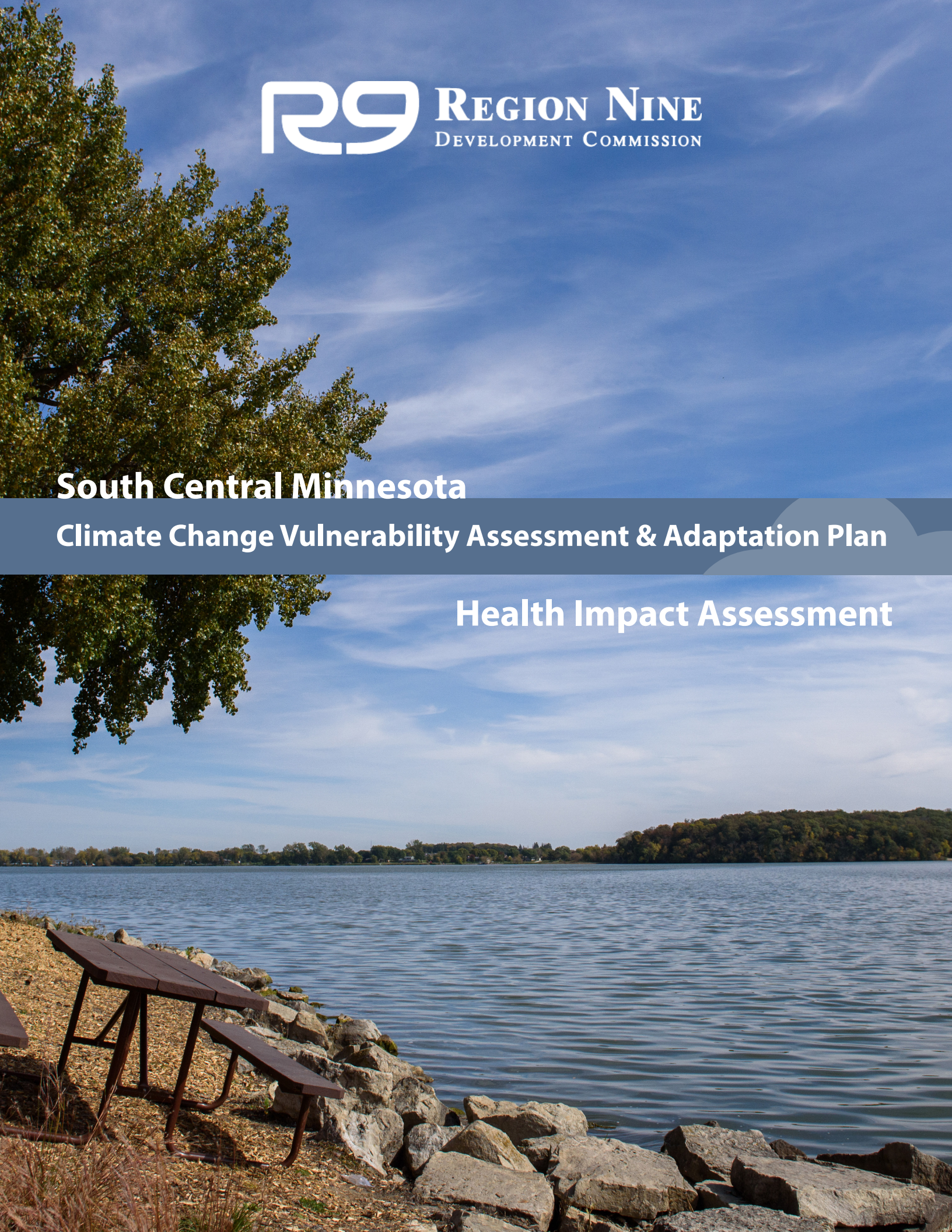


Region Nine
Development Commission

South Central Minnesota

Climate Change Vulnerability Assessment & Adaptation Plan

Health Impact Assessment

Table of Contents

This document was created in partnership with the Minnesota Department of Health.

August 2016

Introduction

In 2015, Region Nine Development Commission received a grant from the Minnesota Department of Health (MDH) to conduct a rapid Health Impact Assessment (HIA) on the Region Nine Climate Change Adaptation Plan strategies. The HIA was done in conjunction with the development of the adaptation plan, with the goal of ensuring that the strategies developed would be health-focused before implementation. By conducting the HIA during the Climate Change Adaptation Plan's development, greater efficiencies were created in terms of addressing strategy-specific health-related issues that could be avoided at the start, rather than discovering them after the strategies had already been implemented.

The original intent of the Region Nine Climate Change Adaptation Plan HIA was to address each of the adaptation plan's objectives and their subsequent strategies. Due to a shortage of time, the Region Nine HIA was only able to fully address the strategies for Objective 1 of the Climate Change Adaptation Plan. However, there was work completed on all of objectives and strategies during the Screening and Scoping phases of the HIA.

The following report is the culmination of the Region Nine HIA process and summarizes each step of the HIA, and includes the HIA Project Team and Advisory Committee's recommendations for improving the Climate Change Adaptation Plan. The adoption of these recommendations will increase the value relevance of the adaptation plan and benefit the health of the region.

Screening

Introduction

The first step in creating a successful Health Impact Assessment (HIA) is the screening process, which determines if an HIA will be useful, feasible, and completed in a timely manner. This section describes the screening process for an HIA on the Region Nine Climate Change Adaptation Plan (see Appendix A).

Project and Timing

The Region Nine Development Commission leveraged the planning process initiated by a grant it received in January of 2015 from the Minnesota Pollution Control Agency (MPCA) to conduct a climate change vulnerability assessment and adaptation plan. By conducting an HIA on some of the strategies identified in the adaptation planning process, the plan, if implemented, may have measurable effects on the environment and human health.

The HIA was performed on several strategies outlined in the plan, which may be adopted by local units of government in Region Nine with the potential to be implemented elsewhere in the State of Minnesota. Attaching an HIA to the plan will help local units of government recognize and focus on health impacts related to climate change and the adaptation strategies.

Work on the adaptation plan began in February of 2015 and was expected to be completed by the end of May 2016. The HIA process began in December of 2015 and coincided with the development of the adaptation plan. The HIA was completed in August 2016.

Health Impacts of Climate Change and the Potential Impact of the HIA Findings

Region Nine serves nine counties in south central Minnesota (Blue Earth, Brown, Faribault, Le Sueur, Martin, Nicollet, Sibley, Waseca, and Watonwan) and the local units of government within those counties (72 cities, 147 townships, and 33 school districts).

Climate change impacts public health in several different ways. Region Nine is particularly concerned with the health impacts of climate change on the elderly. The Minnesota State Demographic Center projects the number of 60-year-old adults in Region Nine will increase 8.3 percent by the year 2040 (from 23.7 percent of the projected population in 2015 to 32 percent of the projected population by the year 2040) before declining slightly in 2045. There are many health challenges related to an aging population.

Other areas of exploration within the adaptation plan may include the following: drought, extreme summer events, extreme winter events, fire, flooding, infectious disease, and land subsidence. Areas that are assessed by the HIA were determined in the scoping phase of the HIA.

Potential Impact of the HIA Process

The direct impact of Region Nine's adaptation plan will be on the townships, cities, counties, and school districts located within Region Nine; however, as climate change concerns grow, additional communities may be informed by the HIA and may implement health promoting climate change adaptation strategies. The finalized HIA will help stakeholders understand the impacts of health from climate change and may guide their decisions in implementing adaptation strategies. Ultimately, it will be the decision of the local units of government on how they move forward with adapting to climate change and the health impacts associated with those changes. This may require communities to build new relationships and work together in order to adapt to expected climate changes.

Stakeholder Interest and Capacity

Key stakeholders include the Climate Change Adaptation Task Force (CCATF) as well as local units of government that Region Nine represents. The CCATF will work directly with the HIA Advisory Committee during the adaptation planning process to ensure that the adaptation plan considers impacts on human health.

Screening Summary

Region Nine decided to perform an HIA on the Region Nine Climate Change Adaptation Plan for several reasons. The timeline for the HIA aligned well with the planning process for the adaptation plan. In fact, performing the HIA in tandem with development of the adaptation plan allowed for extra opportunities to insert health considerations into the plan. Region Nine, with the support of MDH, had the resources to perform the HIA. Most importantly, the HIA would bring valuable information on health and vulnerable populations to the adaptation plan that may not have been considered without an HIA, helping to ensure that climate adaptation strategies benefit human health. If the adaptation plan is adopted by local governments throughout Minnesota, the impacts on climate change adaptation and health could be significant.

Stakeholder Engagement Plan

Background

Stakeholder participation is an important component of effective, equitable, and ethical decision making. It is a critical part of the HIA process and supports the core values of HIA, including: democracy, equity, sustainable development, and ethical use of evidence (HIA Society, 2010).

The Guidance and Best Practices for Stakeholder Participation in Health Impact Assessments states, "Ensuring stakeholder involvement and leadership helps promote a vision of an inclusive, healthy, and equitable community, in which all people, regardless of income, race, gender, or ability, can participate and prosper." Participation by community stakeholders can improve the effectiveness and value of an HIA by helping to:

- Identify important stakeholder concerns
- Bring important reflections of experience, knowledge, and expertise
- Create realistic and livable recommendations that matches with HIA priorities and research findings
- Support equity and democracy within the HIA
- Create more community support for the implementation of HIA recommendations
- Shape communication and dissemination of the HIA

HIA Project Team

The HIA of the Region Nine Climate Change Adaptation Plan was primarily led by the Region Nine Project Development Planner with support given by the Resource Development Planner. Other staff from Region Nine provided assistance as necessary.

The Project Development Planner and Project Assistant were responsible for following the empirical HIA process determined by MDH, facilitating the HIA Advisory Committee meetings, guiding research and development of the HIA, and completing all deliverables by the following deadlines and sending them to MDH:

Deliverable	Date Due
Screening Summary	November 30, 2015
Stakeholder Engagement Plan	January 29, 2016
Scoping Summary	Following the 2nd Advisory Committee Meeting
Assessment	June 30, 2016
HIA Report	July 31, 2016
Presentation of HIA Findings to Decision Makers; Process and Impact Evaluation Report	August 31, 2016

Stakeholder Engagement Plan

The Stakeholder Engagement Plan identified key stakeholders to serve on the HIA Advisory Committee and discussed how they will be involved in the HIA. By leveraging the existing CCATF, the HIA Advisory Committee and the CCATF established overlay when possible. To ensure effective implementation of this process, an appointed liaison was established between the Climate Change Task Force and the HIA Advisory Committee. Having the HIA Advisory Committee liaison at the planning meetings directly helped inform the goals, strategies and action items. Input from the HIA Advisory committee helped ensure that health challenges were considered during the planning process. In that capacity, the HIA had a direct impact on the plan from conception to implementation.

<table>
<tr><th colspan="4">HIA Engagement in the Planning Process</th></tr>
<tr><td></td><td>Climate Change Adaptation Task Force Meeting Dates</td><td>Liaison/Overlay in Planning Process</td><td>Health Impact Assessment Advisory committee</td></tr>
<tr><td>Adaptation Planning Including HIA Advisory Committee</td><td>March 2016</td><td rowspan="2">1-2 Climate Change Adaptation Task Force Member Liaisons and 1 Health Impact Assessment Member Liaison</td><td>March 2016</td></tr>
<tr><td rowspan="2"></td><td>April 2016</td><td>June 2016</td></tr>
<tr><td colspan="3">Climate Change Adaptation Plan Due to MPCA</td></tr>
<tr><td rowspan="2">HIA Assessment of Completed Adaptation Plan</td><td rowspan="2">Adaptation Plan Completed</td><td rowspan="2">1-2 Climate Change Adaptation Task Force Member Liaisons</td><td>July 2016</td></tr>
<tr><td>August 2016</td></tr>
</table>

At an internal HIA project planning meeting, Region Nine staff conducted a stakeholder analysis to identify key stakeholders to recommend for the HIA Advisory Committee. The following chart highlights stakeholder groups, interest in HIA, power to influence decisions, how and when stakeholders should be engaged, the potential role and contribution of the stakeholder, and barriers/challenges to engagement.

Stakeholder Group (Description/Key Contact)	Interest in HIA or related decision?	Power to influence decision	How and when (what stage) to engage?	Potential role in HIA / Contribution to HIA	Barriers/ challenges to engagement
Health Professionals and Advocates					
Kristin Raab, HIA and Climate Change Project Director, Minnesota Department of Health or Chris Kimber, Climate and Health Program Planner, Minnesota Department of Health	Working for the State Health Department for health equity in Minnesota and expansive knowledge of climate change and effects on human health.	High/ Medium	All Steps	HIA Advisory committee / Knowledge of health and climate change issues	Time, Location
Karen Moritz, Brown County Public Health	Works in one county of Region Nine. Brown County Public Health's mission is to promote health, safety, and well-being and prevent disease and injury during all ages and stages of life.	Medium	Scoping through remaining steps of HIA	HIA Advisory committee / Knowledge of public health issues	Time and distance to meeting site
Candace Fenske, CEO of Madelia Community Hospital and Clinic	CEO of health care system in Madelia and Commissioner at Region Nine Development Commission representing Health and Human Services.	Medium	Scoping through remaining steps of HIA	HIA Advisory committee / Knowledge of health and the community	Time
Service Providers					
Linda Giersdorf, Executive Director of Minnesota River Area Agency on Aging, Inc. or Robin Thompson, Contact Center & Community Outreach Coordinator	Service area covers all of Region Nine service area. Working to build communities where seniors live through advocacy and education, fund distribution, systems changes, capacity building, and information and assistance.	Medium	Scoping through remaining steps of HIA	HIA Advisory committee / Knowledge of health, community and barriers in the system, knowledge of issues affecting aging populations.	Time

Stakeholder Group (Description/Key Contact)	Interest in HIA or related decision?	Power to influence decision	How and when (what stage) to engage?	Potential role in HIA / Contribution to HIA	Barriers/ challenges to engagement
Academic Institutions					
Dr. Amy Hedman, Chair of Community Health, Minnesota State University - Mankato	Chair and Professor in Community Health field of study at Minnesota State University – Mankato. Knowledge of health impacts in region.	Medium	Scoping through remaining steps of HIA	HIA Advisory committee / Academic knowledge and teaching, experience in public health field	Schedule
Other					
Cathi Fouchi, DNR Regional Planner, Minnesota Department of Natural Resources	Currently serves on the Region Nine Climate Change Task Force and will serve as a liaison representing that Task Force. Experience with Department of Natural Resources.	Medium	Scoping through remaining steps of HIA	TBD/Knowledge and expertise in Natural Resource planning, education, and outreach, and watershed coordination. Interest in climate change and its effects on the environment.	Work Load, Time
Nancy Lageson, Emergency Management Director, Waseca County	Currently serves on the Region Nine Climate Change Task Force and will serve as a liaison representing that Task Force. Experience with Emergency Management.	Medium	Scoping through remaining steps of HIA	TBD/Knowledge and expertise in Emergency Management planning and disaster preparation, educational leadership background	Work load, Time
Molly Westman, Community Development Coordinator, City of Mankato	City government experience in community and economic development, improving quality of life for all	Medium	Scoping through remaining steps of HIA	TBD/ Community and economic development experience	Time

Stakeholder Group (Description/Key Contact)	Interest in HIA or related decision?	Power to influence decision	How and when (what stage) to engage?	Potential role in HIA / Contribution to HIA	Barriers/ challenges to engagement
Tyra Laughlin, Resident	Knowledge and experience as a resident of the region.	Medium	Scoping through remaining steps of HIA	HIA Advisory committee / Knowledge of community	Time
Breeanna Bateman, Water Quality Compliance	Currently serves as the Water Quality Compliance specialist in the Mankato office.	Medium	Scoping through remaining steps of HIA	HIA Advisory Committee/ Knowledge of environmental concerns (water quality)	Time

Role of the HIA Advisory Committee

The primary goal of the HIA Advisory committee was to help guide the process, activities, and outcomes of the HIA. The HIA Advisory committee was involved in the following ways:

- Guided the overall direction of the HIA.
- Provided strategic direction for the scope and implementation of the HIA, speaking to the views of people represented by their affiliate organizations.
- Reviewed and provided input on data, analyses, and deliverables developed in the HIA.
- Helped develop recommendations based on HIA analysis.
- Supported the HIA to ensure partnerships and linkages to other stakeholders and key relevant processes.
- Identified available resources and activities relevant to the HIA.
- Provided a communication channel to other stakeholders not formally represented on the HIA Advisory Committee.
- Monitored and evaluated ongoing HIA progress.

