NATURAL INFRASTRUCTURE SOLUTIONS FOR FLOOD RISK:

A Case Study in the Prairie Creek Watershed

Natural Infrastructure Solutions That Can Support Reducing Flood Risk Downstream

The majority of the Mississippi River Basin region's land is privately owned, dedicated to farming operations. Given agriculture's importance, the report looked specifically at natural infrastructure measures that could deliver the greatest environmental benefit with the least amount of cropland conversion possible, to ensure the economic continuity of this industry while addressing flood risk. Natural infrastructure measures include:

- **CREP WETLANDS:** Taking areas of land out of agricultural production and converting them to wetlands via the Conservation Reserve Enhancement Program (CREP), a long-term conservation cost-share assistance program administered by the Farm Service Agency (FSA).
- **DEPRESSIONAL WETLANDS INSIDE AND OUTSIDE THE FLOODPLAIN:** Restoring wetlands located in natural depressions in a floodplain (e.g., swamps) or similar areas outside the floodplain i.e., prairie potholes). Depressional wetland opportunities are relatively limited in the Prairie Creek Watershed.
- **RIPARIAN BUFFERS:** Creating vegetated areas adjacent to a body of water (i.e. pond, river or stream) that intercept runoff. Riparian buffers do not provide floodwater storage but mitigate flooding by reducing runoff velocity and enhancing water infiltration.
- **ROW CROP CONVERSION ON HIGHLY ERODIBLE LAND:** Converting highly erodible row crop land (i.e., on slopes greater than 7%) to native grassland/prairie to reduce runoff velocity and enhance water infiltration.
- **ROW CROP CONVERSION WITHIN THE FLOODPLAIN:** Converting land used for conventional row crop production located within the floodplain to native grassland/prairie.
- **WATER AND SEDIMENT CONTROL BASINS (OR WASCOBS):** Creating small earth embankments on agricultural land that collect and store runoff from concentrated flow paths.

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Spanning 31 states from Minnesota to Louisiana, the Mississippi River Basin is the most significant and extraordinary watershed in the United States. The river system includes more than 7,000 rivers and streams, with more than 50 cities sitting on the banks of these bodies of water—providing critical clean drinking water, good-paying jobs and support for the economy. Yet, development and agricultural use of the surrounding lands have led to dramatic alterations of the river ecosystem. This is leading to declining watershed health and extensive flooding when severe storms occur.

Flooding is a costly setback for property owners, land managers, governments and taxpayers, causing infrastructure damage, social disruptions and economic losses. Some work has been done to flood-proof communities in the Basin from extreme weather events, but more is needed as these events become more frequent, intense and widespread due to climate change.

As leaders work to build resilience in their communities to withstand more frequent and intense storms and the subsequent higher flood risks, they should consider how working with nature can be complementary to engineered solutions.

Natural infrastructure solutions are measures that mimic and enhance natural water storage capabilities and reduce runoff upstream, effectively mitigating flooding downstream. Natural infrastructure solutions have been found to provide notable environmental and economic benefits.

They are durable, maintain themselves over time and are effective at reducing flooding in downstream population centers, reducing the associated costs of flood damage.

Natural infrastructure solutions do present a different set of complexities to implementation given much of the land in the Mississippi River Basin is privately owned and used for agricultural purposes. Yet natural infrastructure solutions provide significant economic value that they are worth pursuing through public investment, partnerships and private incentives.

CEDAR RAPIDS, IOWA

In June 2008, an extreme weather system devastated the city with record flooding when the river topped 31 feet in depth and the water had nowhere else to go but into the city. The floodwaters covered 10 square miles (14% of the city) and caused an estimated $2.4 billion in damage. More than 18,000 people were displaced, nearly 6,000 homes were flooded and more than 300 city facilities needed to be rebuilt. While a deluge of this proportion only had a 0.3% chance (or roughly between a 100- and 500-year storm) of ever hitting the city, Cedar Rapids officials, and leaders in other communities, are anticipating increased chances of what used to be once-in-a-lifetime storms, and pursuing strategies to better protect their communities and reduce flood risk.

THE ANALYSIS:

The new report examines the Prairie Creek Watershed near Cedar Rapids, Iowa which is part of the Cedar River Basin. This watershed was chosen as the Prairie Creek Watershed headwaters are primarily rural while the river's outlet passes through the more developed area of Cedar Rapids. The rural upstream region presents many potential locations to implement natural infrastructure practices that store water.

