

Amy Freeze

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Part Two:

Amy Freeze's Stormwater Action Alert Program:

A Call to Action

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Introduction for Stormwater Action Alert Program (SAAP)

The Stormwater Action Alert Program (SAAP) is designed to improve the quality of water in local waterways. With this community-based initiative, the primary goal is to minimize runoff. The program is based upon this principle: the actions of water consumers can help to manage stormwater. Stormwater can be managed and overflows can be reduced, if water consumers: (1) minimize runoff during heavy rain events; (2) reduce the possibility of flash flooding in sensitive areas; (3) lessen the load for combined sewers. The program is a community alert system used to minimize runoff. The concept is that water consumers are given a heightened sense of awareness about water management and will act to manage stormwater with their personal water habits. Ultimately, any reduction in high-impact runoff could improve water quality which is the objective of this program. The Stormwater Action Alert Program need to have parameters defined, alert actions defined, funding identified, and plans outlined to initially execute the program in Chicago, Illinois.

Concept: A Call to Action

The concept behind action alerts is already working for the environment in the arena of air quality. *Partners for Clean Air* is a coalition committed to “improving air quality through voluntary actions.” The *Partners for Clean Air* “Air Quality Action Alert” program has 144 state and local partners across the country; their motto is “Clearing the Air Together.” The coalition started in the 1980s as a preventative campaign to protect at-risk people from pollution, by increasing the public’s awareness of air quality.

The Air Quality Alerts were designed to inform sensitive groups of poor air quality and also, to advise them to limit their exposure to polluted air. The coalition has evolved into a larger partnership. Now, in addition to warning the public about air quality, the group encourages people to take active steps to reduce pollution. The Air Quality Alerts are based on weather conditions including: temperatures, chances for rain, wind, high pressure systems, sunshine, and other factors including stagnant weather patterns. An air quality forecast is prepared daily in certain regions and correlates to the Air Quality Index (AQI.) There’s a multi coded alert system (**Figure 1**) ranging from purple, which is very unhealthy, to green, indicating good air quality (Air Now Coalition).

Figure 1

AQI Ranges and Descriptor Categories	Health Effects	Cautionary Statements
0 - 50 Good		
51 - 100 Moderate		
101 – 150 Unhealthy for Sensitive Groups	Increased likelihood of respiratory symptoms and breathing discomfort in sensitive groups.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor activity.
151 – 200 Unhealthy	Greater likelihood of respiratory symptoms and breathing difficulty in sensitive groups.	Active children and adults, and people with respiratory disease, such as asthma, should avoid heavy outdoor exertion; everyone else, especially children, should limit heavy outdoor exertion.
201 – 300 Very Unhealthy	Increasingly severe symptoms and impaired breathing likely in sensitive groups.	Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.
301 – 500 Hazardous	Severe respiratory effects and impaired breathing likely in sensitive groups.	Everyone should avoid all outdoor exertion.

The website, CleanTheAir.com, is devoted to the Air Quality Action Alert program. It is run by the organization, *Partners for Clean Air*. The website is an informational source of air quality data, forecasts, actions to take, and a list of participating partners. The information is largely available in mass media form, from the following sources: the official website, newspapers, and public broadcasts (including TV and radio weather segments). This organized effort has become a resource for those concerned about

air quality. The alerts are based on air quality data, which is recorded both regionally (and by city.) The program is voluntary and organized by cities or states. Although, currently there is no research on the impact of action alerts, *Partners for Clean Air* believe that their program helps sensitive people avoid polluted air that would damage their health. The action alerts may also result in improved air quality (Partners for Clean Air).

The concept of the Air Quality Action Alerts is the foundation of the Stormwater Action Alert Program (SAAP). By alerting the community to the impacts of poor water quality, residents can be a part of the solution and help manage stormwater. The motto of the program is “*When it Rains, it Drains... Ration, Reduce, Redirect*” and a website has been designed with preliminary information, www.stormwateractionalert.com.

The program will require the support of many water quality organizations in the area that the SAAP is practiced. City water departments and/or invited stakeholders of the water community may join this effort and initiate the SAAP. There are many organizations that are already collaborating to educate communities on stormwater management. These organizations could collectively adopt the Stormwater Action Alert Program and help to organize it on a nationwide scale. The overall success of the program will be determined by the support it receives and its practice on local levels.

Stormwater Action Alert Program

SAAP: The First of Its Kind

The Stormwater Action Alert Program will be the first of its kind. At this time in the U.S., there is not an organized system that issues alerts for stormwater actions. The SAAP would be the first program to attach urgency to water usage habits (and surface water pollution.) Organized programs, like SAAP, are education-based and work through the philosophy that the more people learn; the more likely they are to change their habits over time. Perhaps, if more consumers correlated rain events and water quality... stormwater education (and water quality) would take a giant leap forward.

Defining Parameters for a Stormwater Action Alert

The parameters for issuing a stormwater action alert are unique to each watershed. However, there are two categories that summarize such parameters: meteorology and geography. Specific criteria of these categories must be considered, watershed by watershed, in order for the parameters to be set effectively. For example, the climate data might appear similar in two areas; but, the meteorology involved in determining how the runoff occurs varies from place to place. Consider Chicago and Seattle, their average rainfall is nearly equal, at about 36 inches per year. Yet the *way* in which the rain falls is different, in both Chicago and Seattle—meaning that the runoff also affects water quality differently in both cities.

Chicago receives rain in heavy downburst thunderstorms—sometimes several inches fall at once! While Seattle, receives rain in light precipitation events that happen over many days. National climate records show that there are 126 rainy days per year in Chicago, while Seattle has 154 rainy days annually (equaling almost 18 more days of rain each year). (NOAA Climate)

Seattle’s rain occurs mostly, as drizzle; droplets 0.02 mm in size fall at 5 mph. Slow rainfall means environmental concerns are lessened. While the heavy rains in Chicago can send droplets of 0.25mm plummeting towards Earth at 25 mph. Fast runoff has a high impact on water quality. Therefore, Chicago and Seattle would require different parameters to be set for Stormwater Action Alerts (regardless, of similar 30-year precipitation/climatological factors.)

Geography must also be considered when determining parameters for SAAP. During a storm, runoff occurs across a watershed when the precipitation, snow melt, or irrigation appears at the surface, on its way to above ground streams, rivers, lakes, drains, or sewers. The amount of green space versus developed area, the proximity of waterways to urban development, sloping, and infrastructure capacity—all influence runoff.