Stakeholder Engagement by Step of HIA

Step 1: Screening

A screening process was successfully conducted by the project team that determined an HIA on the Region Nine Climate Change Adaptation Plan would be useful, feasible, and completed in a timely manner. Stakeholders were not engaged during this process.

Step 2: Scoping

The primary focus of the scoping phase was to create a plan for conducting the HIA and to determine the health issues that will be assessed. The HIA Project Team and HIA Advisory Committee determined the goals of the HIA and identified roles for the HIA. The HIA Project Team provided a review of baseline health data and trends affecting the local jurisdictions specific to Region Nine's service area. The HIA Advisory Committee prioritized the health issues.

Prioritization of the health impacts was assessed based on the following criteria:

- Health impacts with the greatest potential significance, magnitude, severity, certainty, and permanence in Region Nine jurisdictions
- Stakeholder/community priorities
- Equity
- Available resources: time, existing data/research, ability to collect new data for gaps in data/research

Step 3: Assessment

The HIA Project Team used the baseline assessment, data, and literature to project the potential positive and negative impacts of some of the strategies in the Region Nine Climate Change Adaptation Plan. The HIA Project Team was primarily responsible for the data collection, literature review, and analysis; however, the Advisory Committee was engaged in the review of the analysis and provided additional feedback.

Time and funding limitations prevented the HIA from conducting highly technical analyses or primary data collection. The HIA Project Team made this clear to the HIA Advisory Committee to manage expectations.

Step 4: Recommendations

The HIA Advisory Committee used results from the final assessment to develop draft recommendations that mitigate any negative health impacts and maximize health benefits.

In general, recommendations should be:

- Responsive to predicted impacts
- Specific and actionable
- Best practices or evidence-based
- Experience-based and effective
- Technically feasible
- Politically feasible
- Economically efficient

Step 5: Reporting

The HIA Project Team wrote the draft final report for the HIA, and will be presenting the HIA findings at the next CCATF meeting which is tentatively scheduled for October 2016. The HIA draft final report was given to each Advisory Committee member with the purpose of sharing the findings with their organization and constituents.

Step 6: Monitoring and Evaluation

The HIA Project Team developed the monitoring and evaluation plan with assistance from the HIA Advisory Committee. Together, they identified measures of success and selected appropriate parties to monitor the impacts of the HIA. Committee members contributed to this discussion via e-mail communication. Finally, the HIA Advisory Committee was given a survey to gauge their understanding of the HIA process in order to understand lessons learned and build capacity for future HIAs in Region Nine's service area.

There will be some challenges to monitoring and evaluation due to lack of time and resources.

Participation by Stakeholder

For a full account of all HIA Advisory Committee members and meeting information (including attendance), see Appendix B.

Scoping

Introduction

The second phase of the Health Impact Assessment of the Region Nine Climate Change Adaptation Plan is scoping, which established the plan for the HIA and determined the health indicators that were assessed. The Research Plan and Research Questions in Appendices D and E outlines the specific health indicators the HIA was able to address comprehensively in the assessment, recommendation, and reporting phases.

Selecting Health Indicators

The Region Nine HIA Advisory Committee met on June 8, 2016 to discuss the scope of the plan. Advisory Committee members were encouraged to reflect on health issues that were prevalent in the communities they served and relate those effects to climate change. Health issues related to climate change impacts like flooding, extreme weather (heat, cold, storms), air and water quality problems were discussed. Physical ailments as well as mental health conditions that arise from additional stress caused by weather events were also mentioned. Discussion followed on accidents, power outages, rural isolation and an aging population, and cultural/socioeconomic differences affecting the availability of heat and air conditioning.

The Region Nine project team then discussed a pathway diagram exercise. The exercise described the objectives of the Region Nine Climate Change Adaptation Plan and how they fit within the HIA. The adaptation plan objectives included the following:

1. Enhance soil and water management
2. Expand alternative genetics and crop choices
3. Infrastructure management
4. Increase adaptive capacity for livestock and human health
5. Expand risk management and management planning across planning platforms
6. Special focus on resilience sector strategies

The pathway diagrams linked the strategies within the adaptation plan with short- and long-term outcomes and their corresponding influence on health. See page 17 for each of the six draft pathway diagrams constructed by Region Nine staff.

The HIA Advisory Committee examined the developed pathway diagrams and discussed how health could play a role in the outcome of each objective. Committee members were encouraged to share their thoughts and to provide additional input into the health outcomes of each objective.

The HIA Advisory Committee determined the following health priorities to scope the HIA. The results are in order of highest priority to lowest priority and are based on weighted averages:

1. Pathogens and chemicals in drinking water (e-coli, other nitrates)
2. Respiratory illnesses due to air quality changes/wildfires (asthma, COPD)

3. Heat illnesses (heat stroke, algae blooms)
4. Increased falls, mobility issues and traffic crashes/deaths due to extreme winter storms
5. Drowning/other injuries, mobility issues, mental health/economic issues due to flooding
6. Vector-borne illnesses from increase in ticks, mosquitoes
7. Injuries due to storms

Baseline Assessment of Region Nine

The Region Nine Climate Change Plan and HIA will affect residents living within Region Nine including the following counties: Blue Earth, Brown, Le Sueur, Faribault, Martin, Nicollet, Sibley, Waseca, and Watonwan. Of those living within these boundaries, children, older adults, certain races, low-income families, and those living with a health condition may be less resilient to the effects of climate change and adaptation decisions. The following tables and paragraphs summarize some of the demographic and health data available for Region Nine counties.

Region Nine encompasses over 231,000 residents and is illustrated in Table 1. The range of population is 11,211 (Watonwan County) to 64,013 (Blue Earth County). As a whole, Region Nine has a large aging population (15.3 percent) compared to the State of Minnesota (12.9 percent). The average age of residents in Region Nine is 39.9 years. Blue Earth County maintains the lowest median age at 29.8, while Faribault County median age is 46, closely followed by Martin County at 45.5, and Brown County at 43.3.

Table1: Region Nine Population, Age and Sex

Total Population, Age and Sex						
	Total Population	Number of Males	Number of Females	Percent Less than 18	Percent 65 and over	Median Age (years)
Blue Earth	64,013	32,209	31,804	19.3%	11.8%	29.8
Brown	25,893	12,856	13,037	22.0%	18.9%	43.3
Faribault	14,553	7,231	7,322	22.0%	21.8%	46.0
Le Sueur	27,703	13,988	13,715	25.5%	14.4%	39.8
Martin	20,840	10,229	10,611	22.2%	20.7%	45.5
Nicollet	32,727	16,364	16,363	22.6%	12.0%	33.5
Sibley	15,226	7,648	7,578	25.6%	16.3%	40.3
Waseca	19,136	8,976	10,160	23.6%	14.7%	39.3
Watonwan	11,211	5,612	5,599	25.0%	19.0%	41.2
Region 9	**231,302**	**115,113**	**116,189**	**22.3%**	**15.3%**	**39.9**
Minnesota	**5,303,925**	**2,632,132**	**2,671,793**	**24.2%**	**12.9%**	**37.4**

Source: 2010, Decennial Census, U.S. Census Bureau

Overall, the counties located in Region Nine are predominately White/Caucasians. The greatest number of White/Caucasians in Region Nine is located in Brown County (97.5 percent), Martin County (96.7 percent), and Faribault County (96.5 percent). Watonwan County experiences the most diversity with 13.1 percent of residents a race other than White/Caucasian. Blue Earth County has the highest percentage of Black/African Americans at 2.7 percent, Asians at 2.0 percent, and two or more races at 1.6 percent. The highest percentage of American Indian is Waseca County with 0.8 percent. Counties in Region Nine contained few Hawaiian/Pacific Islanders. Watonwan County had 10 percent of residents with another race other than White/Caucasian, Black/African American, American Indian, Asian, or Hawaiian/Pacific Islander.

Although less racially diverse than Minnesota, Region Nine (4.8 percent) has a slightly higher percentage of Hispanics/Latinos compared to the state (4.7 percent). Watonwan County (20.9 percent) has one of the highest percentages of Hispanics/Latinos throughout Minnesota. Blue Earth County has the lowest percentage of Hispanics/Latinos with 2.5 percent (see Table 2).

Table 2: Region Nine Demographics, Race and Ethnicity

Race and Ethnicity							
	White/ Caucasian	Black/ African American	American Indian	Percent Asian	Some Other Race	Two or More Races	Hispanics/ Latinos
Blue Earth	92.8%	2.7%	0.3%	2.0%	0.6%	1.6%	2.5%
Brown	97.5%	0.2%	0.1%	0.6%	0.9%	0.7%	3.3%
Faribault	96.5%	0.3%	0.4%	0.3%	1.5%	0.9%	5.6%
Le Sueur	95.5%	0.3%	0.3%	0.6%	2.2%	1.1%	5.2%
Martin	96.7%	0.3%	0.3%	0.5%	1.3%	0.9%	3.6%
Nicollet	93.7%	2.0%	0.3%	1.3%	1.2%	1.4%	3.7%
Sibley	94.8%	0.3%	0.2%	0.6%	3.0%	1.2%	7.2%
Waseca	93.7%	2.0%	0.8%	0.7%	1.3%	1.5%	5.1%
Watonwan	86.9%	0.7%	0.4%	0.8%	10.0%	1.2%	20.9%
Region 9	**94.3%**	**1.4%**	**0.3%**	**1.1%**	**1.3%**	**1.2%**	4.8%
Minnesota	**85.3%**	**5.2%**	**1.1%**	**4.0%**	**1.9%**	**2.4%**	4.7%

Source: 2010, Decennial Census, U.S. Census Bureau

Table 3 shows that the percentage of population below the poverty level in Region Nine (12.6 percent) is higher than Minnesota's poverty level (11.5 percent). The highest percentage of poverty in Region Nine is in Blue Earth County with 18.9 percent and the lowest is in Brown County with 8.4 percent. Faribault County (22.2 percent) has the highest amount of people 18 and under below the poverty level. Brown County (11.6 percent) has the highest amount of the population 65 years and over below the poverty level.

Table 3: Region Nine Population, Poverty Levels

Poverty Levels			
	Population below poverty level	Population under 18 below poverty level[1]	Population 65 years and over below poverty level[2]
Blue Earth	18.9%	15.0%	7.6%
Brown	8.4%	9.3%	11.6%
Faribault	13.2%	22.2%	10.0%
Le Sueur	9.1%	10.9%	8.1%
Martin	10.6%	17.3%	7.6%
Nicollet	10.7%	9.1%	7.6%
Sibley	10.8%	19.2%	9.5%
Waseca	9.9%	13.8%	7.3%
Watonwan	9.9%	13.1%	5.9%
Region 9	**12.6%**	**13.7%**	**8.4%**
Minnesota	**11.5%**	**14.8%**	**7.8%**

[1]Poverty level for a family of four with two children under 18 years was $22,811.
[2]Poverty level for one person 65 years and over was $10,788 and $13,609 for two-person household 65 years and over.

Source: 2010-2014, American Community Survey 5 year, AmericanFact Finder

Data shown in Table 4 concerns reasons for hospitalizations throughout the counties in Region Nine and Minnesota. The rate of asthma emergency department visits was lowest in Faribault County at 18.2 per 100,000 people and highest in Martin County at 34.1 per 100,000. Faribault County has the highest rate of asthma hospitalizations. Sibley County has the lowest amount of asthma hospitalizations at 3.1 per 100,000. Chronic Obstructive Pulmonary Disease (COPD) hospitalizations were lowest in Le Sueur County and Watonwan County at a rate of 20.2 per 100,000 and the highest at in Martin County at 63.8 per 100,000. Carbon monoxide poisoning emergency department visits were highest in Nicollet County at 8.1 per 100,000. Carbon monoxide hospitalizations were unstable throughout the counties located in Region Nine. Heart attack hospitalizations were lowest in Le Sueur County at a rate of 28.4 per 100,000 and highest in Martin County at a rate of 56.8 per 100,000. Minnesota has a significantly lower rate of heart attack hospitalizations at 29.2 per 100,000. The rate of heat-illness emergency department visits was highest in Martin County at 37 per 100,000 and lowest in Faribault County at 6.6 per 100,000. Heat-illness hospitalizations were lowest in Martin County at a rate of 0.7 per 100,000 people.

Table 4: Region Nine Population, Hospitalizations

Hospitalizations								
	Asthma emergency department visits	Asthma	COPD	Carbon monoxide poisoning emergency depart. visits	Carbon monoxide poisoning	Heart attack	Heat-illness emergency department visits	Heat-illness
Blue Earth	24.1	4.7	35.1	5.6 (UR)	0.0 (UR)	33.1	14.6	0.9 (UR)
Brown	25.1	4.6	23.9	*	0.0 (UR)	49.5	29	1.6 (UR)
Faribault	18.2	6.5	42.5	*	0.0 (UR)	49.3	6.6 (UR)	2.3 (UR)
Le Sueur	25.4	4.2	20.2	*	0.0 (UR)	28.4	27.1	1.3 (UR)
Martin	34.1	6.3	63.8	*	0.0 (UR)	56.8	37	0.7 (UR)
Nicollet	31.8	3.5	34.1	8.1 (UR)	0.0 (UR)	32.6	21.5	1.2 (UR)
Sibley	19.4	3.1 (UR)	26.5	*	0.0 (UR)	36.9	18.6 (UR)	1.1 (UR)
Waseca	39.9	5.7	26.2	*	0.0 (UR)	36.5	29.6	0.8 (UR)
Watonwan	39.7	6.3	20.2	*	0.0 (UR)	35.2	25.3 (UR)	1.4 (UR)
Minnesota	**38.7**	**6.3**	**28**	**10.6**	**0.8**	**29.2**	**16.7**	**1.7**

Source: 2011-2013, Minnesota Public Health Data Access, Minnesota Environmental Public Health Tracking Program, Minnesota Department of Health
1. Based on crude death rate, which is the number of deaths divided by the total population, multiplied by 100,000

The top five cancer incidences in the counties of Region Nine included the following: breast, colorectal, lung and bronchus, melanoma, and non-Hodgkin lymphoma (see Table 5). Waseca County had the highest rate of breast cancer at 152.8 per 100,000 and Watonwan County had the lowest rate at 83.7 per 100,000. The colorectal cancer rate was highest in Martin County at 49.6 per 100,000 and lowest in Waseca County at 33.8 per 100,000. Lung and bronchus cancers were highest in Watonwan County at 66.7 per 100,000 and lowest in Martin County at 47.7 per 100,000. Melanoma was most prevalent in Martin County with a rate of 42.3 per 100,000 and the least prevalent in Sibley County at 12.6 per 100,000. Non-Hodgkin Lymphoma was highest in Waseca County with a rate of 31.6 per 100,000 and lowest in Le Sueur County with a rate of 16.4 per 100,000.

