Regulatory Assessment

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PubH 6132
Air, Water and Health
University of Minnesota

Jurisdiction

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

Minnesota Pollution Control Agency

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	

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[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

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Engineering

Matthew Bechle, Ethan Lipscomb, Shiyue Zhang

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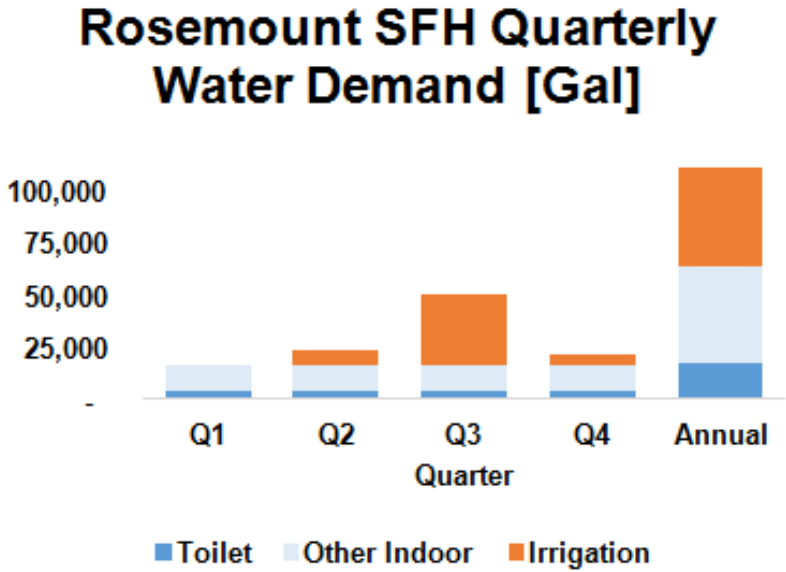
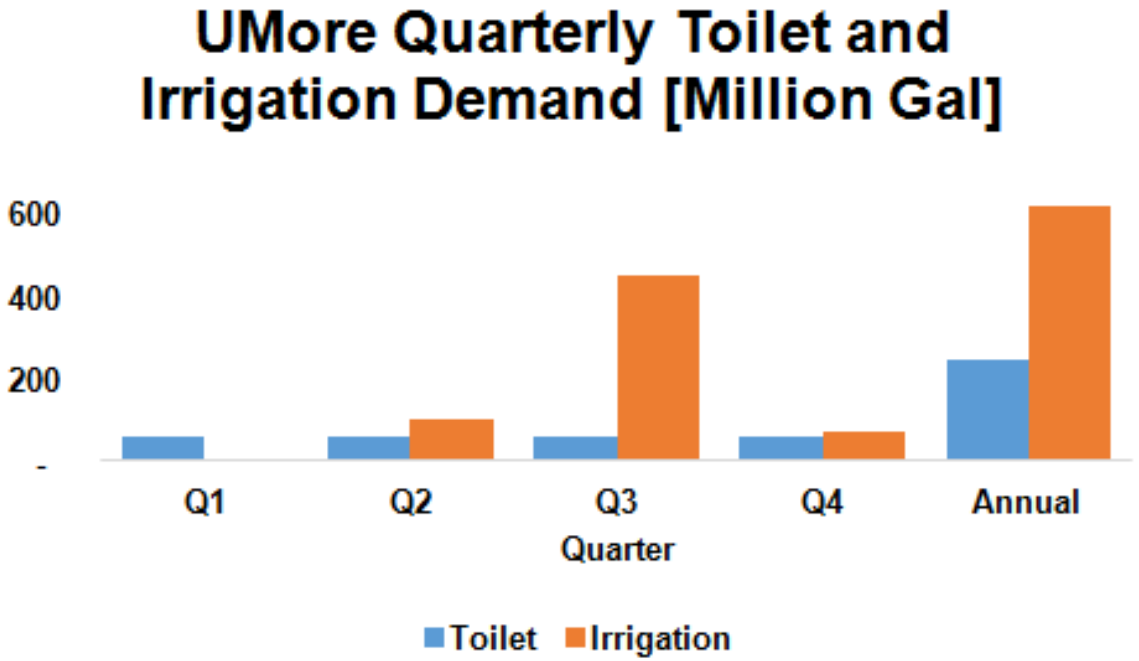
UMore Water Demand