Stormwater Action Alert: Meteorological Parameters for Chicago, Illinois

The meteorological parameters to consider for Chicago include: type of precipitation, rainfall intensity, rainfall amount, rainfall frequency and duration, distribution of rainfall over the watersheds, direction of storm movement. Examples of climatic conditions that affect evapotranspiration are: temperature, wind, and relative humidity. (Table 1)

Table 1

Meteorological Factors that Affect the Significance of Stormwater Runoff:		
· Season of the Year	· Type of Precipitation (rain, snow, sleet)	· Rainfall Intensity
· Rainfall Amount	· Rainfall Frequency and Duration	· Rain Rates
· Distribution of Rain	· Direction of Storm Movement	· Other Climate
Other Climatic Conditions that Affect Evapotranspiration:		
· Temperature	· Wind	· Relative Humidity

Type of precipitation

The *American Meteorological Society* has a glossary that defines types of precipitation (**Table 2**). Rain that is steady, moderate, or heavy may warrant an alert. Climate data from the *National Weather Service* lists the number of days in Chicago with a 24-hour rainfall total of at least one inch (**Table 3**.) On average, a rainfall of one inch occurs at least eight times annually. Rain, or water equivalent, of one inch in 24 hours may be enough precipitation to trigger an alert in some Chicago counties (the season and amount of prior precipitation must also be considered).

Table 3

CHICAGO OHARE AIRPORT													
Number of Days with Precipitation \geq 1.0 inch													
(Years: 1971-2000)													
Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average	0.2	0.2	0.4	0.9	0.6	1.0	1.0	1.3	0.9	0.5	0.6	0.5	8.2

The climate database does not break down one inch rain falls into increments less than 24 hours—however, the records indicate that Chicago has had 227 one inch (24hours) rain events in the last 30 years.

Season of the Year

In every month of the year, there is a threat to water quality in Chicago. Superintendent of *Metropolitan Water Reclamation District of Greater Chicago*, Richard Lanyon, said that a storm producing as little as one half inch of rain could cause a combined sewer overflow (CSO) in Chicago. With this figure in mind, there are many ½” rain events in Chicago. The NWS Climate NOWDATA in **Table 4** shows the monthly frequencies of precipitation, equalling a half inch or greater, from the Chicago O’Hare Airport (the location of Chicago’s official climate station), for the years, 1971-2000 (30 years = climate average).

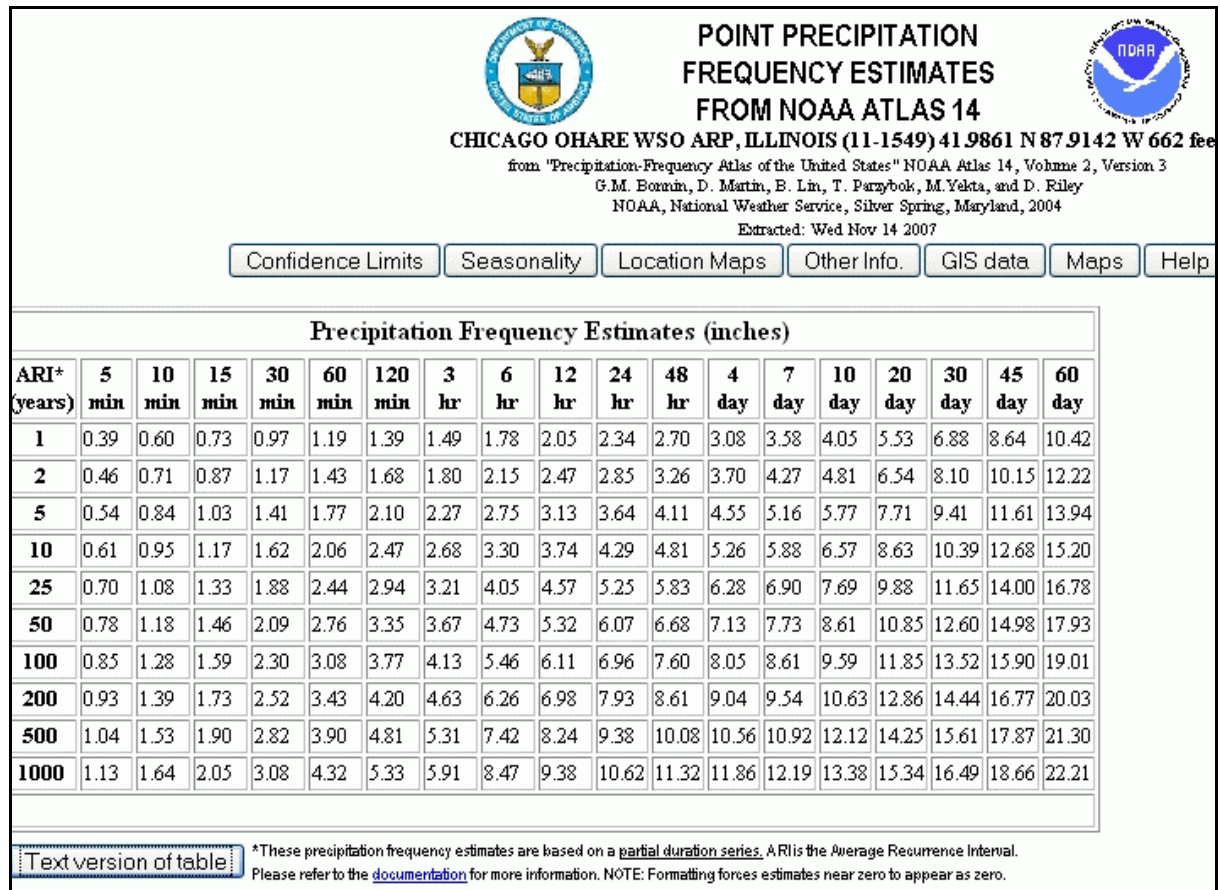
Table 4

CHICAGO OHARE AIRPORT													
Number of Rain Events Per Month \geq 0.5 inch													
(Years: 1971-2000)													
Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average	0.9	0.8	1.4	2.3	2.3	2.7	2.3	2.9	2.1	1.8	1.7	1.3	22.4

The least likely months for a half-inch precipitation event are January or February. The data shows that the half-inch precipitation can occur on average, 22 times per year. Considering the climate averages, a SAAP could be issued on average as many as 22 times per year during half-inch precipitation events.

Extremely hard rainfalls with microburst downpours are difficult to pinpoint in a forecast. However, if high confidence forecasts are possible—an alert should be issued. In **Figure 2**, the recurrence interval for a ~ 1 inch rain (1.03") in 15 minutes is 5 years.

Figure 2



Rainfall duration and intensity

Rainfall duration and intensity must also be considered when setting parameters for SAA. If multiple days of rain are expected, an alert would be issued. Hydrologists, from the NWS River Forecast Centers, also use special calculations to evaluate the flooding potential at a given time; it's called the Flash Flood Guidance (FFG). These hydrologists routinely issue FFG for every county in their respective areas across the country. The River Forecast Centers determine one, three, and six hour Flash Flood Guidance values for all counties (in addition to 12-hour and 24-hour values for some parts of the country). The NWS Weather Forecast Offices use this guidance system when issuing flash flood watches and warnings. Based on current soil moisture conditions, the FFG estimates the average amount of rainfall (in inches), for a given duration, required to produce flash flooding in the indicated county. For flash flooding to occur in urban areas, less rainfall is required.

