

# **Dane County Lake Level Management Guide for the Yahara Chain of Lakes**



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Dane County Land & Water Resources Department

Approved by Lakes and Watershed Commission October 13, 2010  
Updated August 2019

*Cover photo by Mike Kakuska*

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# 1 Introduction and Purpose

This guide provides an overview of the Yahara River chain of lakes (Mendota, Monona, Waubesa, and Kegonsa) and the strategies that are employed in an effort to manage lake levels within regulatory limits. System characteristics, regulatory obligations, and other important considerations are covered. The strategies and scenarios described in this guide are based on years of management experience and the best information available at the time of publication. Strategies are subject to change based on physical changes in the system, the collection of data, and the ever-growing knowledge about the hydraulic and hydrologic characteristics of the system.

The guide will be periodically revisited to assess whether the strategies are still effective based on advancements in modeling and monitoring and other relevant data.

Appendices are included to provide supplemental information about the physical characteristics of the lakes, control structures (locks and dams), and management equipment.

## 2 Overview

Management of the Yahara Lakes water levels and flows is a collaborative effort amongst the Wisconsin Department of Natural Resources (WI DNR), Dane County, City of Stoughton and all affected local municipalities. The WI DNR's primary role is issuing regulatory orders and providing technical support to water level managers. The WI DNR has the authority to issue and revise the standing lake level orders and the authority to issue emergency operating orders. Dane County is responsible for developing and carrying out the operational strategies necessary to comply with the lake level orders set for Lakes Mendota, Monona, Waubesa, and Kegonsa. The City of Stoughton is responsible for developing and carrying out the operational strategies necessary to comply with the regulatory orders for the Stoughton Dam. Dane County and the City of Stoughton are responsible for coordinating their management efforts and communicating operational changes to the WI DNR and all affected municipalities.

Dane County's Land and Water Resources Department (LWRD) is responsible for managing lake levels on Lakes Mendota, Monona, Waubesa, and Kegonsa. The Director is responsible for monitoring lake levels and the factors that influence lake levels and makes day-to-day operational decisions. When the director is unavailable, the responsibility falls upon the Water Resource Engineering Division staff.

Staff throughout the department collaborate to support the Director and carry out management activities. Lakes Management staff carry out the operational duties and provide feedback to the Director regarding conditions in the field. Department staff also provides public outreach and education. The Director works closely with WI DNR Staff, the City of Stoughton and other local municipal officials to coordinate management efforts

## 2.1 Regulatory Orders

The State of Wisconsin’s statutory mandate is to regulate operation of the Yahara River dams in the public interest. Predecessors to the WI DNR established a series of water level orders to address the state’s “public interest”. The WI DNR issued the most recent orders in 1979. The orders seek to balance many competing interests, including navigation, flood control, and fisheries and wildlife. A summary lake level and flow orders are presented in Table 1 and the complete orders are included in Appendix I.

The water level orders do not specify how the control structures (dams) are to be operated. The orders only specify minimum and maximum water levels, minimum flows, and require that each lake be managed as part of the river system. Winter minimum and summer minimum and maximum target levels are specified. The specified summer ranges for each lake are five tenths of a foot (six inches). The winter minimum is in effect between November 1st and the first spring runoff occurring after March 1<sup>st</sup>. The first spring runoff may be the result of precipitation, or the melting of accumulated snow.

**Table 1. WI DNR Lake Level Order Summary for Yahara Lakes**

	<b>Mendota</b>	<b>Monona</b>	<b>Waubesa</b>	<b>Kegonsa</b>
Ordinary High Water Mark	850.70	845.82	845.67	841.85
Target Maximum	850.1	845.2	845.0	843.5
Target "Summer" Minimum (March 1 - October 30) <sup>a</sup>	849.6	844.7	844.5	843.0
Target "Winter" Minimum (November 1 - March 1) <sup>b</sup>	848.2	842.2	842.0	-
Minimum Flow	4cfs (May 15 - March 30)	-	10 cfs 50cfs (April 1 - May 15)	-