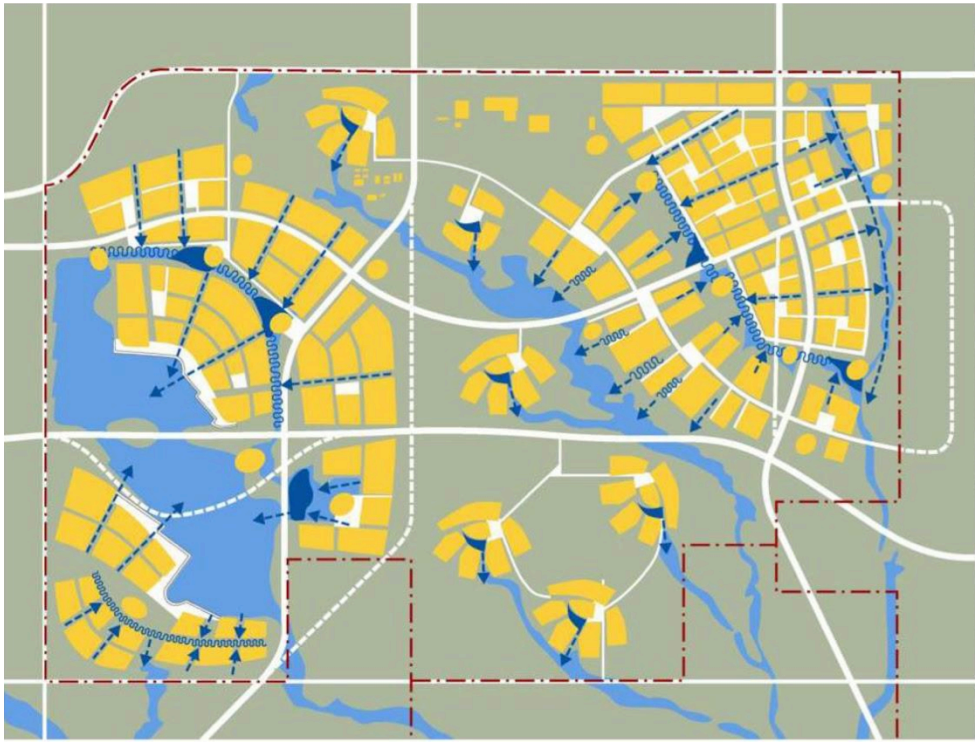
- Assume water usage in Q1 was 100% indoors; difference in other quarters was irrigation
- 27% of indoor usage from toilets (based on U.S. EPA)
- Extrapolate to the expected 13000 SFHs at UMore