For example, FFG for Cook County, IL, in six hours in December 2007 is 2.75"—meaning that 2.75" of rain, in six hours, can create flooding in some areas of Cook County. Guidance can be *much lower* during the summer months. Also, high intensity rain events can create more rain than the infrastructure can handle. Urban areas have more pavement and therefore, are areas where flash flooding occurs quickly. When the FFG is met, a stormwater action alert would be issued. (NWS)

***A lot of rain, in a short amount of time can turn out to be too much to handle...
Consider the amount of liquid!***

One inch of rain on a thousand square feet of land, equals 623 gallons of water.
One inch of rain on one acre of land, equals 27,151 gallons.

That's a lot of water that needs someplace to go!

In urban areas, most rain has no where to go—so, it will rush along the pavement and run into the sewer system (which most likely, is running to capacity based upon the 5 million people it serves daily, in the Cook County, Illinois.

Direction of storm movement

The direction that a storm is traveling can make a difference when determining whether a storm will create flooding. The “training” thunderstorms, or severe thunderstorms, with heavy downpours that repeat over the same area are a reasonable cause to issue an action alert.

Prior precipitation

While water quality can be impacted by any storm, if the weather has been dry for several days prior to an expected soaking rain, the threat to water quality is significantly increased. Storms wash any pollutants off impervious services (sidewalks, streets, parking lots, and even rooftops). The most recent National Water Quality Inventory Reports say that runoff from urbanized areas is “the leading source of water quality impairments to surveyed estuaries and the third-largest source of impairments to surveyed lakes.” Due to the amount of impervious surfaces, like pavement and rooftops, a typical city block generates more than 5 times the runoff of a woodland area of the same size. Some of the stormwater drains deliver runoff directly to Chicago’s local waterways, without any treatment at all. In a study from, The Practice of Watershed Protection called “First Flush of Stormwater Pollutants Investigated in Texas,” Tom Schueler, discovered that the "first flush" contains the highest concentration of pollutants. The "first flush" happens during the first major storm after an extended dry period. This would mean that an extended dry period would also be considered when issuing a stormwater action alert. (EPA)

Other factors that could be considered are climatic conditions that affect evapotranspiration, such as temperature, wind, relative humidity, and season. Areas in which the distribution of rainfall over the watersheds have high stream/river levels due to snow melt (with the threat of rain) and areas that are over-developed, might have lowered thresholds for alerts.

Stormwater Action Alert:

Geographical Parameters for Chicago, Illinois

Geography is the other major factor to consider when determining parameters for Stormwater Action Alerts. There are many geographical characteristics that affect runoff including: watershed location and area, land use, vegetation, soil type, drainage area, elevation, slope, topography, and also, additional water bodies, like reservoirs and ponds in the watershed, may prevent or alter runoff from continuing downstream. **(Table 5)** When setting geographical parameters, it's important to recognize that rain which falls in forested watersheds is absorbed into soils and stored as ground water. The water slowly discharges to streams through seeps and springs. The forested areas have less flooding, because runoff is absorbed into the ground. In an urbanized area like Chicago, where vegetation is replaced by impervious surfaces, the area of infiltration to ground water is greatly reduced. The runoff does have to go somewhere—therefore, it is collected by extensive drainage systems, made of curbs, storm sewers, and ditches, which most always carry stormwater runoff directly to streams.

Table 5

Geographical and Physical Land Characteristics that Affect Runoff:			
· Land Use	· Vegetation	· Soil Type	· Drainage Areas
· Elevation	· Slope	· Topography	· Downstream Basins*

**Examples of downstream basins are ponds, lakes, reservoirs, and sinks, which all prevent or alter runoff from continuing downstream.*

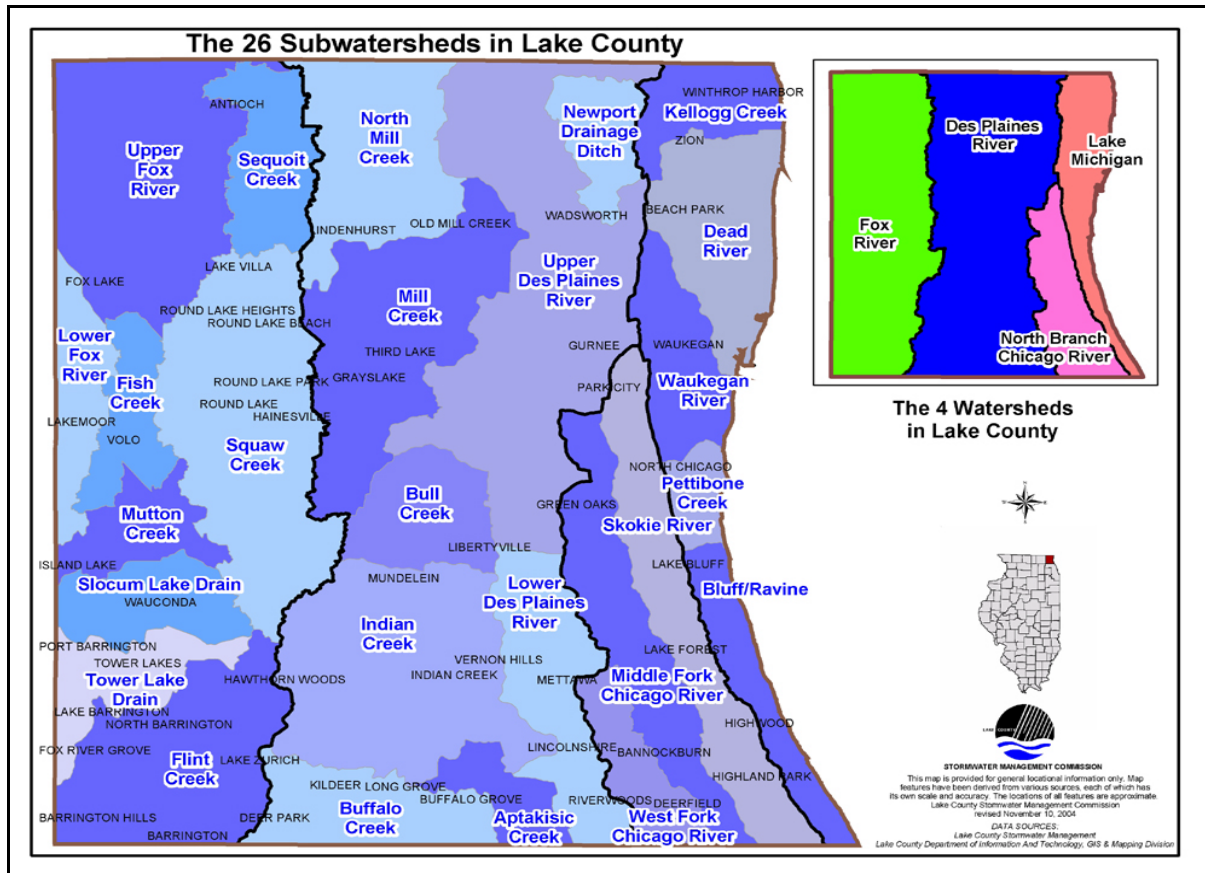
Watershed location

Chicago's official geographic coordinates are 41°53'0"N, 87°39'0"W. There are several major watersheds in Illinois, as depicted in **Figure 3**. The city sits on the continental divide, at the site of the Chicago Portage, connecting the Mississippi River and the Great Lakes watersheds. **Figure 4** illustrates Chicago's location along Lake Michigan and two rivers which flow through the city—the Chicago River (downtown) and the Calumet River (in the industrial, far South Side). The Chicago Sanitary and Ship Canal connects the Chicago River with the Des Plaines River, which runs to the west of the city. The immediate watersheds include: the Lake Michigan Watershed, the Calumet Chicago River Water Shed, the Des Plaines River Watershed, and the Fox River Water Shed.