All elevations are reported in relation to the National Geodetic Vertical Datum of 1929 (NGVD 1929), also know as mean sea level (MSL)

a. "Summer" minimum levels are to be maintained from the first spring runoff event after March 1 and October 30

b. "Winter" minimum levels are to be maintained between November 1 and the first spring runoff event after March 1

## 2.2 Vertical Datum

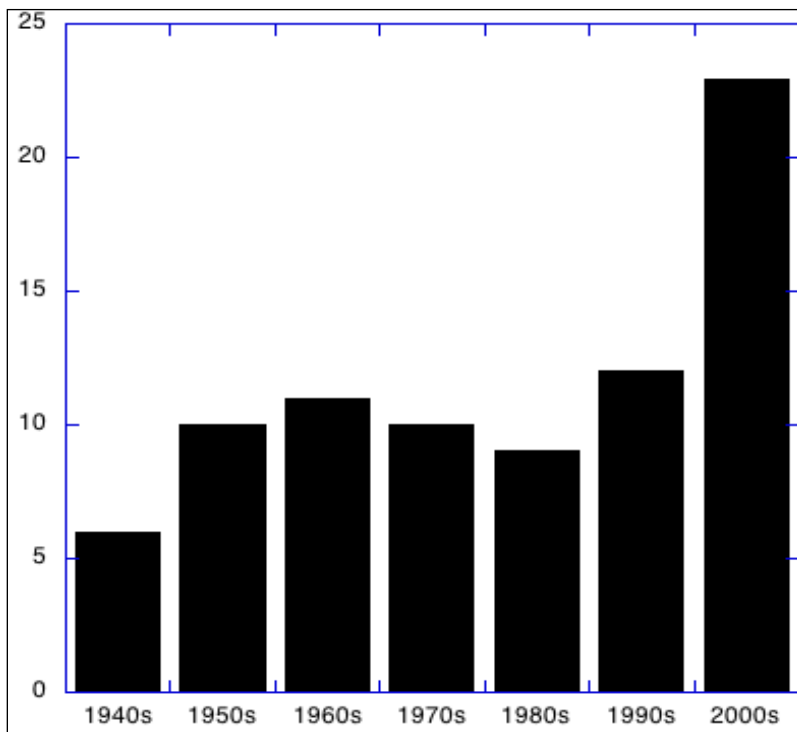
It is critical to take into consideration the vertical datum (a reference for elevation measurements) when evaluating elevation information, such as lake levels and topography. Failure to take vertical datum into account can result in erroneous conclusions about water level impacts on shorelines and shoreland structures. The DNR water level orders and the USGS gauging station water elevations are reported in NGVD 29. The most recent Flood Insurance Relief Maps (FIRM) and Dane County topographic information is reported in NAVD 88.<sup>1</sup>

<sup>1</sup> All elevation data is reported in relation to a vertical datum. The two most commonly referenced datum are the National Geodetic Vertical Datum of 1929 (NGVD 1929) and the North American Vertical Datum of 1988 (NAVD 1988). These datum were developed using different methodologies and consequently they vary spatially. Therefore, there is not a simple conversion between the two datum. A computer program called VERTICON is required to

### 2.3 Weather Forecasting and Historical Trends

Short-term fluctuations in lake levels are primarily driven by precipitation and the resultant stormwater runoff. Predicting the spatial and temporal distribution of rainfall remains a significant limiting factor in lake level management. This factor is further complicated by changes in precipitation patterns. More intense rainfall events occurring in the last decade have added challenges to lake level management, and extreme rainfall events are predicted to increase in the future.

According to the Wisconsin Initiative on Climate Change Impacts Stormwater Working Group<sup>2</sup>, climate change in Wisconsin is likely to increase the severity and frequency of high river flows and water levels. The analysis of downscaled climate projections suggest that Wisconsin precipitation is trending toward wetter conditions and more intense rainfall, as can be seen in Figures 1 and 2. The working group also states “Climate models predict increases in cold season precipitation and increases in the ratio of rainfall to snowfall, potentially increasing the frequency of damaging flooding from rivers, lakes, and groundwater”.