UMore Water Demand



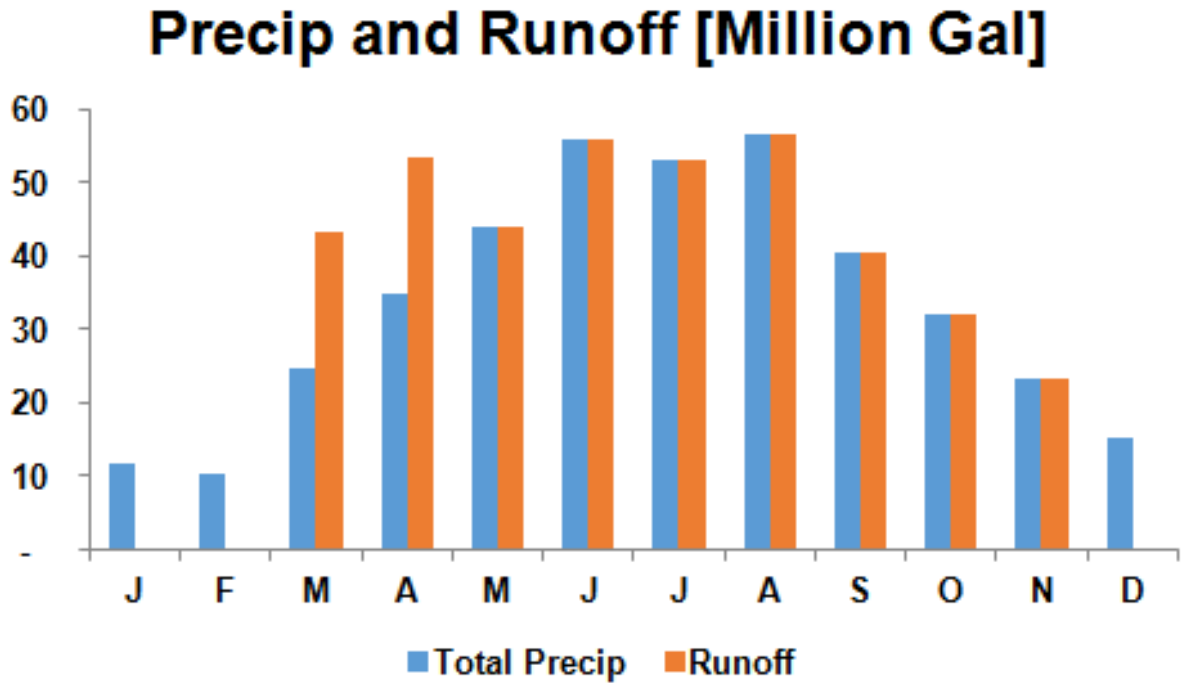
Stormwater Potential



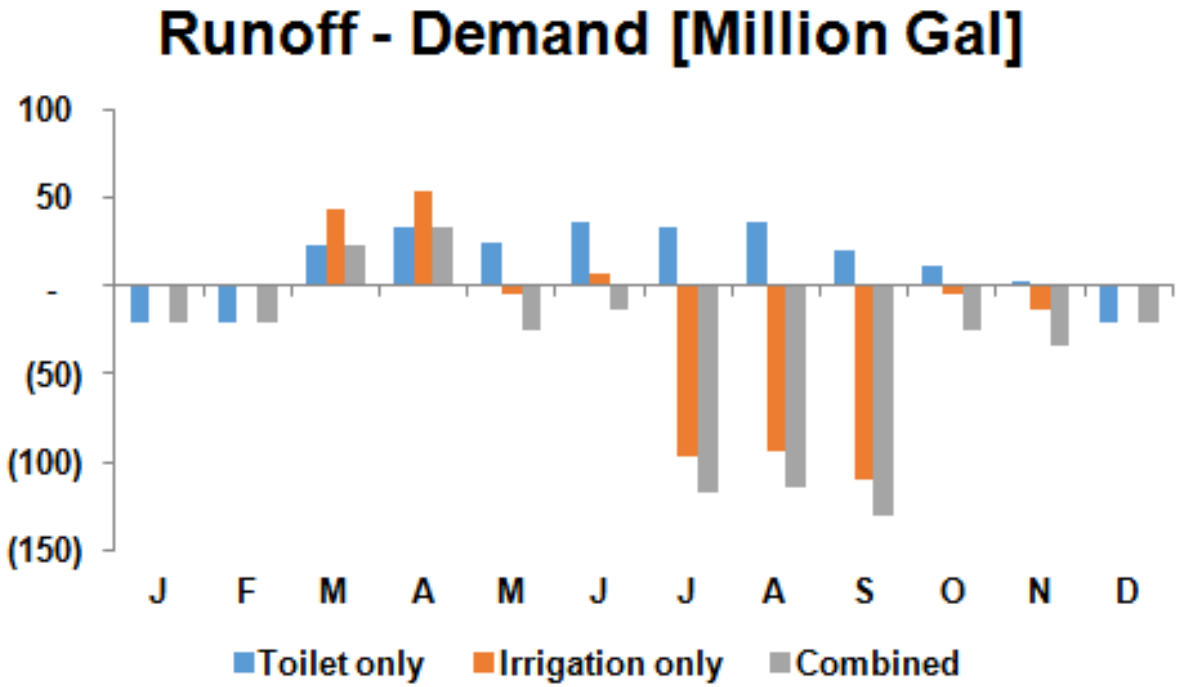
Stormwater Potential

- ~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

Environmental Reuse:

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

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- ≤ 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.

Greywater, Gray Water, or Grey Water?

We prefer greywater.