Table 5: Region Nine Population, Cancer Incidence

Cancer Incidence					
	Breast	Colorectal	Lung and Bronchus	Melanoma	Non-Hodgkin Lymphoma
Blue Earth	133.3	40.9	50.5	21.4	21.7
Brown	139.9	47.2	56.1	25	17.9
Faribault	125.4	47	51.6	36	19.5
Le Sueur	114	48.3	55.2	22.5	16.4
Martin	124.6	49.6	47.7	42.3	17.3
Nicollet	124.9	37.9	50.2	34.2	18.2
Sibley	116.8	36.2	63.9	12.6	22.3
Waseca	152.8	33.8	53.5	18.3	31.6
Watonwan	83.7	38	66.7	34.4	30.4
Region 9	123.9	42.1	55	27.4	21.7
Minnesota	**130.3**	**41**	**55.4**	**27.1**	**23**

Minnesota Department of Health: Environmental Public Health Tracking Program, 2008-2012

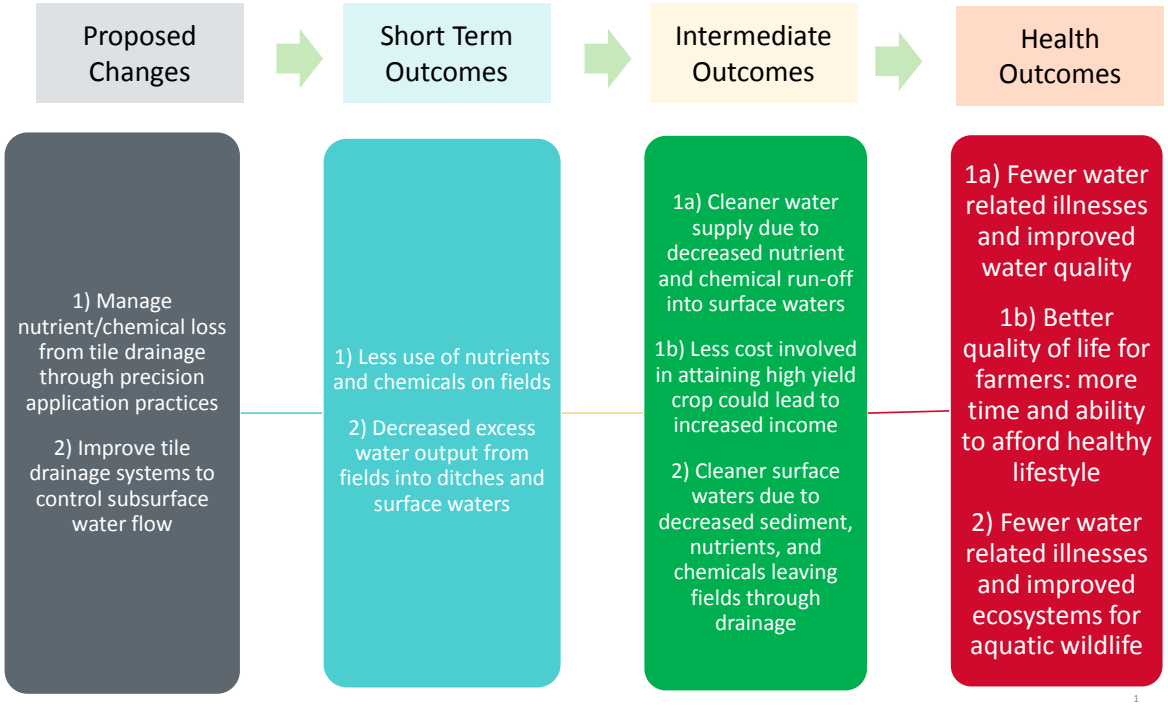
Scoping Summary

Due to limited time and resources, the Region Nine HIA Project Team and Advisory Committee narrowed the assessment of the HIA to the first health priority, pathogens and chemicals in drinking water, and the strategies within Objective 1. While some of the data discussed in the baseline assessment of Region Nine may not be relevant to this priority, the foundation was set during the Screening and Scoping phases to assess all of the Climate Change Adaptation Plan objectives and strategies, should funding, time, and value be found.

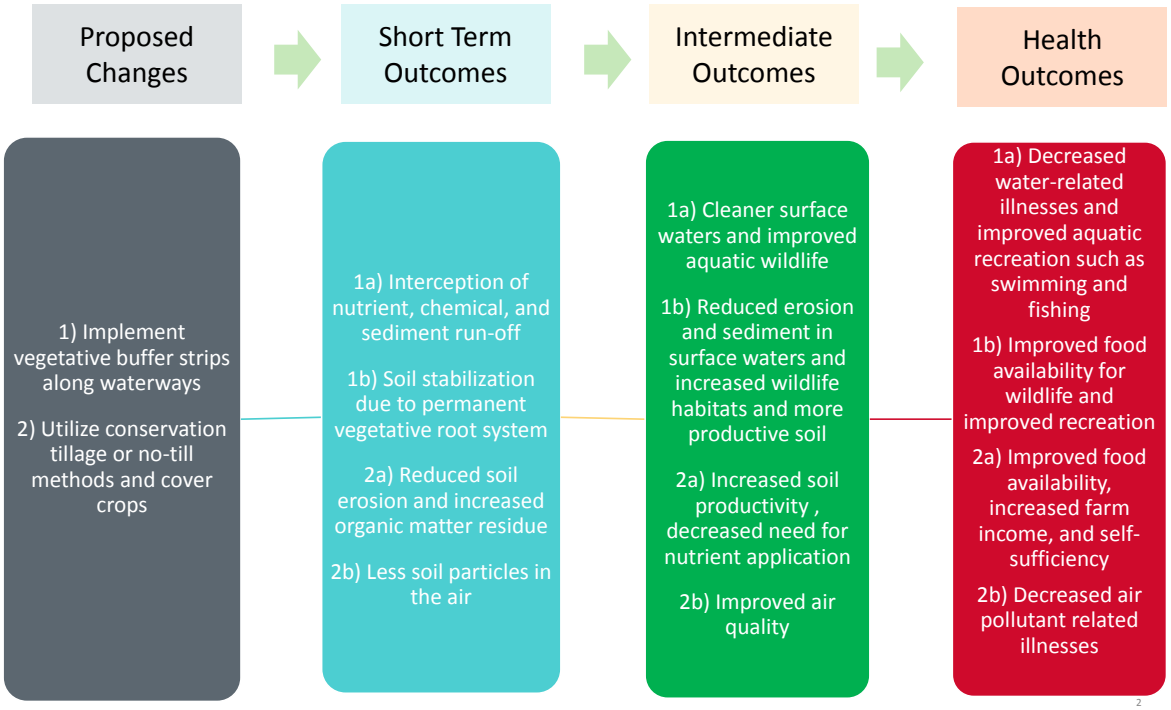
Pathway Diagrams

The following pathway diagrams describe the ways health may be affected by the five strategies in Objective 1 of the Climate Change Adaptation Plan.

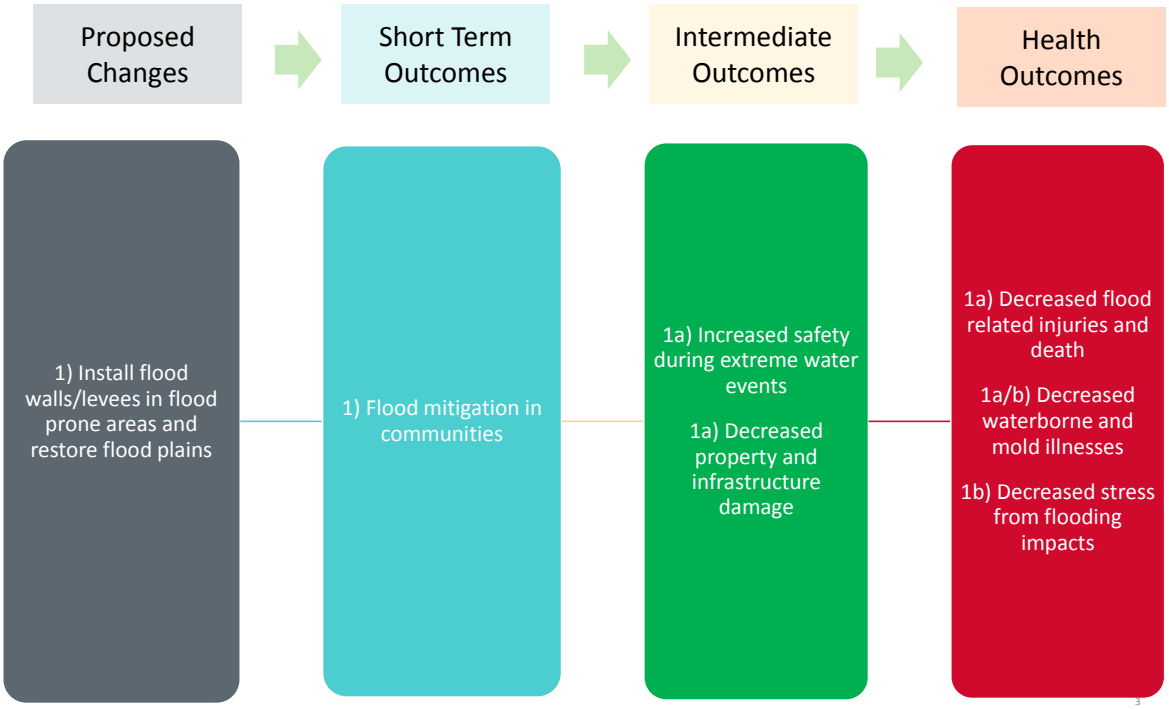
Strategy 1.1: Increase Conservation Practices



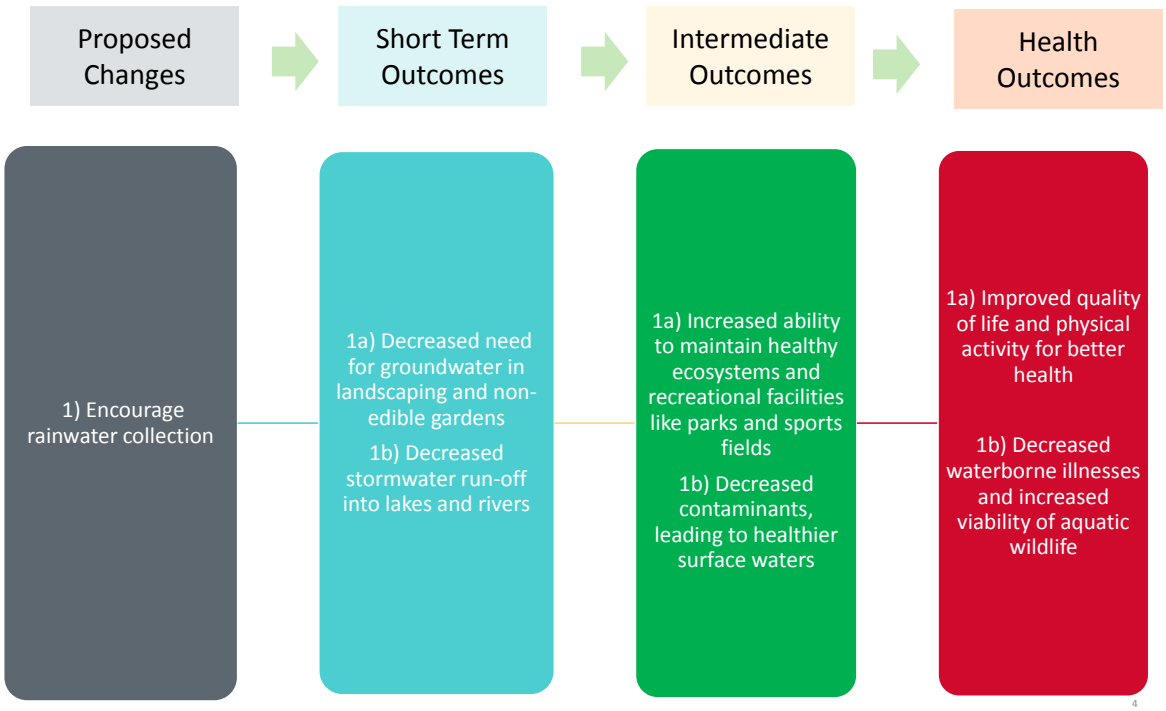
Strategy 1.2: Retain topsoil and agriculture productivity during extreme rain, drought, and freezing events



Strategy 1.3: Manage impact of flooding



Strategy 1.4: Promote water conservation



Assessment

Introduction

The third phase of the HIA is assessment, which involves two parts. The first part identifies population characteristics that will be affected by the adaptation strategies. This includes information on specific infrastructure within the nine-county service area and scientific information relevant to the strategies. The assessment phase also utilizes the previous baseline data gathered in the scoping phase.

The second part of the assessment phase determines how this information, along with the adaptation strategies, will affect the health of Region Nine residents. This is accomplished by conducting a literature review of scientific studies, including any benefits/detriments to health these strategies may cause Region Nine residents.

Adaptation Strategies Reviewed

The HIA that Region Nine is conducting is a rapid HIA. Due to the shortened timeframe, the assessment phase focuses on Climate Change Adaptation Plan: Objective 1 and the strategies developed by the task force which pertain to it. The HIA assessment will examine any policies or tactics that could affect health, both qualitatively and quantitatively.

Objective 1: Enhance Soil and Water Management

Soil and water are not only the foundations that life is based on, but also a major economic driver within Region Nine. This objective seeks to help Region Nine leaders make good, health-conscious policy decisions combined with outreach and education to residents in terms of managing these important natural resources in a changing climate.

With temperatures expected to increase between 1.1 and 6.4 degrees Celsius during the 21st century and precipitation patterns altering, soil quality and soil erosion are of a major concern to the environmental and agricultural communities (Brevik 2013). Increased heavy rain events create more erosion of the soil as the precipitation washes away top soil. This could create crop yield issues if the soil becomes too degraded and increasing amounts of nutrients needed to combat the decreased soil quality, the run-off from the soil may have negative impacts on surface and groundwater.

Soil erosion and run-off caused by increasing heavy rain events lead to an increase in sediment accumulation in surface waters. This increase in sediment is a major source of nutrient contamination in rivers and lakes in Region Nine.

Soil Quality

Soil quality refers to the "capacity of a soil to function for specific land uses or with ecosystem boundaries," (U.S Department of Agriculture [hereafter USDA] 1995). High quality soil supports multiple ecosystem services, including helping to clean water and air, and developing strong/ healthy plant growth which are essential for a healthy region.

When soil quality degrades either through environmental or artificial (human) means, the ability of that soil to produce is impaired. The most common cause of soil impairment is soil erosion. When soil erosion occurs, organic matter is lost, rooting depth decreases and the amount of water retained in soil is diminished. This process can be accelerated by farming practices like cultivation and excessive tillage as well as natural events like flooding, droughts, or fires.

Another contributor to impaired soil quality is the accumulation of added nutrients or chemicals to the soil. If over-applied, the soil may not be able to absorb the nutrients or chemicals effectively, thus increasing environmental contamination through leaching and run-off (University of Massachusetts, Amherst n.d.).

Both issues with soil quality and impairment can lead to ground, water, or air pollution. When soil erodes, the sediment, which may contain added nutrients or chemicals, can pollute ground water and nearby water bodies. Natural events like flooding can also cause soil and water run-off to carry these chemicals and nutrients into the region's water supplies.

Protecting the quality of soil and water is critical to the physical, environmental, and economic health of Region Nine. Agriculture continues to be a large part of the region's economy. This includes crop farming as well as animal production, both of which rely on high quality soil and water. Tied in with the agriculture industry are related businesses, such as ethanol plants, food manufacturing, and agriculture-based retail sales. These businesses rely on the region's farmers to provide them with a premium product and in the quantities they need.

Water quality

Water quality is fundamental to the health of the region's residents and environment. Some of the ways in which Region Nine utilizes its water supply are drinking water, recreational activities, wildlife habitats, and agricultural and commercial uses. The water supplies that are of primary concern for Region Nine are freshwater bodies (rivers and lakes) and groundwater environments.

