribute the graywater.

Cost

The average cost of materials for the installation of these systems was $215.51, while the average total installation cost including materials, labor, and contracted plumber was $1,248.53. Under the Memorandum of Understanding between the Department of Development Services and the Long Beach Water Department, this represents an average cost per installation of $740.51 for LBWD. The average cost per installation incurred by the Office of Sustainability was $383.41. In an effort to encourage residents to undertake the installation of their own graywater systems, the Office of Sustainability will post on its website a guide to parts and costs, a copy of which can be found in this report.

Water Usage

Despite the functionality of the systems, the water usage for homes with graywater systems does not appear to have decreased. In fact, on average, homes with graywater systems use an average of .94 billing units of water more than before installation, based on monthly usage statistics. This is based on limited data, but it runs counter to the expected result of graywater system installation.

Landscape

20 of 26 participants interviewed report that the graywater system has helped their garden/landscaping, while 5 say they are not sure and 0 say that it has not helped.

Upon the follow-up evaluations these claims were verified, with most plants and trees showing noticeable signs of growth and health.

Food Production

15 of 26 participants interviewed reported that their graywater system provides water to fruit trees or other food plants, indicating a potential additional benefit provided by graywater. Depending on the type of trees or plants irrigated by graywater, potential cost savings by home production of fruit or other food irrigated with re-purposed water could be significant.

Community

Findings from interviews with homeowners found that participants were likely to receive positive reactions from others regarding the installation and use of a graywater system, and that participants were likely to recommend the system to others as well. Moreover, none of the participants indicated a belief that the installation of a graywater system poses any risks to the surrounding community.

Discussion

While the Office of Sustainability staff was surprised to find that an initial review of water usage records did not indicate that homes with graywater systems installed showed a reduction in water use, it is not clear why this is not the case. One possible explanation is a light rainfall year (8 inches vs. 12 inch annual average). It is also possible that homeowners will become more accustomed to an irrigation method that involves re-purposed graywater and will show a reduction in potable water use over time. In one specific instance, the homeowner reported a belief that the system is saving water, even though the overall water use is greater due to added residents in the home. The Office of Sustainability will continue to monitor water usage in participating Laundry to Landscape Graywater Pilot Program homes in order to be fully informed of the effectiveness of the program in this area. Despite this increase in water usage, the Office of Sustainability considers the amount of re-usable water diverted from sewer treatment, the use of re-purposed water for home food production, the increased involvement in green practices by residents and a heightened awareness of water usage as valuable benefits provided by the Graywater Program.

An emphasis on education and maintenance of the graywater system by homeowners could be valuable for future installations. Less than one third of homeowners reported checking their system for problems more than once per year. The most common problem found in the systems, unequal distribution of water to discharge points, is something that is easily fixed by performing regular maintenance and having a thorough understanding of the system. By educating homeowners and encouraging maintenance of the graywater system, we will promote a more efficient use of re-purposed water, thereby furthering the goals of the Graywater Program.

Community Engagement & Education

Abdi Hussein, Alex Kim, Kelly McCormick, & Ryan McGlynn

PubH 6132
Air, Water and Health
University of Minnesota

Demography

- Important to take into consideration when developing plans for education and outreach efforts
- Age distribution, spending habits, and household income can often predict community values and interests
- Employing info facilitates recruitment of community members for engagement in the project
- Helps identify trends that indicate where advertising efforts will have most impact

Population: Reflective of population of Dakota County

- Total number of occupied homes in Rosemount: 7,587
- Total population in households: 21,852
- Median age: 34 years
- Racial statistics:
  - White: 87%
  - Asian: 5%
  - Hispanic or Latino: 3%
  - Black or African American: 3%
  - 2 or more races: 2%
  - Other: 1%
- Population of homes with one or more people under 18 years: 3,528
- Population of homes with one or more people 60 years and over: 1,747
- Population of owner occupied homes: 6,639