Julie Kebisek, Shannon Sullivan, and Teegan Wydra

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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 cannot contain 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

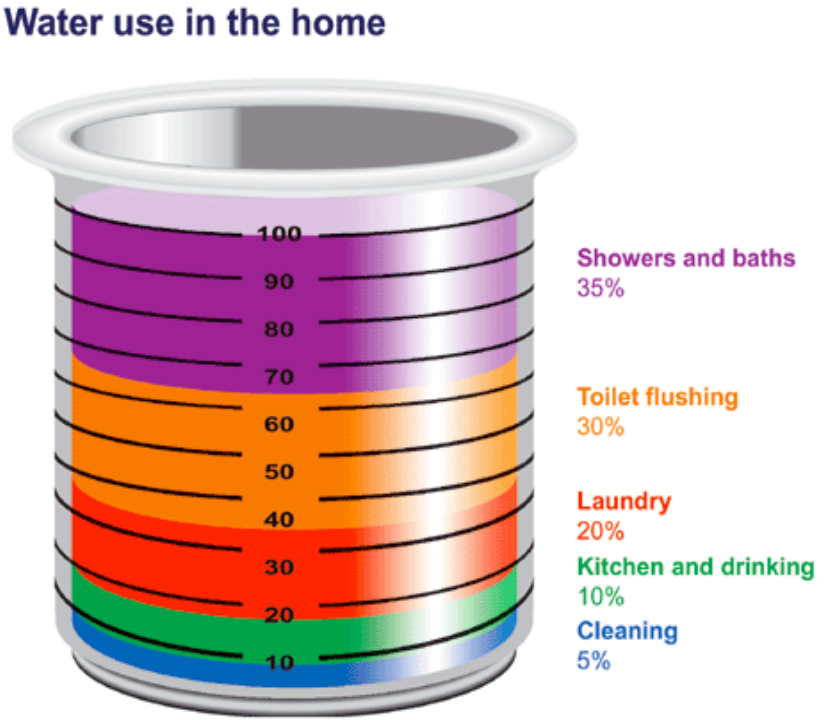
Dark greywater:

- 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

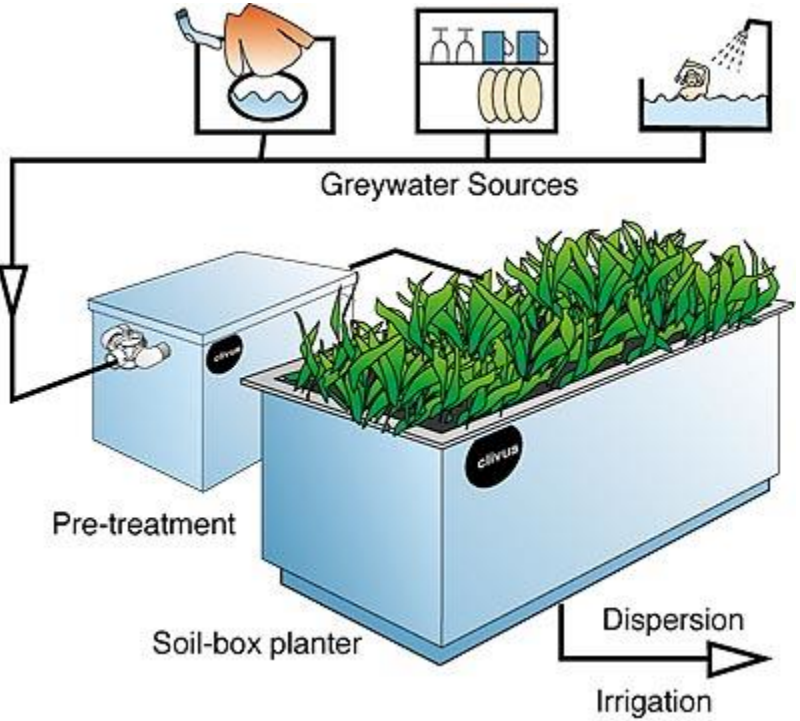
Table 2
Microbial nutrient requirements and the concentrations present in different grey waters.