The quality of water supplies are closely linked to the surrounding environment and land use including urban and industrial uses, agriculture, and recreation. Human adjustments to water pathways, like dams and weirs, can also affect water quality.

Approximately 95 percent of rural Minnesota residents use groundwater to supply their drinking and agricultural needs (Anderson, Liukkonen, and Bergsrud 1993). Urban areas also utilize groundwater, but the majority of them are run through a municipal or public water system that requires regular testing for quality standards. In Minnesota, water quality concerns of public health officials besides certain chemicals and metals include disease-causing bacteria and viruses, such as coliform bacteria and nitrates (Anderson, Liukkonen, and Bergsrud 1993).

Pollution Pathways

There are two main ways that pollutants enter the water: point and nonpoint sources.

Point Sources

A point source is a "single, identifiable source of pollution, such as a pipe or drain," (Environmental Protection Authority, Victoria 2012). This type of pollution is often seen in industrial waste discharges into rivers and lakes.

Nonpoint Sources

Often called "diffuse" pollution, nonpoint sources refer to "inputs and impacts which occur over a wide area and are not easily attributed to a single source," (Environmental Protection Authority, Victoria 2012). In terms of pollution sources, the main concerns of this HIA fall into this category. Examples of nonpoint sources of pollution include the following:

- Urban and Residential Sources: run-off from stormwater and septic systems
- Agriculture: run-off from pesticides, nutrients, and animal manure

Existing conditions question: *What are the pathways of pathogen and chemical contamination of water in Region Nine?*

Impact question: *What are the human health impacts of contaminated water?*

Pathways in Region Nine

Depending on the type of pollutant, water contamination can come from multiple pathways. The most common methods of transmitting a contaminant into a water environment are caused by water itself in the form of rain and flooding. Excessive rainfall on fields and city streets may cause pesticide, chemical, nutrient, and effluent run-off to enter water bodies causing contamination. Ground leaching from over-applied chemicals and nutrients, such as nitrate may cause groundwater contamination depending on the depth and composition of the soil (World Health Organization 2004).

Water Contaminants

Water contaminants that will be focused on in this section consist of nutrients and pesticides used in agriculture production and seen in run-off from urban sewer management systems.

Nutrient Pollution

Nitrogen and phosphates are essential for healthy plant life. Farmers will often apply additional nitrogen and phosphorus to grass crops like corn to boost the productivity of each plant, increasing crop yield. The most common nitrogen and phosphorus application is in the form of fertilizer. If over application occurs, the excess fertilizer may run-off the field in the form of nitrates and phosphates. These excess nutrients can then make their way to adjacent surface waters.

Nitrate Health Impacts

The primary population affected by an increase of nitrates in drinking water is infants under six months of age. Formula mixed with nitrate contaminated drinking water can cause blue baby syndrome. This occurs when normally present bacteria in an infant's stomach convert the nitrate to nitrite. Nitrite can "interfere with the ability of the infant's blood to carry oxygen" (Minnesota Department of Health [hereafter MDH] August 2015), which causes the baby's skin to turn blue. If the levels of nitrates are high enough and medical attention is not received quickly, death can occur (MDH August 2015).

Nitrate concentration tends to be more pronounced in groundwater than in surface waters making well water contamination in high-nitrate pollution areas a developing concern. This does not mean that nitrates do not get into surface waters. According to a study by the Minnesota Pollution Control Agency (MPCA) on nitrogen levels in Minnesota surface waters, each of the counties in Region Nine's service area had either a high area of concentration, or the highest level of nitrogen pollution (Minnesota Pollution Control Agency [hereafter as MPCA] 2013). High levels of nitrate in lakes can hurt the ecosystem of the water, harming fish and other aquatic life. It is also believed that nitrate pollution from Minnesota via the Mississippi River has contributed to an oxygen depleted "dead zone" in the Gulf of Mexico (MPCA 2013).

In south central Minnesota, the highest nitrate yielding watersheds are Cedar, Blue Earth, and Le Sueur. It should be noted that standard water-treatment practices remove very little of the nitrate found in drinking water. One practice that water utilities perform is combining more than one water supply so the blended combination of water has acceptable nitrate levels (MDH May 2015).

Phosphate Health Impacts

Phosphates are generally not harmful to humans unless ingested at extremely high levels. Phosphorus in the form of phosphates, is most damaging to surface water ecology. As a key element for plant and animal growth, significant increases due to run-off either from rural or urban environments will cause algal and aquatic plants to grow wildly, choke up the water ways, and use up large amounts of oxygen (Kumar and Puri 2012). This process of over-fertilization is known as Eutrophication. This rapid growth can cause death and decay of vegetation and animal life because of the decrease in the water body's dissolved oxygen levels (Kumar and Puri 2012).

Pathogens in Water

There are many different bacteria, viruses and microorganisms that exist in surface and groundwater. Because there are so many different kinds of pathogens that can be present in water that are harmful to human health, two "indicator organisms" are normally used to detect possible problems in water quality.

Fecal Coliform and E. coli provide a good indication of whether pathogens may be present in water (MPCA 2008). These bacteria originate from human, pet, livestock, and wildlife waste and are seen in agricultural areas as well as near wastewater treatment plants. Within animal waste there may also be other protozoa microorganisms such as Cryptosporidium or Giardia.

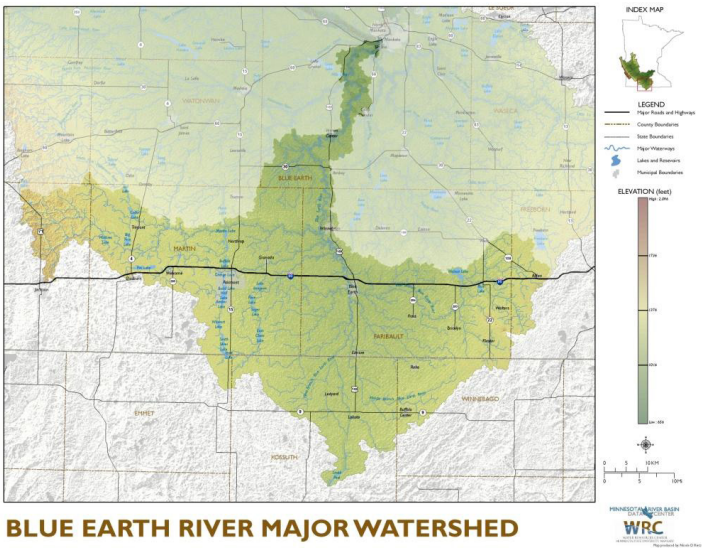
Common symptoms of waterborne diseases may include gastrointestinal illnesses such as severe diarrhea, nausea, jaundice as well as associated headaches and fatigue (MDH July 2015).

Existing Conditions Question: *What are the conditions of Watersheds in Region Nine?*

Region Nine Watershed Contaminant Concerns

The State of Minnesota has 81 major watersheds. The nine-counties located in Region Nine are within these seven watersheds, and are illustrated in Figures 1-7.

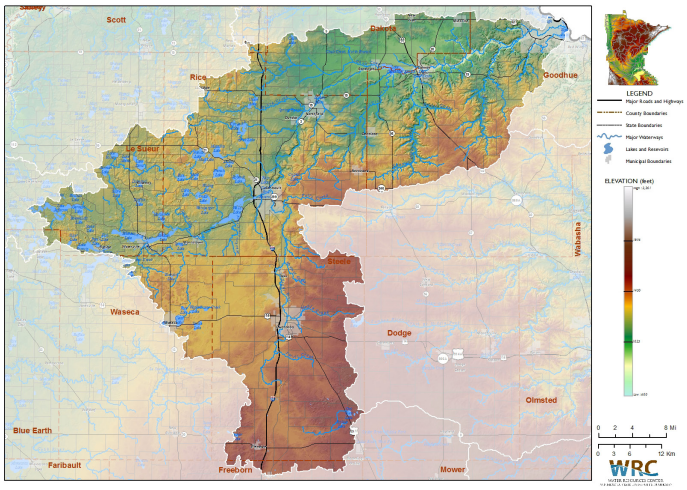
Figure 1: Blue Earth River Major Watershed: Minnesota River Basin Data Center



BLUE EARTH RIVER MAJOR WATERSHED

Blue Earth River: The Blue Earth River Watershed has an area of 1,550 square miles, or 992,034 acres. Agriculture is the primary land use. Region Nine counties that are within this watershed are Blue Earth, Faribault, Martin, and Watonwan. The Blue Earth River is the Minnesota River's largest tributary, and a major contributor of sediment. Water quality concerns include soil erosion and sediment, turbidity impacting fish and other aquatic life, total suspended solids, and bacteria (MPCA, Blue Earth River).

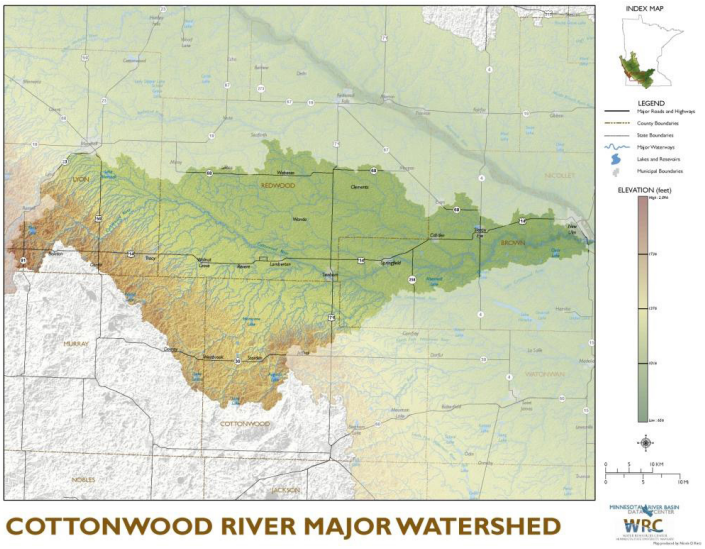
Figure 2: Cannon River Major Watershed: Minnesota River Basin Data Center



CANNON RIVER MAJOR WATERSHED

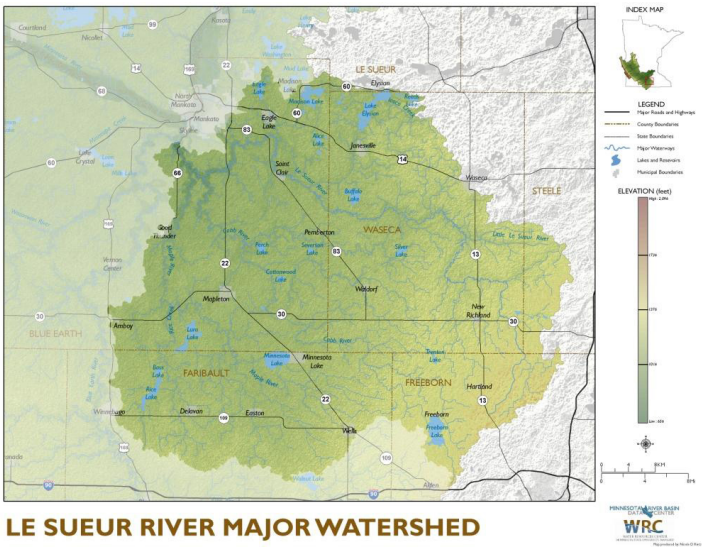
Cannon River: The Cannon River Watershed has an area of 1,460 square miles, or 934,400 acres. Agriculture is the primary land use. Region Nine counties within this watershed are Le Sueur and Waseca. The two main water channels are the Cannon and Straight Rivers that drain into the Mississippi at Redwing, MN. Water quality concerns include turbidity, bacteria, and excessive nutrients (MPCA, Cannon River).

Figure 3: Cottonwood River Major Watershed: Minnesota River Basin Data Center



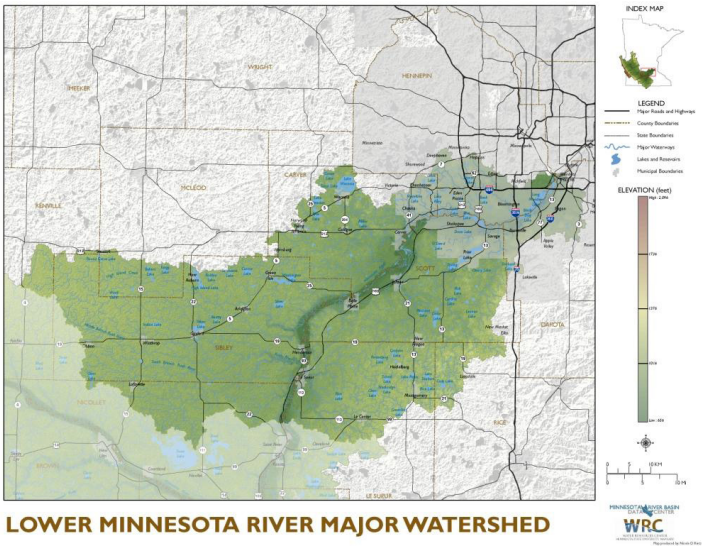
Cottonwood River: The Cottonwood River Watershed has an area of 1,313 square miles, or 840,000 acres. Agriculture is the primary land use. Brown is the only Region Nine county within this watershed. Water quality concerns include turbidity and bacteria (MPCA, Cottonwood River).

Figure 4: Le Sueur River Major Watershed: Minnesota River Basin Data Center



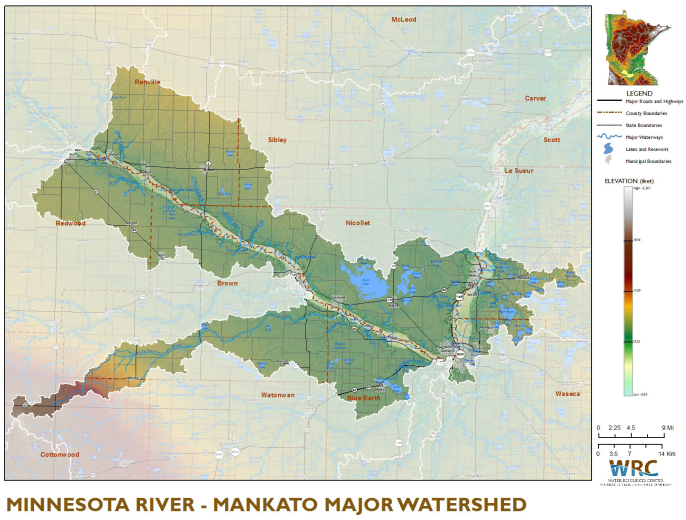
Le Sueur River: The Le Sueur River Watershed has an area of 1,112 square miles, or 711,838 acres. Agriculture is the primary land use. Region Nine counties that are within this watershed are the counties of Blue Earth, Faribault, Le Sueur, and Waseca. The Le Sueur River joins the Blue Earth River near the Red Jacket Bridge in Mankato, MN. Water quality concerns include low dissolved oxygen, turbidity, and excess nutrients. The Le Sueur waters are also a major source of sediment and nutrients to the Minnesota River (MPCA, Le Sueur River).