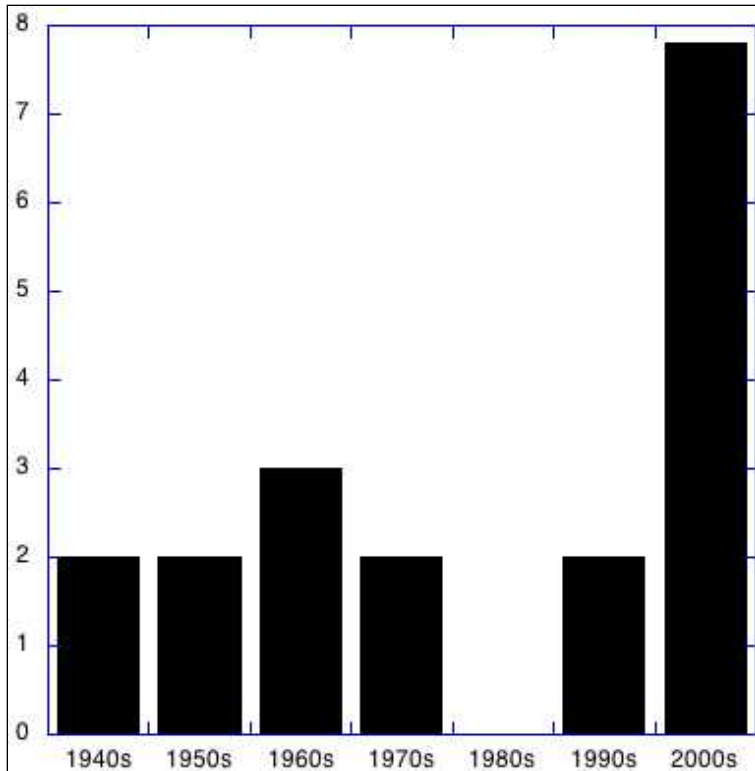
**Figure 1. Occurrences of 2-inch or Greater Daily Precipitation at Madison, WI**

Source: Stephen J. Vavrus, Ph.D., Atmospheric Sciences, University of Wisconsin-Madison

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report the difference between the two datum at any one point. Vertical information reported in different datum should not be compared without proper conversion.

<sup>2</sup> WICCI Stormwater Working Group. June 2010. “Stormwater Management in a Changing Climate: Managing High Flow and High Water Levels in Wisconsin”. Madison, WI.



**Figure 2. Occurrences of 3-inch or Greater Daily Precipitation at Madison, WI**

Source: Stephen J. Vavrus, Ph.D., Atmospheric Sciences, University of Wisconsin-Madison

Figure 3 shows predicted changes to the annual average precipitation in Wisconsin, with Dane County forecasted to have an increase of 1.50 inches of average annual precipitation by the year 2055. With the potential for more frequent and larger storm events to occur in the future, strategies for managing high flow situations becomes more critical.