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

Li 2009

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

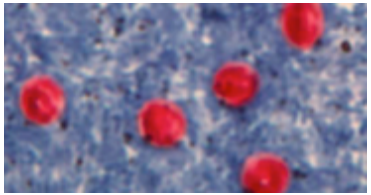
Image source: greywater.com

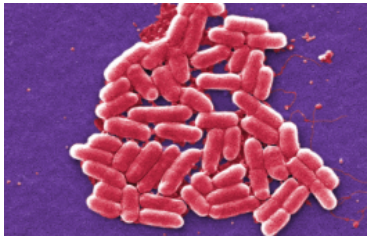
Chemical Treatment

- 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**

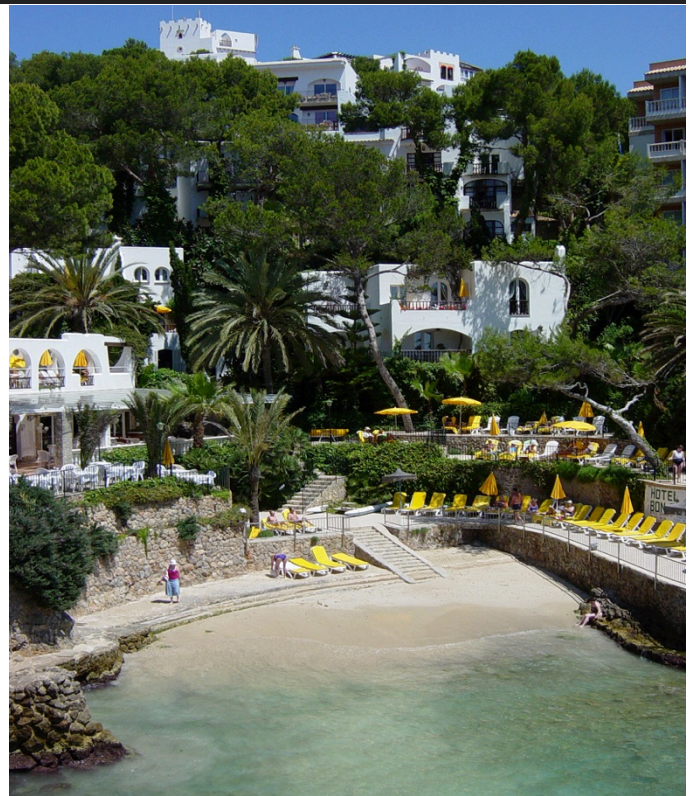
Milkweed can jazz up a Californian garden

If interested, contact:

Larry Rich Sustainability Coordinator	Phone: 562-570-5839	Email: larry.rich@longbeach.gov
Jason Gallup Project Lead	Phone: 562-570-6281	Email: jason.gallup@longbeach.gov

Case Study
Hotel on Mallorca Island, Spain

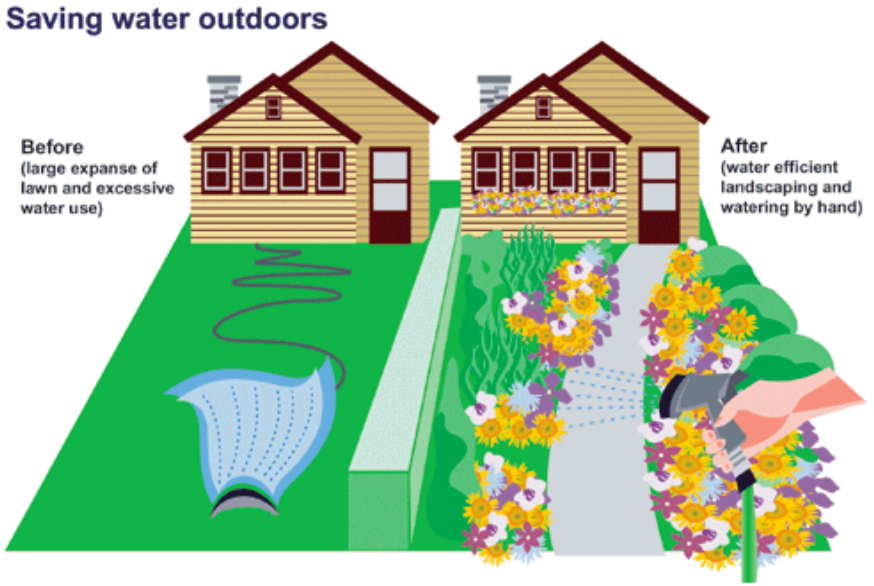
- 81 rooms (63 with a kitchen) and nine floors
- Indoor greywater recycling system to flush toilets
    - Used filtration, sedimentation, and disinfection treatments using sodium hypochlorite
- 23% of water consumption from greywater reuse
- Calculations of total cost of the system vs. savings from water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



Reference: Wise Water Use. Environment Canada https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=F25C70EC-1 Date Modified: 2013-07-23

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Community Engagement & Education

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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.