Figure 5: Lower Minnesota River Major Watershed: Minnesota River Basin Data Center



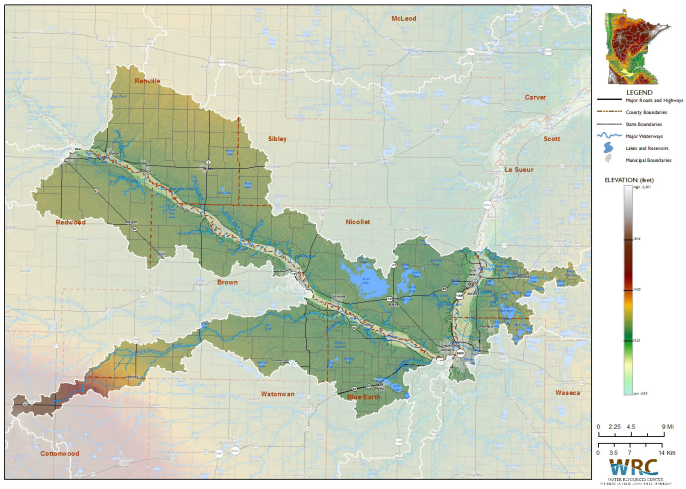
Lower Minnesota River: The Lower Minnesota River Watershed has an area of 1,821 square miles, or 1,165,229 acres. Agriculture is the primary land use. Region Nine counties in this watershed are Le Sueur, Nicollet, and Sibley. Water from the Lower Minnesota River flows into the Mississippi River at Fort Snelling, MN. Water quality concerns include levels of sediment, bacteria, nutrients and chloride, and their impacts to fish and other aquatic life (MPCA, Lower Minnesota River).

Figure 6: Minnesota River – Mankato Major Watershed: Minnesota River Basin Data Center



Minnesota River – Mankato: The Minnesota River – Mankato Watershed has an area of 1,347 square miles, or 861,886 acres. Agriculture is the primary land use. Region Nine counties within this watershed are Blue Earth, Brown, Le Sueur, Nicollet, and Sibley. Water quality concerns are sediment and erosion control, stormwater management, drinking water and source water protection, drainage management, waste management, nutrient management, surface water quality and wetland management (MPCA, Minnesota River – Mankato).

Figure 7: Watonwan River Major Watershed: Minnesota River Basin Data Center



MINNESOTA RIVER - MANKATO MAJOR WATERSHED

Watonwan River: The Watonwan River Watershed has an area of 875 square miles, or 561,620 acres. Agriculture is the primary land use. Region Nine counties within this watershed are Blue Earth, Brown, Martin, and Watonwan. The Watonwan River flows into the Blue Earth River near the Rapidan Reservoir in Blue Earth County. Much of the river has been straightened and/or altered for farmland drainage and flood reduction. Water quality concerns are sediment and erosion control causing turbidity and their impacts to fish and other aquatic life, total suspended solids, and bacteria (MPCA, Watonwan River).

The MPCA evaluates each watershed in Minnesota every ten years (MPCA 2015). The process consists of four steps:

1. Monitor and assess each river, stream, and lake's water quality
2. Identify stressors that may positively or negatively affect water quality
3. Develop strategies to restore and protect water bodies in the watershed
4. Implement restoration/protection projects in each watershed

Of the areas assessed within Region Nine, swimming and recreation/fishing on lakes, rivers and streams are heavily affected by pollutants. Areas that have large populations of people and livestock along water bodies were found to have more problems with contamination. Lakes suffered specifically from large amounts of algae bloom that makes swimming in these water bodies undesirable, while rivers and streams had elevated levels of pathogens like E. coli bacteria. All the watersheds in Region Nine had high levels of nitrogen, phosphorus and suspended solids contamination (MPCA 2015).

Health Impacts of Surface Water Contamination

One health impact related to increased algae in lakes concerns the development of blue-green algal blooms and dinoflagellates that produces red tide. These microorganisms can release powerful and poisonous toxins into the water. These toxins are harmful to livestock and humans. When ingested in low concentrations, the toxins can cause liver failure and death in higher concentrations (United Nations Environment Programme n.d). Typical symptoms of toxin ingestion in humans include: diarrhea, rashes, eye irritation, sore throats, coughs and headaches (Forum News Service 2016).

This form of algae grows in warm, nutrient-rich environments, and can be seen in most lakes in Region Nine. Unfortunately, there is no way to know by sight if the blue-green algae in water is

producing toxins. Instead, it is recommended that people stay away from lakes and streams that have a green, thick, soup-like appearance and a foul odor emanating from them. As temperatures continue to rise due to climate change, blue-green algae will continue to be an issue in Region Nine.

Region Nine Drinking Water Sources

The primary sources of drinking water in Minnesota are through groundwater wells, either domestic or public. However, Twin Cities and St. Cloud residents rely heavily on surface waters from the Mississippi River, and the Duluth area utilizes waters from Lake Superior (Freshwater Society 2012). Region Nine gets most its groundwater from bedrock sources, although parts of the counties in the northeastern portion of Region Nine receive their groundwater from glacial drift sources. Table 6 details the groundwater source(s) for each county in Region Nine.

Table 6: Region Nine Groundwater

Ground Water Sources	
Blue Earth	Bedrock, Glacial Drift
Brown	Glacial Drift
Faribault	Bedrock
Le Sueur	Bedrock
Martin	Bedrock, Glacial Drift
Nicollet	Bedrock, Glacial Drift
Sibley	Bedrock, Glacial Drift
Waseca	Bedrock
Watonwan	Bedrock, Glacial Drift
Sources: DNR Minnesota's Water Supply, 2000	

Both surface waters and groundwater aquifers require rain to replenish their supply. However, with increased land development, including paved surfaces, the amount of water that can seep into the ground is reduced. This can limit the ability of an aquifer to recharge. While most of the counties within Region Nine have yet to experience a reduction in water availability, it is important to understand how groundwater can be depleted and/or contaminated.

In general, domestic wells are shallower than public-supply wells, which can make them more vulnerable to contamination. In agricultural areas, many domestic wells are located near septic systems, cropland, or animal feeding areas (MDH May 2015). This makes them even more susceptible to contamination by nitrates or bacteria. In addition, private wells are not regularly tested for contamination, as it is the responsibility of the well owner to test the water. Thus, it is challenging to know how many wells may be contaminated in the nine-county region. Table 7 illustrates the number of wells in the nine-county region. Public water supplies are tested regularly for contaminants to ensure a safe drinking water supply.

Table 7: Wells Recorded in Region Nine Counties

	Wells	
	Domestic	**Public-Supply**
Blue Earth	2650	145
Brown	1420	85
Faribault	829	55
Le Sueur	2307	112
Martin	1502	53
Nicollet	1361	82
Sibley	1450	52
Waseca	1088	49
Watonwan	667	54

Sources: MDH Minnesota Wells Index 2016

Strategy 1.1: Increase conservation practices

The focus of this strategy is to manage tile drainage during extreme precipitation events. The strategy may require restructuring of older field drainage systems with controlled systems.

Impact questions: *How will subsurface tile management reduce the levels of pathogens and chemicals in the drinking water for residents with the nine counties covered by Region Nine?*

Tile Drainage Benefits

Tile drainage or subsurface drainage, is the "practice of placing perforated pipe at a specified grade (slope) at some depth below the soil surface. Excess water from the crop root zone can enter the pipe through the perforations and flow away from the field to a ditch or other outlet" (Sands 2001). By draining excess water away from the field, the productivity of the soil is improved while also providing greater soil aeration, crop emergence and growth, and reduction of soil compaction (Sands 2001). Tiling also encourages development of a stronger root system during periods of heavy rain and assists with maintaining planting and harvesting timetables by stabilizing soil moisture.

Tile Drainage Concerns

While the benefits of subsurface drainage for the agriculture sector are clear, there are also problems that can arise. One of those concerns is the effect of tile drainage on water quality. Even though surface run-off can contain more nutrients and chemicals than subsurface drainage, nitrates and other soluble constituents remain an issue with water removed by tiling (Busman and Sands 2002). On average, drainage can cause "10-15 percent more water to leave a field than those without drainage, but is highly dependent on the weather," (Sands 2001). Once the drained water is out of the field, it has the potential to move through natural or man-made soil drainage systems and end up in nearby surface waters.

Tiling Best Practices

The agriculture industry continues to look for ways to improve on standard farming practices that can address water quality issues due to subsurface drainage systems. Currently, there are multiple ways farmers can work to reduce potential impacts due to subsurface drainage, including precision farming practices and improved drainage system design.

Precision farming practices can help manage nutrient application, including nutrient source, application rate/amount, and timing. Using a more precise measurement for the appropriate level of nutrient increases the chances that the nutrient will be absorbed effectively and more completely into the soil, reducing the amount of nitrate run-off. Better control of nitrogen fertilizer can potentially reduce nitrate loss levels by up to 30 percent (Busman and Sands 2002). Less nutrient use also means less expense for the farmer.

Excessive nitrogen use (in the form of fertilizers) has also been linked to increases in atmospheric pollutants, such as carbon dioxide, nitrous oxide, and methane. These compounds, more commonly known as greenhouse gases, are considered a key factor in global warming (Good and Beatty 2011).

Improving current drainage system designs can have a positive impact on reducing nitrate loss in subsurface drainage. New and improved systems may also help water bodies by decreasing the amount of sediment, phosphorus, and bacteria put into lakes from field run-off.

Figure 8: Controlled Drainage vs. Conventional

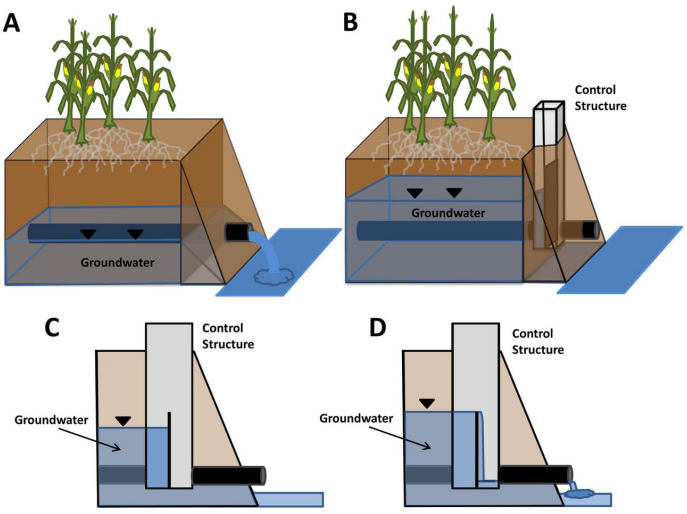
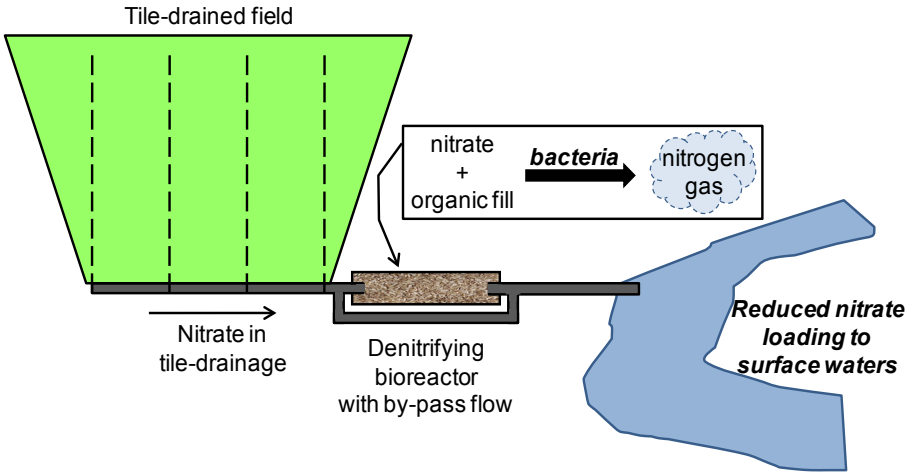


Figure 8 shows the differences between conventional tile drainage (Figure 8:A) and controlled tile drainage (Figure 8:B-D). A controlled drainage system is designed to "release only the amount of water needed to provide an aerated crop root zone and ensure trafficable conditions for field operations" (Minnesota Department of Agriculture [hereafter MDA] n.d.). Controlled drainage systems work best on land that is mostly flat, and they should be monitored by the farmer for maximum benefit. Controlled drainage systems have been shown to significantly decrease the amount of nitrate entering waterways from field drainage compared to conventional drainage systems (MDA n.d.).

Another way to reduce the amount of nitrate from agricultural drainage is to incorporate a denitrifying bioreactor into a drainage system. A denitrifying bioreactor is a structure, typically placed at the end of a tile system, creating a buffer between the field drainage and the ditch or waterway it flows into. Within the bioreactor structure are wood chips that help to remove nitrates from the water. This process is accomplished by denitrifying bacteria within the wood chips. These

"organisms colonize the wood chips, using the carbon in the wood as an energy source and reducing nitrates in the water to nitrogen gas," (Natural Resources Conservation Service 2015). Figure 9 shows the denitrifying bioreactor system and process.

Figure 9: Denitrifying Bioreactors in Tile Drainage



Health Impacts of Managing Tile Drainage Systems

There is much debate on whether subsurface tile drainage causes more harm than surface run-off. While subsurface drainage does cut down on sediment and phosphorus run-off, it may increase dissolved nutrients in drainage water, such as nitrates.

Subsurface drainage systems that are not controlled to prevent drainage from reaching water bodies can also transport run-off containing fecal coliform bacteria from livestock operations or manure application to fields into nearby surface waters (USDA 2009).

Strategy 1.2: Retain topsoil and agriculture productivity during extreme rain, drought, and freezing events

This strategy focuses on the role of vegetated buffers along waterways to minimize nitrate run-off and lessen soil erosion around water bodies. It also seeks to reduce soil erosion due to tillage.

Impact question: *How will vegetative buffers and tillage practices reduce the levels of pathogens and chemicals in the drinking water for residents within the nine counties covered by Region Nine?*

The majority of land use in Region Nine revolves around agriculture, with total cropland accounting for 77.7 percent of all land usage. As such, the methods farmers use have a substantial impact on soil and water quality. Table 8 details agricultural land-use practices in the counties of Region Nine.

Table 8: Agricultural Land-Use Practices in the Counties of Region Nine

Agricultural Land-Use Practices							
	Commercial Fertilizer	Manure	Insecticide	Herbicide	Total Cropland	Total Acres in County	Conservation Land
Blue Earth	233,379	31,411	153,111	308,147	338,830	490,240	11,225
Brown	209,323	30,285	108,640	264,989	296,379	395,520	13,939
Faribault	265,960	26,255	138,364	342,260	370,187	462,080	5,145
Le Sueur	137,292	14,755	69,124	180,498	207,466	303,360	14,091
Martin	304,696	52,066	161,342	383,238	405,588	481,920	6,467
Nicollet	184,611	34,818	73,338	227,245	249,992	298,880	4,991
Sibley	246,302	23,212	97,019	290,189	318,627	384,640	6,266
Waseca	163,389	21,141	83,174	192,871	213,590	277,120	6,937
Watonwan	160,609	17,011	89,674	203,489	223,268	281,600	6,842
Total	**1,905,561**	**250,954**	**973,786**	**2,392,926**	**2,623,926**	**3,375,360**	**72,903**

Sources: 2012 USDA Census Data Measured in Acres

Nutrient application is a common practice by farmers in Region Nine, with 72.6 percent of farmers applying commercial fertilizers and 9.5 percent of farmers applying manure to cropland. It should be noted that studies have shown little to no difference in nitrate loss via tiling systems between commercial fertilizer and manure. The most important indicator of nitrate loss with nutrient use was over-application.

Chemical applications, such as insecticides and herbicides are also used on Region Nine cropland. Herbicide use is the most common practice and is used on 91 percent of all cropland within Region Nine. Insecticides are also used but at a much lower rate than herbicides at 37 percent. Herbicides and insecticides both fall under the category of pesticides, with the first being weed control and the second being bug or pest control. Precision application methods are also recommended for pesticide application to limit water contamination, as are vegetative buffer strips (MDA 2010).

Vegetative Buffer Strips

Vegetative buffer strips serve as a barrier between agricultural land and water bodies or public ditches. Buffers help intercept agricultural run-off before entering into waterways, reducing nutrients and pesticides by 50 percent or more, some pathogens by 60 percent, and sediment by 75 percent or more (Minnesota Department of Natural Resources [hereafter MNDNR] 2007) thereby improving water quality.