Using publicly available data, the report looks at major storms of varying levels (i.e., 10-, 25-, 50-, 100-, and 500-year storms) in present and future conditions (in years 2036-2065) and models the flood impact scenarios in downstream communities with and without natural infrastructure solutions implemented across the watershed area at varying degrees of scale: 2.5% (3,423 acres), 5% (6,846 acres), 10% (13,691 acres) and 17.2% (23,627 acres) of the landscape. The report further uses a publicly available economic flood damage estimation tool called Hazus to calculate the net value of avoided losses when natural infrastructure practices were implemented at these different scenarios.

"Implementing natural infrastructure solutions reduced peak flows of a 50-year storm to levels less than that of a 10-year storm without natural infrastructure." - Kelly Suttles

TOPLINE FINDINGS:

- **THE PRAIRIE CREEK WATERSHED IS EXPECTED TO SEE INCREASED FLOOD IMPACTS**—increased flood depths and expanded flood inundation—across all possible future storm scenarios, putting people, homes, businesses and public infrastructure at economic risk.
- **IMPLEMENTING NATURAL INFRASTRUCTURE SOLUTIONS IN UPLAND AREAS EXHIBIT EFFECTIVENESS IN REDUCING FLOODING IN DOWNSTREAM COMMUNITIES** in both present day and future storm scenarios. Natural infrastructure solutions were particularly effective in the more likely to occur yet still significant storm scenarios (i.e., 10-, 25-, 50-yr storms). For example, implementating natural infrastructure solutions reduced peak flows of a 50-year storm to levels less than that of a 10-year storm without natural infrastructure. (Figure 1)
- **CREP WETLANDS STOOD OUT** for their potential to store substantial flood waters, among the specific natural infrastructure solutions reviewed.
- **THERE IS NO CLEAR THRESHOLD AT WHICH NATURAL INFRASTRUCTURE SOLUTIONS BECOME MORE EFFECTIVE AT REDUCING FLOODING RELATIVE TO THE AREA OF IMPLEMENTATION**–as implementation increased, environmental benefits increased on the same trend.
- **YET, ON A PER-ACRE BASIS, IMPLEMENTING NATURAL INFRASTRUCTURE ON THE LOWEST LEVEL SIMULATED (2.5%) ACHIEVED NEARLY TWICE THE ECONOMIC BENEFIT** of other implementation levels (Figure 2c), This is likely because economic benefits compared to the cost of implementation were relatively the same whether solutions were implemented on 2.5%, 5% and 10% of the landscape.
- **AVERAGE ANNUAL LOSSES DUE TO FLOODING CAN BE REDUCED BY UP TO NEARLY ONE-THIRD (32%), OR A SAVINGS OF UP TO $1.7 BILLION DOLLARS** when natural infrastructure solutions are fully implemented (17.2%) across a watershed such as Prairie Creek Watershed. Accounting for the upfront cost of implementing the natural infrastructure solutions, the overall economic benefit to communities could be $884 million.

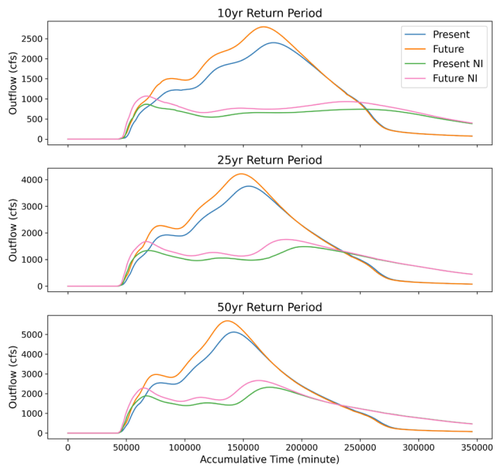

FIGURE 1 (Above): Prairie Creek Watershed outflow by return period (i.e., design storms) for different modeling scenarios.

