HUDSON COMPREHENSIVE PLAN STEERING COMMITTEE
CITY OF HUDSON, WISCONSIN

Monday, January 6, 2020 1:00 p.m.
City Hall Council Chambers, 505 Third Street

AGENDA

(Click on agenda items highlighted in blue to access documents related to that item)

1. Call to Order

2. Discussion and possible action on the December 2, 2019 meeting minutes.

3. New Business
   A. Public Involvement Workshop #1 Results Report
   B. Community Survey Results Update
   C. Public Engagement Planning
   D. Discussion and possible action on utility billing outreach strategy.

4. Communications and Items for Future Agendas

5. Adjournment

Posted in City Hall lobbies and emailed to *Star Observer* on 1/3/2020

Notice is hereby given that a majority of the City Council may be present at the aforementioned meeting of the Plan Commission to gather information about a subject over which they have decision making responsibility. This constitutes a meeting of the City Council pursuant to State ex rel. Badke v. Greendale Village Bd., 173 Wis. 2d 553, 494 N. W. 2d 408 (1993), and must be noticed as such, although the Council will not take any formal action at this meeting.

REGULAR MEETING OF THE COMPREHENSIVE PLAN
STEERING COMMITTEE
CITY OF HUDSON
Monday, December 2, 2019

The Hudson Comprehensive Plan Steering Committee meeting was called to order by Johnson at 1:00 p.m.

PRESENT. Rich O'Connor, Fred Yoerg, Jim Webber, Aaron Reeves, Tiffany Weiss, Michael Mroz, and Michael Johnson.

ABSENT. None.

OTHERS PRESENT. Brea Grace, and Marian Webber.

Discussion and possible action on November 4, 2019 meeting minutes. Motion by O'Connor, seconded by Yoerg to approve the minutes of the November 4, 2019 Comprehensive Plan Steering Committee. All Ayes (7). Motion Carried.

UNFINISHED BUSINESS.
None.

NEW BUSINESS.
Public Involvement Workshop #1 Follow-up. Grace presented the results of the first Public Involvement Workshop held at EP Rock Elementary School on November 21st and highlighted the results of the SWOT analysis and the placemaking exercise as being good constructive feedback. Yoerg expressed disappointment in the public for their lack of participation, given how much the city broadcasted the message to various platforms, both online and in the newspaper. However, he noted the positive turnout of staff and local representatives as well as the great feedback that was received by all who attended the event, making the workshop still worthwhile. Reeves mentioned as well that more people would likely show up at future workshops when the topics become more refined and less vague in nature. The more specific the discussions get, the more those who care about those topics will come out in force to speak up on the subject. O'Connor voiced concerns about those who may attend these more specific discussions and hijack the meetings in their favor.

Community Survey Update. Grace gave an update on the number of surveys received online through POLCO which came out to 149 total surveys done. Roughly 61% of respondents were registered voters. Grace mentioned that overall the feedback that she was seeing come in was useful and constructive. Yoerg asked if any feedback was received based on the parking system. Grace confirmed that some of the comments received do reflect a desire to mitigate downtown parking issues. Yoerg then asked if the responses were going to be grouped into households or kept individual. Grace noted that it would be best to keep it to the individual level since multiple individuals in each household have been invited to take the survey and are welcome to submit their own responses. Yoerg spoke of concerns regarding the number of surveys received thus far and asked how many paper surveys were received. Weiss noted that only 3 hard copies of the surveys have been received at City Hall. Grace mentioned that outreach efforts would be continued so that the total number of respondents equates to at least 10% of households reached in the City. Johnson said the YMCA and church bulletins would be great places to advertise the survey some more. Webber

concurred regarding the Church bulletins. O'Connor desired to have city staff go up and speak in front of church congregations. Johnson noted concerns regarding mixed messaging, in case one staff person mentions things that others don't. Wanting to prevent any confusion, he mentioned that one staff person calling each church with a scripted message would be the best way to go about sending out a message to church congregations as well as utilizing the church bulletins.

Review existing conditions and results from market analysis. Grace went over the results of the market analysis report performed by a 3rd party consultant and physical copies of this report were provided to committee members. Contents of the report consist of an area overview, mobile data analysis of the market area, housing model and market needs analysis, retail market and dining market analyses, and future demand for office and industrial space. The overall market area referred to in the report consists of the City of Hudson as well as some areas of neighboring communities and townships (specifically, southwestern St. Croix County, northwestern Pierce County, and part of eastern Washington County in Minnesota).

COMMUNICATIONS AND ITEMS FOR FUTURE AGENDAS.

Next meeting date was scheduled for Monday, January 6, 2019 at 1:00 p.m.

ADJOURNMENT.
Motion by Yoerg, seconded by Mroz to adjourn at 1:57 p.m. All Ayes (7). Motion Carried.

Respectfully submitted,
Tiffany Weiss, Acting Secretary

505 Third Street
Hudson, Wisconsin 54016
ph: (715)-386-4765 fx: (715)386-3385
www.ci.hudson.wi.us

TO: Hudson Comprehensive Plan Steering Committee

FROM: Community Development

DATE: January 6, 2020

SUBJECT: Public Involvement Workshop #1 Results Report

BACKGROUND:
Brea Grace will provide a summary of the results from the Comprehensive Plan Steering Committee's first Public Involvement Workshop from November 21, 2019.

ATTACHMENTS:
Public Involvement Workshop #1 Results Report and feedback

Prepared by: Tiffany Weiss, Associate City Planner
Through: Mike Johnson, AICP, Community Development Director

City of Hudson, WI

Comprehensive Plan Update

November 21, 2019
Public Involvement Workshop #1 Results

January 6, 2019

Executive Summary

On November 21, 2019 the City of Hudson held a Public Involvement Workshop to inform the public about the process of updating the City's Comprehensive Plan and to seek community input regarding life in Hudson including their vision for Hudson in 2040.

SEH, with assistance from the City of Hudson Comprehensive Plan Steering Committee and Plan Commission members, sought information from the public through two engagement exercises:

- a Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis; and
- a Place-Making Exercise.

Results from these exercises are contained within this report.

Approximately 30 individuals attended this event. The Workshop was advertised through the following methods:

- City of Hudson Press Release issued on November 1, 2019.
- Advertisement on the River Channel.
- Flyers for the event posted at City Hall and at the Public Library.
- Notice at end of the Community Survey on Polco's website.
- Both the Community Survey and PIW #1 has been advertised through the City's website, Facebook, and flyers around City Hall and the Public Library.

This Public Involvement Workshop was the first in a series of public engagement activities for Hudson's Comprehensive Plan update.

Contents

City of Hudson
Comprehensive Plan

How do you see Hudson in 2040?

We'd like to hear your ideas!

Please join us on **November 21st, 2019 from 6pm to 8pm**, for a

Public Involvement Workshop

at EP Rock Elementary School, 340 13th St S, Hudson, WI

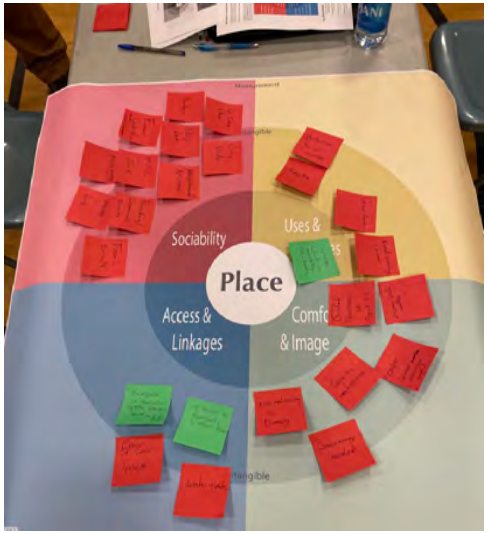
to help shape the future of Hudson's land uses.

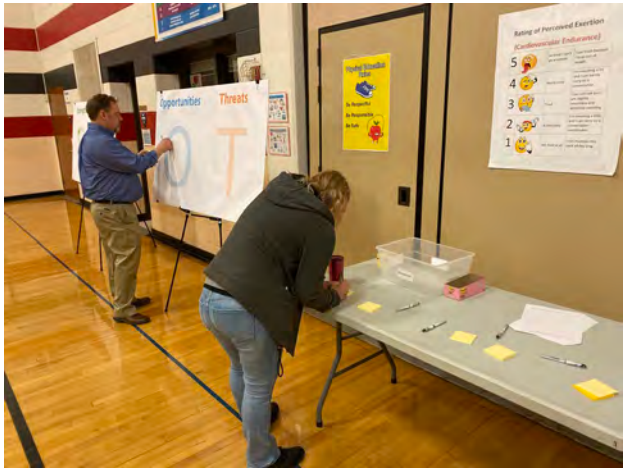
CITY OF HUDSON

The City of Hudson has started the process of updating its Comprehensive Plan. The purpose of the Comprehensive Plan is to identify issues, opportunities, needs and organize public policy to address them in a manner that makes the best and most appropriate use of City resources. It will also describe a desired future for the community over the next 20 years and establish goals to move toward that future.

Please also complete **Hudson's Community Survey** online at: http://hudsoncomprehensiveplan.com/

Paper copies of the survey are available at Hudson City Hall, Hudson Utility Department, and the Hudson Public Library.


Sociability
Uses &
Place
Access &
Linkages
& Image


Opportunities
Threats


Opportunities
Threats


Strengths
Weaknesses
Opportunities
Threats


Strengths
Weakness
Opportunities
Threats

Themes from Workshop #1

- St. Croix and Hudson's lakefront are an asset
- Desire to keep the small town feel and be a welcoming community
- Planned growth versus being reactive to development proposals
- Affordable housing needs
- Downtown parking challenges
- Public transportation, trails, sidewalks wanted
- Climate change
- Strong civic & religious organizations
- Events, gatherings, sense of place
- Increase public involvement

SWOT Exercise Results

Community Strengths

Great schools
Public library
Growth
Small town charm
St Croix River
Phipps Center for Arts
Amazing natural resources in the river
YMCA
River front
Great city staff
Faith communities
River side park and meadows fields
Strong downtown; hometown feel with commercial district on Hill; best of both worlds.
Financially sound
Becoming more "open"
Beautiful parks

Public schools
Great schools
Historic downtown
St. Croix River & Lake Mallalieu
Phipps
Proximity to St. Paul / Minneapolis Metro
YMCA
Lakefront park
A real sense of place
City staff
Interest in preservation of downtown character
Great small town history
Beautiful setting on the river
Efficient city services
YMCA community resources
Library

Community Weaknesses

"Old-fashioned" core
Lack of transit options for those without cars
Affordable housing
Better communications; people don't read the paper
Parking meters restrict boaters and guests from spending the hour needed to boat
Toxic online forums
Getting too large?
Land locked with little room to expand
Library (public meeting space)
Fast growth can force quick decisions

Aging infrastructure
Affordable housing
Not welcoming
Low public participation
Downtown parking
Public engagement/ knowledge in new commercial development
Reactive to developers proposals rather than planning for how the city will grow
Cultural diversity
Shortage of downtown parking
There seems to be little protection of river views or keeping new buildings in character with existing neighborhoods

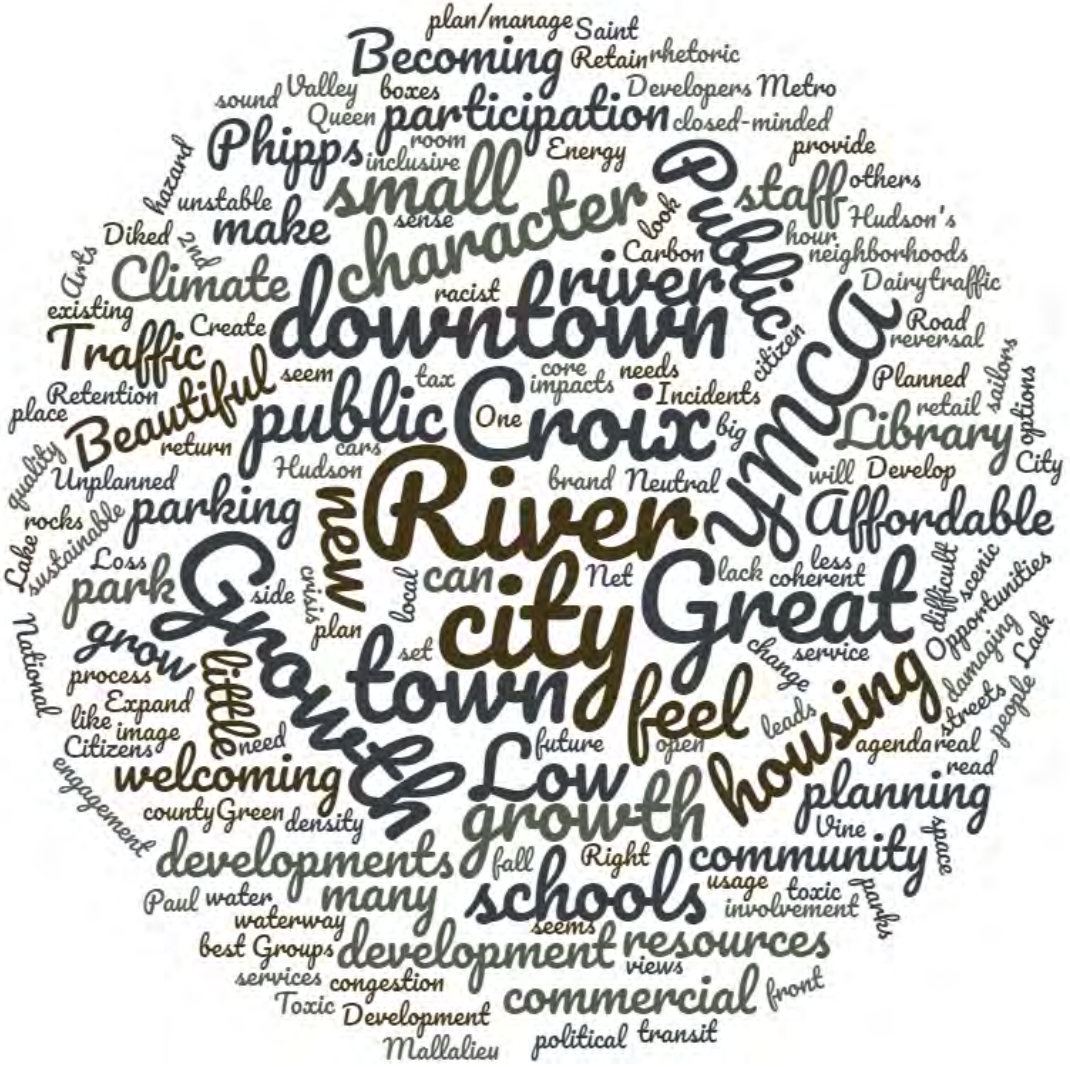
Community Opportunities

Carbon Net Neutral
Green Energy Opportunities
One River, Develop it "Right"
Planned Growth…
Expand citizen participation in city developments
Create an inclusive community
Growth
…more…

Community Threats

Low density housing is difficult to make sustainable from a tax return to service needs	National political rhetoric = toxic between
Climate change local impacts	"Loss" of small town feel
Incidents that can brand Hudson as racist	Groups like the Citizens for the Saint Croix Valley make Hudson's image and welcoming less than it should be
Traffic	Becoming closed-minded (reversal)
Climate crisis	Developers seem to set the agenda
Unplanned growth	Retention of usage, look and feel of 2nd St from Dairy Queen to Vine
A lack of coherent plan for future development	Retain scenic waterway as we grow county
Growth leads to more traffic; need to plan/manage growth	Too many new developments damaging small town character
Development -> St. Croix River water quality	Low public involvement in city planning process
Traffic congestion on some city streets	Too many retail "big boxes"
The Diked Road rocks are unstable and provide a fall hazard to sailors and others	

Word Cloud from SWOT Exercise



Colors are for graphic interest only and do not represent themes or categories.

Place-Making Exercise

What Makes a Successful Place?

- Great spaces…
  - where celebrations are held,
  - social and economic exchanges take place,
  - friends run into each other, and
  - cultures mix.

- They are:
  - the “front porches” of our communities
  - streets, libraries, field houses, parks, neighborhood schools
  - where we interact with each other.

- What makes some places succeed while others fail?

