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POTENTIAL HEALTH EFFECTS OF MUNICIPAL WATER REUSE IN KANSAS

EXECUTIVE SUMMARY

Kansas Health Impact Assessment Project

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212 SW 8th Avenue | Suite 300
Topeka, Kansas | 66603-3936

785.233.5443

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Authors

Sarah M. Hartsig, M.S.
Carlie Houchen, M.P.H.
Tatiana Y. Lin, M.A.

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This report, *Potential Health Impacts of Municipal Water Reuse in Kansas*—further on referred to as the KHI Municipal Water Reuse HIA—is intended to be an accessible and informative resource for Kansas policymakers, municipalities, municipal utility staff and others as they make decisions about water resource planning in Kansas. This report describes potential health effects associated with municipal water reuse to inform decision-making that maximizes potential health benefits and mitigates potential health risks that could result from water reuse.

Acknowledgements

This project is supported by a grant from the Kansas Health Foundation (KHF) through an initiative called "Improving Health Through Access to and Consumption of Water."

Over the course of this project, the Kansas Health Institute's (KHI) Health Impact Assessment Team—further on referred to as the KHI HIA Team—received valuable input and participation from various stakeholders including local municipalities and municipal utility representatives, state agency officials, representatives of water-related organizations, state legislators, academic researchers, and other KHF grantees. We would like to thank them for dedicating their time, energy and expertise to the project.

The KHI HIA Team extends a special thank-you to two groups of people without which this project would not have been possible: the Full HIA Team and the Technical Advisory Panel. Both groups were created to support and guide the implementation of the HIA. The Full HIA Team was created to identify the focus and scope of the project and consisted of representatives from the Kansas Department of Health and Environment (KDHE), Kansas Water Office (KWO), Kansas Municipal Utilities (KMU) and the University of Kansas (KU). Each member of this team was also key in providing data, context and expertise on issues of water, wastewater and water reuse in Kansas. The purpose of the Technical Advisory Panel was to serve as a sounding board to ensure that the project's focus, goals and recommendations were feasible and sensible from a local perspective. The Technical Advisory Panel was made up of representatives from municipalities and municipal utilities across Kansas, including Garden City, Hays, Russell, South Hutchinson, Salina and Johnson County, as well as representatives from the Kansas Rural Water Association. A special thank-you goes to Fred Jones, water resource manager for the City of Garden City, and Toby Dougherty, city manager for the City of Hays, for their engagement and assistance in deploying community surveys in those two locations.

Finally, the authors thank Kansas Health Institute (KHI) colleagues who provided feedback throughout the HIA process: Kari M. Bruffett, director of policy, and Steve Corbett, Ph.D., senior analyst. We also thank Sheena Smith, M.P.P., former KHI analyst, for her preliminary work on the project.

Disclaimer

The authors of this report are responsible for the facts and accuracy of the information presented. Any findings, conclusions or recommendations expressed in this HIA report are those of the authors and do not necessarily reflect the view of the project's funder, the Full HIA Team, the Technical Advisory Panel, or any other stakeholders who provided their perspectives during the process.

The Kansas Health Institute does not endorse or oppose any local decisions related to water reuse projects. KHI delivers credible information and research to support informed decision-making that includes health as one of its priorities. The Kansas Health Institute is a nonprofit, nonpartisan health policy and research organization based in Topeka. KHI was established in 1995 with a multi-year grant from the Kansas Health Foundation.

Water Reuse: The Kansas Water Vision

The Kansas Water Vision, "A Long-Term Vision for the Future of Water Supply in Kansas," was developed by the Kansas Water Office (KWO), Kansas Department of Agriculture (KDA), and the Kansas Water Authority (KWA), in response to Governor Sam Brownback's 2013 call-to-action.[1] The Water Vision focuses on several areas, including water conservation, water management, technology and crop varieties, and additional sources of water supply. The Water Vision calls for an evaluation of the sources and potential uses of lower-quality water as a strategy for additional sources of water supply.[2] It is within this strategy that water reuse is likely to be considered. The Kansas Health Institute (KHI) conducted a health impact assessment (HIA) to examine how municipal water reuse might positively or negatively affect the health of Kansas residents.

An HIA is a practical tool that assesses the health impacts of policies, strategies and initiatives in sectors that are not commonly thought of in relation to health, such as transportation and housing. The overall goal of an HIA is to inform decision-makers of potential positive and negative health effects of proposed policy decisions. The HIA provides evidence-based findings about health impacts and identifies recommendations to maximize health benefits and mitigate health risks.