The primary urban watershed within that boundary is located mostly in Cook County, IL, as illustrated in **Figure 5**. Within Cook County, there are additional watersheds: the Chicago River Watershed, the Calumet River Watershed, the Cal/Sag Channel Watershed, the Lower Des Plaines River Watershed, the Upper Salt Creek Watershed, and the Poplar Creek Watershed.

Sub-watersheds can also be defined, in order to further refine the parameter set up; an example of a sub-watershed is the map showing the Lake County Sub-watershed. **(Figure 6)**

Figure 6



Once the watersheds are defined, certain characteristics need to be monitored to determine how the water will run off—highly developed areas of the watershed would have a quick runoff and therefore, be considered more sensitive. This is true for Northern Cook County, according to MWRD’s Lanyon. There is more development in the area; additionally, the watershed is smaller and closer to the captures. Whereas, the Southern Cook County area is less developed and has more time to slowly runoff, before reaching the treatment facilities.

Land Use, Vegetation, and Soil Moisture

The surrounding vegetation in the watershed and the soil type make a difference, in how quickly water will be absorbed. The moisture conditions of soil can change, which is something that can be monitored via NOAA’s Climate Prediction Center the Hydrologic Information Center (which constantly analyze soil moisture levels on their websites.) Lanyon regards soil infiltration as one of the most important factors leading to floodwater releases in Lake Michigan. Understanding a watershed and the soil moisture content is important before issuing a SAA. (NOAA)

Because Chicago is an urban environment, it is a geographical hot spot for runoff water quality issues. An EPA study documented cases that conclusively linked urbanization and increased watershed

imperviousness to hydrologic water quality impacts on streams. Existing reports and case studies provide strong evidence that urbanization negatively affects streams—thus, resulting in water quality problems, such as: loss of habitat, increased temperatures, sedimentation, and loss of fish populations. (EPA)

A study on the number of trees in Chicago was conducted, called “Quantifying the impact of trees: The Chicago Urban Forest Climate Project.” It mainly focused on the way trees help climate, energy use, and air quality. It has been widely accepted that trees also help a great deal with water absorption. The study estimated tree cover in the Chicago area (Figure 7.) Additionally, it documented the percentage of land cover, available growing space, and canopy for the Chicago area. This type of information must also be considered when setting stormwater parameters. In locations of close proximity to densely forested areas, there will be fewer problems with runoff. (Nowak and McPherson)

Figure 7

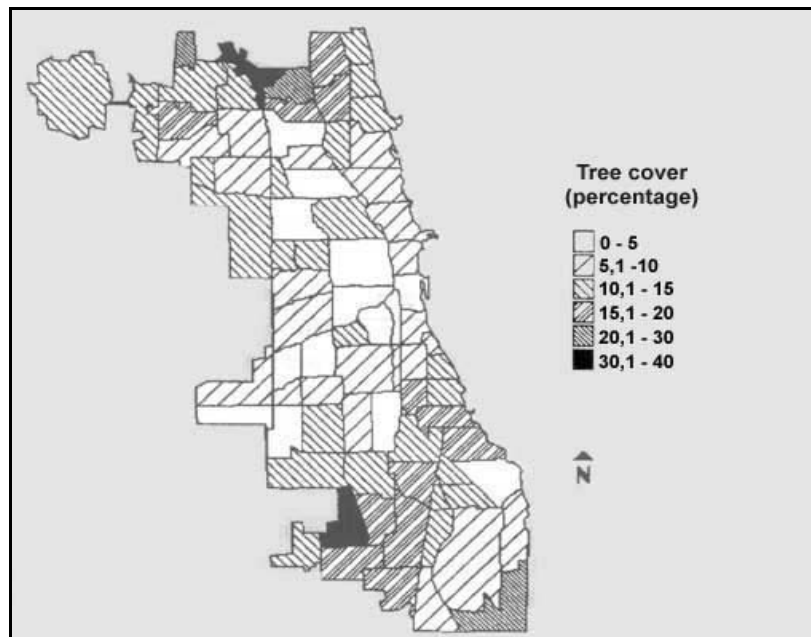


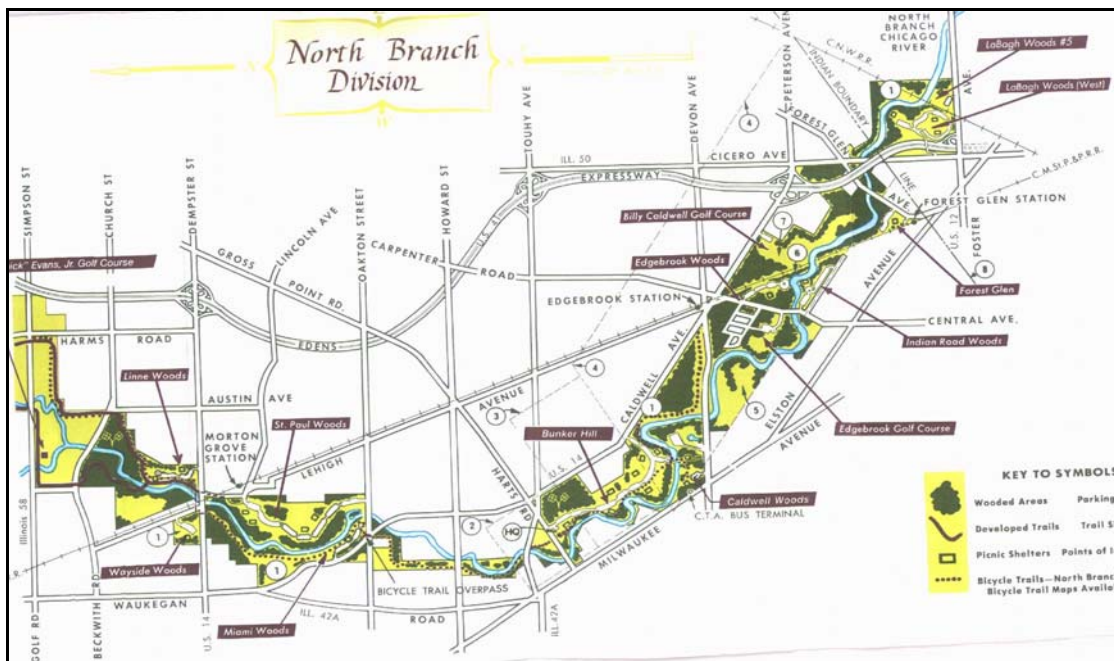
Figure 7A

Percentage of Land Cover, Available Growing Space, and Canopy Stocking in the Chicago Area							
Region	Tree	Grass 1	Building	Paved	Water	AGS 2	CSL 3
Chicago	11.1	26.9	27.4	32.4	2.2	38.0	29.2
Cook County 4	22.5	44.7	12.6	18.2	2.0	67.2	33.5
DuPage County	18.6	56.0	9.4	13.9	2.1	74.6	24.9
Overall region	19.4	44.4	14.5	19.7	2.0	63.8	30.4