Place-Making Exercise

1. What would make Hudson a more **sociable** place?

*List three on your post-it

2. What types of **uses and activities** would make Hudson a better place?

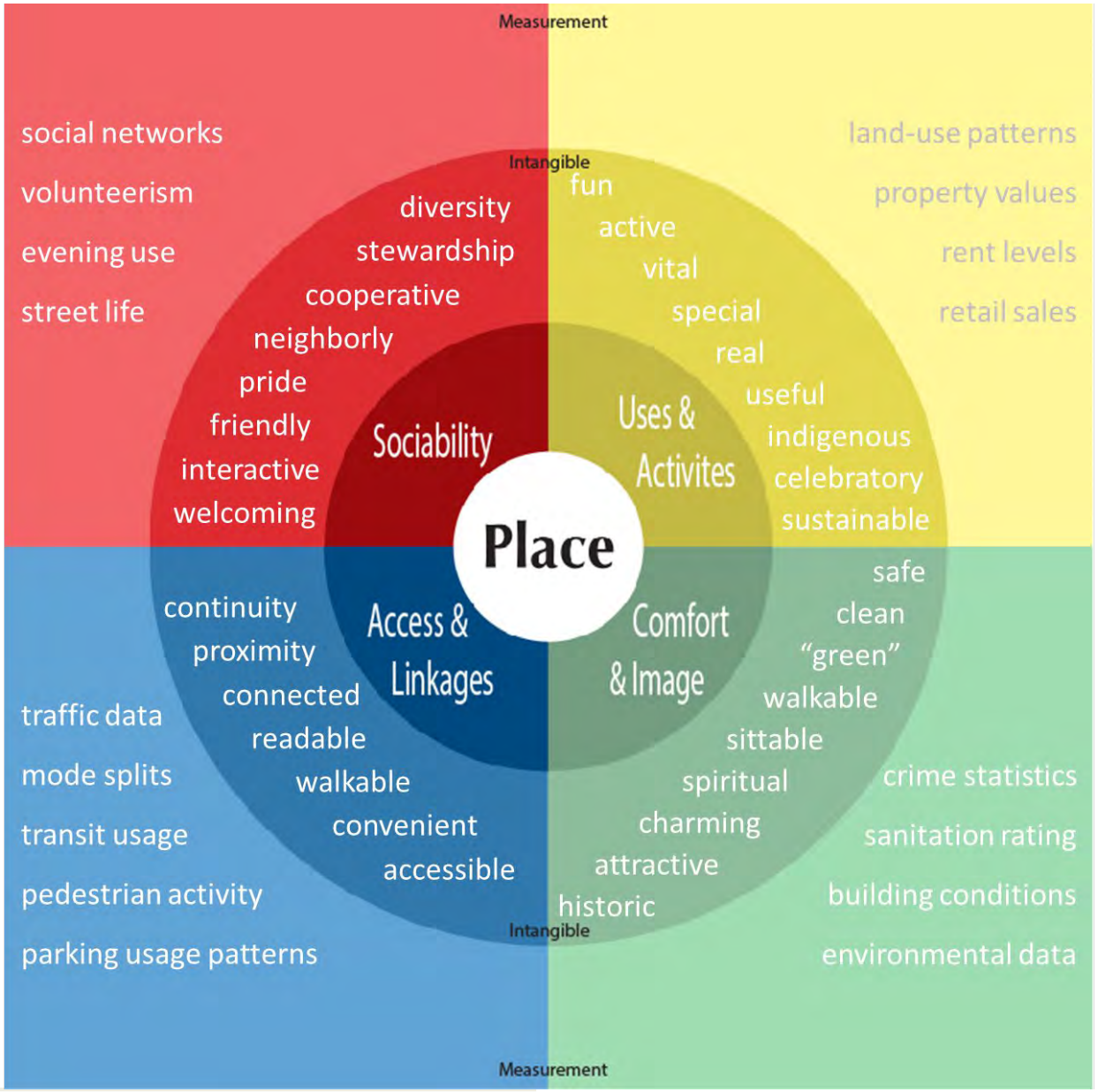
*List three on your post-it

3. What would improve the **comfort** and image of Hudson?

*List three on your post it

4. What types of **links and connections** would make Hudson more accessible?

*List three on your post-it



Community Place-Making Exercise Results

Community Place-Making Exercise: Sociability

More public spaces
People feel welcomed and safe
Connected places
Monthly open house at city hall to welcome newcomers
Winter gathering place
"Work where you live" vs. longer commutes
More perks connected by trails
Cross pollination of silo'd tribes (religious, YMCA, Retirement)
A real, new communication model
Event calendar, push e-mails/Facebook
City pride
Micro parks
Music in the park
Parades/community events
Movies in park
Family events
Riverfest
Dog park
Neighborhood activities
St. Croix Days
Water pump in parks
Bathrooms on diked road

More gathering spaces for families and groups
More "selfie" stations
"Did you know It?" stops on trails and parks
Community Center
Expanded park facilities
More community events
Large gathering place
Website with more info of events
More activities city wide in winter
Public transportation for disabled and folks without cars
Block clubs
River centered activities
Event /convention center
Habitat houses sprinkled throughout new development
More affordable housing and senior housing
Public transportation of some type
Baseball stadium
Lakefront park, farmers market
Parking ramp- event center
Street signs- Hudson Welcomes All
Group seating at end of Dike Road
Park events
Clustered developments with green space

Community Place-Making Exercise: Uses & Activities

Proactive outreach to seniors and lovely people
Mass transit loop up and downtown
Lakefront, more stuff going on
Family trail system
Splash pad and public water feature
Regatta
Birkmose Burial mounds
Curling club on one of the ice sheets
Need community center
Senior Center
Better carry in boat and personal craft
Rental racks at end of Orange St.
Selfie stations

Event/ Convocation center
Ball park
Little zoo with farm animals
Community farmers market downtown
Community center
More bike trails
Boating
Water Access
Special interest parking
Tie ups for boats
Affordable housing
Conference center

Community Place-Making Exercise: Comfort and Image

Universal design- all abilities age in place	100% renewable goal
Splash pad	Welcoming city goal
Not welcoming to diversity	Swing in public parks
Green energy needed	Less water in all of park south of Walnut
Walking divided downtown vs. Topot Hill	Love the videos on Hudson's site, need more
More sidewalks	Direction to parking
Older (NWRF contributes youth)	Boat parking access
Sight line restrictions	Colored plants
Focus on River City	Storm water outlets (pollution control)
Enhancement/maintenance of downtown	Risk assessment on weather changes from climate change
Supportive/inclusive environment	Cradle to grave livability
Senior housing options	Better communication and/or news source

Community Place-Making Exercise: Access & Linkages

ADA for all
Local media coverage of Wisconsin (vs MSP media)
No transit to River Falls or other towns
Water trails
Micropark or meeting spot downtown to bike loops
Camp St. Croix YMCA
Public docking river access
Eclectic vehicle charging
Transit to metro
Public transportation in Hudson

Opportunity for commuters to Twin Cities
Ped/walk path across 94
Other boating towns/cities links online
Community center
Public transportation
City wide free Wi-Fi access
Eclectic scooter rentals or bikes
Boat launch
River access for kayaking and water sports (but are not powe
Overnight parking for boaters and guests

Word Cloud from Place-Making Exercise

Colors are for graphic interest only and do not represent themes or categories.

Appendix A:
Additional Public Comments

Additional comments received by the public are provided in this section.

TO: Comprehensive Plan Steering Committee
City of Hudson WI

FROM: Celeste Koeberl
Strawberry Drive, Hudson WI

RE: Address Community Climate Change Impacts and Sustainability In Hudson's Comprehensive Plan Update

DATE: November 21, 2019

I. The City of Hudson will experience more adverse impacts of climate change in the future.

Last week, at the St. Croix Valley Foundation's sold-out November 13th Conversation of the Valley, climatologist and University of Minnesota professor emeritus Mark Seeley presented comprehensive data on climate change in the Great Lakes Region and its local effects. The St. Croix River Valley where the City of Hudson is located is included in the data sets about which Dr. Seeley spoke.

The hard data show that daytime high temperatures, nighttime low temperatures, and annual precipitation totals all are trending upward significantly, and that the rate of upward changes is accelerating significantly.

The hard data also show that the frequency, intensity, and duration of extreme weather events have increased significantly, and that the occurrence of these extreme weather events is accelerating at a significant rate.

The hard data support climate change models that predict the occurrence of even more frequent, intense, and longer extreme weather events here in the future.

The City of Hudson already has experienced the resulting local adverse impacts of these climate changes, including: more frequent and higher flooding of its St. Croix River frontage; more rainfall events exceeding the capacity of its stormwater infrastructure; and more freeze-thaw cycles breaking up its streets.

The City of Hudson realistically should expect to experience increased adverse impacts of climate change into the future.

II. The City of Hudson should assess the future probability and associated damages of local climate change impacts.

None of us can predict with 100% accuracy what will happen twenty years into the future.

risks resulting from climate change, or is it more prudent and cost-effective to plan to replace and relocate the wastewater treatment functions to higher ground?

IV. The City of Hudson should include practical and reasonable local actions to address climate change in its Comprehensive Plan update.

Communities of all sizes, and throughout the states of Wisconsin and neighboring Minnesota, increasingly are taking local actions to address climate change, and so should the City of Hudson in its Comprehensive Plan Update.

By January 2020, River Falls will be the first municipality in Wisconsin to power all of its city public buildings with 100% renewable energy. The City of Hudson is one of 140 Energy Independent Communities that have partnered with the state of Wisconsin to adopt a goal of producing at least 25% of their energy from renewable sources, but other city governments have set higher renewable energy goals or carbon neutrality goals.

Practical and reasonable local actions to address climate change that should be strongly encouraged, if not mandated, through the Comprehensive Plan Update include:

- Energy-efficient public or private development;
- Renewable energy installations in conjunction with public or private development;
- Water-wise public or private development;
- On-site stormwater retention, filtering, and infiltration in conjunction with public or private development;
- Installation of debris-catching and pollution-load-reducing systems at stormwater outlets to public waters;
- Non-motorized and pedestrian safe-trafficways in conjunction with public or private development;
- Electric vehicle charging stations in conjunction with public or private development;
- Shared transit options in conjunction with public or private development;
- Public transit options in conjunction with public or private development;
- Re-development of previously developed areas rather than new development of previously undeveloped areas;
- Infill development;
- Increased public or private development of affordable housing;
- Increased public or private development of senior housing;
- Public or private clustered-housing development with open and natural spaces; and
- Native landscaping and tree planting in conjunction with public or private development.

Do you have additional comments you would like to share pertaining to the City of Hudson Comprehensive Plan Update? Please share your thoughts with us here:

City Leaders need to appoint people to boards & commissions who look like our population in 2040.

We will be more diverse.

It looks too much like a good ol' boys club.

Thank you for your feedback!

Please leave your completed form at the Public Involvement Workshop, or return it to City Hall, Attn: Comprehensive Plan Update, 505 3rd Street, Hudson, WI 54016-1694.

Mooring Association Supports the Park Master Plans Mooring Field Floating Dock.

The Mooring Association would like to support the current Park Master plan proposal regarding a full length Mooring Field Dock. **Provided that the Mooring Access Dinghy's may be kept and chained by each member to the North side of the dock. Mooring Field access by sliding the light weight dinghy's over the dock as needed**. Our experience with the new rock on the Diked Road have made stairway access too hazardous.**

How much are floating docks?

A **floating dock** costs between $15 to $35 per square foot, depending on the choice of decking. This includes the **dock** and labor to install.
2019 Cost to Build a Dock | Boat & Floating Dock Prices ...
https://www.homeadvisor.com › cost › outdoor-living › build-a-dock

A dock the length of the Mooring Field dock (1200 ft.) could accommodate all the mooring field dingy's on the north side of the dock while providing parking for 30 recreational boats on the south side.

In 1974 the Corp Engineers, authorize the city of Hudson to administer access to the sailboat mooring field, they provided, for up to 50 sailboats. $25,000 per year is collected by the city of Hudson, for assigning mooring position and providing access via Member Dingy's parked along the Diked Road. For mooring field access, over the years the Mooring Association members have given the City of Hudson well over $600,000

** We now have 3 years of experience with the large rocks which now make up the Diked Road. We have found that the rocks remained unstable and are a hazard to walk on. Because the previous propose stair access would continue to require walking on the unstable rocks a floating dock would be preferable dingy access.

Logistics of the Floating Dock along the Mooring Field.

The Mooring field is 1200 ft. long, and with wind from the south, the northern most moored boats remaining 50 ft. from shore. A dock with its south edge 15 ft from the low water shore will leave 35 ft for boat parking and access (85 ft with winds from other directions). That's a minimum 25 ft wide lain for access traffic, while providing 10 ft. of beam for parked boats. The Mooring Field dock would create an additional 30 boat parking spots. At 3 passengers average per boat and a 1% occupancy **(5 one hour boats per day**) the new dock side parking would mean 3240 additional customers for Hudson's down town businesses. (boats*hours*days*people*occupancy).
{30x24x150x3x.01=3240}

mooring Ass
Coast Guard.
Harveychichester@comcast.net
6/12-2026-5288

In 2020 Hudson Car Parking will be a problem for Recreational Boaters.

The unintended consequence of the new parking meter implementation will be a decrease of economic opportunity for Hudson. Boaters often spend many hours on their boats and overnights. A problem arises if boaters and guests that arrive by car and have no long term parking available. **If all the new parking meters in Hudson have a 2 hour limit it restricts boater and guest opportunities**.

It appears that recreational boating will start to limit boat access to 2 hours for most guests. **Hudson does have four free Down Town parking lots but they are not well known to boaters and guests.** These lots have limited capacity and do not offer 24 hour parking for boats that love to spend the night at sea. Overnight boaters offer the best prospects to buy from Hudson merchants..

The St. Croix River is an attraction that generates a variety of economic Benefits to Hudson WI. The city recognizes this and invests in its Parks and community infrastructure to enhance this asset. As a result Hudson offers a boat ramp and trailer parking. The city administers access to an attractive Sailboat mooring field as well. Plus recreational boaters use the river system to visit Hudson from as far away as Lake City MN and beyond.

Recreational boating consists of two groups. One group own and operate recreational boats, and the other group are the guests of those boaters. **Because many boaters arrive in Hudson by car the city should make provision for both groups to park.**

From: Kerry Reis <kerry.reis56@gmail.com>
To: "nday@sehinc.com" <nday@sehinc.com>
Cc: Einar Hanson <ehanson@strobelhanson.com>, Celeste Koeberl <koeberl@mac.com>, Chris Kost <chris.kost@ymcamn.org>
Date: 11/22/2019 10:43 AM
Subject: Memo to Nick Day on Hudson 2040 Planning Project

Hello Nick. Thank you for a great SWOT exercise last evening. Attached is the memo that I promised to send last evening. It covers four broad topics:

1. The need to level set with a current state communication.
2. The urgent need to address climate change.
3. The need to proactively address inclusion in our community.
4. The need for an expanded and modern communications model to manage change.

I have copied Einar Hanson, Celeste Koeberl and Chris Kost (Director of the YMCA) as they are referenced in this memo.

Thank you for the work that you do.

Kerry Reis, (715) 222-6208

Sent from Mail for Windows 10
[attachment "Hudson 2040.docx" deleted by Brea Grace/seh]

What do we need to think about for Hudson, 2040?

When considering the future, it's important to have a common understanding of the current state. While I have found the city to be transparent, it's not unusual to have conversations with people in the community that shows the lack of understanding of our current state. It would be worthwhile to include in your scope of work a simple report of the current state of Hudson …to inform citizens of whatever you feel sets the stage for looking ahead.

We have inherited all of the decisions of our past leaders, good and not so great. That's the reality for all leaders. Yet it's a fact that many cities in Western Wisconsin would love to have the problems that Hudson has. St. Croix County is the fastest growing county in Wisconsin. We have:

- A growing population of young families; families in need of solid school systems.
- A solid business tax base to help pay for infrastructure, protection and city services.
- A great downtown area that is a draw for visitors and locals with an affinity for our shared resource of the beautiful St. Croix River.
- The blessing of a solid faith community, beautiful city parks and a population that cares about our community.
- Beautiful parks and many neighborhoods with sidewalks and other ways to engage each other.

In 2040, it is likely that the City of Hudson will be:

1. An older population.
2. More diverse in terms of race and religion.
3. More focused on conserving our natural resources and,
4. The reality of climate change will be upon us.

I will narrow my comments down to two requests.

1. **Please consider a broader communication platform**: The need to put the information and communication needs of this city and its citizens requires more than the current response. We have various resources: websites and the River Channel YouTube. These are insufficient. What I have personally witnessed on closed Facebook groups, in neighborhood conversations and in my former Townhome association shows that the people of this city and surrounding areas are dangerously uninformed about what is happening in their city. There is a

willingness to listen to and believe online and in person rumors that ascribe false motivations to city leaders and staff. One example is when it comes to parking changes. Another has to do with changes in the way that the city charges for water.

a. With the changes in the way that newspapers are funded, owned and staffed, the local paper is just plain insufficient to serve the people of this community. Few citizens read it, fewer are willing to pay for a subscription and many are more willing to believe online forums than take the time to visit the city website for fact-based information. We need to acknowledge that for all of the good that it does, the Rivertown's / Forum Communications media is not effective in letting the population know what is going on in this community.

b. When I think about this part of the state, I call it the "media dead zone". When it comes to television media, most of our residents can tell you about what is happening at the Minnesota legislature and in Governor Waltz' cabinet but don't know a thing about what is happening in their own state. This makes for a population that is poorly informed and worse, susceptible to misleading and incomplete information. Decisions are being made in Madison that directly affect Western Wisconsin and our citizenry deserve to know what is going on.

c. City officials need to consider outreach beyond what is currently happening to help citizens manage change. Change is the constant. Help people to understand the changes that are being made and why they are being made.