Stream protection is another benefit of vegetative buffer strips. The permanent root system established by the buffers help to stabilize the streambank and reduce erosion. Buffers that also incorporate trees into the vegetation are called riparian forest buffers. This style is particularly helpful near streams, as the trees provide a shaded environment that helps to moderate water temperature. This in turn improves conditions for cold-water fish species in the streams and creates

a less conducive environment for some bacteria and pathogens to grow in (MNDNR 2007).

The increase in permanent vegetation can also enhance wildlife habitats, since buffers are a source of food, shelter, and nesting cover for area animals. This improved ecosystem for local wildlife has recreational as well as conservational benefits for the region.

Planting Vegetative Buffer Strips

There are many different ways to utilize the land in the buffer strip including seed mixes, temporary cover crops and mulch, and even for-profit vegetation like timber, nut or berry producing plants as well as plants with biomass uses (Minnesota Board of Water & Soil Resources [hereafter MNBWSR], Section IX n.d.). Perennials are discouraged due to the need for "herbicide application before conducting seedbed preparation," (MNBWSR, Section IX n.d.).

It is important to note that to remain effective, buffer strips must be maintained. This may require reseeding and erosion repair. This means mowing grasses to prevent weed and woody growth and managing invasive plants and noxious weeds within the buffer strip. Care should be taken to manage the buffer without the additional use of herbicides, as they can decrease the buffer's effectiveness and create additional run-off. If herbicide is needed, it must be an aquatically-certified for of glyphosate if used near open water. Other ways to care for buffer strips include prescribed burning, conservation grazing, conservation haying, spot treatment for weeds, and biological control (MNBWSR, Section X n.d.).

Minnesota Vegetative Buffer Regulations

In June of 2015, Minnesota enacted the buffer law, and then amended the law in April of 2016 to provide clarification on landowner requirements. The law requires the implementation of 50-foot-wide vegetative buffers along shore land districts, agricultural areas adjacent to lakes, rivers, and streams in Minnesota unless the area is already part of a resource management system plan. The law also requires any land adjacent to public ditches to incorporate a vegetative buffer strip of 16.5 feet wide on each side.

Health Impacts of Vegetative Buffer Strips

Implementing vegetative buffer strips along public waterways benefits human health by intercepting a high percentage of nutrient, sediment, and bacteria run-off into surface waters. This results in cleaner surface water, which positively effects recreational usage of lakes and rivers, including swimming and fishing.

Tillage Reduction

Conventional tillage practices involve disking, plowing, and other methods of breaking up crop residue left behind after harvest. Conservation tillage and no-till methods are used by farmers that are attempting to preserve the soil's organic residue and prevent erosion of top soil. Unfortunately, there is no "one-size fits all" method of tillage when it comes to agriculture. Soil composition and field terrain dictate the tillage method that is most effective.

Conservation Tillage and No-Till Methods

Conservation tillage and no-till farming require education on best practices to ensure high yield crops and adequate weed and pest control solutions are in place. The University of Minnesota Extension office recommends a corn-soybean rotation when utilizing conservation or no-till farming methods. It should be noted however that corn contributes more organic residue after harvest than soybeans. Therefore, soybeans may benefit more from a corn-soybean rotation than corn.

Cover Crops

Used in conjunction with reduced tillage, planting cover crops is another solution to reducing soil erosion while increasing organic matter and enriching the soil, but cover crops cost farmers additional time and money. Some cover crops, like winter rye, buckwheat, or clove, can be used for hay, silage, or for grazing, which may reduce the financial burden of planting another crop. Soil retention and enrichment may also benefit the farmer in the form of higher yield crops, which could mean less need for additional nutrients.

Sediment deposits in the surface waters of the Minnesota River basin from soil erosion are a "key source of nutrient enrichment and turbidity of the rivers. [The] nutrient enrichment and cloudiness promotes algal blooms, reduces oxygen levels, and interferes with biological and aesthetic well-being of the rivers," (Randall et al. 2002).

Health Impacts of Soil Erosion

Over 99.7 percent of human food comes from cropland, so protecting and improving soil is critical to maintaining an adequate food supply (Cornell University 2006). Drought or excessive rain can cause soil erosion and reduce the land's productivity and impact nearby waterways. These impacts can affect health directly and indirectly in several ways:

- Less productive soil can lead to lower yield crops, causing less food for consumption
- Increased dust from drought and soil erosion can pollute the air, aggravating existing respiratory diseases (Cornell University 2006)
- Recreational waters, such as lakes and rivers, can become contaminated by bacteria and turbidity leading to exposure of humans or animals to the contaminants or reduce the recreational use of the waters, possibly reducing physical activity (Cornell University 2006)

Strategy 1.3: Manage impact of flooding

This strategy focuses on ways that Region Nine can prevent flooding and minimize the negative impacts of extreme water events.

Impact question: *How will flood impact management reduce the levels of pathogens and chemicals in the drinking water for residents within the nine counties covered by Region Nine?*

Floods

The Federal Emergency Management Agency (FEMA) defines a flood as a general and temporary condition where two or more acres of normally dry land or two or more properties are inundated by water or mudflow (Federal Emergency Management Agency 2016). Floods are also the most common natural disaster in the United States.

Flood Walls and Flood Plains

One way that communities have attempted to lessen the impact of flooding is to build levees or flood walls. These structures are generally built out of reinforced concrete or masonry and thus, may be cost prohibitive to smaller communities that do not have the financial capacity. While flood walls have helped alleviate some flooding in communities, it is important to note that many are often built too close to the body of water, and may not be able to contain severe rises in rivers. It is recommended that flood walls be built back to retain some of the river's natural flood plain which itself acts as a natural barrier to rising waters.

In many areas, flood plains have been developed for use, which makes restoring natural flood plains a difficult task in some areas. However, where possible, restoration of natural flood plains along rivers and streams is beneficial in flood reduction as well as habitat and ecosystem development for wildlife.

Health Impacts of Flood Prevention

The ability to keep populated areas free from flooding has many health benefits. Some of the immediate impacts of flooding include drowning, injuries, waterborne illnesses, and mold growth (DU et al. 2010). Indirect health impacts may include property damage, crop loss and infrastructure damage. Damage to roads can negatively impact the ability to get medical attention and limit access people may have to food and employment. These impacts can influence- a community's health, both physically and emotionally.

Strategy 1.4: Promote water conservation

This strategy involves developing and/or utilizing current methods for rainwater collection to lessen the strain on groundwater supplies.

Impact question: *How may rainwater collection methods impact health in Region Nine?*

Rainwater Collection

There are different ways to collect rainwater for use, but the most common method is to capture the rainwater from roofs and store it in tanks for later use (National League of Cities, Sustainable Cities Institute n.d.). These rainwater systems can be as simple as a barrel under a downspout, but can be extensive and collect large amount of rainwater for multiple uses, including drinking.

Collection Methods

Installation of steel or other non-toxic roofing materials and a collection reservoir are the most common methods of rainwater harvesting for private homes. Depending upon how elaborate the home system is, the owner's reliance on public utilities can be drastically reduced.

Rainwater collection can also be practiced by businesses on a much larger scale. In Minnesota, the Maplewood Mall utilizes a stormwater collection system that captures 20 million gallons of stormwater run-off per year (Ramsey-Washington Metro Watershed District 2013). Used in combination with strategically placed landscaping, rainwater harvesting of stormwater in urban areas can significantly reduce the amount of lake and river contamination due to run-off. It is estimated that the Maplewood Mall's retro-fit has reduced phosphorus contamination by 60 percent and sediments by 90 percent (Ramsey-Washington Metro Watershed District 2013).

Health Impacts of Rainwater Collection

The conservation benefits of rainwater collection are many, including the reduction of stormwater run-off into surface waters, decreased river and lake contamination, and reduced stress on local water supplies. While it is possible to treat harvested rainwater for human consumption, the easiest and safest use is for non-potable purposes like irrigation of gardens, athletic fields and parks.

Rainwater harvesting requires education on proper system development and safe uses for the water collected. Using collection devices with unsafe materials (toxic or leaching materials) can contaminate the water and make it unsafe to drink, even with treatment (National League of Cities, Sustainable Cities Institute n.d). Air pollution, roofing materials or organic matter may further contaminate the water. Rain barrels must be covered to prevent them from being used as mosquito breeding areas, thereby reducing the chances of mosquito-borne illnesses such as West Nile virus and La Crosse Encephalitis (MDH n.d).

The Centers for Disease Control and Prevention (CDC) recommends using harvested rainwater in activities or projects that won't result in the rainwater being ingested. This includes drinking, but also garden irrigation of edible plants as they can be contaminated by pollutants in the harvested rainwater (CDC 2013). Common contaminants in harvested rainwater include asbestos, lead, copper, parasites, and germs.

Recommendations

Introduction

The fourth phase of the HIA of the Region Nine Climate Change Adaptation Plan consists of providing recommendations on the strategies proposed by the Climate Change Task Force. On August 4, 2016, Region Nine Development Commission convened a final HIA Advisory Committee meeting to discuss the assessment findings and make recommendations. The process consisted of the Region Nine HIA Advisory Committee reviewing the strategies along with the assessment findings to make evidence-based recommendations that promote positive and mitigate negative health outcomes. Region Nine also engaged advisory committee members that were unable to attend the final meeting via e-mail, and requested input on each of the strategy recommendations developed.

The recommendations pertain to Objective 1: Enhance Soil and Water Management, and the four strategies suggested by the Climate Change Adaptation Task Force (CCATF). Appendix E provides notes from the final HIA Advisory Meeting in which the recommendations were determined.

The HIA Advisory Committee developed the following recommendations for the CCATF.

Strategy 1.1 Increase Conservation Practices

1. Manage tile drainage during extreme precipitation events by replacing/retrofitting older, conventional tiling systems with controlled systems or denitrifying bioreactors to decrease chemical and nutrient loss.

Each county's drainage authority and/or watershed district authority, along with the Minnesota Department of Agriculture (MDA), should partner with area farmers and landowners over the next five years to discuss funding and design options that are available to implement improved conservation drainage systems in their fields.

Strategy 1.2 Retain topsoil and agriculture productivity during extreme rain, drought, and freezing events

1. Create vegetative buffers along public drainage ditches and waterways to come into compliance with Minnesota law.

The Minnesota Department of Natural Resources (DNR) has released the buffer map that indicates the type and location of each required buffer strip. The implementation deadline for 30-50 foot buffers along public waters is November 1, 2017. The implementation deadline for 16.5 foot buffers along DNR-identified public ditches is November 1, 2018. As the current buffer law is mandatory, next steps should involve county extension services and Minnesota DNR outreach to area landowners on best practice implementation and increasing landowner's return on investment regarding buffer strips.

2. Reduce tillage by encouraging alternative residue management methods such as cover crops and crop rotation.

The MDA and each county's Soil and Water Conservation District (SWCD) should reach out to landowners and farmers in Region Nine to determine if there are ways to incorporate conservation tillage practices into their business. The goal of this outreach is to not only increase conservation tillage and reduce soil erosion, but also to help farmers determine best practices on a case-by-case basis. The results being beneficial, not only to Region Nine soil and water quality, for Region Nine farmers. This recommendation should be implemented within the next five years, with a priority on new farmers entering the agriculture business as baby boomers retire.

Strategy 1.3 Manage impact of flooding

1. Build flood walls in flood-prone areas and restore flood plains. Short-term flood mitigation along critical infrastructure and vulnerable populations should be prioritized - this may include strategically placed pumping stations where flooding occurs - until long-term flood control methods can be established.

Each county's Emergency Management and Environment Services Department, along with each Watershed Management District should utilize National Flood Insurance Program (NFIP) and Federal Emergency Management Agency (FEMA) county studies and current hazard mitigation plans to create a detailed plan of each flood-prone area within the county and determine a course of action to prevent flooding from occurring. Once a prioritized list of flood-prone areas is completed, county officials can determine if there is grant funding available for flood mitigation projects through the Minnesota DNR and Minnesota Homeland Security and Emergency Management compatible with their needs. With torrential rain and flooding issues becoming more common, this recommendation should be implemented within the next two-three years, with the knowledge that projects may take longer to implement due to funding and changes in conditions. The ultimate goal of this recommendation is to maintain watershed integrity and natural flood plains as much as possible, while understanding that there are some instances where levees may be most appropriate.

Strategy 1.4 Promote water conservation

1. Promote water harvesting/collection so rainwater can be used for landscaping and gardens to conserve groundwater supplies and mitigate extreme heat/drought events.

City Public Utilities (Water) Departments or Municipal Separate Storm Sewer Systems (MS4s) in Region Nine should partner with the Minnesota Pollution Control Agency (MPCA) and their Watershed Management Districts to promote rainwater harvesting best practices to homeowners and facilities managers. There should be a strong focus on homeowners with extensive landscaping and/or underground sprinkler systems, like subdivisions and homeowner association communities. Outreach to facilities could include schools with athletic fields to maintain, parks, and larger venues such as hotels, event centers or malls. Rainwater harvesting workshops could be promoted through local environmental outreach groups to increase awareness. This recommendation should begin after the MPCA updates their rainwater harvesting best practices and would be ongoing in each community.

Evaluation and Monitoring

Introduction

The evaluation and monitoring phase of the HIA consists of three components: process evaluation, impact evaluation, and monitoring health outcomes. The goal is to determine the effect the HIA had on the decision process as well as the effectiveness of the recommendations.

Process Evaluation

Process evaluation seeks to determine whether the methods used to conduct the HIA were helpful, appropriate, and done according to the original plan. The Region Nine Climate Change Adaptation Plan HIA evaluation included a self-assessment by Region Nine's HIA Coordinator as well as a post HIA survey given to the advisory committee. The following questions were considered in evaluating the processes used for this HIA.

1. Did the HIA meet its established goals as reflected in the original plan and advisory committee expectations?
2. Were the right people involved in the HIA?
3. What were the barriers or challenges encountered, and were they overcome?
4. What were some of the successes of the HIA?
5. What could be done differently in future HIAs?
6. What were the results from the post HIA evaluation surveys given to the advisory committee?

Goals and Expectations

The main purpose of this HIA was to assist the CCATF by determining any health impacts (positive or negative) of the adaptation strategies and create health-focused recommendations based on the HIA findings. Due to time constraints, the HIA was only able to complete an assessment and recommendations on the strategies for Objective 1 of the Climate Change Adaptation Plan.

Were the right people involved in the HIA process?

The HIA Advisory Committee consisted of public and private sector representatives mainly in the environmental, health, emergency management, and academic institutions. Two of the representatives are also on the CCATF, which helped the advisory committee have a clearer understanding of the proposed adaptation strategies, as well as creating CCATF buy-in for the HIA recommendations.

What were the challenges or barriers encountered, and were they overcome?

The most difficult barrier to the HIA was meeting attendance/availability by the advisory committee. The final HIA meeting was only attended by an MPCA representative and a representative from MDH. While the notes from the meeting, and the subsequent recommendations created from those notes were sent out via e-mail to the advisory committee, not all the members responded or gave feedback.

What went well?

Those that could attend the HIA meetings were engaged with the process and seemed comfortable sharing their expertise and experience. The advisory committee was open to brainstorming new ideas and asking questions about the clarity and purpose of some of the adaptation strategies proposed by the CCATF.

Things to Consider for Future HIAs

It may be worth planning all the HIA meetings at the time of the advisory committee's inception. This way the members will know the meeting dates before/when they accept their role on the advisory committee and can decide whether the time commitment is feasible. This would also give the HIA process a more structured time-table while ensuring the region's interests are fully represented at each meeting.

At the beginning of this process, the HIA Advisory Committee could have been given more background information on Climate Change, along with an explanation of how each member's daily work fits into the scope of this HIA. By understanding their role and how their individual experiences bring value to the HIA, it is possible that the level of engagement and retention of members may have been greater.