1 Percentage of area occupied by both grass and soil.
 2 Available growing space (percentage of tree and grass cover).
 3 Canopy stocking level (percentage of available growing space occupied by trees).

Breaking down the land use of a watershed is very helpful in identifying problematic areas. The map showing the North Branch of the Chicago River division is an example of how to do this, as seen in Figure 8.

Figure 8



Other parameters that influence runoff are elevation, topography, and slope. Chicago is built on flat land. The average land elevation is 579 feet (176 m) above sea level. The lowest points are along the lake shore at 577 feet (176 m), while the highest point at 735 feet (224 m) is a landfill, located in the far Southside, community of Hegewisch. (GIS DATA)

When it Rains, it *Drains*... Ration, Reduce, Redirect

The top consideration is how much water is going down the drains when it rains. The Alleghany, PA watershed management program uses a similar phrase for their stormwater education programs. The line “when it rains, it drains,” connects the concept of stormwater, streets, and a drain. It says that water is coming from a storm and going to a drain--- the activities that happen surrounding those events are what can impact water quality. Three specific objectives that relate to how much runoff is going down the drain include: reducing the amount of water going into the sewer system during high runoff events (help lessen CSOs,) minimizing the pollution that happens in stormwater runoff, and use stormwater as a resource.

These three objectives can be broadly conveyed to the community with **3 Rs**:

- ◆ **Ration** Water Consumption
- ◆ **Reduce** Use of Pollutants
- ◆ **Redirect** Runoff

Chicago’s MWRD has an extensive database that could lead to more information about how the drainage happens and how the rationing, reducing, and redirecting can be the most effective. Their database provides a wealth of information about the geography and drainage rates for specific areas, according to their geographical parameters. Alert can be defined and issued according to specific parameters defined by the MWRD database. The alert should suggest an action that will help reach the objectives (3 R’s above) for protecting water quality.

Ration Water Use

Alert Action: Immediately reduce water usage through conservation. Don't leave water running, reduce use of water appliances like dishwashers and clothes washers, turn off sprinklers, minimize toilet flushes, etcetera.



Reduce Personal Water Use

In Chicago, per capita water use is estimated at 100 gallons per day by MWRD. This average is slightly below the estimated 121 gallons of water, used daily by Americans (not taking into account extracurricular uses of water, like cooking and dog washing.) (USGS)

While the statistics differ from a city level to a national one, the amount of water used also varies with individuals. Whereas one person might use five gallons of water to hand wash dishes; another may use ten. And while, one person may leave the water running when brushing their teeth, another might not. Also, people living in newer homes, probably have toilets that use less water per flush than toilets in older houses. Newer homes may also have “water saving” shower heads and faucets.

The action alert calls for the amount of water being consumed to be cut down. During an alert, this effort should be significant. Consider the amount of water used in personal habits in **Figure 8**: bathing takes an average of 50 gallons, while showering averages 2 gallons per minute. Allowing the faucet to run while brushing teeth can use as much as a gallon of water. The water that goes down the drain, clean or dirty, ends up mixing with raw sewage, getting contaminated. It is critical that water consumers are aware of this precious resource and make efforts to conserve it.

Figure 8

Bath: 50 gallon
Shower: 2 gallons per minute
Teeth brushing: 1 gallon
Hands/face washing: 1 gallon
Face/leg shaving: 1 gallon
Dishwasher: 20 gallons/load
Dishwashing by hand: 5 gallons/load
Clothes washing (machine): 10 gallons/load
Toilet flush: 3 gallons
Glasses of water drunk: 8 oz. per glass (1/16th of a gallon)

Source: Usgs <http://ga2.er.usgs.gov/edu/sq3action.cfm>

During a storm—every gallon counts! Each person who changes their habits, even temporarily, can make a difference. During major rain events, the act of rationing water goes a long way in trying to

alleviate the stress of a storm/sewer system. Usage habits can likely be altered without much discomfort to the consumer—especially considering, that much of the world survives on 2.5 gallons of water per day.

Reduce water appliance use

Consider these simple actions that reduce the water going down the drain. These are simple actions: choosing to turn off the water while brushing teeth or shaving; only washing laundry and dishes with full loads; sweeping, instead of spraying, down the driveway; taking shorter showers; or, as Tree Hugger dot com lists the old joke, showering with a friend! (Tree Hugger)

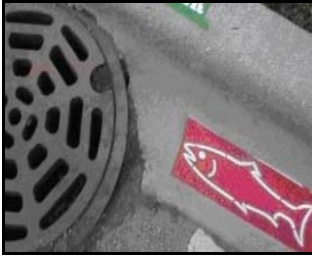
Dishwashers use 20 gallons per load, on average—while hand washing dishes, in a sink, full soapy water, can reduce the amount of water consumed, to just 5 gallons. (Averages and amounts vary; they are dependent upon the type of appliances used.)

Changing or updating appliances can be a huge step in reducing water consumption. *Tree Hugger* collects national data on environmental issues. It estimates that a dripping faucet can waste 20 gallons of water a day and that a leaking toilet can use 90,000 gallons of water in a month. These figures can be reduced, by getting out the wrench and changing washers on sinks and showers. Installing new fixtures like low-volume or dual flush toilets, low-flow showerheads, and water-efficient dishwashers will also help to lower the amount of water used. Also, aerators on faucets can significantly reduce water volume; water-saving showerheads cut the volume of water used down to 1.2 gallons per minute (some models even have a “pause button”—that allows the individual stop the water, while soaping up, shampooing, or shaving.) Other actions that help during stormwater emergencies are: avoiding appliances like the washing machines and dishwashers; taking shorter showers, instead of baths; and avoiding unnecessary toilet flushes.