This HIA focuses on municipal water reuse in Kansas. Municipal water reuse involves the utilization of highly treated municipal wastewater for beneficial purposes. The term "water reuse" is generally used synonymously with water reclamation and water recycling. The goals of the HIA were to: 1) add to the data collection and research on public health impacts related to the access, promotion and consumption of water in Kansas; 2) identify options and provide evidence-based recommendations to enhance potential positive impacts on health and mitigate potential negative health impacts that could result from water reuse; and 3) build HIA sustainability in Kansas by continuing to introduce this tool to state and local decision-makers.

To assess the potential health effects of municipal water reuse in Kansas, the KHI HIA Team reviewed existing literature, analyzed data, and gathered stakeholder input from multiple groups, such as representatives of local municipal utilities, environmental groups, state personnel involved in water regulation, and water professionals from states with widespread reuse, among others.

Research Questions

The assessment of health effects was guided by several research questions related to water reuse, including:

How will municipal water reuse in Kansas affect the following factors?

- Water availability
- Community sustainability
- Water quality
- Community perception of water quality
- Consumption of beverages other than municipal tap water
- Costs and utility rates
- Guidance and regulations

How will changes in these factors affect health?

Throughout the report, special attention was given to populations that could be disproportionately affected by decisions to reuse municipal water.

Summary of Findings and Recommendations

Following are brief summaries of the findings from each of the identified issue areas. *Figure 1* (page 5) outlines the projected impacts along with the magnitude, direction and quality of evidence for each impact. The findings were developed based on literature and data. Additionally, to maximize the potential positive health effects and mitigate the potential negative health effects associated with the water reuse in Kansas, the KHI HIA Team—with input from stakeholders—developed a set of recommendations to inform future decisions related to water reuse.

Key recommendations are listed below the findings for each issue area. The recommendations listed

are those that were identified as high priority by the stakeholders based on the criteria of feasibility, responsiveness to findings, and whether implementation of the recommendation is likely to produce a meaningful result. The full list of findings and recommendations is available in *Appendix C*, page 75.

Water Availability and Community Sustainability: Water reuse has the potential to increase the water available for community use, which in turn, could increase community sustainability. However, the magnitude of these increases in the context of overall water use may be relatively small as community sustainability is influenced by many factors, of which water availability is just one. There are social, economic and environmental factors that contribute to the resilience of communities in the face of changes to water availability. Potential health impacts of increased community sustainability include reduced stress and improved individual and community mental health.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- Water utility managers could consider managing water reuse and water conservation in collaboration with other partners;
- Researchers could consider quantifying the social, economic and environmental consequences of water reuse in areas of water scarcity in Kansas;
- Policymakers/legislators could consider encouraging water reuse as a strategy for additional supply through recommendations and/or financial incentives; and
- Municipalities could consider participating in processes for ongoing, long-term water planning.

Water Quality: Reused water quality may increase, decrease, or stay the same in comparison to current drinking water quality. While current technology can be used to treat water to any quality required, the quality of reused water depends on the availability of funds and on the intended end use. Non-potable reused water is treated to a lower standard by design, while indirect and direct potable reused water typically undergo advanced treatment and quality controls. In general, the reviewed literature suggests that the quality of reused water has not harmed human or environmental health. Nevertheless, the risk of system failure remains, and such an event could result in exposure to contaminants and potential illness. There is also uncertainty about the contaminants of emerging concern. There is not adequate evidence to conclude how prevalent they are and whether they present a risk to health.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- The Kansas Department of Health and Environment (KDHE) could consider establishing consistent requirements for signage to limit public contact with lower-quality, non-potable reused water; and
- KDHE and municipalities could consider working together to identify and adhere to standards, processes and best practices for ensuring the quality of reused water.

Community Perception of Water Quality: While perception varies from community to community, the perception of reused water quality is generally lower than that of current drinking water. There are several components of this perception. The first is what has been referred to as the "yuck" factor, or psychological aversion to treated wastewater. Another is trust in public officials, experts and technology. The public's perception of the quality of the water is generally lower for all reuse types, and the acceptability of water reuse declines as the potential for human contact with the water increases. A community's acceptance of water reuse depends on multiple factors, such as the extent of communication, outreach and meaningful engagement of the public. Communication efforts can improve acceptability of water reuse, while issues such as the "yuck" factor and lack of trust in local government could decrease a community's perception of the quality of reused water. The primary health implications of a decrease in community perception of water quality were found in the switch from drinking tap water to bottled water or sugary beverages.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- Kansas municipalities could consider implementing targeted outreach and educational campaigns about reuse, including information about the social and environmental costs and benefits, institutional structures, regulatory systems and alternate solutions;
- Kansas municipalities could consider demonstrating the utility's trustworthiness by maintaining compliance with the Safe Drinking Water Act standards; and
- State agencies that are involved in water education could consider educating and communicating with the public about water reuse.