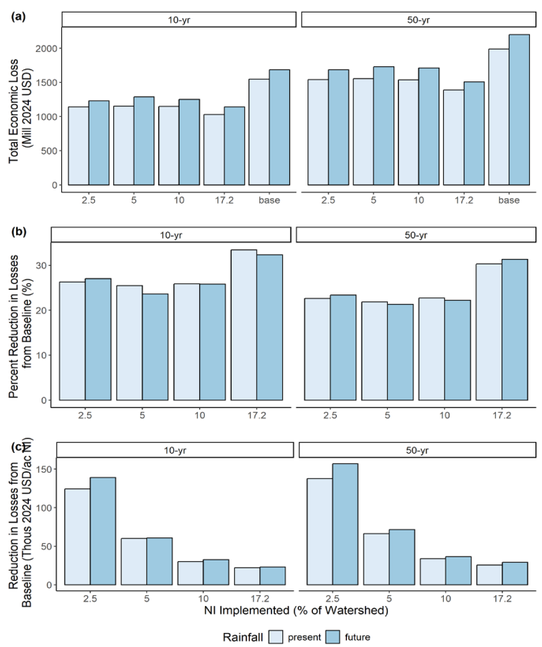

FIGURE 2 (Right): (a) Total economic loss compared to percent with natural infrastructure solutions implemented. (b) Percent reduction in losses compared to percent with natural infrastructure solutions implemented. (c) Reduction in losses per acre compared to percent with natural infrastructure solutions implemented.

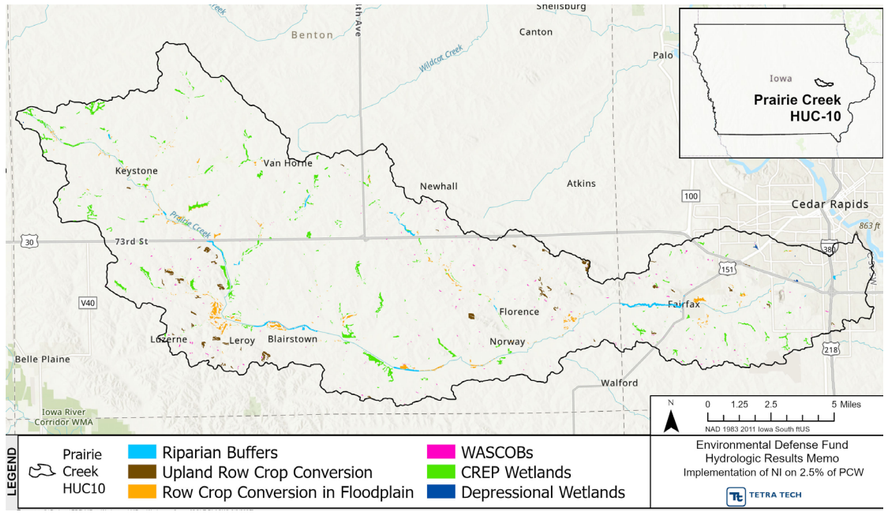

FIGURE 3: Location and extent of natural infrastructure implemented on 2.5% of the Prairie Creek Watershed area.

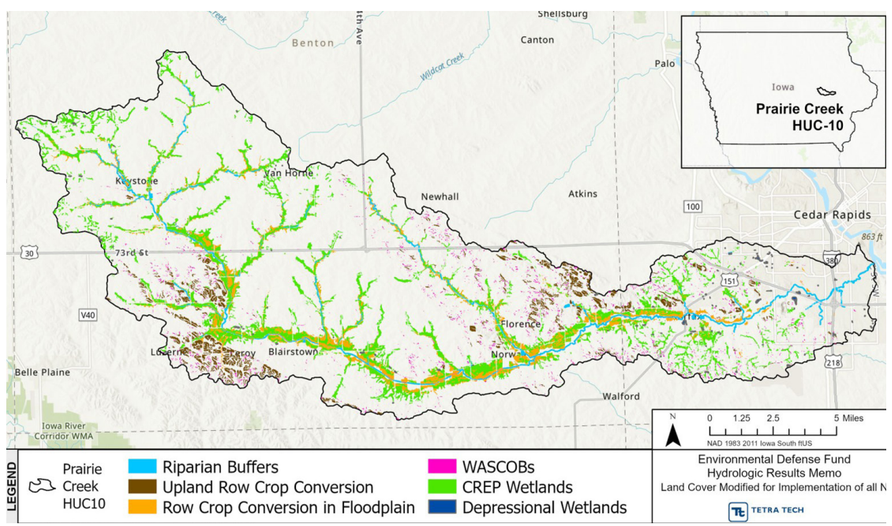

FIGURE 4: Location and extent of all potential natural infrastructure solutions implemented on 17.2% of the Prairie Creek Watershed.

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