When put into practice, these changes would have a significant impact. According to the University of Minnesota, a typical household of four uses 260 gallons of water a day. Forty percent of this water is used for toilets and an additional 35% is from showers, baths, and faucets—three-quarters of the average household's total water usage, is going directly down the drain! Low-flow showerheads and faucets cost about \$30; but when installed, they are estimated to save the average household 45 gallons of water, of the 260 gallons it uses daily—that's almost 18% of the average usage. Splurging on a low-flow toilet could save another 50-80 gallons of water a day. Together, these changes nearly cut the household's daily use in half, saving a considerable amount of water—an invaluable action during stormwater emergencies... not to mention, the amount saved on the water and water heating bills.

Reduce Pollution

Alert Action: Immediately clean up any spills; remove trash from streets, curbs, and drains; avoid using any fertilizers or pesticides; and clean up after your pet.



While rationing water use is believed to be beneficial for sewer systems (preventing overload) for several hours before, during and even after a storm; other actions should be considered within 48 hours (or perhaps 24/7) in advance of a storm or heavy rain event. Including the pollution-oriented actions outlined below.

Never Dump

Consider where water will run before it goes down the drain and try to minimize the pollution. Municipalities and many other public agencies are required to mark storm drain inlets with messages reminding people that storm drains are connected to local water bodies. Drain stencil kits were issued in 2005, as part of the “Illinois: Be River Smart” campaign by the Illinois River Coordinating Council. The stencil campaign has been adopted by numerous communities. It helps citizens understand the difference between the drain that leads to the sewer and the drain that leads directly to stream. This is critical in helping people avoid pollution. A SAA would tell water consumers specific instructions about what not to place into street drains: solvents, oils, paints, varnish, thinners, paint strippers, pesticides, poisons, fertilizers, acids, and solid objects.

Other instructions during an alert, address the usage and disposal of hazardous products. Hazardous products used in the home or workplace should be disposed of properly. Read the label for guidance and do not pour any hazardous products down a storm drain—storm drains are usually connected to local water ways (**Figure 9.**)

Figure 9



Avoid car maintenance projects

During an action alert, car maintenance should be performed by professionals, because they can easily recycle fluids/oils and clean up accidental spills. Keeping a car properly tuned up will prevent leaks—however, if a leak occurs, never wash away spills. Sweep up all spills, after absorbing them with sawdust or kitty litter. Cars should be washed on the grass or better yet, at a professional car wash; where it is required by law to treat dirty water before releasing it back into waterways.

Avoid pesticides and fertilization

There are many ways to avoid poisoning the surface that water runs off during a storm. During an alert do not use pesticides or fertilizers of any kind—the storm will end up taking most of the chemicals in runoff right into the street drains which can often lead to streams. Always check the forecast to see if heavy rain is predicted before applying a fertilizer of any kind. Consider a soil test to see if/what type of fertilizer is needed. If fertilizers and pesticides are used, follow the instructions exactly as they appear on the label. Look into natural/less toxic alternatives for pesticides. Choose a fertilizer w/ low or no phosphorous. Maintain a small lawn and keep the rest of the yard in a natural state with trees and other native vegetation. Make fertilizer-free zones, 20' away from water ways. Dispose of yard waste properly, keeping leaves and grass out of storm drains. Most cities have yard waste collection rules, follow them. Consider leaves and grass clippings as a resource for compost. Use a mulching mower that recycles grass clippings into the lawn. Remember to hire smart—use a lawn care company that practices the above actions.

Clean up pet waste

Clean up after pets and properly dispose of pet waste dropped on public or other people's property. Use newspaper, bags or pooper-scoopers to pick up wastes. Dispose of the wrapped pet waste in the trash or unwrapped in a toilet. Never discard pet waste in a storm drain. Studies have shown that about half of all dog owners walk their dogs in public areas. Up to 50 percent do not pick up after their pets. While one study in Washington State showed that pet waste is a significant pollution source in the Puget Sound area, they also did a survey that showed citizens did not believe that it is an important water pollution problem. The ability of pet waste collection systems to decrease fecal coli form levels has never been precisely quantified, according to their study. However, DNA fingerprinting techniques have clearly shown pet waste to be a major contributor of bacteria in urban and suburban watersheds. Within the last 5 to 10 years have local governments have been focusing more on the control of pet wastes (for reasons other than it's a messy, nuisance!) Stormwater action alerts would be another reason to make regular habits on cleaning up on this nonpoint source pollution. (WA State Dept of Ecology)

Redirect Water Runoff

Alert Action: Immediately disengage water spouts, use rain barrels, and look for opportunities to catch water and reuse it.



Rationing water, reducing pollution can be complimented with redirection water during a storm. For example, as an immediate way to alleviate stress on local sewer loads, downspouts can be disconnected. This is

Redirect water

Redirect downspouts away from paved surfaces; disconnect them if necessary to slow down runoff. A Toronto study on redirecting downspouts indicates that some parts of the combined sewer system overflowed as many as 15 times per year, resulting in a discharge of stormwater and wastewater to receiving watercourses. It was estimated that disconnecting one quarter of the downspouts in the study area would result in a 50% decrease in the number of CSOs. Disconnecting two thirds of the downspouts would nearly eliminate CSOs. The number of CSOs avoided elsewhere depends on specific features of the sewer system, as cited by Canada's CityFarmer.org.

Before an redirecting occurs, it's important to follow the water... pooling onto another property can create legal issues, sending the water to another problem area is not a solution, and creating flooding elsewhere is not smart. Look for ways to redirect drainage from where water lands on the roof-- toward a lawn or garden area. Adjust downspouts or gutters so they allow water to flow into vegetation. Portland's Willamette River Valley participated in an aggressive disconnecting project and has removed over 768 million gallons of roof water each year from the storm drain system. Other considerations for redirecting stormwater are valuable too. Lawns are typically sloped to encourage water to run off onto neighboring property and streets, but if a property is landscaped with shrubs and flowers can soak into the ground instead of becoming runoff. Remember to vegetate bare soil which will also help slow runoff and increase absorption. (Ecology Center)

Harvest the rainwater

Put a rain barrel (see **Figure 10**) at the end of downspouts and use this water for irrigation. Rain cisterns come in all shapes and sizes ranging from larger underground systems to smaller, freestanding

ones. They can catch anywhere from 80 gallons to hundreds of gallons. The rain barrel guide article “How much water could be saved with rain barrels states: for every inch of rain that falls on a roof of 1,000 square feet, expect to collect approximately 600 gallons of rainwater. Ten inches of rain falling on a 1,000 square foot catchments area will generate about 6,000 gallons of rainwater. Chances are good no one will catch 6,000 gallons. But even one gallon decreases the stormwater runoff going into the sewer system. For example, of a location with an average rainfall of 20 inches per year, there is the potential to collect 24,000 gallons of water in one year. The math goes like this: 1,200 gal x 20 inches of rain = 24,000 gallons. Depending on the needs of a household, that can be significant amount of water.