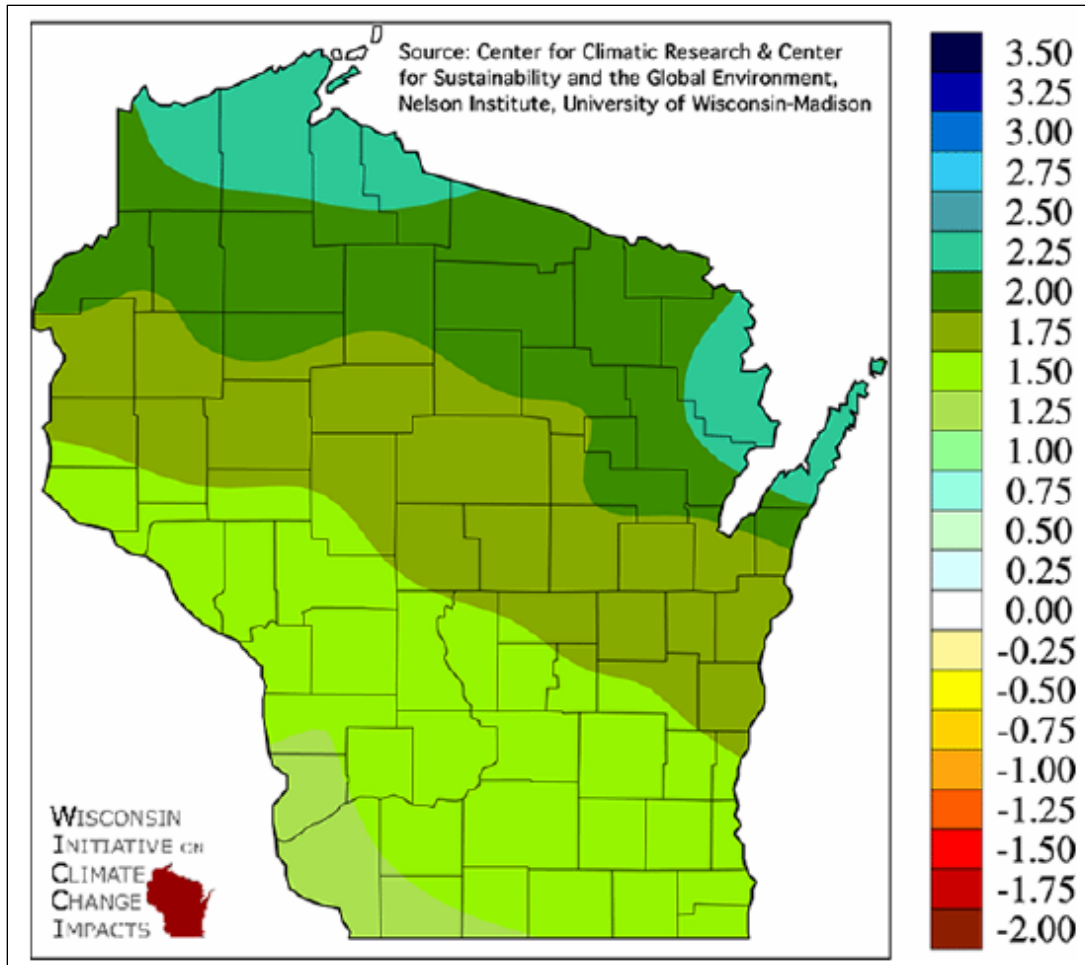