2. **Become a leader in addressing climate change.**

Any look into the future requires that the city address the climate crisis. We are already dealing with the cost of a changing climate. Multiple freeze and thaw cycles in one season result in expenses in road repair. Increasingly large rainfall events and record setting weather events are becoming the norm. Here are some specific thoughts on the matter:

a. The city can show leadership in adopting a **green city approach** to how its buildings and resources are managed. This can save taxpayers and set the tone for the future.

b. **Manage our water resources** as though they are a precious and rare resource. Clean, drinkable water is life. A recent letter to the editor describes the source of our water. It's not just Hudson. It's the Mount Simon Sandstone aquifer. It covers Dakota County and is named for structures all the way to Eau Claire.

c. Here are some specific examples of waste that I've seen in our city:

    i. I recently sold a townhome in Hudson. That association had an in-ground sprinkler system. Like all associations, some residents insisted on having very green lawns. Even in the hottest days of the summer, regardless of the cost.

        1. A side note … people need to un-learn many years of marketing which has made them think that they need to live on a golf course and that it should look like Agusta National … in August. We have far too much runoff of drinkable water and far too much chemical treatment going into our water systems.
        2. I am building a new home in Hudson. The building covenants require that I put in an in-ground irrigation system.
        3. In the future, I propose that the city not approve in ground irrigation systems which drain our natural resources.
        4. For those that do have in-ground irrigation systems, they need to be upgraded to so-called smart servers that are based on irrigation need, not a timer. How often have we seen clean, drinkable water being spread on lawns or filling the gutter curbs in the middle of a downpour?

d. **Look at how we use our resources in a holistic way.** This includes how we dispose of refuse, how we use electricity and mass transportation. Encourage the use of renewable energy by encouraging solar, wind and electric recharging stations for modern vehicles. Consider a mass transit option that brings people to downtown without adding to the congestion and parking problems.

e. **Partner at the regional, state and national level to provide for a cleaner future**. As I mentioned earlier on water, we don't have a private reservoir for Hudson alone. What happens in Dakota County, MN affects us in Hudson. This need to collaborate should not be optional. It should be in the job descriptions of our city leaders.

i. **Extreme weather events are becoming the norm**. Last week, I heard Dr. Mark Seeley, a climatologist and meteorologist with the U of Mn speak about climate change. He has determined, like many scientists, that we are in a crisis. He talked about extreme rainfall events and the expense to cities when their sewer, roads, and bridges are wiped out. Not to mention the human costs in these events.

ii. **We can't wait**. Adopting the standards of the Paris Accord has to happen at all levels. Cities throughout the country aren't waiting for leadership at the national level. Because we can't afford to wait.

World Scientists' Warning of a Climate Emergency

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation and the graphical indicators presented below, we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

Exactly 40 years ago, scientists from 50 nations met at the First World Climate Conference (in Geneva 1979) and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017). Yet greenhouse gas (GHG) emissions are still rapidly rising, with increasingly damaging effects on the Earth's climate. An immense increase of scale in endeavors to conserve our biosphere is needed to avoid untold suffering due to the climate crisis (IPCC 2018).

Most public discussions on climate change are based on global surface temperature only, an inadequate measure to capture the breadth of human activities and the real dangers stemming from a warming planet (Briggs et al. 2015). Policymakers and the public now urgently need access to a set of indicators that convey the effects of human activities on GHG emissions and the consequent impacts on climate, our environment, and society. Building on prior work (see supplemental file S2), we present a suite of graphical vital signs of climate change over the last 40 years for human activities that can affect GHG emissions and change the climate (figure 1), as well as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically collected for at least the last 5 years, and updated at least annually.

The climate crisis is closely linked to excessive consumption of the wealthy lifestyle. The most affluent countries are mainly responsible for the historical GHG emissions and generally have the greatest per capita emissions (table S1). In the present article, we show general patterns, mostly at the global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working to implement the Paris climate agreement, the United Nations' Sustainable Development Goals, and the Aichi Biodiversity Targets.

Profoundly troubling signs from human activities include sustained increases in both human and ruminant livestock populations, per capita meat production, world gross domestic product, global tree cover loss, fossil fuel consumption, the number of air passengers carried, carbon dioxide (CO_2) emissions, and per capita CO_2 emissions since 2000 (figure 1, supplemental file S2). Encouraging signs include decreases in global fertility (birth) rates (figure 1b), decelerated forest loss in the Brazilian Amazon (figure 1g), increases in the consumption of solar and wind power (figure 1h), institutional fossil fuel divestment of more than US$7 trillion (figure 1j), and the proportion of GHG emissions covered by carbon pricing (figure 1m). However, the decline in human fertility rates has substantially slowed during the last 20 years (figure 1b), and the pace of forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy has increased 373% per decade, but in 2018, it was still 28 times smaller than fossil fuel consumption (combined gas, coal, oil; figure 1h). As of 2018, approximately 14.0% of global GHG emissions were covered by carbon pricing (figure 1m), but the global emissions-weighted average price per tonne of carbon dioxide was only around US$15.25 (figure 1n). A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018 (figure 1o).

Especially disturbing are concurrent trends in the vital signs of climatic impacts (figure 2, supplemental file S2). Three abundant atmospheric GHGs (CO_2, methane, and nitrous oxide) continue to increase (see figure S1 for ominous 2019 spike in CO_2), as does global surface temperature (figure 2a–2d). Globally, ice has been rapidly disappearing, evidenced by declining trends in minimum summer Arctic sea ice, Greenland and Antarctic ice sheets, and glacier thickness worldwide (figure 2e–2h). Ocean heat content, ocean acidity, sea level, area burned in the United States, and extreme weather and associated damage costs have all been trending upward (figure 2i–2n). Climate change is predicted to greatly affect marine, freshwater, and terrestrial life, from plankton and corals to fishes and forests (IPCC 2018, 2019). These issues highlight the urgent need for action.

Despite 40 years of global climate negotiations, with few exceptions, we have generally conducted business

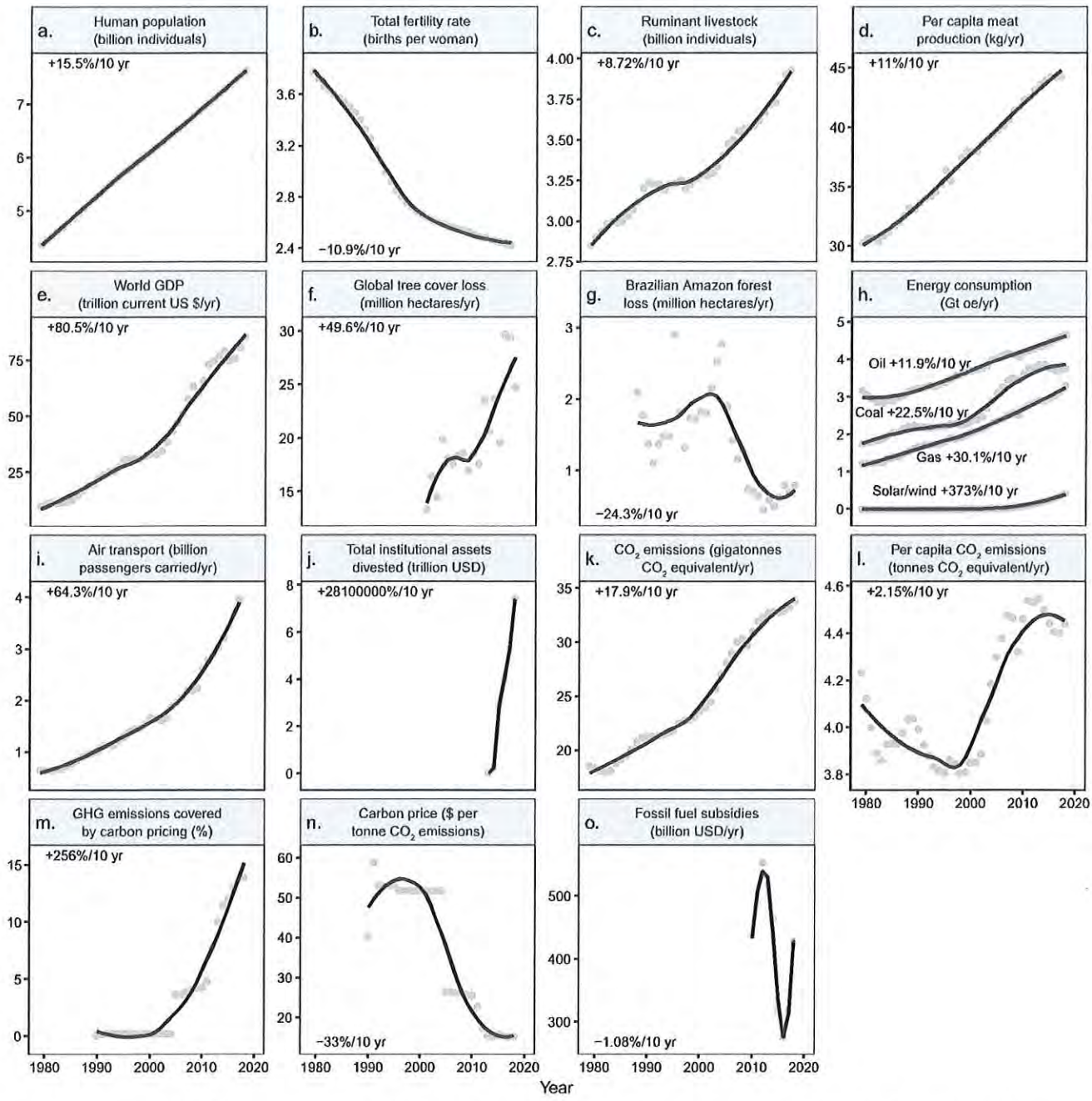


Figure 1. ***Change in global human activities from 1979 to the present. These indicators are linked at least in part to climate change. In panel (f), annual tree cover loss may be for any reason (e.g., wildfire, harvest within tree plantations, or conversion of forests to agricultural land). Forest gain is not involved in the calculation of tree cover loss. In panel (h), hydroelectricity and nuclear energy are shown in figure S2. The rates shown in panels are the percentage changes per decade across the entire range of the time series. The annual data are shown using gray points. The black lines are local regression smooth trend lines. Abbreviation: Gt oe per year, gigatonnes of oil equivalent per year. Sources and additional details about each variable are provided in supplemental file S2, including table S2.***

as usual and have largely failed to address this predicament (figure 1). The climate crisis has arrived and is accelerating faster than most scientists expected (figure 2, IPCC 2018). It is more severe than anticipated, threatening natural ecosystems and the fate of humanity (IPCC 2019). Especially worrisome are potential irreversible climate tipping points and nature's reinforcing feedbacks (atmospheric, marine, and terrestrial) that could lead to a catastrophic "hothouse Earth," well beyond the control of humans (Steffen et al. 2018). These climate

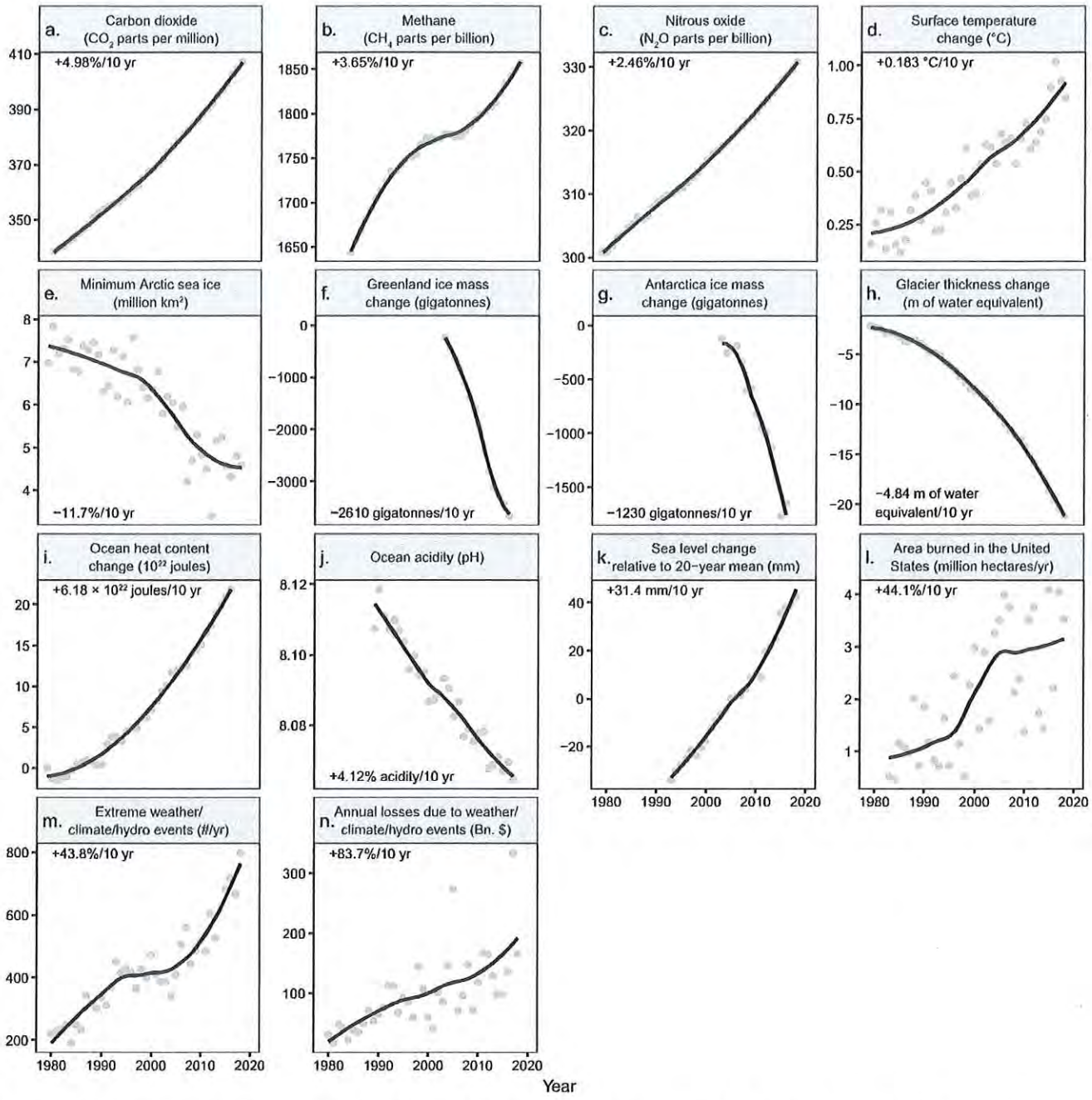


Figure 2. ***Climatic response time series from 1979 to the present. The rates shown in the panels are the decadal change rates for the entire ranges of the time series. These rates are in percentage terms, except for the interval variables (d, f, g, h, i, k), where additive changes are reported instead. For ocean acidity (pH), the percentage rate is based on the change in hydrogen ion activity, a_{H^+} (where lower pH values represent greater acidity). The annual data are shown using gray points. The black lines are local regression smooth trend lines. Sources and additional details about each variable are provided in supplemental file S2, including table S3.***

chain reactions could cause significant disruptions to ecosystems, society, and economies, potentially making large areas of Earth uninhabitable.

To secure a sustainable future, we must change how we live, in ways that improve the vital signs summarized by our graphs. Economic and population growth are among the most important drivers of increases in CO_2 emissions from fossil fuel combustion (Pachauri et al. 2014, Bongaarts and O'Neill 2018); therefore, we need bold and drastic transformations regarding economic and population policies. We suggest six critical and interrelated steps (in no particular order) that governments, businesses, and the rest of

humanity can take to lessen the worst effects of climate change. These are important steps but are not the only actions needed or possible (Pachauri et al. 2014, IPCC 2018, 2019).

Energy

The world must quickly implement massive energy efficiency and conservation practices and must replace fossil fuels with low-carbon renewables (figure 1h) and other cleaner sources of energy if safe for people and the environment (figure S2). We should leave remaining stocks of fossil fuels in the ground (see the timelines in IPCC 2018) and should carefully pursue effective negative emissions using technology such as carbon extraction from the source and capture from the air and especially by enhancing natural systems (see "Nature" section). Wealthier countries need to support poorer nations in transitioning away from fossil fuels. We must swiftly eliminate subsidies for fossil fuels (figure 1o) and use effective and fair policies for steadily escalating carbon prices to restrain their use.

Short-lived pollutants

We need to promptly reduce the emissions of short-lived climate pollutants, including methane (figure 2b), black carbon (soot), and hydrofluorocarbons (HFCs). Doing this could slow climate feedback loops and potentially reduce the short-term warming trend by more than 50% over the next few decades while saving millions of lives and increasing crop yields due to reduced air pollution (Shindell et al. 2017). The 2016 Kigali amendment to phase down HFCs is welcomed.

Nature

We must protect and restore Earth's ecosystems. Phytoplankton, coral reefs, forests, savannas, grasslands, wetlands, peatlands, soils, mangroves, and sea grasses contribute greatly to sequestration of atmospheric CO_2. Marine and terrestrial plants, animals, and microorganisms play significant roles in carbon and nutrient cycling and storage. We need to quickly curtail habitat and biodiversity loss (figure 1f–1g), protecting the remaining primary and intact forests, especially those with high carbon stores and other forests with the capacity to rapidly sequester carbon (proforestation), while increasing reforestation and afforestation where appropriate at enormous scales. Although available land may be limiting in places, up to a third of emissions reductions needed by 2030 for the Paris agreement (less than 2°C) could be obtained with these natural climate solutions (Griscom et al. 2017).