ROSEMOUNT
SPIRIT OF PRIDE AND PROGRESS

Economy

- Steady growth and demand for housing
- ⅔ available land is undeveloped
- Retail growth is slow, due to nearby Eagan and Apple Valley
- Small town feel, no "big box" stores
- Ongoing downtown revitalization effort

Employment

- Top 3 employers (accounting for ~6,351 jobs in a population of ~22,000):
  - Rosemount School District
  - Flint Hills Resources (petroleum products)
  - Wayne Transports (trucking)

- Median household income: $84,325 (compared to $59,126 for MN)
- Retail sales per capita: $3,507 (compared to $13,751 for MN)
- Percentage of people living below the poverty level: 5.7 (compared to 11.2 for MN)

Taxation

- In 2013, 60% of the Rosemount city government's funds came from taxes.
- Nearly 86% of Proprietary funds came from charges for services
- This project could boost the tax base with new housing units/residents

Community Engagement

Potential beneficial liaisons to be nurtured include those engaged throughout the RCP initiative:

- Local city government employees
- Community leaders (to gain access to community subgroups and to promote local resident ownership)
- Minnesota state and federal government representatives (to ensure compliance with environmental, health and safety regulations)
- Water Control Corporation (to help meet corporate legal requirements)

Suggested Actions

In order to achieve maximum community engagement, we suggest:

- Formulation of an official *Community Engagement Policy* that describes RCP's commitment to community engagement
- Development and publication of an *Implementation Framework* that describes step by step strategy of how the intended policy will be executed by RCP
- Drafting and articulation a *Community Engagement Processes* that describes a number of community engagement methods

Communication

- Maintaining communication with holders of population data and community leaders is paramount
- Possession of accurate and up-to-date information provides the community with balanced and objective material to help understand problems and devise creative and holistic solutions
- Collaboration and consultation with the target population is imperative to obtain community feedback and involve the appropriate players in decision-making processes

Deliverables

- One-page informational fact sheet
- Tri-fold pamphlet to be distributed at town meeting
- List of suggested language for use on social media
- Sample press release for mass media use

Sample Rosemount FAQs ?

Some anticipated questions and sample language for responses that can be used by project implementers in future engagement and educational materials and correspondence include…

Sample FAQ

Q: Is treated water safe to use?

A: Yes. The water used in homes has been treated extensively in a wastewater treatment plant and continues to be treated in the city water system before it reaches your home. Water purity standards are rigorously enforced and allowable levels for contaminants are constantly re-evaluated based on studies of human and environmental health.

Sample FAQ

Q: How will this affect my family financially?

A: The stormwater reuse project should not have a noticeable effect on family finances beyond what each family is already paying for water usage. Water, like all regulated resources, is paid for based on how much is used. The stormwater reuse project will not change that.

A: It won't affect them adversely, and may ultimately reduce municipal water costs by making more efficient use of water that would otherwise have to be transported long distance for disposal, via a costly and energy-intensive process. The new housing development will boost Rosemount's overall tax base.

Sample FAQ

Q: Will this effort make our town a leader/frontrunner? How could that impact my life/prosperity?

A: The establishment of new water management processes will increase the town's notoriety in terms of sustainability and decreased ecological footprint. The positive attention generated by the project will result in increased property values, a stimulated local economy, and a sustainable decrease in the town's consumption of existing natural resources. Furthermore, lessons learned from infrastructure installation in the new development and the partnerships forged with national experts to further project implementation can be tapped for possible future improvements in other parts of Rosemount.

Executive Summary: Community Engagement and Education

Abdi Hussein, Alex Kim, Ryan McGlynn, and Kelly McCormick

Relevant Demographic and Local Economy Information

It is important to take into consideration the information below when developing plans for education and outreach efforts. The age distribution, spending habits, and household income can often predict community values and interests. Employing this information will facilitate recruitment of community members for engagement in this project, as well as identify trends that indicate where advertising efforts will have most impact.