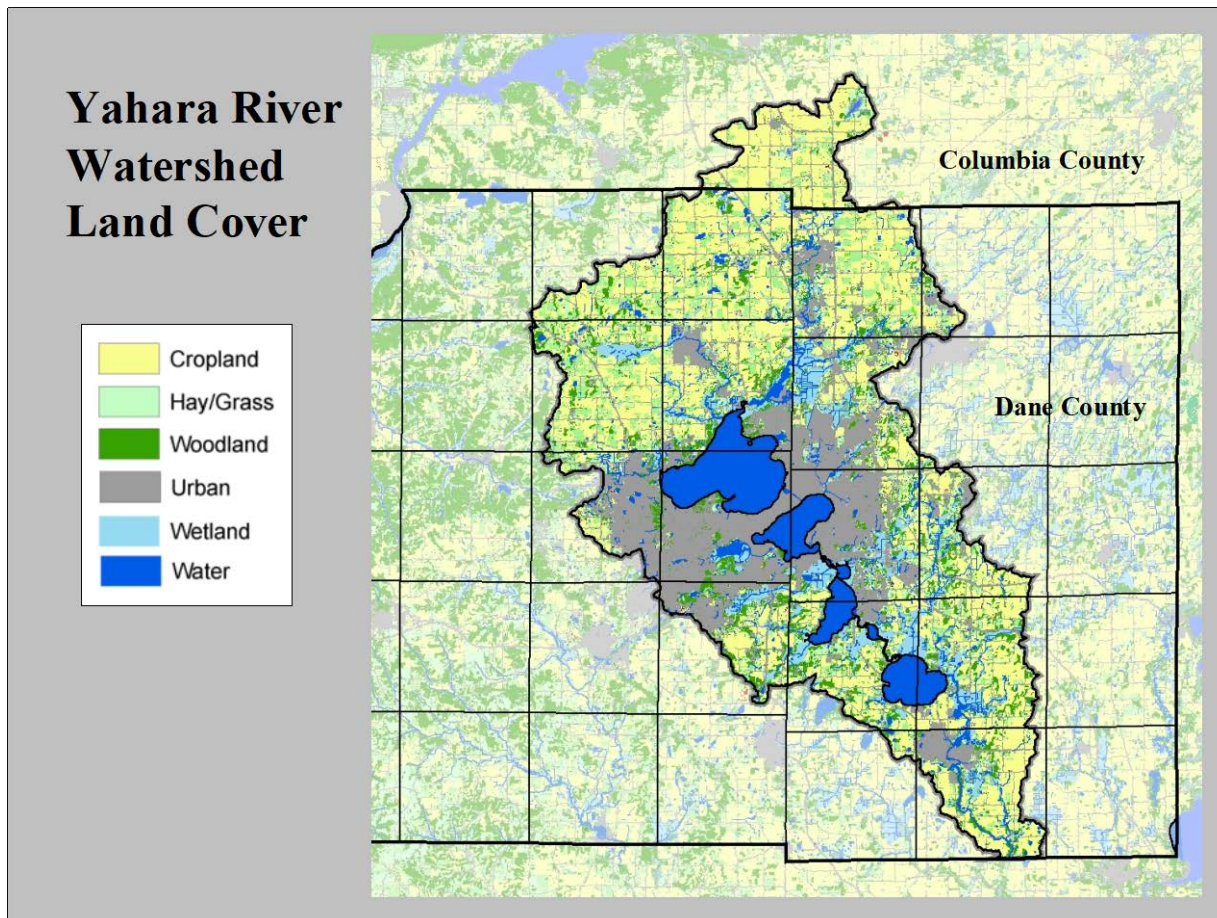