While the composition of the advisory committee was a knowledgeable group, it may be prudent to include an elected official in future HIA advisory committees. Some of the strategies discussed included changes to policy, and it may be beneficial to have a representative on the committee that can affect change at that level, while understanding the current political climate.

Post HIA Survey Results

After the final meeting, Region Nine sent out a survey to the HIA Advisory Committee regarding their experience and takeaways. The survey questions and results can be found in Appendix F. Of the ten HIA Advisory Committee members, only two responded to the survey. Both respondents represented local government and included the fields of health and emergency management.

The three main achievements of the HIA that both advisory committee members felt were accomplished included an increased understanding of the connection between climate adaptation and health, networking with other people interested in health and climate adaptation, and identifying more resources for implementing the climate adaptation plan.

Impact Evaluation

Impact evaluation endeavors to determine which recommendations were adopted and implemented, and to what degree. This step also seeks to discover if the HIA was influential in the decision-making process of the CCATF and any other benefits/impacts of the HIA.

The impact evaluation portion of this HIA is still in progress. The CCATF will meet again in October 2016 to discuss the HIA findings and determine whether to adopt the HIA Advisory Committee's final recommendations regarding Objective 1: Enhance Soil and Water Management. Once the

CCATF has completed their adaptation plan, the following questions can be addressed regarding the HIA's impact.

1. Did the HIA influence the Climate Change Adaptation Plan strategies? If so, how?
2. Were any of the recommendations implemented or used by the decision-making body?
3. Were there any additional impacts (positive or negative) due to the HIA?

Monitoring

The goal of monitoring is to develop a plan to track the outcomes of the adopted recommendations including their implementation and health impacts. If the HIA recommendations are adopted by the CCATF, Region Nine will coordinate with the organizations responsible for the strategy implementation (included within each HIA recommendation unless altered by the CCATF) to ensure that the strategies are being implemented and are having the desired health impacts determined by the HIA.

Region Nine will update the Evaluation and Monitoring portion of the Climate Change Adaptation Plan HIA once the CCATF finalizes its plan in December 2016.

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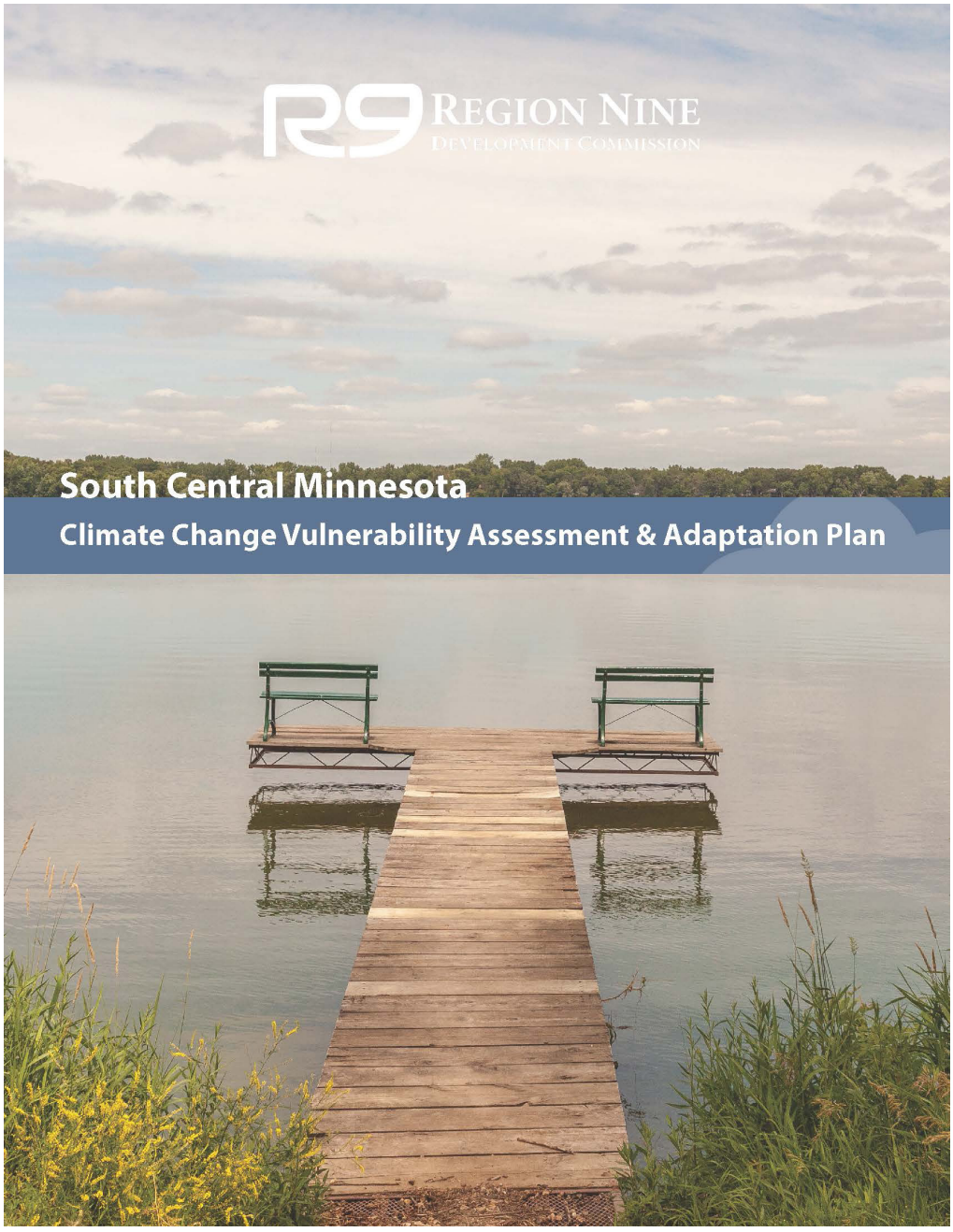
Appendix A

View the complete South Central Minnesota Climate Change Vulnerability Assessment and Adaptation Plan at www.rndc.org/climatechange.



Appendix B

HIA Meeting Agendas and Participants

HIA Advisory Committee Kickoff Meeting

Tuesday, April 5, 2016 | 1:30 p.m. – 3:30 p.m.

Minnesota Valley Room, Intergovernmental Center, Mankato

Advisory Committee Members Present: Candace Fenske, Catherine Fouchi, Amy Hedman, Jennifer Hyk, Nancy Lageson, Tyra Laughlin, Karen Moritz,

MDH and Region Nine Staff Present: Allison Bluhm, Chris Kimber, Brent Pearson, Kristin Raab, and Jacob Thunander

Introductions – Jacob Thunander

MDH Presentation – Kristin Raab – PowerPoint Presentation

Climate Change Adaptation Task Force (CCATF) background and relation to HIA – Brent Pearson

The Health Impact Assessment (HIA) will be done on the CCATF strategies to determine what positive/negative impacts these plans could have on the region's health. Task force and subject matter experts have spent the last year doing vulnerability assessments and research in order to develop strategies to address the effects of climate change on the region.

Climate Change Main Impacted Sectors: forestry, agriculture, business economic development, human health, energy, ecosystems, transportation systems, and water

Top Four weather events for our region: flooding, extreme weather - summer/winter, drought

Three weeks ago, the CCATF crafted specific climate change adaptation strategies, which will lead to the creation of action items at the next CCATF meeting. It will be those action items/strategies that the HIA will focus on.

HIA will be part of the final CCATF report.

Discussion followed pertaining to infectious diseases related to flooding and vectors

HIA has to be connected to climate change in some way to be included in the report – the HIA will be focused on health issues that come from the effects of climate change or the strategies implemented to adapt to it.

Review of HIA work plan – Jacob Thunander

1. Screening Summary regarding the feasibility and importance of an HIA- completed
2. Stakeholder Engagement Plan – (attached) HIA Advisory members suggested adding an agriculture representative and an environmental health representative (water treatment knowledge preferred) to the committee.

3. Scoping Summary – What health incidents in the region should be focused on? What are the goals and roles of the HIA?
4. Assessment due July 2016 – baseline data assessment/literature to predict positive and negative impacts of CCATF strategies

August 2016 – report

Monitoring and Evaluation

Regional Demographics and Health Concerns – Jacob Thunander

HIA Advisory members expressed an interest some of the data specifics: air quality standards/ particle data and water quality in wells – what are the standards for arsenic/danger levels, lead, and well pollution mitigation from run-off.

Next Steps - Jacob Thunander

Next HIA meeting – sometime after CCATF meeting (April 22nd, 2016). 1:30-3:30 time is good. A meeting doodle will be sent out.

Health Impact Assessment (HIA) Advisory Meeting #2

Wednesday, June 8, 2016 | 9:00 a.m. – 11:00 a.m.

3rd Floor Conference Room, 10 Civic Center Plaza, Mankato

Members Present: Breeanna Bateman, Barbara Conti, Chris Kimber, Nancy Lageson, Karen Moritz, Robin Thompson, and Molly Westman.

Staff Present: Jacob Thunander, Brent Pearson, and Allison Bluhm.

1. Introductions: Jacob Thunander, Project Development Planner with Region Nine, began the meeting at 9:05 a.m. and discussed the agenda, having each person at the meeting introduce themselves.

2. Baseline Data Review: Allison Bluhm, contractor with Region Nine, reviewed the baseline data information of the nine-county service area. The data pulled from American Factfinder Survey, Minnesota Environmental Public Health Tracking Program, and the Department of Employment and Economic Development included population information such as: age, language, race and ethnicity, health insurance, unemployment, poverty levels, hospitalizations due to illness, cancer incidence, water quality (arsenic) and air quality (fine particles).

Nancy Lageson requested clarification of the data set for ethnicity/race in regards to white/Caucasian and Hispanic populations. Karen Moritz informed the group that the two are separate questions, and the percentage attributed to white/Caucasian would include Hispanic as well. Brent Pearson, Resource Development Planner for Region Nine, discussed the data timeframe and availability

of census/population information as it pertains to the reliability and accuracy of the data. Moritz requested vector illness data if available. Discussion followed.

3. Discussion of Health Issues and Relation to Climate Change: Breeanna Bateman spoke of a direct correlation between increased tiling and blue algae increases in lakes, which then effects water quality. Barbara Conti spoke of "Be Air Aware" link on MDH website which discusses air quality issues. Health issues and impacts regarding climate change issues like flooding, extreme weather (heat, cold, storms), air and water quality problems, were discussed including physical ailments as well as mental health conditions that arise from additional stress caused by weather events. Discussion followed on accidents, power outages, rural isolation and an aging population, cultural/ socioeconomic differences affecting the availability of heat and air conditioning.

4. Review of Adaptation Strategies and Pathway Diagram Exercise: Pearson conducted a recap of the climate change adaptation strategies the task force has developed and how those strategies fit into the HIA. Thunander explained the pathway diagram process that will be used – not all of the strategies will be addressed by the HIA. Thunander went over strategies in the climate change plan, objectives 1 and 3, Pearson went over objectives 5 and 6.

Bateman asked for clarification on the term "urban landscape." Pearson and Thunander agreed to change the term to "anyone of Region Nine's 72 cities and townships."

5. Prioritizing Health Issues: Thunander and Chris Kimber facilitated the development of the health issues. The health priorities that the meeting attendees came up with were:

- Pathogens and chemicals in drinking water (e-coli, other nitrates)
- Respiratory illnesses due to air quality changes/wildfires (asthma, COPD)
- Drowning/other injuries, mobility issues, mental health/economic issues due to flooding
- Heat illnesses (heat stroke, algae blooms)
- Increased falls, mobility issues and traffic crashes/deaths a due to extreme winter storms
- Vector-borne illnesses from increase in ticks, mosquitos
- Injuries due to storms

The attendees each ranked 1-3, their top health priorities out of the seven listed (one being the most important).

6.Conclude: Thunander stated that he will be sending out the health priorities to the HIA committee members that were unable to be at the meeting. Tallies of priorities will be done once they are all in. A doodle will be sent out to each HIA committee member in order to schedule the next meeting in July. Region Nine staff members will be working to put together the Scoping piece of the HIA, and it will be sent out to the committee for review.

Health Impact Assessment (HIA) Advisory Committee Final Meeting

Thursday, June 4, 2016 | 9:00 a.m. – 11:00 a.m.

3rd Floor Conference Room, 10 Civic Center Plaza, Mankato

Advisory Committee Members Present: Breeanna Bateman

MDH and Region Nine Staff Present: Allison Bluhm, Chris Kimber, and Brent Pearson

1. Introductions & Meeting Format (10 minutes)
2. Assessment (20 minutes)

    Quick overview/Questions and answers/Bringing it back to climate change

3. Recommendations Process – Presentation (15 minutes)
4. Development of Recommendations (1 hour & 10 minutes)
5. Conclude (5 minutes)

Final meeting workshop notes can be found in Appendix G.

Committee Participants

HIA Advisory Committee Member, Title	Organization
Breeanna Bateman, Environmental Specialist	Water Quality Compliance - MPCA
Barbara Conti, Agency Policy Specialist	MPCA
Candace Fenske, CEO	Madelia Community Hospital
Cathi Fouchi, Regional Planner	DNR and CCATF member
Linda Giersdorf, Executive Director	Minnesota River Area Agency on Aging
Amy Hedman, Community Health Education	Minnesota State University, Mankato
Jennifer Hyk, Executive Director	Red Cross SW MN - withdrew after first meeting
Nancy Lageson, Emergency Management Director	Waseca County, MN and CCATF member
Tyra Laughlin	Resident of Region Nine
Karen Moritz, Public Health Director	Brown County, MN
Robin Thompson, Contact Center/Community Outreach Coordinator	MNRAAA
Molly Westman, Community Development Coordinator	City of Mankato, MN
Support Staff	**Organization**
Allison Bluhm, Intern/Project Assistant	Region Nine
Chris Kimber, Climate and Health Program Planner	MDH
Brent Pearson, Resource Development Planner	Region Nine
Kristin Raab, HIA and Climate Change Project Director	MDH
Jacob Thunander, Project Development Planner	Region Nine

Appendix C

Research Plan

Existing Conditions Research Questions	Impact Research Questions	Indicators	Data Sources	Methods	Priority	Notes
Objective 1: Enhance Soil and Water Management						
What are the current sources of drinking water for residents with the nine counties covered by Region Nine?	How will the Climate Adaptation Plan strategies impact drinking water sources for residents within the nine counties covered by Region Nine?	Public and private wells	MPCA	Literature reviews		
What are the current levels of pathogens and chemicals in the drinking water within the nine counties covered by Region Nine?	What are the human health impacts of contaminated water?	Presence of contaminants in ground and surface water, number of private wells tested	MDH, MPCA, University of Minnesota Extension,	Literature reviews		
What are the pathways for drinking water contamination from E-coli, nitrates and other pathogens and chemicals of concern with the nine counties covered by Region Nine?	What is the status of each watershed within Region Nine?	Algal Blooms in water bodies, low oxygen levels causing dead areas in surface water, contaminant levels, usability of surface waters	MPCA, University of Minnesota Extension, Minnesota River Basin Data Center	Literature reviews		
Strategy 1.1 Increase conservation practices						
What subsurface drainage methods are available	How will subsurface tile management reduce the levels of pathogens and chemicals in the drinking water for residents within the nine counties covered by Region Nine?	Controlled vs. Conventional drainage, Denitrifying bioreactors, Department of Agriculture tiling best practices	Department of Agriculture, MPCA, University of Minnesota Extension	Literature reviews		