The population of Rosemount, like much of Dakota County, has shown steady growth and demand for housing. According to a market study commissioned by the city in 2010, two-thirds of Rosemount's available land is undeveloped, and retail growth has been slow (especially compared to population growth) due to large retail districts in nearby Eagan and Apple Valley. Rosemount has no big-box retail stores and the downtown consists mostly of local shops, which is in line with the small-town feel promoted by the city. An ongoing downtown revitalization effort has been responsible for the construction and renovation of buildings for apartments, offices and commercial spaces, as well as a Park and Ride for commuters who use the Cedar Avenue corridor to reach Minneapolis.

The top three employers in Rosemount are Rosemount School District, Flint Hills Resources (petroleum products), and Wayne Transports (trucking). According to the official city web site, major employers located in Rosemount account for 6,351 jobs in a population of roughly 22,000. According to the most recent US Census, the median household income as of 2012 was $84,325 (compared to $59,126 for the state of Minnesota), retail sales per capita were $3,507 (compared to $13, 751 for the state), and the percentage of people living below the poverty level was 5.7 (compared to 11.2 for the state). The comparisons paint a picture of a well-do-do city where people tend to make and spend most of their money elsewhere.

According to official financial reports, in 2013, 60% of the Rosemount city government's funds came from taxes. Notable areas where costs outstripped revenue were in the maintaining of public works and the sewer and wastewater systems-our project could be a way of (at least partially) addressing this while boosting the tax base (with new housing units).

- Total number of occupied homes in Rosemount: 7,587
- Total population in households: 21,852
- Median age: 34 years
- Racial statistics:
  - White: 87%
  - Asian: 5%
  - Hispanic or Latino: 3%
  - Black or African American: 3%
  - 2 or more races: 2%
  - Other: 1%
- Population of homes with one or more people under 18 years: 3,528

- Population of homes with one or more people 60 years and over: 1,747
- Population of owner occupied homes: 6,639

Community Engagement

Effective community engagement will encourage the local population to participate in decision-making processes regarding the development and operation of RCP policies, plans, and services.

Rosemount's end goals include facilitation of a vibrant and inclusive city, a clean and sustainable environment, and a prosperous economy. In order to achieve these goals, it is vital that project implementers identify long-term community engagement priorities based on the principles of sustainability and social equity. The best ways to ensure this is done effectively is to increase community access and foster relationships. Potential beneficial liaisons to be nurtured include those engaged throughout the RCP initiative, local city government employees, community leaders (to gain access to community subgroups and to promote local resident ownership), Minnesota state and federal government representatives (to ensure compliance with environmental, health and safety regulations), and the Water Control Corporation (to help meet corporate legal requirements).

In order to achieve maximum community engagement, we suggest the:

- formulation of an official *Community Engagement Policy* that describes RCP's commitment to community engagement,
- development and publication of an *Implementation Framework* that describes step by step strategy of how the intended policy will be executed by RCP, and
- drafting and articulation a *Community Engagement Processes* that describes a number of community engagement methods.

Maintaining communication with holders of population data and community leaders is paramount. Possession of accurate and up-to-date information provides the community with balanced and objective material to help understand problems and devise creative and holistic solutions. Collaboration and consultation with the target population is imperative to obtain community feedback and involve the appropriate players in decision-making processes. For example, we encourage project implementers to stay in two-way touch with the community through regular town meetings, distribution of informational/promotional materials, press releases, social media, online Q&A forums, phone-based surveys, etc. Deliverables provided to project implementers by our group include a:

- ➢ One-page informational fact sheet,
- ➢ Tri-fold pamphlet to be distributed at town meeting,
- ➢ List of suggested language for use on Twitter and Facebook,
- ➢ Sample press release for mass media use.

Frequently Asked Questions

Listed below are anticipated questions and sample language for responses that can be used by project implementers in future engagement and educational materials and correspondence.

Q: Is treated water safe to use?

A: Yes. The water used in homes has been treated extensively in a wastewater treatment plant and continues to be treated in the city water system before it reaches your home. Water purity standards are rigorously enforced and allowable levels for contaminants are constantly re-evaluated based on studies of human and environmental health.