Consumption of Beverages Other Than Municipal Tap Water: A decrease in the perception of water quality could impact the purchase and consumption of beverages other than municipal water, such as bottled water or sugary beverages. There is a common perception that bottled water is of higher quality than municipal drinking water, although some evidence points to the opposite. Health impacts of increased sugary beverage consumption include impacts on oral health and chronic conditions such as obesity and diabetes. Purchasing beverages that are more expensive than municipal water could also have negative financial implications for populations that are economically disadvantaged as it could decrease the availability of funds for other essential needs. Some racial and ethnic minority groups may be more likely to consume bottled water and sugary beverages as a result of low trust in the quality of the municipal drinking water, and therefore may be at higher risk of negative health impacts.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- Municipalities could consider improving community perception of drinking water by communicating early and often, and building/maintaining transparency and trust with the community; and
- Local public health agencies could consider engaging in health promotion strategies to highlight the health benefits of water consumption over other beverages such as sodas, juices and other sugary drinks.

Costs and Utility Rates: Water reuse projects are associated with a variety of initial and ongoing costs related to infrastructure, operations and maintenance. The costs may depend on the type of reuse, the desired water quality, and the method and distance of water distribution. Reusing water in smaller communities may be more expensive on a per-capita basis, but in some cases, water reuse may be less costly than the development of other new water sources. Due to water reuse, utility rates could increase, decrease or stay the same. Changes in utility rates may depend on the costs of reuse, availability of alternate funding sources, and the community's perception of and demand for reused water. Increases in utility rates could negatively impact the health of individuals who are already paying a higher percentage of their income on water and wastewater bills, including those who are low-income, elderly, and those served by small and rural community water systems. Because of the importance of water and wastewater service, keeping these utilities turned on could require trade-offs with other necessities such as food, medical expenses, and heating and cooling.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- Kansas municipalities could consider working with partners to share the costs and benefits of reuse infrastructure (e.g., industry partners, neighboring municipalities);
- Kansas municipalities could consider balancing the most cost-effective reuse option with community acceptability;
- Kansas municipalities could consider pricing water to account for scarcity by increasing the rate for high-volume users; and
- Kansas municipalities could consider implementing affordability programs for low-income individuals, such as lifeline rates, payment plans, bill discounts, leak repair assistance programs, among others.

Guidance and Regulations: As more Kansas communities pursue water reuse, new guidance and regulations for water reuse projects are likely to be developed in Kansas. Regulations in states with current or planned widespread water reuse include requirements for water quality, public access, monitoring and reporting. Because most water reuse regulations exist to protect the public's health and the environment, the successful implementation of the regulations may have a beneficial effect on health. However, it is possible that the regulations will help to maintain, rather than improve upon, the current state of health in Kansas, since current federal regulations, such as the Clean Water Act (CWA) and Safe Drinking Water Act (SDWA), are set to ensure the safety of water for health and the environment.

Recommendations to maximize any potential health benefits and mitigate any potential health risks include:

- KDHE could consider incorporating best practices into any new regulatory guidance. Best practices include:
  - Maintaining public health as a top priority;
  - Preventing cross-connections (actual or potential contact between potable and non-potable water supplies);
  - Marking all non-potable components;
  - Having a proactive public information program;
  - Having a monitoring and surveillance program;
  - Training utility staff members on reuse;
  - Establishing construction and design standards; and
  - Ensuring physical separation of potable and non-potable water lines.

Additional best practices may be found in *Guidelines for Water Reuse* from the U.S. Environmental Protection Agency (EPA).

The following table summarizes potential health impacts associated with water reuse in Kansas for each of the areas studied (*Figure 1*). See *Figure 2*, page 7, for the legend that corresponds to *Figure 1*.