Food

Eating mostly plant-based foods while reducing the global consumption of animal products (figure 1c–d), especially ruminant livestock (Ripple et al. 2014), can improve human health and significantly lower GHG emissions (including methane in the "Short-lived pollutants" step). Moreover, this will free up croplands for growing much-needed human plant food instead of livestock feed, while releasing some grazing land to support natural climate solutions (see "Nature" section). Cropping practices such as minimum tillage that increase soil carbon are vitally important. We need to drastically reduce the enormous amount of food waste around the world.

Economy

Excessive extraction of materials and overexploitation of ecosystems, driven by economic growth, must be quickly curtailed to maintain long-term sustainability of the biosphere. We need a carbon-free economy that explicitly addresses human dependence on the biosphere and policies that guide economic decisions accordingly. Our goals need to shift from GDP growth and the pursuit of affluence toward sustaining ecosystems and improving human well-being by prioritizing basic needs and reducing inequality.

Population

Still increasing by roughly 80 million people per year, or more than 200,000 per day (figure 1a–b), the world population must be stabilized—and, ideally, gradually reduced—within a framework that ensures social integrity. There are proven and effective policies that strengthen human rights while lowering fertility rates and lessening the impacts of population growth on GHG emissions and biodiversity loss. These policies make family-planning services available to all people, remove barriers to their access and achieve full gender equity, including primary and secondary education as a global norm for all, especially girls and young women (Bongaarts and O'Neill 2018).

Conclusions

Mitigating and adapting to climate change while honoring the diversity of humans entails major transformations in the ways our global society functions and interacts with natural ecosystems. We are encouraged by a recent surge of concern. Governmental bodies are making climate emergency declarations. Schoolchildren are striking. Ecocide lawsuits are proceeding in the courts. Grassroots citizen movements are demanding change, and many countries, states and provinces, cities, and businesses are responding.

As the Alliance of World Scientists, we stand ready to assist decision-makers in a just transition to a sustainable and equitable future. We urge widespread use of vital signs, which will better allow policymakers, the private sector, and the public to understand the magnitude of this crisis, track progress, and realign priorities for alleviating climate change. The good news is that such transformative change, with social and economic justice for all, promises far greater human well-being than does business as usual. We believe that the prospects will be greatest if decision-makers and all of humanity promptly respond to this warning and declaration of a climate emergency and act to sustain life on planet Earth, our only home.

Contributing reviewers

Franz Baumann, Ferdinando Boero, Doug Boucher, Stephen Briggs, Peter

Carter, Rick Cavicchioli, Milton Cole, Eileen Crist, Dominick A. DellaSala, Paul Ehrlich, Iñaki Garcia-De-Cortazar, Daniel Gilfillan, Alison Green, Tom Green, Jillian Gregg, Paul Grogan, John Guillebaud, John Harte, Nick Houtman, Charles Kennel, Christopher Martius, Frederico Mestre, Jennie Miller, David Pengelley, Chris Rapley, Klaus Rohde, Phil Sollins, Sabrina Speich, David Victor, Henrik Wahren, and Roger Worthington.

Funding

The Worthy Garden Club furnished partial funding for this project.

Project website

To view the Alliance of World Scientists website or to sign this article, go to https://scientistswarning.forestry.oregonstate.edu.

Supplemental material

Supplemental data are available at *BIOSCI* online. A list of the signatories appears in supplemental file S1.

References cited

Briggs S, Kennel CF, Victor DG. 2015. Planetary vital signs. Nature Climate Change 5: 969.

Bongaarts J, O'Neill BC. 2018. Global warming policy: Is population left out in the cold? Science 361: 650–652.

Griscom BW, et al. 2017. Natural climate solutions. Proceedings of the National Academy of Sciences 114: 11645–11650.

[IPCC] Intergovernmental Panel on Climate Change. 2018. Global Warming of 1.5°C: An IPCC Special Report. IPCC.

[IPCC] Intergovernmental Panel on Climate Change. 2019. Climate Change and Land. IPCC.

Pachauri RK, et al. 2014. Climate Change 2014: Synthesis Report. Intergovernmental Panel on Climate Change.

Ripple WJ, Smith P, Haberl H, Montzka SA, McAlpine C, Boucher DH. 2014. Ruminants, climate change, and climate policy. Nature Climate Change 4: 2–5.

Ripple WJ, Wolf C, Newsome TM, Galetti M, Alamgir M, Crist E, Mahmoud MI, Laurance WF. 2017. World scientists' warning to humanity: A second notice. BioScience 67: 1026–1028.

Shindell D, Borgford-Parnell N, Brauer M, Haines A, Kuylenstierna J, Leonard S, Ramanathan V, Ravishankara A, Amann M, Srivastava L. 2017. A climate policy pathway for near- and long-term benefits. Science 356: 493–494.

Steffen W, et al. 2018. Trajectories of the Earth System in the Anthropocene. Proceedings of the National Academy of Sciences 115: 8252–8259.

William J. Ripple (bill.ripple@oregonstate.edu) and Christopher Wolf (christopher.wolf@oregonstate.edu) are affiliated with the Department of Forest Ecosystems and Society at Oregon State University, in Corvallis and contributed equally to the work. Thomas M. Newsome is affiliated with the School of Life and Environmental Sciences at The University of Sydney, in Sydney, New South Wales, Australia. Phoebe Barnard is affiliated with the Conservation Biology Institute, in Corvallis, Oregon, and with the African Climate and Development Initiative, at the University of Cape Town, in Cape Town, South Africa. William R. Moomaw is affiliated with The Fletcher School and the Global Development and Environment Institute, at Tufts University, in Medford, Massachusetts.

doi:10.1093/biosci/biz088

FACT SHEET

JULY 9, 2019

Newspapers Fact Sheet

MORE FACT SHEETS: STATE OF THE NEWS MEDIA

Audience
Economics
News organization
Find out more

Newspapers are a critical part of the American news landscape, but they have been hit hard as more and more Americans consume news digitally. The industry's financial fortunes and subscriber base have been in decline since the mid-2000s, and website audience traffic, after some years of growth, has leveled off. Explore the patterns and longitudinal data about U.S. newspapers below.

Audience

The estimated total U.S. daily newspaper circulation (print and digital combined) in 2018 was 28.6 million for weekday and 30.8 million for Sunday, down 8% and 9%, respectively, from the previous year.

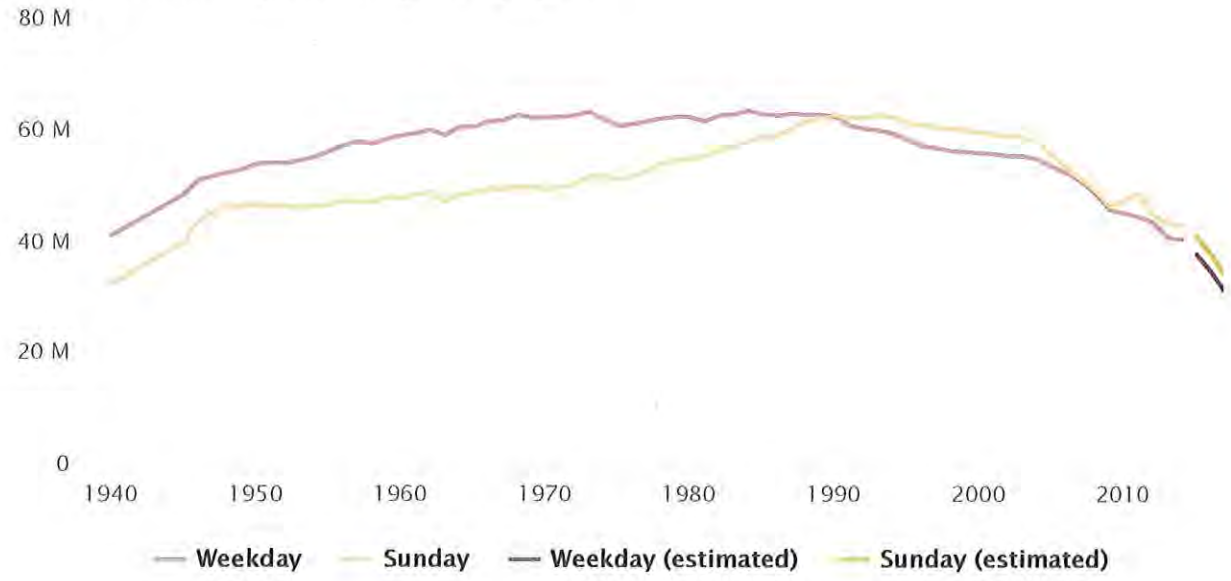
Weekday print circulation decreased 12% and Sunday print circulation decreased 13%.

(Note that in this fact sheet and in the chart below, data through 2014 is from Editor & Publisher, which was published on the website of the News Media Alliance (NMA), known at the time as the Newspaper Association of America (NAA). Since then, the NMA/NAA no longer supplies this data, so the Center determined the year-over-year change in total circulation for those daily U.S. newspapers that report to the Alliance for Audited Media and meet certain criteria, as detailed in the note of the chart below. This percentage change was then applied to the total circulation from the prior year – thus the use of the term "estimated total circulation.")

Total estimated circulation of U.S. daily newspapers

Chart Data Share Embed

Total circulation of U.S. daily newspapers



Note: To determine totals for 2015 onward, researchers analyzed the year-over-year change in total weekday and Sunday circulation using AAM data and applied these percent changes to the previous year's total. Only those daily U.S. newspapers that report to AAM are included. Affiliated publications are not included in the analysis. Weekday circulation only includes those publications reporting a Monday-Friday average. For each year, the comparison is for all newspapers meeting these criteria for the three-month period ending Dec. 31 of the given year. Comparisons are between the three-month averages for the period ending Dec. 31 of the given year and the same period of the previous year.
Source: Editor & Publisher (through 2014); estimate based on Pew Research Center analysis of Alliance for Audited Media data (2015-2018).

PEW RESEARCH CENTER

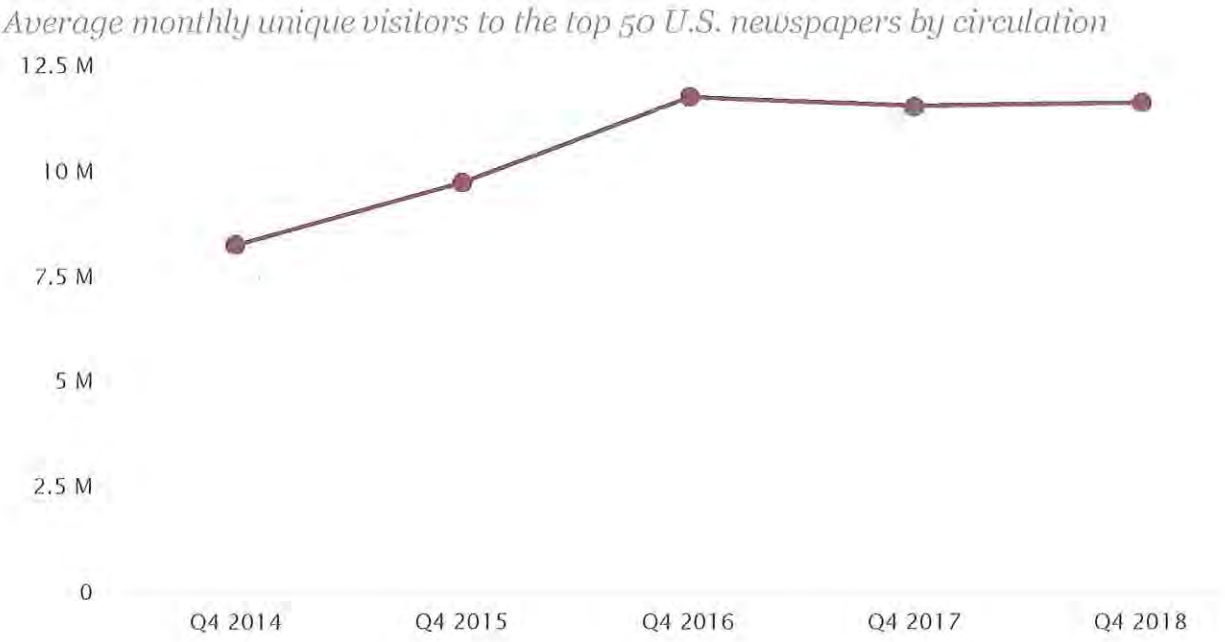
Digital circulation is more difficult to gauge. Three of the highest-circulation daily papers in the U.S. – The New York Times, The Wall Street Journal and The Washington Post – have in recent years not fully reported their digital circulation to the Alliance for Audited Media (AAM), the group that audits the circulation figures of many of the largest North American newspapers and other publications. Two of these papers report such digital circulation elsewhere: The New York Times in their financial statements and The Wall Street Journal in reports available on the Dow Jones website. (The Washington Post does not fully report digital circulation in any forum.) But because they may not be counted under the same rules used by AAM, these independently produced figures cannot easily be merged with the AAM data.

Taking these complexities into account, using only the AAM data, digital circulation in 2018 is projected to have risen, with weekday up 6% and Sunday up 8%. According to the independently produced reports from The New York Times and The Wall Street Journal, both companies experienced substantial gains in digital circulation in the past year: 27% for the Times and 23% for the Journal, on top of large gains in 2017. If these independently produced figures were included with the AAM data in both 2017 and 2018, weekday digital circulation would have risen by 17%.

The addition of these figures would also change the overall picture for combined print and digital circulation. The digital boost driven by these two large, national brands would still result in an overall drop in circulation year over year, but a smaller one: Overall weekday circulation would have fallen by 1% in 2018 rather than 8%.

Unique visitors of newspaper websites

Chart | Data | Share | Embed



Note: For each year, the average traffic for each website for October/November/December was calculated; the data point represents the overall average of those numbers. Analysis is of the top 49 newspapers by average Sunday circulation for Q3 2016, Q3 2017 and Q3 2018, according to Alliance for Audited Media data, with the addition of The Wall Street Journal. For each newspaper, the Comscore entity matching its homepage URL was analyzed.
Source: Comscore Media Metrix® Multi-Platform, US, Unique Visitors, October-December 2014-2018.

PEW RESEARCH CENTER

Gauging digital audience for the entire newspaper industry is difficult since many daily newspapers do not receive enough traffic to their websites to be measured by Comscore, the data source relied on here. Thus, the figures offered above reflect the top 50 U.S. daily newspapers based on circulation. In the fourth quarter of 2018, there was an average of 11.6 million monthly unique visitors (across all devices) for these top 50 newspapers. This is nearly the same as in Q4 2017 (11.5 million) and 2016 (11.7 million); following two years of growth from 2014 to 2016, newspapers' website traffic has leveled off. (The list of top 50 papers is based on Sunday circulation but also includes The Wall Street Journal, which does not report Sunday circulation to AAM. It also includes The Washington Post and The New York Times, which make the top 50 even though they do not fully report their digital circulation to AAM. For more details and the full list of newspapers, see our methodology.)

Visit duration of newspaper websites

Chart | Data | Share | Embed

Average minutes per visit for the top 50 U.S. newspapers by circulation

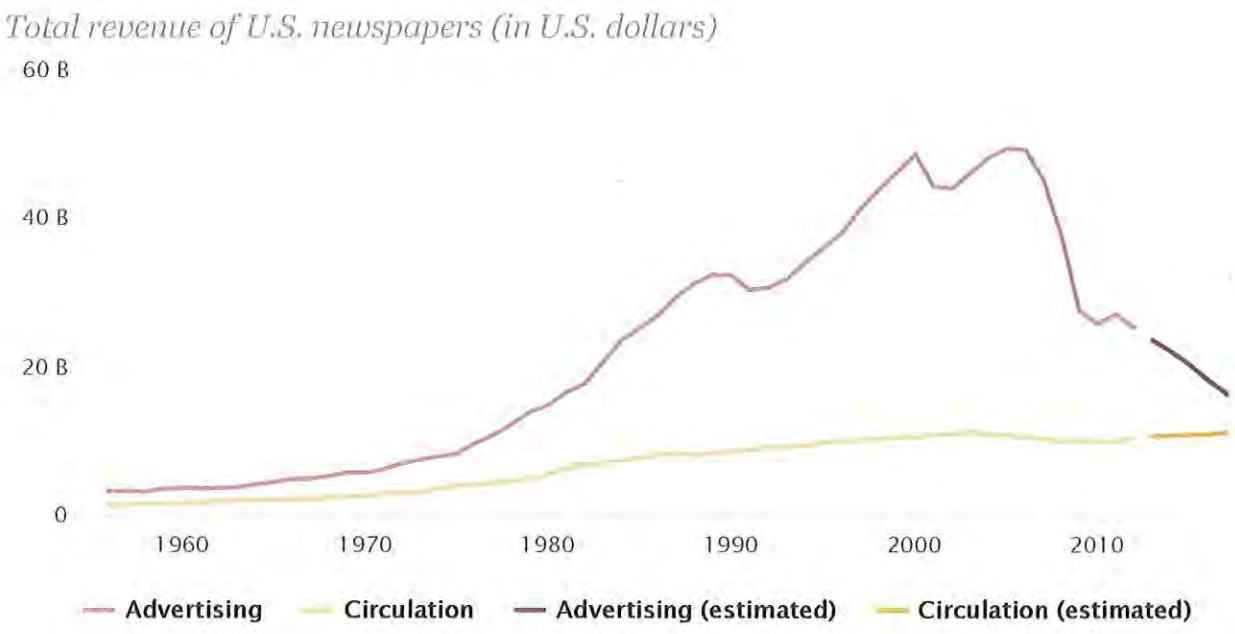
Note: For each year, the average minutes per visit for each website for October/November/December was calculated; the data point represents the overall average of those numbers. Analysis is of the top 49 newspapers by average Sunday

Economics

The total estimated advertising revenue for the newspaper industry in 2018 was $14.3 billion, based on the Center's analysis of financial statements for publicly traded newspaper companies. This is down 13% from 2017. Total estimated circulation revenue was $11.0 billion, compared with $11.2 billion in 2017.