Strategy 1.2 Retain topsoil and agriculture productivity during extreme rain, drought, and freezing events						
How is the land in the nine counties of Region Nine currently used?	How will vegetative buffers and tillage practices reduce the levels of pathogens and chemicals in the drinking water for residents within the nine counties covered by Region Nine?	Soil application and management practices in Region Nine, use of cover crops and conversation or no-till methods	Department of Agriculture, MPCA, University of Minnesota Extension	Literature reviews		
Strategy 1.3 Manage impact of flooding						
What and where are the current flood impacted areas in Region Nine?	How will flood impact management reduce the levels of pathogens and chemicals in the drinking water for residents within the nine counties covered by Region Nine?	Flood incidents, contaminant levels in water supplies, property and infrastructure functionality	FEMA	Literature reviews		
Strategy 1.4 Promote water conservation						
What are the methods of collecting/harvesting rainwater?	How may rainwater collection methods impact health in Region Nine?	Rainwater usage, amount of stormwater run-off, collection materials used	MDH, MPCA, CDC	Literature reviews		

Appendix D

Research Questions

Existing Conditions Research Questions	Impact Research Questions	Data Sources	Methods
Health Determinant: Pathogens and chemicals in drinking water (e-coli, other nitrates)			
How does climate change affect water quality?	How will the proposed changes to policy, programming, and projects affect water quality?	MPCA	Literature review
What type of pathogens and chemicals are most commonly found in drinking water? How does each county compare?	How will the proposed changes to policy, programming, and projects affect water quality?	MPCA, County Public Health, Public Works	Literature review Case studies
What are the primary causes of pathogens and chemicals in drinking water? Where do pathogens and chemicals in drinking water come from?	How will the proposed changes to policy, programming, and projects affect the cause, location, number and/or rate?	MPCA	Literature review Case studies
What human health illnesses result from contaminated water?	How will the proposed changes to policy, programming, and projects affect human health?	MDH	Literature review
What are different strategies to prevent excessive pollutants in drinking water?	How will the proposed changes to policy, programming, and projects affect human health?	MPCA, MDH	Literature review
How accessible are medical facilities?	How will the proposed changes to policy, programming, and projects affect the location and number of illnesses?	MDH, Google Search	Literature review
Health Determinant: Respiratory illnesses due to air quality changes/wildfires (asthma, COPD))			
How does climate change relate to respiratory illnesses?	How will the proposed changes to policy, programming, and projects affect respiratory health?	MPCA, MDH	Literature review

What types of respiratory illnesses are prevalent in each county? How does each county compare?	How will the proposed changes to policy, programming, and projects affect the number and/or rate of illnesses?	MDH, County Public Health	Literature review
What are the primary causes of respiratory illnesses?	How will the proposed changes to policy, programming, and projects affect the cause, location, number and/or rate of illnesses?	MDH, Google Search	Literature review
How accessible are medical facilities?	How will the proposed changes to policy, programming, and projects affect the location and number of illnesses?	MDH, Google Search	Literature review
Health Determinant: Heat illnesses (heat stroke, algae blooms)			
How does climate change relate to heat illnesses?	How will the proposed changes to policy, programming, and projects affect heat related illnesses?	MPCA, MDH	Literature review
How many heat related illnesses occur every year? How does each county compare? Are different races more susceptible to heat related illnesses? Are there specific areas within each county that have higher rates of heat illnesses?	How will the proposed changes to policy, programming, and projects affect the number and/or rate of illnesses?	MDH	Literature review, Case studies, GIS Mapping
What are the primary effects of heat illness?	How will the proposed changes to policy, programming, and projects affect the cause, location, number and/or rate of illnesses?	MDH	Literature review
How accessible are medical facilities?	How will the proposed changes to policy, programming, and projects affect the location and number of illnesses?	MDH, Google Search	Literature review

Appendix E

HIA Final Meeting: Recommendation Workshop

Strategy 1.1 Increase Conservation Practices

1. Manage tile drainage during extreme precipitation events.
2. Replace/retrofit older tiling systems with new/controlled drainage systems.

POSITIVES

- Increased nutrient absorbency in soil
- Controlled tiling can limit excessive water drainage and maintain moisture during drought
- Pathogen reduction/UV exposure
- Decreased bank erosion and phosphates in water
- Promotes best management processes

NEGATIVES

- Feasibility is an issue – consistent excess moisture may not lend itself to closing stop-gates on controlled tiling systems, making them less beneficial to farmers
- Tile upgrades are costly
- Lack of regulation/incentives

ALTERNATIVES

- Denitrifying bioreactors may be a more effective choice
- Enlist more help from subject matter experts

PARTNERS: Board of Water and Soil Resources, Local Government Units (LGUs), county Extension Services, Department of Agriculture.

PCA may have grants available too

Strategy 1.2 Retail topsoil and agriculture productivity during extreme rain, drought, and freezing events

1. Create vegetative buffers along public drainage ditches and waterways to come into compliance with Minnesota law.
2. Reduce tillage by encouraging alternative residue management such as cover crops and crop rotation.

POSITIVES

- Increased uptake of excess nutrients
- Natural filter for surface run-off

- Reduced soil erosion
- Current buffer law makes implementation mandatory

NEGATIVES

- Decreased return on investment for farmers – cost of implementation

Strategy 1.3 Manage impact of flooding

1. Build flood walls in flood-prone areas and restore flood plains

POSITIVES

- Decreased property damage, injuries, drowning, infrastructure damage
- Decreased spread of pathogens
- Decreased stress levels = improved mental health of residents

NEGATIVES

- Cost
- Downstream effects of modifying the river bank
- Urban/rural conflict

ALTERNATIVES

- Strategically placed pumping stations around critical infrastructure and vulnerable populations

PARTNERS: DNR assists with enforcement, NFIP/FEMA, insurance companies

Strategy 1.4 Promote water conservation

1. Promote rainwater harvesting/collection so it can be used for landscaping and gardens in order to conserve groundwater supplies and mitigate extreme heat/drought events.

POSITIVE

- Decreased storm run-off in urban areas
- Maintained green spaces during drought events = environmental impacts/benefits and human physical/ mental health benefits
- Increased water for basic necessities of life
- Costs cut for water treatment facilities if using less city water and costs for the harvester

NEGATIVE

- Costs may be extensive in retrofitting a home/facility (with the exception of harvesting on a smaller scale such as rain barrels)

- Potentially harmful effects if harvested rainwater used improperly (on edible food or drinking water if not properly treated)
- Increased vector issues with improperly stored rainwater
- Impacts downstream

PARTNERS: General public, LGUs, building owners/facilities managers, MS4s – PCA (cities 10,000+), public health departments, Region Nine Renewable Energy Task Force (RETF)

Objective 1 Enhance soil and water management

Partners for regional soil and water (ag-based) education outreach

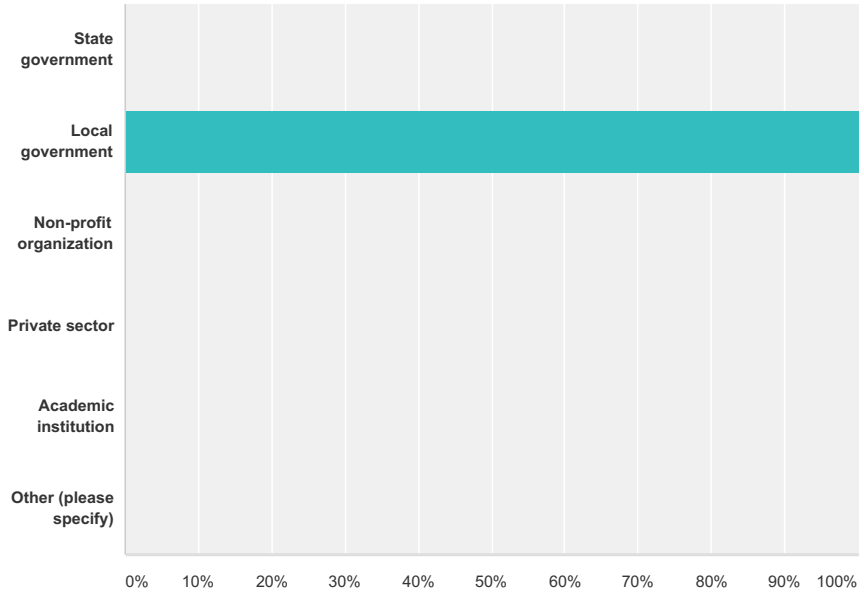
- Universities/Higher education institutions
- County forums
- 4-H and FFA (Future Farmers of America)
- Youth learning activities (Children's Water Festival at SCC)
- Independent specific associations
- County Ag Extension

Appendix F

Post HIA Survey Results

Q1 What setting best describes your work?

Answered: 2 Skipped: 0

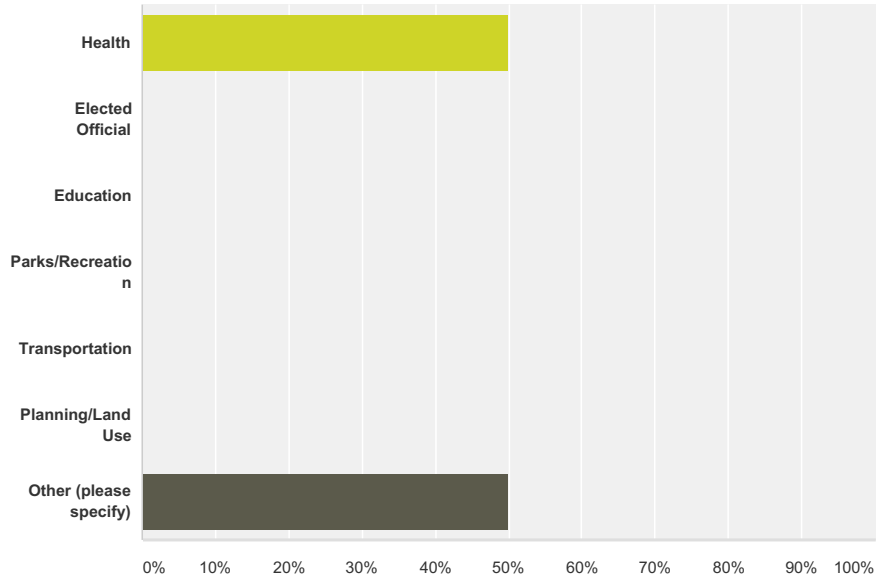


Answer Choices	Responses	
State government	**0.00%**	0
Local government	**100.00%**	2
Non-profit organization	**0.00%**	0
Private sector	**0.00%**	0
Academic institution	**0.00%**	0
Other (please specify)	**0.00%**	0
Total		**2**

#	Other (please specify)	Date
	There are no responses.	

Q2 What best describes the sector you represent?

Answered: 2 Skipped: 0

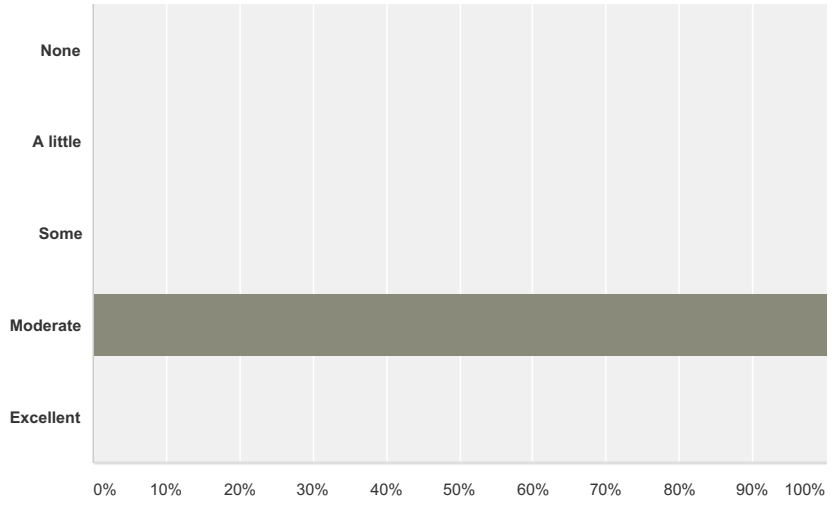


Answer Choices	Responses	
Health	**50.00%**	1
Elected Official	**0.00%**	0
Education	**0.00%**	0
Parks/Recreation	**0.00%**	0
Transportation	**0.00%**	0
Planning/Land Use	**0.00%**	0
Other (please specify)	**50.00%**	1
Total		**2**

#	Other (please specify)	Date
1	Emergency Management	8/16/2016 2:43 AM

Q3 After participating in this HIA, how would you rate your level of knowledge of HIA?

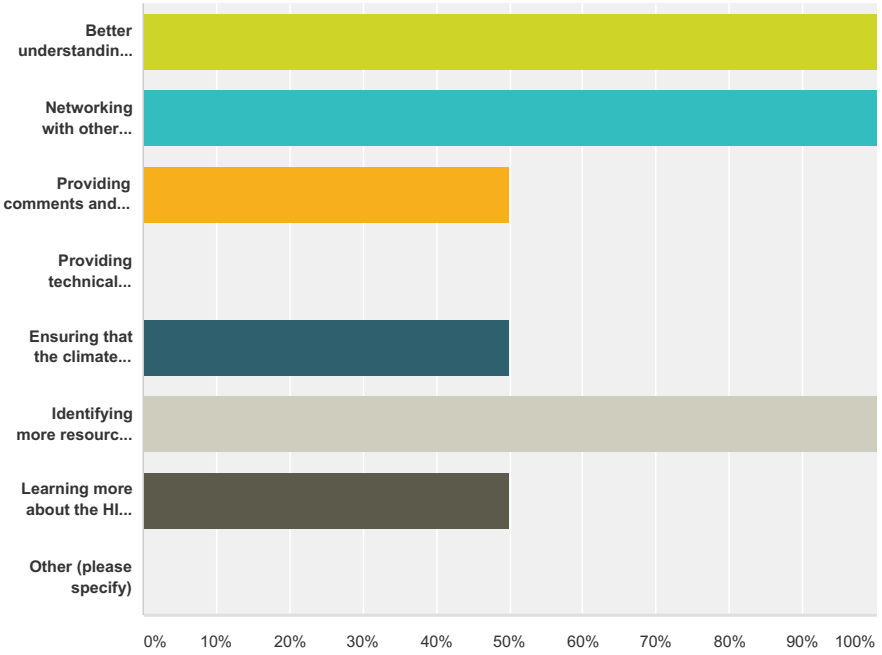
Answered: 2 Skipped: 0



Answer Choices	Responses	
None	**0.00%**	0
A little	**0.00%**	0
Some	**0.00%**	0
Moderate	**100.00%**	2
Excellent	**0.00%**	0
Total		**2**

Q4 Check any of the following that you achieved by participating in this HIA.

Answered: 2 Skipped: 0



Answer Choices	Responses	
Better understanding of the connection between health and climate adaptation	**100.00%**	2
Networking with other people interested in health and climate adaptation	**100.00%**	2
Providing comments and suggestions to inform the climate adaptation plan	**50.00%**	1
Providing technical information to the HIA and/or the climate adaptation plan	**0.00%**	0
Ensuring that the climate adaptation plan benefits the health of Region Nine residents	**50.00%**	1
Identifying more resources for implementing the climate adaptation plan	**100.00%**	2
Learning more about the HIA process	**50.00%**	1
Other (please specify)	**0.00%**	0
Total Respondents: 2		

#	Other (please specify)	Date
	There are no responses.	

Q5 Is there anyone else that should have been invited to participate in the HIA?

Answered: 1 Skipped: 1

#	Responses	Date
1	local county environmental health professional	8/19/2016 8:20 AM

Q6 Based on your experience, do you think HIA was an effective tool for this project? Why or why not?

Answered: 2 Skipped: 0

#	Responses	Date
1	Yes - I think it was very beneficial to consider the health impacts of the proposed strategies.	8/19/2016 8:20 AM
2	HIA is an effective tool for many, many projects - even more so for this one.	8/16/2016 2:43 AM

Q7 Please share any additional comments about participating in this HIA and/or plans for implementing the HIA recommendations or other activities that came out of the HIA.

Answered: 1 Skipped: 1

#	Responses	Date
1	I learned a lot and have an increased understanding of the benefits of an HIA	8/19/2016 8:20 AM

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