Figure 3. Projected Changes in Annual Average Precipitation (inches) by the year 2055

### 3 Characteristics of the Yahara River System

The Yahara River system is a chain of impounded lakes connected by a low gradient (relatively flat) river (See Figure 4). The levels of the lakes are maintained by lock and dam structures at Tenney Park (Lake Mendota), Babcock Park (Lakes Monona and Waubesa), and LaFollette Park (Lake Kegonsa).



**Figure 4. Yahara River Watershed and Land Cover**

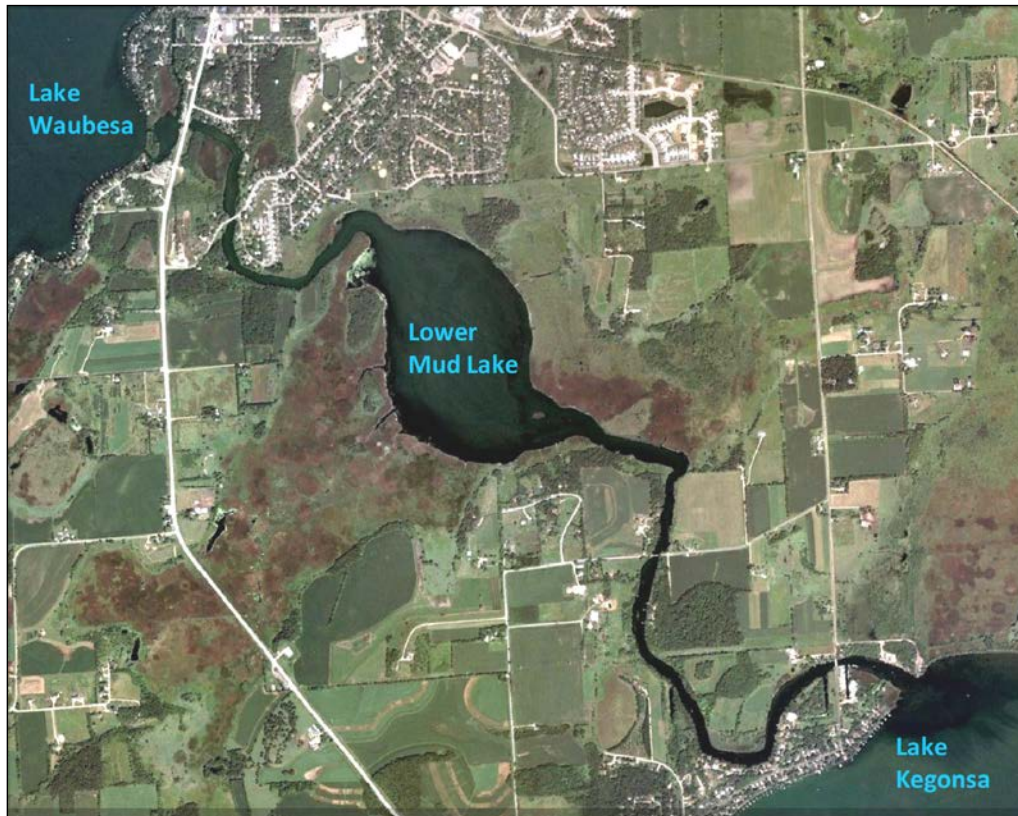
Since 1835 the Yahara Lakes have lost significant portions of the wetlands associated with them. Additionally, since the 1950's significant development has occurred in nearly all areas tributary to the chain of lakes. Urbanization has led to an increased inflow of stormwater and heightened lake level responses<sup>3</sup>.

### 3.1 Yahara River

The river channel between the Babcock Dam in McFarland and Lake Kegonsa (See Figure 5) only drops 1.5 feet in 21,000 linear feet (.007% slope). This results in very slow moving water. During the summer, flow is impeded significantly by aquatic plant growth. The county typically operates two aquatic plant harvesters in the channel between Lake Waubesa and Lake Kegonsa to increase flow between the lakes during heavy plant growth periods. When high flow conditions occur during the summer months, the county may deploy its entire harvester fleet in the river.

<sup>3</sup> Yahara Lakes Advisory Group. September 2002. "Yahara Lakes Advisory Group Final Report: Executive Summary". Madison, WI.

Vallisneria (also known as wild celery, eelgrass, or tapegrass) is the predominant plant growing in the Yahara River. This plant is considered a high quality aquatic plant for waterfowl and fish habitat<sup>4</sup>, so harvesting is limited to areas necessary to maintain flow.



**Figure 5. Yahara River Between Lakes Waubesa and Kegonsa**

Other human-made flow restrictions exist within the Yahara River other than bridges and piers. Just downstream of Lower Mud Lake a Native American fish weir and corduroy bridge cross the river. Since the river riffles through this section, it has long been assumed that these structures are impeding flow.

### **3.2 Lakes and Watersheds**

Lake Mendota is the largest of the lakes and its watershed covers approximately 232 square miles. Land use in the watershed is primarily agriculture (nearly 80%), but every year additional land is converted to more urbanized uses. Lake Monona is approximately one third the size and its direct watershed is about one fifth the size of Lake Mendota's. Lake Monona's watershed is much more urbanized resulting in a quick response to runoff events. Lake Waubesa is about two-thirds the size of lake Monona and has about the same direct drainage area. Lake Waubesa's watershed is much less urbanized than Lake Monona's. Lake Kegonsa is similar in size to Lake Monona and has a slightly larger direct drainage area. Land use in Lake Kegonsa's

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<sup>4</sup> Yahara Lakes Advisory Group. September 2002. "Yahara Lakes Advisory Group Final Report: Executive Summary". Madison, WI.

watershed is primarily agricultural and open space. Due to its comparatively large size, Lake Mendota acts as a buffer to provide storage for the lower lakes following large runoff events and in combination with the Tenney Dam, provides the primary means of controlling lake levels throughout the system.