Estimated advertising and circulation revenue of the newspaper industry

Chart Data Share Embed



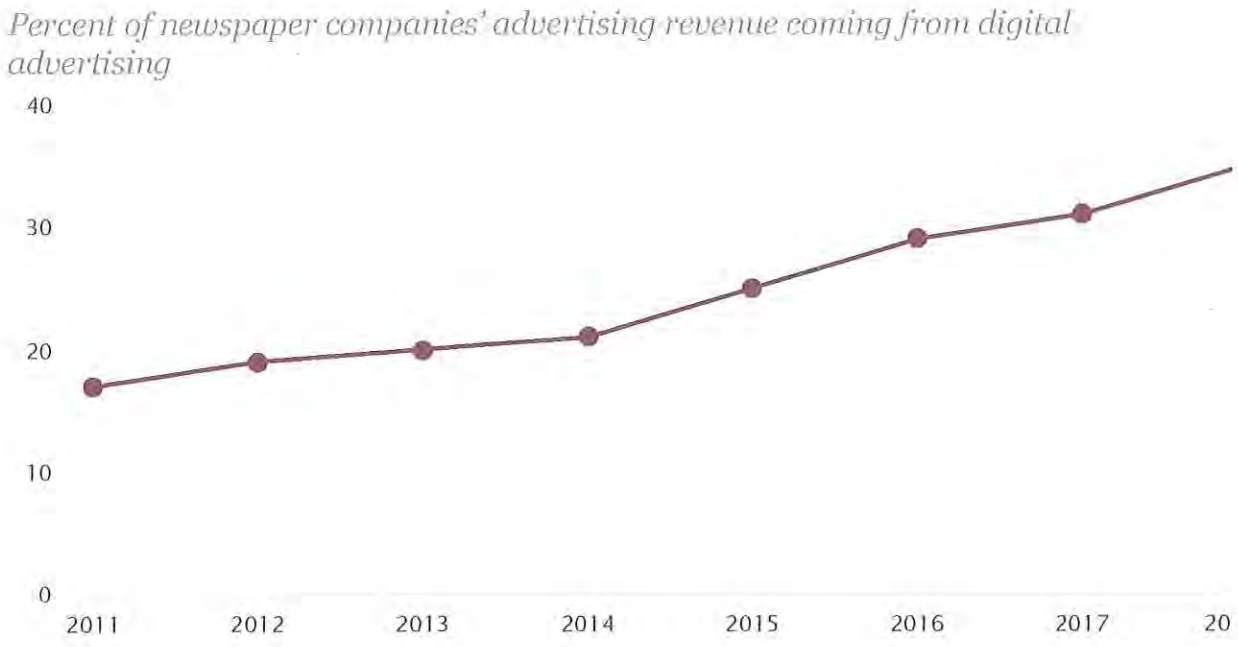
Source: News Media Alliance, formerly Newspaper Association of America (through 2012); Pew Research Center analysis of year-end SEC filings of publicly traded newspaper companies (2013-2018).

PEW RESEARCH CENTER

In the chart above, data through 2012 comes from the trade group formerly known as the Newspaper Association of America (NAA), now known as the News Media Alliance (NMA). Data from 2013 onward is based on the Center's analysis of financial statements from publicly traded U.S. newspaper companies, which now number seven and account for more than 300 U.S. daily newspapers, from large national papers to midsize metro dailies and local papers. From 2013 onward, the year-over-year percentage change in advertising and circulation revenue for these companies is calculated and then applied to the previous year's revenue totals as reported by the NMA/NAA. In testing this method, changes from 2006 through 2012 generally matched those as reported by the NMA/NAA; for more details, see our 2016 report.

Share of newspaper advertising revenue coming from digital advertising

Chart | Data | Share | Embed



Source: Pew Research Center analysis of year-end SEC filings for publicly traded newspaper companies that break out digital advertising revenue for each year.

PEW RESEARCH CENTER

Digital advertising accounted for 35% of newspaper advertising revenue in 2018, based on this analysis of publicly traded newspaper companies. The portion stood at 31% in 2017 – but at 17% in 2011, the first year it was possible to perform this analysis.

Newsroom investment

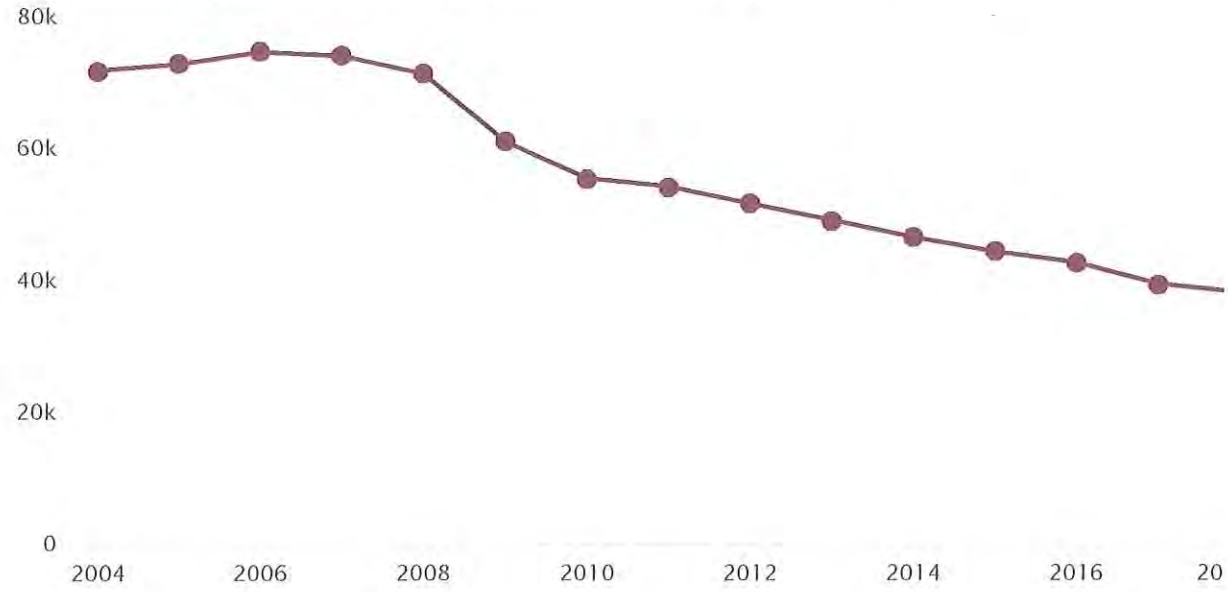
According to data from the Bureau of Labor Statistics' Occupational Employment Statistics, 37,900 people worked as reporters, editors, photographers, or film and video editors in the newspaper industry in 2018. That is down 14% from 2015 and 47% from 2004. Median wages for editors in 2018 were about $49,000, while for reporters, the figure was about $35,000.

Employment in newspaper newsrooms

Employees Wages

Chart Data Share Embed

Total number of newsroom employees in the newspaper sector



Note: The OES survey is designed to produce estimates by combining data collected over a three-year period. Newsroom employees include news analysts, reporters and correspondents; editors; photographers; and television, video, and motion picture camera operators and editors.
Source: Pew Research Center analysis of Bureau of Labor Statistics Occupational Employment Statistics data.

PEW RESEARCH CENTER

Find out more

This fact sheet was compiled by Senior Researcher Michael Barthel.

Read the methodology.

Find more in-depth explorations of U.S. newspapers by following the links below:

- U.S. newsroom employment has dropped a quarter since 2008, with greatest decline at newspapers July 9, 2019
- For Local News, Americans Embrace Digital but Still Want Strong Community Connection, March 26, 2019
- Interactive: What are the local news dynamics in your city?, March 26, 2019
- Social media outpaces print newspapers in the U.S. as a news source, Dec. 10, 2018
- Americans Still Prefer Watching to Reading the News – and Mostly Still Through Television, Dec. 3, 2018
- About a third of large U.S. newspapers have suffered layoffs since 2017, July 23, 2018
- Covering President Trump in a Polarized Media Environment, Oct. 2, 2017
- For election news, young people turned to some national papers more than their elders, Feb. 17, 2017
- Trump, Clinton Voters Divided in Their Main Source for Election News, Jan. 18, 2017

ULI Resilience Program

White Paper Series

A Guide for Assessing Climate Change Risk

Urban Land Institute Center for Sustainability

About the Urban Land Institute

THE MISSION OF THE URBAN LAND INSTITUTE is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. ULI is committed to

- Bringing together leaders from across the fields of real estate and land use policy to exchange best practices and serve community needs;
- Fostering collaboration within and beyond ULI's membership through mentoring, dialogue, and problem solving;
- Exploring issues of urbanization, conservation, regeneration, land use, capital formation, and sustainable development;
- Advancing land use policies and design practices that respect the uniqueness of both the built and natural environments;
- Sharing knowledge through education, applied research, publishing, and electronic media; and
- Sustaining a diverse global network of local practice and advisory efforts that address current and future challenges.

Established in 1936, the Institute today has more than 34,000 members worldwide, representing the entire spectrum of the land use and development disciplines. Professionals represented include developers, builders, property owners, investors, architects, public officials, planners, real estate brokers, appraisers, attorneys, engineers, financiers, academics, students, and librarians.

ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

Recommended bibliographic listing:

Urban Land Institute. *A Guide for Assessing Climate Change Risk*. Washington, DC: Urban Land Institute, 2015.

1025 Thomas Jefferson Street, NW
Suite 500 West
Washington, DC 20007-5201

About the Urban Resilience Program

THIS PAPER HAS BEEN PRODUCED AS PART OF THE URBAN LAND INSTITUTE'S Urban Resilience Program, which is generously supported by the Kresge Foundation and the ULI Foundation. The Urban Resilience Program works to help communities prepare for increased climate risk in ways that allow a quicker, safer return to normalcy after an adverse event, but also an ability to thrive going forward. Through careful land use planning, wise investment in infrastructure, and smart building design, we can protect the value we have created in our cities and make them more robust when facing adversity.

Project Team

Authors

Byron Stigge
Director
LEVEL Infrastructure

Editors

Nicholas Lalla
Analyst to the CEO and Chief Content Officer
Urban Land Institute

Brenden McEneaney
Director, Urban Resilience
Urban Land Institute

ULI Program Staff

Sarene Marshall
Executive Director, ULI Center for Sustainability

Brenden McEneaney
Director, Urban Resilience

James A. Mulligan
Senior Editor/Manuscript Editor

Betsy Van Buskirk
Creative Director

Anne Morgan
Graphic Designer

Craig Chapman
Senior Director, Publishing Operations

ULI Senior Executives

Patrick L. Phillips
Global Chief Executive Officer

Cheryl Cummins
Executive Officer

Michael Terseck
Chief Financial Officer/Chief Administrative Officer

Jason Ray
Chief Technology Officer

Lela Agnew
Executive Vice President, Strategic Communications

Kathleen B. Carey
Executive Vice President/Chief Content Officer

David Howard
Executive Vice President, Development and ULI Foundation

Lisette van Doorn
Chief Executive, ULI Europe

John Fitzgerald
Chief Executive, ULI Asia Pacific

Marilee Utter
Executive Vice President, District Councils

Contents

Executive Summary

City decision makers are responsible for protecting a broad array of physical properties, economic sectors, and cultural assets from a wide variety of risks—both in the short and long term. It can be challenging to determine the magnitude of such risks, which assets and communities are most vulnerable, and where to invest limited resources.

This paper offers an analytic framework that looks at types of risks, the types of assets that need protecting, and potential damages a city may face, resulting in a guide that can be used to set priorities for developing a resilience strategy and implementing projects. Whereas ULI's Urban Resilience Program focuses on risks related to climate change, the general process outlined here can be used for any type of risk, whether related to climate change or not.

This paper is directed primarily at cities and local government decision makers because they bear fundamental responsibility for the safety and well-being of their communities. Local governments often have few resources for preparedness and planning, even though prevention is a far more cost-effective approach to sustainability than recovery after a disaster. A 2005 National Institute for Building Sciences report showed that every $1 spent on prevention saves $4 in recovery costs.

The concepts and framework presented here are intended to help these decision makers—as well as any property or portfolio owner—identify and understand the risks they face. But whereas this paper is about assessing risk, it does not explore strategies to *reduce* risk. For more on strategies to *reduce* risk, see *Resilience along the Rural–Urban Transect* and other ULI publications at uli.org/resilience.

What Is Risk?

Risk is the product of two elements: *probability* and *damage*. In the context of climate change and cities, probability refers to the likelihood of a severe weather event or natural disaster occurring, while damage refers to the consequences such an event would have on a city's infrastructure, economy, and people. Also called exposure, risk is a quantifiable measure that city decision makers in cities of all sizes can use in prioritizing spending, planning for future hazardous events, and ultimately beginning to mitigate the consequences of climate change.

Definition of Risk

risk = probability × damage

Risk-Assessment Process

The risk-assessment process begins with a *risk profile*. This profile is developed by identifying the types of events that could occur in a particular city, the probability that events of varying severity will occur, and the consequences of those events, including economic, infrastructure, socio-cultural, and public health losses. Total risk is calculated by summing the values of risk associated with individual events. In general, taking action to minimize damage caused by extreme weather

events is the best way to reduce exposure because the probability of a natural disaster occurring is beyond the community's control.

The analytical process summarized below begins with a look at all possible hazards. By defining specific scenarios and estimating total damages to all types of assets, a community can begin to quantify the impact of various events.

The Process

Step 1: Define types of relevant hazards

Make a list of the types of hazardous events that could have a serious impact on a city or property.

Step 2: Define event scenarios

For each event type, develop two to four scenarios covering a range of low to high impact of that event, then assign an annual probability of occurrence for each scenario.

Step 3: Identify affected assets

For each event scenario, identify the physical, economic, and social assets affected.

Step 4: Assess the damages to each asset

For each asset, estimate damages for all the types of hazards for all scenarios across all event types.

Step 5: Calculate annual risk exposure

For each event type and each asset, create a risk curve, then calculate the annual risk exposure by estimating the area under the curve.

Step 6: Calculate cumulative risk exposure

Perform steps 2 through 5 again to estimate scenarios, probabilities, and damages for future years, then calculate the net present value of all future annual risk-exposure values to understand the total risk a city or asset faces.

SENIOR AIRMAN JESSE LOPEZ

Devastating floods hit Minot, North Dakota, in June 2011.

Resilience Planning Process

The risk assessment is one part of a larger resilience-building process. Next, specific risk-mitigation strategies should be developed and specific projects identified using a cost/benefit analysis. These strategies and projects should be prioritized and, finally, must be implemented to address risk. Figure 1 shows where risk assessment fits into the overall process.