Figure 1. **Summary of Health Impacts of Municipal Water Reuse in Kansas**

				Based on Literature and Data					Literature
Health Factor or Outcome	Literature Review	Data Analysis	Stakeholder Perspectives	Overall Projection	Expected Health Impact	Magnitude of Impact	Distribution of Impact	Likelihood of Impact	Quality of Evidence
Water Availability†	Increase	Increase	Increase	Increase	Beneficial	Most/All	Communities with lower water security; Water-dependent industries or amenities	Possible	**
Community	Increase	Increase	Increase	Increase	Beneficial	Most/All	Those without the resources to relocate or seek services elsewhere	Possible	****
Water Quality	Mixed	N/A	No change/ Increase	Mixed	Neutral^	N/A	N/A	N/A	****

Figure 1. **Continued**

				Based on Literature and Data					Literature
Health Factor or Outcome	Literature Review	Data Analysis	Stakeholder Perspectives	Overall Projection	Expected Health Impact	Magnitude of Impact	Distribution of Impact	Likelihood of Impact	Quality of Evidence
Non-potable §	Decrease	N/A	No change	Decrease	Neutral to Adverse	Few	Individuals with a compromised immune system or other health-related issues	Unlikely	N/A
Indirect potable Δ	Increase	N/A	Mixed	Increase	Neutral	N/A	N/A	N/A	N/A
Direct potable #	No change/ Increase	N/A	No change/ Increase	No change/ Increase	Neutral^	N/A	N/A	N/A	N/A
Community Perception of Water Quality ††	Decrease	N/A	Decrease	Decrease	See *"Consumption of beverages other than municipal water"* below				****
Consumption of beverages other than municipal water	Increase	N/A	Increase	Increase	Adverse	Some	Some racial and ethnic minority groups; Low-income populations; Individuals with a compromised immune system	Possible	****
Costs of Reuse	Increase	N/A	Increase	Increase	See "Utility Rates" below				****
Utility Rates	Mixed	N/A	Increase	Mixed	Neutral to Adverse	Some	Low-income; Elderly; Those from small/rural community water systems	Possible	**
Regulations	Increase	N/A	Increase	Increase	Neutral to Beneficial	Most/All	Communities with water reuse	Likely	**

Note: See Legend, *Figure 2*, page 7.

† = Relates to communities with lower water security. The health impact would not be applicable to communities who are water secure, because they will have access to other water resources.

^ = As of December 2016, research does not indicate that there have been any outbreaks of illness connected to direct potable or other types of reuse. However, concerns remain about the potential risks of human error or system breakdown and associated impacts on health given the source and end use of the reused water.

§ = Non-potable reuse is: "All water reuse applications that do not involve potable reuse, including the use of water for car washing, irrigation, industrial cooling, etc."

Δ = Indirect potable reuse is: "Augmentation of a drinking water source (surface or groundwater) with reclaimed water followed by an environmental buffer that precedes drinking water treatment."

= Direct potable reuse is: "The introduction of reclaimed water directly into a drinking water treatment plant, either co-located or remote from the advanced wastewater treatment system."

† † = Despite a perception that reused water quality is lower than that of the current/traditional municipal water supply, acceptability may vary by type of reuse. Non-potable reuse may have highest acceptability, whereas direct potable reuse has the lowest acceptability.

Source: KHI Municipal Water Reuse HIA, 2017.

Figure 2. **Legend: Health Impacts for Kansas**

CRITERIA	DESCRIPTION
Direction — Projects the direction of change based on the proposed rule.	Increase — Literature (data) achieves consensus that this indicator might increase. Decrease — Literature (data) achieves consensus that this indicator might decrease. Mixed — Literature (data) lacks consensus about this indicator's potential direction. No effect — Literature (data) suggests that this indictor might remain unchanged.
Expected Health Impact — Indicates whether the health impact is beneficial or adverse.	Beneficial — Change may improve health. Adverse — Change may impair health. Uncertain — Unknown how health may be impacted. Mixed — Change may be positive as well as negative. None — No identified effect on health.
Magnitude — Indicates how widely the health effects would be spread within a population or across a geographical area.	Few — Few or very few people, such as specific individuals or households. Some — Less than half of the population of a given community. Many — More than half of the population of a given community. Most/All — Nearly the entire community or regional impact.
Distribution — Describes the population most likely to be affected by changes in the health factor or outcome.	The populations that are projected to be impacted.
Likelihood — The chance that a given exposure will occur.	Likely — There is a high chance that impacts will occur as a result of municipal water reuse. Possible — There is some chance that impacts will occur as a result of municipal water reuse. Unlikely — There is a low chance that impacts will occur as a result of municipal water reuse. Uncertain — It is unclear if impacts will occur as a result of municipal water reuse.
Quality of Evidence — The strength of the quality of evidence (literature only) to support the judgements made when characterizing the impacts.	**** — Strong literature. ** — Sufficient literature. N/A — Quality of evidence wasn't separately assessed for this health factor/ outcome.

Source: KHI Municipal Water Reuse HIA, 2017.

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