Chicago’s average rainfall can run between 20-40 inches, it’s currently about 37 inches for a 30 year average annual rainfall. While rainwater harvesting systems aren't necessarily 100% efficient, most sources do estimate efficiency between 70% and 90%. All rainwater harvesting systems lose some of the rainwater. It may spill out of the gutters or the wind may blow it away. Evaporation will undoubtedly affect some of it. (NOAA Climate)

Figure 10



Many rain barrel initiatives including the EPA's Green Infrastructure Webpage cite rain barrels as a way to handle stormwater runoff. A recent study “Rain Barrels – Truth or Consequences” showed that the logistical and cost issues are deterrents to rain barrel effectiveness. Also there are also issues in the realm of environmental ethics when it comes to water being a free resource. The study done in Milwaukee with the Milwaukee Metropolitan Sewage District (MMSD) showed that there were no CSO volume reductions during a city rain barrel campaign. Many of the problems in this study were the fact that people did not understand how rain barrels worked, how to empty them, and how to use them effectively. The bottom line

with rain barrels is that for them to work, water consumers need to understand and use them! (Sands and Chapman)

Riverside Stewardship Alliance created a partnership in the Alleghany watershed to educate people on rain barrel usage and gauge their effectiveness. They targeted a specific area known as “Nine Mile Run.” A residential participation rate of 40% comprehensive rain barrel program would reduce the volume of CSO discharges. The analyses showed that a reduction in 18 million gallons in a year or a reduction of 4.9% over existing conditions. The upper limit control of a comprehensive participation on residential properties in “Nine Mile Run” would reduce CSOs to 47 million gallons or a 12.8% reduction over existing conditions. This type of comprehensive study done on a sensitive area like the North Branch watershed in Chicago might yield the effectiveness of an rain barrel education plan in that area.

Harvest Greywater

Water that has been used at least once but is still clean enough for other uses is called greywater. Water from sinks, showers, dishwashers, and clothes washers are the most common household examples. Greywater can be recycled with simple practices such as emptying the fish tank in the garden instead of the sink. One way or another, avoid putting water down the drain when it could be used for something else.

Figure 11



Figure 12



Other ways to redirect water include changing surfaces from non porous to porous, to channeling (**Figure 11**), to sloping (**Figure 12**), and even creating wetlands and holding ponds.

Summary of Alert Actions

There are two action time frames: short term actions to take during a storm alert and long term actions to consider over time. Here’s an example list:

Short Term Actions

- 1- Ration Water Usage: delay dishwasher, clothes washer, and baths. Do dishes by hand with sink and avoid running water for long periods of times, clean the clothes after a storms passes, or take a short shower.

- 2- Reduce Pollution: make sure streets and gutters outside your property are free and clear. Pick up trash or broom up any harmful debris.
- 3- Redirect Water: make sure sprinklers are not on, disconnect spouts, clean drains so water can flow in the right direction.

Long Term Actions

- 1- Ration Water Useage: change appliances to low flow.
- 2- Reduce Pollution: use car wash shops instead of doing it yourself, use biodegradable fertilizers and pesticides, or don't use harmful chemicals at all!
- 3- Redirect Water: install and use rainbarrels... consider starting a block program to use them with your neighbors.

In order for the actions to be done by public they need to have a significant environmental improvement that can be understood by water users. There should be low cost, good return on investment considerations. Also, the steps for implementation need to be quick and easy. Research needs to be done to see if these outlined actions are things that most people would be willing to do to protect waterways.

Issuing a Stormwater Action Alert

Many municipalities have stormwater pamphlets that offer guides to handling runoff and preventing water pollution. Alert actions should be stronger than just “suggestions.” These are advisements that should be taken seriously and followed. While it’s true the opportunity of urgency may also lend itself to education of the importance of water consumers and their actions with water, the alert is just that – an urgent message. (City of Chicago Water Department)

The alerts should be delivered by decision makers. The list of possible partners (see **Table 6**) to issue an alert include: NWS, Department of Environmental Protection (DEP,) Environmental Protection Agency (EPA,) and MWRD. A Stormwater Action Alert means that a storm would likely produce more rain than the infrastructure could contain. The SAA should be issued to minimize the amount of water runoff. There are several ways alerts could be issued to the public. Currently, the MWRD Chicago Water uses an email subscription to inform water customers when there has been a CSO. It’s called EnviroFlash. Interested individuals can sign up for email subscriptions to alert them when a CSO has happened. This system could also be used to notify water consumers of Stormwater Action Alerts. Other public information agencies like the National Weather Service and mass media could be utilized to notify the public of an alert (see Table DVD Sample of TV Weather Broadcast.)

New research is also emerging with GIS-based Stormwater Modeling which offers efficient and accurate stormwater modeling capabilities. Semi-automated procedures for modeling stormwater behavior required tedious and time-consuming data collection, manipulation, and data input preparation activities. Computer-based models present primitive punch card-like interfaces for entering data and commands and produce volumes of output in non-graphical, tabular report format. Calculating parameters such as drainage area, curve number, and time of concentration can take weeks for a single watershed. It’s expected that future application of new computer technology will improve stormwater analysis activities. This could be a critical tool in issuing stormwater action alerts. (Thomas)

One of the unanswered questions – how far in advance does an alert need to be issued to work. How much time is need for the water consumer action to benefit the MWRD system load to be effective? This is an area that must be researched further so that the timing is right between the storm happening and the alert being issued. What are the dynamics of actual measurements of water quality and the quantity of water in an overflow? The MWRD website cites that every gallon kept out of the system is helpful but this information should be quantified to verify effectiveness. More research is needed.

Funding of Stormwater Action Alert Program

There are many local, state, and federal financial sources for stormwater education. These might be funding sources for the Stormwater Action Alert Programs in communities across the country. On the state level there are several resources and many of them are generous. On April 6, 2006 Governor Blagojevich announces additional funding for Conservation 2000 Grants to protect Illinois environment and water quality. Regionally, the EPA has a database of funding. See **Figure 13**.

Additional grant information can be researched on grants.gov and fedgrants.gov. The one that might prove to be the best applicable grant available for a stormwater education program like the stormwater action alert program is called “Project Title: Stormwater.” See **Figure 14**.

Loans as a Funding Source

Another funding source for acquiring financial support of this program could be loans. America’s largest water quality financing source is the Clean Water State Revolving Fund (CWSRF) programs has provided more than \$5 billion annually to fund water quality protection projects for wastewater treatment, non point source pollution control, and watershed and estuary management. CWSRFs has funded over \$63 billion projects, providing over 20,700 low-interest loans to date. Many of the projects are infrastructure based. But the projects do remain diverse. The CWSRF program has assisted a range of borrowers including municipalities, communities of all sizes, farmers, homeowners, small businesses, and nonprofit organizations. CWSRFs partner with banks, nonprofits, local governments, and other federal and state agencies to provide the best water quality financing source for their communities. Based on the set up of this loan, the stormwater alert program could be funded or supplemented by CWSRF.

Conclusion

Understanding the story of rainwater runoff (see **Figure 15**) is only part of the mission of a Stormwater Action Alert. The primary focus is to get quick results, which requires immediate action. The SAAP would certainly face compliance (will people do it?) issues and other challenges. It's impossible to define all the obstacles. More research is needed on the willingness of people to take part in the action alerts. Then there should be ongoing, post alert evaluation of the effectiveness of the program. There should be research to see if the alerts influence people's behavior short or long term.