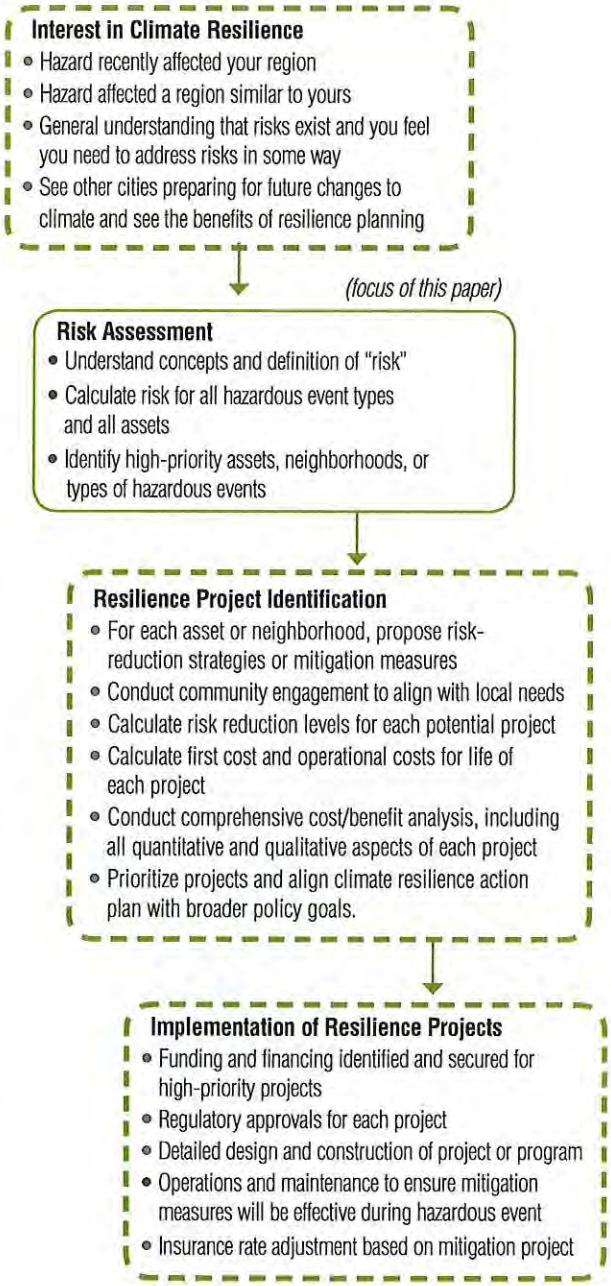
Applications for Risk Assessments

Comprehensive risk assessment can be helpful during a variety of planning and policy-making activities. Cities can assess which areas are most and least exposed to a variety of climate change–related risks, then direct growth and investment appropriately. Long-term plans using unbiased information can more precisely reflect anticipated impacts from rising sea levels, extreme heat, storms, flooding, and other hazards.

Cities can use a quantitative risk-assessment process to inform Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan documents and to support applications for mitigation grants. And, as communities and neighborhoods compete for investment, a risk assessment sends a message that the community is well informed and understands the reality of the risks it faces.

Property owners will find the process outlined here and its results useful when deciding how to design or adapt a building or other asset to the impacts of climate change. Identifying all risks and calculating the total financial losses faced today based on all future annual risk exposures are the basis for a cost/benefit analysis and an assessment of mitigation alternatives. A comprehensive risk assessment essentially provides the total possible benefit in a cost/benefit calculation if a mitigation option can be designed to reduce risk from a particular type of hazardous event.

Figure 1: Resilience Planning Process



Introduction to Risk Assessment

Cities today face unprecedented and uncertain risks from climate change. This paper details a process through which cities and other property owners can assess that risk. Using this comprehensive and quantitative process, decision makers can understand the types of hazardous events and the particular assets most at risk over a long-term planning horizon so they can better address urban resilience issues now. This approach is intended to be conceptually applicable at a wide variety of scales, to a wide variety of climates, and for a wide variety of users.

Risk is a dynamic element that can change as the probability of a particular event changes or as a city's ability to mitigate damage increases or decreases. Risk here relates to natural disasters, including hurricanes and other extreme rain or snow events, tornadoes, extreme temperatures, drought, wildfire, and earthquakes. In recent years, increased attention has been paid to natural disasters because climate change is changing the probability that they occur and their severity.

When the probability of natural disaster increases or the severity increases, the exposure of cities to risk increases in ways that are difficult to predict using historical events—the typical method used to assess risk. Better predictive models are being developed, but this uncertainty of future risk is problematic for policy makers and infrastructure planners who must make decisions about public investment that will take place over a long time horizon.

Risk assessment is particularly relevant for cities because they are increasingly vulnerable to severe events. The rising global population and massive migration to urban areas, particularly in developing countries, tends to concentrate people in coastal areas, which are particularly

How Risk Changes: Probability and Severity

The probability and severity of hazardous events are interdependent and change together in the context of the impacts of climate change on hazardous events. For example, a location may face a low likelihood of experiencing a moderately severe storm during a given year—say, a 5 percent chance of experiencing 70-mile-per-hour winds. In that same year, it faces an even lower probability of an extremely severe storm—say a 1 percent chance of a category 1 hurricane with 90 mph winds—and a still lower probability for a category 2 storm with 100 mph winds, and so on. Probability and severity are dependent variables that correlate with one another.

It can be easier to explain how probability and severity change over time by holding one variable constant and seeing how the other changes. For instance, in 2015 a flood with a 1 percent chance of occurring might elevate water levels by 12 feet, but in 2050 a flood with 1 percent probability might raise them 14 feet. Or on the same property, the probability of a 12-foot flood might be 1 percent in 2015, but in 2050 the probability of a 12-foot flood might rise to 5 percent.

prone to the risk of natural disasters linked to climate change. Furthermore, many of the new urban dwellers have little in the way of financial means to recover from a disaster. As the trend toward urbanizing populations increases, so too will the importance of risk assessment and resilience planning for cities worldwide.

For a risk assessment to be more robust and socially responsible, consideration should be given to the needs of vulnerable populations. In locations where it is hard to get data, it can also be useful to speak with community groups to understand the burdens their members have faced in the past.

Several factors can overlap to increase the vulnerability of urban populations to hazards, including low income, lack of health insurance, age, disability, language ability, limited social connectivity, and others. For example, low-income people might not have access to air-conditioned spaces, which would place them at higher risk in a period of extreme heat. After an event, people may have trouble finding needed resources, particularly immigrants or non-native speakers.

A risk assessment should help cities and property owners see which types of events are most likely and which assets and communities most need support and resilience planning efforts. The risk-assessment process also often uncovers areas that need further study, for instance to better understand the effect of rising water temperatures on a fishing industry or the benefits of developing a comprehensive drought response plan.

After a risk assessment is complete, further steps help deliver comprehensive resilience projects. Community engagement provides direction from residents and businesses on their specific needs and issues. Projects, policies, and programs that reduce risk must be developed and alternatives must be weighed with a cost/benefit analysis to understand which projects lead to the greatest reduction of risk at the lowest cost. Funding and financing of climate change adaptation and risk mitigation can be limited, so creative and opportunistic solutions are often required. Projects must be designed and constructed so as to protect communities without becoming unsightly urban nuisances. And projects must be operated and maintained through many uneventful years so that they are effective when natural disasters eventually do strike.

DON BECKER, USGS

Extensive flooding in June 2008 affected communities throughout the Midwest, including this neighborhood in Cedar Rapids, Iowa.

A risk assessment such as the one presented here is one of the first and most important steps for cities in creating a more resilient community. This process is not the only way to assess risk. Appendix A lists other approaches and tools that range across a wide spectrum from more quantitative to more qualitative. It is important that a city develop a process tailored to its communities and its needs. The goal of this paper is to offer critical background information to help a city engage in an informed and comprehensive decision-making process.

Risk-Assessment Process

The process of assessing risk for a city or a specific asset is fairly linear. It starts with consideration of all possible event hazards that exist in the region. Then, by creating scenarios for each type of hazardous event and assigning a probability that that event occurs, a matrix is formed that provides the foundation for the risk assessment.

Each scenario is played out to estimate the areas of a city that will be affected, the assets that are at risk, and the level of damage to each asset during and after each event. For a city, this process can entail projecting damages to thousands of buildings, miles of infrastructure, and millions of people, so estimates must be made in order to understand orders of magnitude and scales of impact. Many different types of damages aside from simple property damage should be considered—for example, loss of business activity, temporary relocation costs, or macroeconomic impacts. Other impacts—such as loss of life or reduced investment attributable to reputation risk—may be harder to quantify, but it is crucial that they be included.

Once damages are tallied for each scenario, a curve can be drawn to graphically represent the risk profile. The area under that curve is the sum of all expected annual damages from all possible event scenarios in a given year. As the impacts of climate change on storms, droughts, and other natural hazards are better understood, the process of calculating the annual risk exposure for future years will become more precise. Current evidence suggests that climate change is increasing risk by increasing the severity or probability of some types of extreme events. The risk-assessment procedure outlined in this paper can help cities verify and quantify how climate change will directly affect them.

As the final step, the cumulative risk exposure can be calculated using net present value to provide a single value of risk for each type of hazardous event for all future years' annual risk exposure values. This cumulative risk exposure is valuable because it allows each event type to be compared and ranked in priority. It also gives policy makers a sense of the potential benefit a city or a property might receive over time if investments are made in risk mitigation. The process of cost/benefit analysis, evaluation of mitigation options, and implementation of mitigation steps can follow on from this critical first component of risk assessment.

Steps in Risk-Assessment Process

1. Define types of relevant hazards
2. Define event scenarios
3. Identify affected assets
4. Assess the damages to each asset
5. Calculate annual risk exposure
6. Calculate cumulative risk exposure

Step 1: Define Types of Relevant Hazards

The first step of the risk-assessment process is to inventory possible hazards and determine their relevance to a particular location, both today and in the future (see box, page 8).

Though the list may initially seem daunting, most cities and property owners quickly narrow the focus of a risk assessment according to climatic or geographic conditions specific to their location. Wildfires typically are not relevant in tropical climates; sea-level rise likely is not relevant in the mountains.

Locations may have other hazards not listed here. One danger of climate change is that not only will existing risks be exacerbated, but also new risks will develop in communities that previously have not experienced them. While rising temperatures certainly pose a challenge in warm climates, they pose a more complicated problem for cold climates where buildings may not have air conditioning. The resulting short list of relevant event types forms the basis of a risk assessment as outlined in steps 2 through 6.

Types of Hazard Events

Hazard events potentially affected by climate change

- Hurricanes
- Extreme rainfall/flooding
- Extreme temperatures
- Drought
- Wildfire
- Landslides/mudslides
- Extreme snowfall/avalanche
- Ice storms
- Dam/levee failure
- Wildfire

Other natural-hazard events

- Earthquake
- Tsunami
- Volcanic eruption
- Windstorm/tornado
- Lightning strike

Other hazard events

- Terrorist attack
- Electrical blackout
- Water supply failure
- Disease outbreak

Step 2: Define Event Scenarios

For each event type short-listed in step 1, a variety of versions of each event are possible in a given year. For example, a mild drought, an extreme drought, and a drought of historic proportions are all possible each year. Each of these event scenarios has a certain probability of playing out: the most extreme events having the lowest probability and the mildest versions having a higher probability.

An analysis can use any number of scenarios for each event type, but typically two to four scenarios will provide sufficient information to develop a reasonably accurate picture of risk for each type of event. For the following examples, three scenarios have been outlined, corresponding to different probabilities of occurrence:

- Scenario 1: high probability—10 percent annual probability, a ten-year event
- Scenario 2: lower probability—1 percent annual probability, a 100-year event
- Scenario 3: highly unlikely—0.2% annual probability, a 500-year event

Probability-Based Event Scenarios

Finding references that accurately predict the probability that a scenario will play out may be one of the most difficult components of the risk-assessment process. In the United States, a broad variety of engineering design, hazard mitigation, and risk assessment research has provided data sources for many event types. For some event types, a survey of the best available historical data may be required in order to generate probabilities for each scenario. Other event types may require a combination of historical data and probabilities with projections of event probabilities based on the impacts of climate change. Once probabilities have been determined, an event scenario matrix can be developed similar to the one in figure 2.

Considering Future Probabilities of Events

Climate change is fundamentally changing the probability of extreme events, which leads to a range of possible future event probabilities. For example, predictions of sea-level rise in New York Harbor over the next 30 years range from 11 inches to 31 inches. This range may not be relevant for land that is 20 feet above sea level, but it may be critical for land that is only two feet above sea level.

Figure 2: Event Scenarios Matrix

Event type	Scenario 1	Scenario 2	Scenario 3	Data source example
Hurricane/high winds	40 mph, gusting to 60 mph	60 mph, gusting to 80 mph	80 mph, gusting to 100 mph	Structural code or local building code
Hurricane/storm surge	8-foot storm surge	11-foot storm surge	16-foot storm surge	FEMA flood maps
Extreme rainfall	6 inches in 24 hours	11 inches in 24 hours	8 inches in 4 hours	State stormwater design standards
Extreme temperature	Over 100° F for more than five days in a month	Over 100° F for more than five days in a row	Over 100° F for more than ten days in a row	Mechanical or HVAC codes (ASHRAE)
Drought	Snowpack less than 10 feet in water-shed; reservoir at +20 feet depth	Snowpack less than 5 feet in water-shed; reservoir at +10 feet depth	Snowpack less than 2 feet in water-shed; reservoir less than +5 feet depth	State department of environment; water control board

The choice of a value from this range of possibilities will depend on the goal of the risk assessment, and sensitivity analysis may be useful in making this choice. Despite the uncertainties, it is important to begin to try to quantify the increasing probability of an extreme event in order to create the most accurate risk profile.

Determined using the example of flood levels along the East River in New York City, figure 3 shows the predicted impacts (midrange estimates) of sea-level rise on storm-surge levels for three event scenarios for 2014, 2050, and 2100, as offered by the New York City Panel on Climate Change (NYCPCC), which was charged with predicting a variety of impacts of climate change on the city.

DAVID SHANKBONE

The East River rose along its banks in New York in the aftermath of Hurricane Sandy in October 2012.

Figure 3: East River Storm Surge: Three Scenarios for 2014, 2050, and 2100

Scenario	2014	2050	2100
Scenario 1: 2% probability	9.7 feet	11.2 feet	13.3 feet
Scenario 2: 1% probability	11.1 feet	13.6 feet	15.7 feet
Scenario 3: 0.2% probability	14.3 feet	15.8 feet	17.9 feet

Source: New York City Panel on Climate Change.

Step 3: Identify Affected Assets

In the same way that step 1 identified the possible hazards to be considered and step 2 assigned probabilities to each of those hazards, step 3 identifies what may be damaged and step 4 estimates the amount of those damages.

Direct and Indirect Impact

Damages from an event scenario can be *direct* or *indirect*. A comprehensive assessment should consider all direct and indirect impacts. Whereas direct impacts are often obvious, such as homes destroyed during a wildfire, indirect consequences are often less obvious but can be equally or more significant.

An example of indirect consequences: in the event of a flood on a commercial street, a store employee will be out of work until the business repairs the shop and restores inventory, and customers return to the neighborhood. It can take months for insurance coverage to pay on a claim, and many struggling businesses simply cannot come back after a major natural disaster. Some employees may lose their jobs permanently, reducing spending in the local economy. Likewise, displacement or uninsured repair costs can saddle homeowners with major debt for years and even force them into bankruptcy.

Impact Categories

Direct impacts

- Property damages
- Inventory losses
- Loss of business revenues
- Personal property losses
- Displacement costs
- Loss of life

Indirect impacts

- Personal debt or bankruptcy
- Reduced home values
- Higher insurance rates
- Job losses
- Loss of employee wages
- Costs associated with lost services, such as water or electrical infrastructure
- Long-term depression of local economy
- Damaged reputation of city or neighborhood leading to less long-term investment

Regional, macroeconomic impacts of catastrophes should also be considered. Although difficult to quantify, they can have significant impact on the long-term vibrancy of a community. How a city acts before, during, and after serious events can affect its reputation as a safe place to live. Cities that become known for being "risky" may experience downward pressure on property values, business activity, tax revenues, and overall economic vitality.

Identify Directly Affected Areas or Groups

Each event scenario will affect a city or a building directly or indirectly depending on its location, elevation, proximity to the hazard source, economic status, and other variables. Narrowing the study set to defined groups or spatial areas will help focus the risk analysis and provide insight into a city's vulnerability.

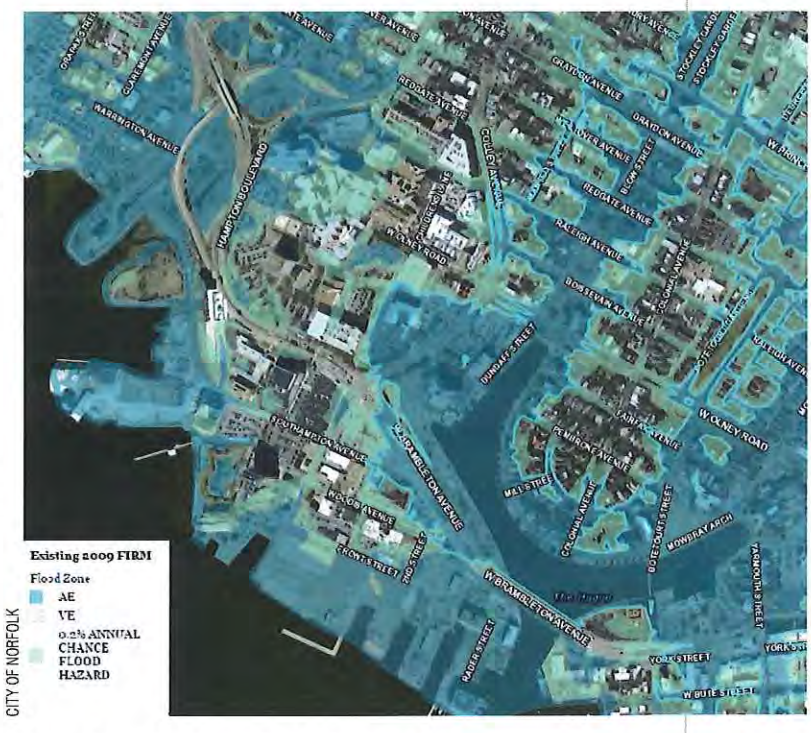
For example, flooding will directly affect buildings at lower elevations, but not those at higher elevations. Within a single building, flooding will directly affect the ground floors and basement levels, and high winds may affect windows, top floors, and the roof more than the ground levels. Regionally or citywide, one can see the spatial variance inherent in events such as flooding and sea-level rise. The box above catalogs some of the factors to be evaluated for understanding spatial variance.