Q: How will this affect my family's health?

A: The city of Rosemount would not pass legislation on an initiative that would harm the health of its residents. The stormwater reuse project is designed to save water, help the environment, and subsequently help the citizens of our town. A healthy environment leads to healthy, happy people.

Q: How will this affect my family financially?

A: The stormwater reuse project should not have a noticeable effect on family finances beyond what each family is already paying for water usage. Water, like all regulated resources, is paid for based on how much is used. The stormwater reuse project will not change that.

A: It won't affect them adversely, and may ultimately reduce municipal water costs by making more efficient use of water that would otherwise have to be transported far away, via a costly and energy-intensive process, for disposal. The new housing development will boost Rosemount's overall tax base.

Q: How is this initiative being funded?

A: The project will be paid for by currently existing tax codes and through future water savings. Construction projects are cheaper and more efficient when all of the necessary work is done all at once, rather than in multiple stages. The city plans to finalize details and undergo construction work as soon as possible in order to save money on overall costs and reduce environmental degradation in a timely manner.

A: Through a combination of grants and city government fund surplus.

Q: How will this impact to our town's agricultural production and development?

A: Agricultural water demand is high. Any water-saving improvements to town systems will facilitate the ability to supply sufficient water for local agricultural production. Agricultural development is particularly vulnerable to the effects of climate change; sustainable water management in the town of Rosemount will ensure it is well placed to remain competitive and fully functional despite the inevitable changes in precipitation patterns, growing seasons, and frequency of extreme weather events.

Q: What are the potential environmental impacts, both immediately and in the future?

A: Climate change is exacerbating the already heavy toll that increasing populations and modernization place on existing water resources. The city of Rosemount's water reuse project will decrease dependency on other, more energy intensive or waste-producing methods for town water provision. The benefits of this will be felt not only in the development where the new infrastructure will be implemented, but also in increased ease in maintenance of public spaces.

Q: Will this effort make our town a leader/frontrunner? How could that impact my life/prosperity?

A: The establishment of new water management processes will increase the town's notoriety for sustainability and decreased ecological footprint. The positive attention generated by the project will result in increased property values, a stimulated local economy, and a sustainable decrease the town's consumption of existing natural resources. Furthermore, lessons learned from infrastructure installation in the new development and the partnerships forged with national experts to further project implementation can be tapped for possible future improvements in other town neighborhoods.

Q: Why should I, as a current resident, care?

A: Although the water treatment procedures being planned for the new development will not affect current resident water use, the project will positively affect the town as a whole, both economically and culturally. More efficient practices introduced into the new development will minimize its financial burden on the town in the long term. Cost savings in this area will therefore be able to address other town concerns. The town reputation will be augmented, which will be positive for local business and other endeavors.

Fact Sheet Outline/Guidelines

- **Current tax code information along with updated guidelines based on the stormwater reuse project financial plan**
    - This should inform Rosemount citizens as well as prospective inhabitants of UMore Park of the specific ways in which they will be affected by the project

- **Relevant statistics, including comparisons between current per capita water usage and proposed water savings based on project analyses**

- **Project timeline (when, where, how, etc)**
    - Will construction inconvenience citizens in any way? If so, how will the local government mitigate that?

- **Safety information**
    - Brief overview of current wastewater treatment practices
    - Comparison information about updated regulations in terms of the stormwater reuse project
    - How will the recycled stormwater be used? Will it be hazardous to human health and well being?

- **Benefit information**
    - How will the project positively affect both humans and the environment?
    - Will the benefits outweigh any potential drawbacks?

- **Employment/volunteer opportunities**

- Will the project promote job opportunities? If so, long or short term? Will Rosemount citizens be given priority in the hiring process? Will there be any volunteer positions available to help with the project? Paid/unpaid internships for students/recent graduates?

- **History of this type of project**
    - Is there a precedent for this? How will successful implementation of the project affect Rosemount's standing within the state? Within the nation? Could workers/volunteers have further opportunities if similar projects are implemented elsewhere?