Figure 15



Environmental Researcher Michael Broili wrote the word water. Then he wrote as many words as he could get out of water:

**WATER ART, ATE, AWEEAR, EAT, ERARAT, RATE,
RAW, RET TAR, TARE, TAW, TEA, TEAR WAR,
WARE, WART, WEAR, WET**

The list is pretty impressive. The number of words that come out of the letters W A T E R --- but the list is finite. The ways to *protect and improve* water are endless. There are many options. And many opportunities. Based on current habits and trends, water will not take care of itself. It's up to every community to become a steward of water. Each watershed and its consumers must try something, then another thing, until they find what works to protect their water quality. A call to action is the next best step to reach complacent water consumers. Alerting the public that action needs to be taken to protect water is an affordable, sustainable solution. One action will hopefully lead to more actions and even habits.

Obstacles to a program like this include: organization, dissemination, and follow up. A strong organization must start and test the program with an aggressive campaign to get the alerts set out. Then follow up – including surveys, water quality testing and research should follow. The changes in public water habits may not be enough to match Mother Nature's fury. Storms will continue to have an element of unpredictability that prevents enough warning time to make a difference in the water reductions met with stormwater action alerts. But this is an opportunity to approach responsible watershed management in communities that does not cost the millions of a reservoir design, it does not take time to build, and it does not require legislated policy to enforce. The next step in responsible watershed management understands the meteorological and geographical parameters for alerting the average water consumer to urgent action.

Parameters for Issuing An Alert in Chicago

The next step is action. A website has been designed www.stormwateralert.com The Amy Freeze SAAP has been trademarked and a powerpoint presentation is available for communities interested in implementing the program. Details of the program and this research is available on that website:

www.stormwateralert.com

The discussion and research in this paper defines these parameters for issuing a SAA in Chicago. A Stormwater Action Alert should be issued if ½" of rain or more in less than a 12-hours is expected. Chicago is highly urbanized with sensitive waterways. This would be an aggressive, yet reasonable parameter for the program to issue alerts for the urban area of Cook County. The surrounding suburban areas and counties should go under an alert when Flash Flood Guidance is expected to be met, when watches and warnings for flooding are issues, during forecasted severe weather with heavy rain, and during

the first major rainfalls after a dry period (6 days or more.) Additional parameters could be set by local agencies.

Suggestions for Name of the Alert:

H2O Alert, Stormwater Alert, Rainwater Alert, Water Pollution Alert, Water Impact Alert, Water Action Alert, Stormwater Action Alert.

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Author Note: EPA defines stormwater as one word.

Table 2

FORMS OF PRECIPITATION

(as Defined by the American Meteorological Society Glossary of Meteorology)

Rain

Precipitation in the form of liquid water drops, which have diameters greater than 0.02 inch, or, if widely scattered, the drops may be smaller. Generally produced by nimbostratus or cumulonimbus clouds.

Intensity is classified as:

- (a) "very light" when scattered drops do not completely wet an exposed surface regardless of duration
- (b) "light" when the rate of fall varies between a trace and .10" per hour with the maximum rate of fall being no more than .01" in six minutes
- (c) "moderate" when the rate of fall is between .11" and .30" per hour with the maximum rate of fall being no more than .03" in six minutes
- (d) "heavy" with over .30" per hour or more than .03" in six minutes.

Drizzle

Very small, numerous, and uniformly dispersed water drops that appear to float while following air currents. Unlike cloud/fog droplets, drizzle actually falls to the ground. It usually falls from low stratus clouds and is frequently accompanied by low visibility and fog. By convention, drizzle drops are considered to be less than 0.5 millimeter/0.02 inch.

Intensity of drizzle is based upon rate of fall:

- (a) "very light" is when exposed surface is never completely wet
- (b) "light" is when rate of fall is trace to .01" per hour
- (c) "moderate" is when rate of fall being .01" to .02" per hour
- (d) "heavy" is when rate of fall is more than .02" per hour even though when rate is equal or exceeds .04" per hour, all or part of the precipitation is generally rain

Freezing Rain

Rain (see above) that falls in liquid form but freezes upon impact to form a coating of glaze on the ground and exposed objects. While the temperature of the ground surface and glazed objects initially must be near or below freezing, it is also necessary that the water drops be supercooled before striking. A shallow layer of sub-freezing air at the surface is common. Freezing rain frequently occurs as a transient condition between the occurrence of rain and ice pellets (sleet) as cold air advection and the deepening of the cold air layer occurs. When encountered by an aircraft in flight, freezing rain can cause a dangerous accretion of

clear aircraft icing. Droplet size, as in rain, must be greater than 0.02 inch.

Freezing Drizzle

Drizzle (see above) that falls in liquid form but freezes upon impact to form a coating of glaze. The physical cause of this phenomena is the same as that for freezing rain (see above). Droplet size, as in drizzle, must be less than 0.02 inch.

Hail

Precipitation in the form of balls or irregular lumps of ice, always produced by convective clouds (cumulonimbus). By convention, hail has a diameter of 0.2 inch or more, while smaller particles of similar origin may be classified as ice pellets or snow pellets (graupel). Thunderstorms which are characterized by strong updrafts, large liquid water contents, large cloud droplet size and great vertical heights are favorable to hail formation. Hail size is important in determining the strength, of course, of the up and downdrafts and, therefore, the severity of thunderstorms. By definition, hail size of 0.75 inch (3/4 inch) or greater is one criteria that classifies a thunderstorm as being "severe."

Ice Pellets (Sleet)

A type of cold weather precipitation consisting of transparent or translucent pellets of ice, 0.2 inch or less in diameter. They form from the freezing of rain droplets or refreezing of largely melted snowflakes when falling through a fairly significant below-freezing layer of air at or near the earth's surface. The ice pellets may be spherical, irregular, or (rarely) conical in shape. Ice pellets usually bounce when hitting the ground and usually make a distinctive sound.

Snow

Cold weather precipitation form composed of white or translucent ice crystals, chiefly in complex branched hexagonal form and often agglomerated into snowflakes. Snow is produced in supercooled clouds where water vapor is deposited (deposition) as ice crystals that remain frozen during their entire descent, which usually requires a deep layer of sub-freezing air. Snowflakes can be up to 0.8 inch in diameter.

Intensity of snow is based upon visibility:

- (a) "light" snow is when visibility is 5/8 statute mile or more
- (b) "moderate" snow is when visibility is less than 5/8 but more than 5/16 statute mile
- (c) "heavy" snow is when visibility is less than 5/16 statute mile

Table

Potential Partners for a Stormwater Action Alert Program in Chicago:

- MWRD
- City of Chicago
- Local TV, Radio, Newspapers and Online Media



- American Rivers

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- Association of State and Interstate Water Pollution Control Administrators

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