Factors to Consider for Direct Impact

- Elevation of building or neighborhood
- Proximity to hazard
- Demographic groups
- Building size and construction type
- Economic or industry group

For this aspect of the risk assessment, it can be useful to develop exposure maps to better understand the spatial component. Historical information will be helpful in understanding how different areas of a city will be affected by specific events, but future projections are also critical when it comes to climate change impacts.

This part of the evaluation should also focus on the people and communities that may be more vulnerable or disproportionately affected by catastrophic events, such as the poor, elderly, and isolated.



A map of a neighborhood in Norfolk, Virginia, shows projected flood zones. Such a map can be used to create a list of vulnerable assets.

Create a List of Vulnerable Assets

After determining vulnerable groups, locations, neighborhoods, or economic sectors, one can begin to identify and list specific assets within those categories (see figure 4). For each event scenario, a list of assets that will see direct and indirect impacts should be created. High-likelihood event scenarios that are not severe and have minimal impacts tend to have fewer assets at risk. Low-likelihood scenarios that represent extreme disasters tend to have a much longer list of assets at risk because the impact areas tend to be larger.

Particular attention should be paid to *critical* assets that provide essential background operations allowing cities to function, such as emergency response facilities and organizations, infrastructure, and operating facilities (see box at right).

Response facilities and organizations—those crucial to post-event efforts—are those that will be involved in ensuring public safety, health, and recovery in the aftermath of an extreme event.

Critical Facilities

Response facilities

- Emergency operations and response centers
- Police stations
- Fire stations
- Hospitals
- Emergency shelters

Infrastructure

- Pipelines
- Refineries and other petrochemical facilities
- Streets
- Bridges
- Drinking-water and wastewater treatment plants and associated infrastructure
- Power plants
- Pumping stations
- Major roadways
- Communications infrastructure

Operating facilities

- City hall
- Municipal or government buildings
- Schools
- Food storage facilities

Figure 4: Example of Affected Assets for Three Scenarios for a Single Event Type

Scenario 1	Scenario 2	Scenario 3
Residential (130 homes)	Residential (250 homes)	Residential (500 homes)
Wastewater treatment facility	Wastewater treatment facility	Wastewater treatment facility
Marina	Marina	Marina
Fishing industry	Fishing industry	Fishing industry
	Police headquarters	Police headquarters
		Power plant
		Historic shopping district (27 small businesses)
		Industrial district
		Shopping mall

Critical infrastructure includes assets or systems that, if damaged, would have severe impacts on public health, safety, and the economy. Operating facilities are those that contribute to the functioning of a city or region and have the potential to slow down or halt recovery efforts after a major event. Locating each of these facilities on an impact map provides an added layer of understanding of the intersection of vulnerable people, places, and infrastructure.

Step 4: Assess the Damages to Each Asset

The next step is to estimate damages to each asset for each scenario for each type of event.

For large, unique assets such as a pipeline, hospital, or power plant, an assessment should be conducted to estimate the amount of damage that facility will suffer during a particular event scenario. This can be done by interviewing facility managers or owners. The results of the risk assessment for that asset can be plotted as a risk curve (see figure 5). The data point for scenario 1 shows that the high-probability, low-impact event will cause nearly zero damage to the asset. As the probability of an event falls and its severity rises, the expected damages rise (see figure 6).

In the modeling of a large number of assets—thousands of homes in a hurricane-prone area or hundreds of businesses in a central business district—a typical risk vulnerability curve can be developed and applied. Vulnerability curves, or "depth-damage curves," describe the amount of damage expected according to the severity of the event, such as wind speed, flood height, or extreme temperature. (See the appendix for a link to the Hazus modeling tool, which generates depth-damage curves for specific buildings or neighborhoods based on user inputs and available data, such as tax assessor records for building values.)

After a damage estimate has been established for each scenario, all asset damages for each scenario can be totaled to provide a total damage estimate for that scenario (see figure 7).

Figure 5: Risk Curve

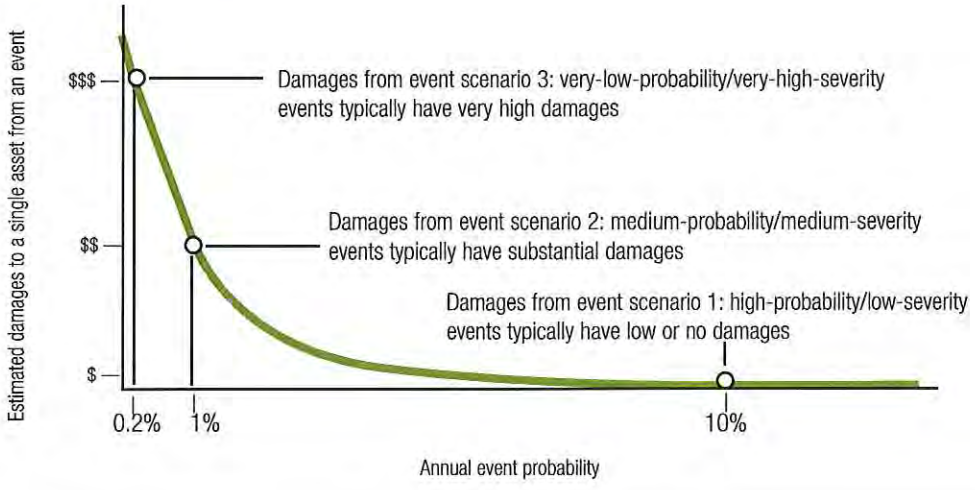


Figure 6: Risk Exposure for All Assets for a Single Event Type

Asset	Scenario 1	Scenario 2	Scenario 3
Residences	$500,000	$4 million	$10 million
Wastewater treatment facility	$2 million	$10 million	$15 million
Marina	$1 million	$2 million	$4 million
Fishing industry	$1.5 million	$30 million	$100 million
Police headquarters	—	$4 million	$6 million
Power plant	—	—	$20 million
Historic shopping district	—	—	$25 million
Industrial district	—	—	$10 million
Shopping mall	—	—	$10 million
Total	**$5 million**	**$50 million**	**$200 million**

Figure 7: Total Damages Estimate by Event Type

Event	Scenario 1	Scenario 2	Scenario 3
Hurricane/high winds	$5 million	$50 million	$200 million
Extreme rainfall	$2 million	$25 million	$125 million
Drought	$10 million	$50 million	$100 million
Extreme temperatures	—	$5 million	$10 million
Wildfire	—	$1.5 million	$8 million

Step 5: Calculate Annual Risk Exposure

To determine the risk exposure for all possible event scenarios during a year, the area under the risk curve should be calculated using the data points from the three event scenarios as determined in step 4 (see figure 8). Risk curves and annual risk exposure can be calculated using modeling software, examples of which can be found in the appendix, or by using the trend line–fitting functions in software such as Microsoft Excel.

Alternatively, manual calculation methods can be used. The method described below simply uses average values to block out and estimate areas under the curve.

Estimation Method

With three data points on the risk curve, the risk exposure can be estimated as shown in the graph and table on the following page. This estimation method divides the curve into rectangular areas that approximate the area under the curve (see figure 9). The results tend to be slightly overestimated, but within 10 to 20 percent accuracy. Through visual inspection, one can reduce the height of the area bars for each of the areas to find a bar that appears to better equate areas included above the curve to those excluded below the curve.

The result of the annual risk exposure value essentially provides the value of the damages a city or property would see each year if all damages from all types of events could be averaged out and evenly distributed every year.

Once the annual risk exposure has been calculated for each event type, a table can be created to compare the annual risk exposure for each event type. A total annual risk exposure value can be calculated by adding all annual risk values from all the event types (see figure 10). Figure 11 demonstrates what the annual risk exposure might look like for a small town.

Figure 8: Annual Risk Exposure

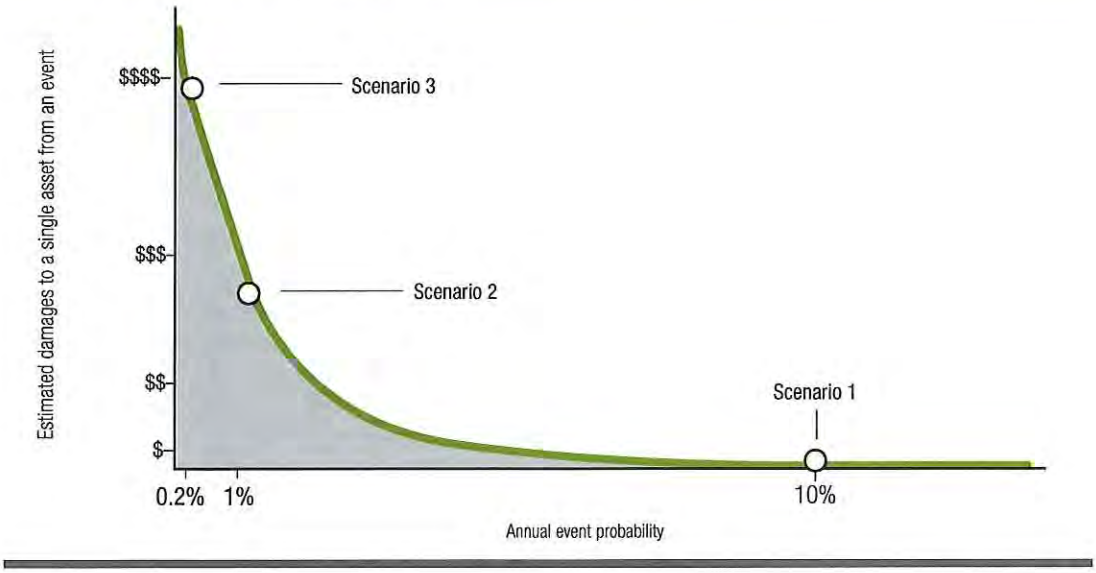


Figure 9: Area Method to Estimate Annual Risk Exposure

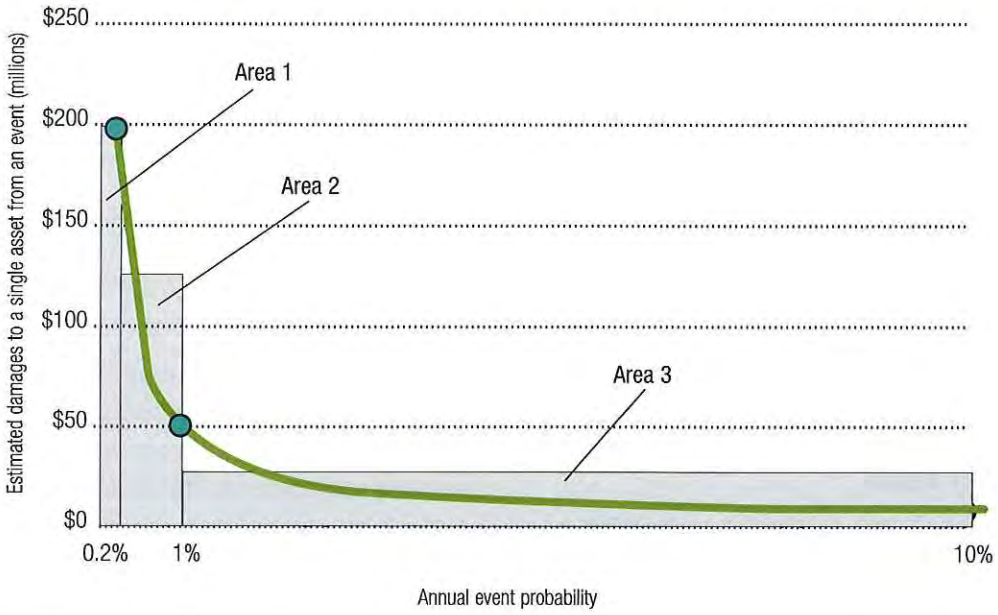


Figure 10: Calculating Risk Exposure

Area	Values/calculations	Risk exposure (width × height)
Area 1	width: 0.2% – 0.0% = 0.2% height: $200 million	$400,000
Area 2	width: 1% – 0.2% = 0.8% height: $50,000,000 + [½ × ($200,000,000 – $50,000,000)] = $125,000,000	$1,000,000
Area 3	width: 10% – 1% = 9% height: $5,000,000 + [½ × ($50,000,000 – $5,000,000)] = $2,750,000	$2,475,000
	Total	**$3,875,000**

Figure 11: Total Annual Risk Exposure for All Event Types

Event type	Risk exposure
Hurricane/high winds	$3,200,000
Extreme rainfall	$800,000
Drought	$1,700,000
Extreme temperatures	$200,000
Wildfire	$100,000
Total annual risk	**$6,000,000**

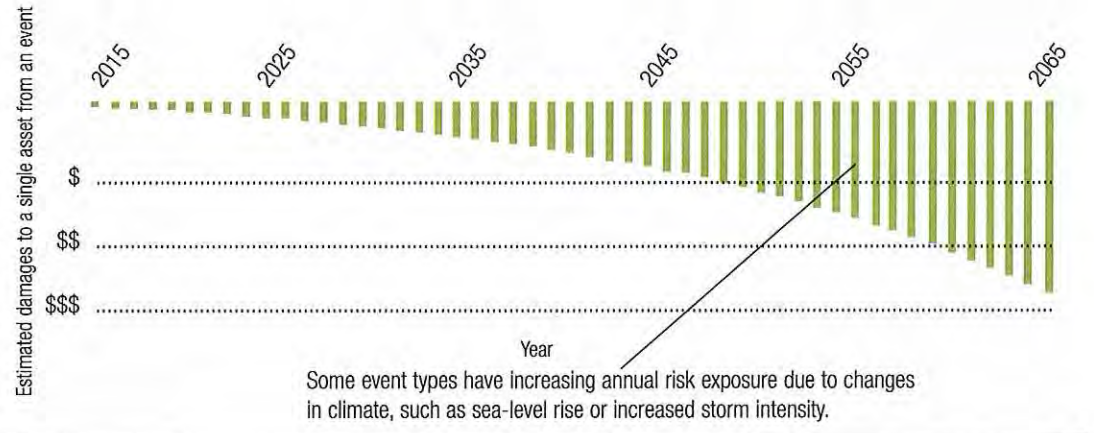
Step 6: Calculate Cumulative Risk Exposure

Total risk—or *cumulative risk exposure*—for a given event type is determined by calculating the net present value of future annual risk exposure values (see figure 12).

The purpose of calculating cumulative risk exposure as a single value is to compare cumulative risk exposures for a variety of different event types, assets, or neighborhoods and determine which have the highest total risk exposure into the foreseeable future. This is different from annual risk exposure in that it accounts for how risks will change over time and includes many estimated damages for future years in a single value.

Some event types will have the same annual risk year after year if the probability of the event does not change and the estimated damages from the event are not projected to change. But the probability of natural events affected by climate change will increase, as will the damages.

Figure 12: Evaluating Future Event Scenarios and Losses



Interpreting the Results

The results of a comprehensive risk assessment tell the story of a city's relative vulnerabilities in a quantifiable manner. Organizing the results into priority lists helps a city develop a more articulate understanding of its exposure to risks. The results also can provide motivation to address high-risk assets because the exposure to risk can be surprisingly high.

Risk information should inform a city's comprehensive planning process to ensure that growth is targeted toward appropriate locations and that public investment will retain long-term value. None of the following prioritization lists gives a complete picture of risk and priority, but together they begin to paint a picture of risk in a city and can help decision makers develop a more nuanced view of which issues, areas, and facilities need the most attention.

The Station Fire in Los Angeles in 2009 killed two people, burned 257 square miles, and cost almost $100 million to contain. Future temperature increases combined with reduced water availability are likely to exacerbate fire vulnerability in the region.

Prioritize Event Types

As the results of a risk assessment emerge, they can be organized to understand which types of hazard events have the highest potential to affect a city or building. The hazards with quantifiable risk can be sorted purely by cumulative risk exposure, with the highest risk exposure corresponding to the highest-priority hazard. Figure 13, providing an example from a fictional city in an arid climate, describes why certain event types represent high or low risk and how climate change alters those risks. Understanding which types of event are high priority allows decision makers to focus planning efforts, funding resources, and community preparedness on the highest-priority events.

JEREMY MILES

Figure 13: Event Prioritization

Event	Cumulative citywide risk exposure	Description	Priority
Drought	$2.7 billion	The figure is based on recent frequent droughts in the region and projections for increased frequency of droughts.	High
Wildfire	$2.1 billion	Many properties are at high risk of wildfire.	High
Extreme temperatures	$1.2 billion	Because the city is a popular retirement destination and contains vulnerable communities, extreme temperatures could cause a significant number of fatalities.	High
Extreme rainfall (flooding)	$300 million	Projections for increasingly arid conditions reduce ground cover and increase runoff, which will increase local flooding.	Medium
Landslides/mudslides	$25 million	Landslides have been a problem, but they affect few properties.	Low
Hurricane/high winds	$15 million	The probability of winds strong enough to damage assets is low, but if such an event were to occur, damage would be significant.	Low
Hurricane/storm surge	$2 million	Exposure to coastal flooding is limited and the probability that it will occur is low.	Low
Extreme snow	None identified	There is no snow in the region.	—
Tornadoes	None identified	There is no history of tornadoes in the region.	—
Ice storms	None identified	No ice storms occur in the region.	—

Prioritize Affected Areas

An understanding of the spatial and organizational distribution of hazards also helps cities and property owners focus attention on industries, neighborhoods, or demographic segments with the highest risk exposure. If an analysis is set up correctly, a city can be subdivided by geography, markets, and demographics in a way that allows all potential damages from all event types to be summed up for a particular area. Each area's cumulative risk exposure can be ranked by value and a prioritization begin to emerge. Figure 14 shows an example priority list from a fictional city near a river and a mountain range.

Figure 14: Impact Area Prioritization

Area	Area cumulative risk exposure	Description	Priority
Riverfront adjacent to central business district	$1.4 billion	This neighborhood is built on fill and has little protection from high floodwaters; the impact on the overall economy would be massive.	High
Low-income communities near downtown	$700 million	Many people living in these communities have jobs in high-risk areas and would be out of work in the event of a major flood; some would lose their homes.	High
Historic shopping district	$350 million	In addition to high monetary losses, the cultural value of the district is irreplaceable if an extreme event causes severe damage.	High
Tourism industry	$100 million	A drought caused by minimal snowfall for more than two consecutive years could have a substantial impact on the ski industry.	Medium
Residential subdivisions on western edge of the city	$30 million	Wildfires could engulf significant swaths of homes in the event of prolonged drought.	Medium
City-critical facilities	$25 million	Although these facilities are in areas with a high probability of flooding, the city has focused on flood-protection measures, so damages would be minimal.	Medium
Fishing industry	$20 million	The fishing industry has learned over decades and even centuries how to protect boats and facilities in the event of a flood.	Medium

Prioritize Vulnerable Assets

Cities have both concrete assets such as power plants, industries, and city operational facilities, and less-tangible assets key to its success, such as reputation, access to skilled labor, quality of life, and other components. Understanding the risk exposure of specific assets and prioritizing them is another way to help decision makers focus their efforts on areas where the greatest gains can be made. Figure 15 ranks both the tangible and intangible assets of a fictional city in the United States in priority.

Figure 15: Asset Prioritization

Asset	Cumulative risk exposure	Description	Priority
Power plant	$500 million	Built over 50 years ago along a river, the facility has no physical flood protection.	High
Historic shopping district	$350 million	Many of the historic buildings in the city's central business district could not be replaced if severely damaged by flood.	High
Wastewater treatment facility	$100 million	Located along the river with no flood protection, this facility would incur major damage from extreme flood.	Medium
City's reputation as a livable city	Nonquantifiable	Recent tornadoes, winter storms, and floods have caused a number of businesses to rethink the attractiveness of the city.	Medium
Industrial district	$50 million	The industrial district is in a low-lying area of filled land, putting facilities and jobs at risk due to flooding.	Medium
Police headquarters	$20 million	This facility has taken many steps in the past five years to mitigate risks.	Low
Shopping mall	$15 million	Built 30 years ago on high ground, this facility is particularly exposed to high winds.	Low
Marina	$5 million	The marina is a small facility and would not see major damage in most hazard events.	Low
Fishing industry	$5 million	The fishing industry is located in a highly vulnerable location, but steps have been taken to reduce risk.	Low

Next Steps: After Risk Assessment

Once a clear understanding is achieved regarding the scale of risk a city or building faces, the process of planning, investing, insuring, and protecting assets can begin. Knowing which neighborhoods, facilities, populations, and infrastructure networks qualify as high-priority assets allows cities to deploy limited resources most effectively.

Though not the focus of this paper, strategies to mitigate risk, the process for a cost/benefit analysis, and key issues to consider when implementing mitigation projects are addressed in this section. Some mitigation and preparation approaches reduce risk for specific hazards, and others are useful to reduce risk and damages for all types of hazards—even those not considered in step 1 of the risk-assessment process.

Risk Mitigation Approaches and Strategies

On a property-by-property basis, many strategies may exist to reduce (or mitigate) risks. To address flood risk, for example, one could build a wall around the property, raise the property elevation, use deployable flood protection devices, buy adequate flood insurance, or relocate. There are also many community-scale infrastructure strategies, such as levee walls, floodgates, deployable structures, and breakwaters.

Typical Types of Hazard Mitigation

- Protection and hardening
- Insurance
- Relocation
- Wet flood-proofing
- Hazard preparation

All such mitigation measures have costs and benefits. All properties and cities have some subset of mitigation measures that are cost-effective to reduce risk. The process of identifying, prioritizing, funding, and implementing mitigation measures is the hard work of climate change adaptation and resilience-building.

Cost/Benefit Analysis

After a set of feasible mitigation projects is determined, a cost/benefit analysis can help inform the decision of which risk-mitigation measures should be implemented.

Definition of Benefit-to-Cost Ratio

$$\frac{B}{C} = \frac{\text{net present value of all project benefits}}{\text{net present value of all project costs}}$$

Project costs should include more than initial investments; costs for maintenance, operations, or upgrades should be considered and included in the calculation of the complete net present value.

Project benefits are typically realized as avoided losses. They can be calculated as the difference between risk exposure for a defined "business as usual" scenario and a "with project" scenario. The ratio of benefits to costs can be used to compare the relative cost-effectiveness of a number

Definition of Project Benefit

Benefit = "business-as-usual" scenario risk minus "with project" scenario risk

of viable mitigation options, or it can be used determine the cost-effectiveness of a particular preferred option.

It is important to realize that though project benefits may be most directly quantified as avoided losses, mitigation strategies may lead to competitive advantages on a regional scale. Communities that are seen as actively prepared for risks may attract additional investment.

Mitigation and preparation strategies may also help spur a local industry and knowledge base related to a particular risk. For example, due to land subsidence, Norfolk, Virginia, is facing the largest amount of sea-level rise on the U.S. East Coast, but a cottage industry has developed in helping homeowners fortify and adapt their homes to this ongoing risk.

Implementation

As with other large-scale endeavors, the implementation phase for hazard mitigation can take years—if not decades—to move from concept to reality. Some of the key components are briefly described below, though each in itself could justify a significant body of guidance.

Community Outreach

The best projects seek input from residents and businesses to fully understand the needs and concerns of the community about how climate change will affect them. Engaging a community from the outset can help shape projects and gain buy-in from the people they will directly affect. In view of how directly climate change hazards can affect people, outreach is fundamental and critical to project design and implementation.

Funding and Financing

Public infrastructure is notoriously difficult to fund. Climate change impacts can put neighborhoods or even whole cities at risk, and the best risk mitigation solutions may be implemented at a neighborhood or city scale. The public good/public expense nature of infrastructure projects that reduce risks posed by climate change tend to put them in the purview of local governments, which face enormous demands on very limited financial resources.

Regulatory Approvals

Regulations developed in North America and Europe to protect public interests in waterways, public space, environmental assets, and cultural assets will apply to most large-scale climate change mitigation projects. Often the approvals process can be costly and time consuming. If regulatory requirements are understood from the outset, they can be anticipated so that progress can continue and surprises do not cause delays.

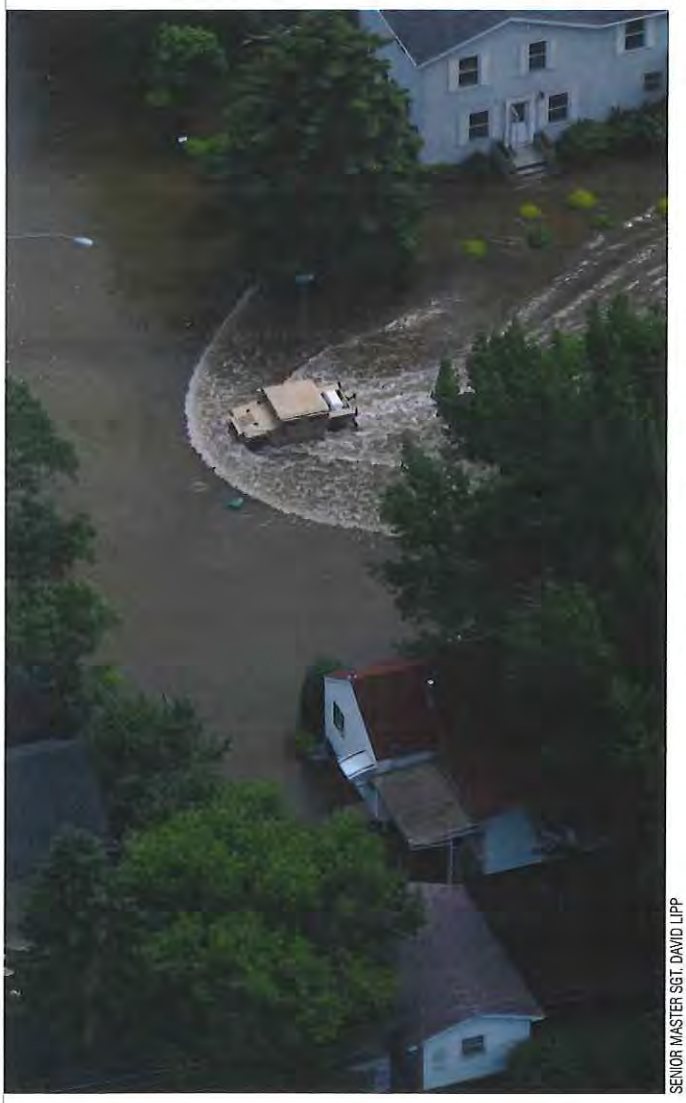
Other Issues to Consider

A common issue that arises with flood protection projects is the difficulty in having a reduction of flood risk be reflected in the premiums that businesses and homeowners pay for flood insurance. The U.S. Army Corps of Engineers recently developed a levee "certification" system in collaboration with the insurance industry so that flood-insurance premiums reflect the reduction in probability of flooding offered by the levee. Other types of hazard events have less history and solutions have less maturity, making insurance companies less comfortable about predicting risk reductions.

Political interests, trends, and viewpoints change between administrations and over time, and most large-scale infrastructure projects will be implemented over multiple administrations. Setting up processes for project implementation that can operate across political cycles is a key to the successful implementation of projects aimed at adapting to climate change.

Conclusion

Climate change has shifted the landscape of risk for communities around the world. For municipal leaders, the best way to respond to this challenge is to understand the risks that their communities face.



SENIOR MASTER SGT. DAVID LIPP

A National Guard vehicle moves through flooded streets in Burlington, North Dakota, in June 2011.

The first step is to define all the hazards a community faces. Next, a range of scenarios can be developed for each hazard representing events with a range of probabilities and impacts. Then, physical, economic, and social assets that are affected under these scenarios can be identified. For each of these assets, potential damages in each scenario can be calculated and added up to produce a total annual risk exposure for the community. Finally, annual risk exposures can be calculated for future years and aggregated to understand the net present value of the total risk the community faces.

This risk-assessment process can help a community understand the resources it will need to invest in and how it might prioritize strategies to reduce risk. Informed and prepared communities will be more resilient to risks and will bounce back more quickly than those that are unprepared and uninformed. Building resilience starts long before disaster strikes, and this guide can help cities get started.

Appendix: Risk-Assessment Tools and Resources

CanVis

The CanVis tool, from the National Oceanic and Atmospheric Administration (NOAA), allows users to upload a local picture and use the software to visualize impacts from flooding and sea-level rise projected onto the picture.

http://coast.noaa.gov/digitalcoast/tools/canvis

Climate Adaptation Knowledge Exchange

This searchable database contains case studies, local government adaptation plans, and resilience tools for a broad range of geographies and risks.

www.cakex.org

Climate Change Knowledge Portal

This tool developed by the World Bank provides information, data, and reports on climate change using an interactive map, including historical temperature and precipitation data for each month of the year.

http://sdwebx.worldbank.org/climateportal/index.cfm

Coastal Resilience Mapping Portal

This site helps in visualization of sea-level elevation now and in the future in cities in certain parts of the United States.

http://maps.coastalresilience.org/network

Colorado Wildfire Risk Assessment Portal

www.coloradowildfirerisk.com/map

CRiSTAL

The Community-based Risk Screening Tool—Adaptation and Livelihoods (CRiSTAL), developed by the International Institute for Sustainable Development, provides downloadable software and models for use in community planning and risk assessment, with special packages for food security and forests.

www.iisd.org/cristaltool

FloodTools

Developed by the private company National Flood Services, this tool provides flood-risk maps and a loss calculator based on a property's address. The loss calculator provides a dollar figure for property damage and personal losses based on the depth of floodwater.

www.floodtools.com/Home.aspx

Hazus

Hazus is a software tool from the Federal Emergency Management Agency (FEMA) that uses geographic information system (GIS) data to estimate loss scenarios from floods, earthquakes, and hurricanes.

https://www.fema.gov/hazus

National Climatic Data Center

The National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) provides public access to the nation's climate and historical weather data and has a specialized component that studies and predicts climate change variability.

www.ncdc.noaa.gov

Texas Wildfire Risk Assessment Portal

https://www.texaswildfirerisk.com/map

Additional Resources

Federal Emergency Management Agency (FEMA)

- Mitigation Planning How-To Series (11 documents)

www.fema.gov/media-library/collections/6

- "Understanding Your Risks: Identifying Hazards and Estimating Losses"

www.fema.gov/media-library-data/20130726-1521-20490-4917/howto2.pdf

- Guidelines and Standards for Flood Risk Analysis and Mapping (nine documents)

www.fema.gov/media-library/resources-documents/collections/361

ICLEI Resilient Cities Series

http://resilient-cities.iclei.org

National Flood Insurance Program

https://www.floodsmart.gov/floodsmart

Rockefeller Foundation 100 Resilient Cities Challenge

www.100resilientcities.org

ULI Urban Resilience Program

uli.org/research/centers-initiatives/urban-resilience-program

1025 Thomas Jefferson Street, NW
Suite 500 West
Washington, DC 20007-5201

www.uli.org

City of Hudson
Comprehensive Plan

505 Third Street
Hudson, Wisconsin 54016
ph: (715)-386-4765 fx: (715)386-3385
www.ci.hudson.wi.us

TO: Hudson Comprehensive Plan Steering Committee

FROM: Community Development

DATE: January 6, 2020

SUBJECT: Community Survey Results Update

BACKGROUND:
Brea Grace will provide a summary of the online results compiled for the Community Survey so far.

ATTACHMENTS:
None

Prepared by: Tiffany Weiss, Associate City Planner
Through: Mike Johnson, AICP, Community Development Director

CITY OF HUDSON

505 Third Street
Hudson, Wisconsin 54016
ph: (715)-386-4765 fx: (715)386-3385
www.ci.hudson.wi.us

TO: Hudson Comprehensive Plan Steering Committee

FROM: Community Development

DATE: January 6, 2020

SUBJECT: Public Engagement Planning

BACKGROUND:
Brea Grace will provide next steps in the public engagement process for the comprehensive plan update.

ATTACHMENTS:
None

Prepared by: Tiffany Weiss, Associate City Planner
Through: Mike Johnson, AICP, Community Development Director

CITY OF HUDSON

505 Third Street
Hudson, Wisconsin 54016
ph: (715)-386-4765 fx: (715)386-3385
www.ci.hudson.wi.us

TO: Hudson Comprehensive Plan Steering Committee

FROM: Community Development

DATE: January 6, 2020

SUBJECT: Discussion and possible action on utility billing outreach strategy.

BACKGROUND:
Community Development staff has reached out to the City's Utility Department to utilize the upcoming January Utility Billing period to notify residents of the Comprehensive Plan Community Survey. Staff was notified that the job would consist of 9,000 full-page prints of the Community Survey flyer that was designed by SEH, and the print job would need to be completed prior to January 16th when the utility bill mailing is sent to the post office.

It should be noted that the utility bill mailings and the Comprehensive Plan survey notice would be sent to both City of Hudson and Village of North Hudson residents.

Staff is looking to confirm which direction the committee would like to go with this strategy.

A. Move forward with the 9,000 prints of the Community Survey flyer that would be mailed along with the utility bills to all residences in the City and the Village of North Hudson as soon as January 16th. No additional labor on staff's part would be required. A note can be added into the flyer mentioning that North Hudson residents should not take part in the survey.
B. Mail postcards to individual utility address accounts in the City of Hudson. Would require staff to create a mailing list and perform in-house printing. May also require organization of 'mailing routes' and postcards per Post Office request.

STAFF RECOMMENDATION:
Recommends approving either Direction A or Direction B (noted above) for the utility bill mailing outreach strategy.

ACTION REQUESTED:
Approve either Direction A or Direction B for the comprehensive plan survey notice, either to be combined with utility bills or mailed as a postcard by city staff.

Prepared by: Tiffany Weiss, Associate City Planner
Through: Mike Johnson, AICP, Community Development Director