**Table 2. Yahara Lakes Surface Area and Volume Comparison**

Lake	Surface Area <sup>a</sup> (acre)	Direct Drainage	Total Drainage	Volume Equivalent Depth of One Inch in Lake Mendota (in)
		Area <sup>b</sup> (mi <sup>2</sup> )	Area <sup>b</sup> (mi <sup>2</sup> )	
<b>Mendota</b>	9,842	217	232	1
<b>Monona</b>	3,274	42	278	3.0
<b>Waubesa</b>	2,080	44	325	4.7
<b>Kegonsa</b>	3,209	54	385	3.1

Sources

a. WI DNR

b. UW Limnology

### 3.3 Structures

The Yahara River lake system has been artificially manipulated in one form or another for over one hundred and fifty years. Over the years, numerous human-made structures have been constructed over and within the Yahara River lakes system. Structures include locks and dams, bridges, piers, and a fish weir. Each structure contributes to the hydraulic characteristics of the system and plays a role in the management of lake levels.

#### 3.3.1 Locks and Dams

Tenney Dam controls flows out of Lake Mendota. The dam was originally constructed in 1847 to raise Lake Mendota by 4.5 feet to provide power. Locks were constructed in 1904. The locks and dams have been updated over the years, most recently by Dane County in 2018. The Babcock Lock and Dam were constructed in 1938 to assist in lake level management and improve navigation. The dam controls the water levels for Lakes Monona and Waubesa during low flows. During high flows the dam is submerged and does not aid in lake level management. LaFollette Dam was constructed in 1938 on Lake Kegonsa. The dam was constructed to improve lake level management during low flows and aid navigation. Similar to the dam at Babcock Park, the LaFollette Park Dam is submerged during high flows and does not aid in lake level management. The Stoughton Dam is the last dam in the system that effects water levels in the Yahara chain of lakes. The dam is under the control of the City of Stoughton, and its operation is regulated by separate orders issued by the WI DNR.



**Figure 6. Dam at Tenney Park, Outlet from Lake Mendota**



**Figure 7. Dam at Babcock County Park, Outlet from Lakes Monona and Waubesa**



**Figure 8. Dam at Lafollette County Park, Outlet from Lake Kegonsa**

Construction and regulation of the Yahara River dams was originally in the jurisdiction of the Railroad Commission and the Public Service Commission. They set operating orders for these dams as early as 1917. Operating orders have been reissued through the years for these dams, but they have remained largely unaltered.<sup>5</sup>

### **3.3.2 Bridges and Piers**

Several bridges cross the Yahara River throughout the system. The hydraulic effect of bridges varies and in several cases it is not completely known. Older bridges were not necessarily designed to any hydraulic standard. Newer free span bridges have little or no impact on flow. Appendix II contains a table that lists of all the bridges that cross the Yahara River beginning just upstream of Lake Mendota and moving downstream to the Stoughton Dam.

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<sup>5</sup> Yahara Lakes Advisory Group. September 2002. "Yahara Lakes Advisory Group Final Report". Madison, WI.



**Figure 9. Piers on the Yahara River Between Lakes Monona and Waubesa**

## **4 Management Goals and Operational Strategies**

While users on individual lakes have differing needs and expectations, the Yahara Lakes are managed as a watershed-based system. The first priority is to keep lake levels from approaching flood stage and thus protecting property, but pending the circumstances at any given time, water levels may be adjusted to comply with individual water level orders, provide for recreation and navigational use, flood storage, shoreline protection, and fish spawning.

Since the lock and dam structures at Babcock and Lafollette Parks are only designed to operate during low flows, the Tenney Park lock and dam is the primary operational structure in the Yahara River system. In addition, Lake Mendota is regulated to maximize in-lake storage capacity to protect downstream lakes from flooding due to its comparatively large size.

Daily logs are kept for structural adjustments, precipitation, and corresponding lake levels. The LWRD communicates all adjustments for the LaFollette Dam with the Stoughton Dam Operator. The LWRD also coordinates with the City of Monona when an increase in flow out of Lake Mendota may raise Lake Monona water levels to a point that infrastructure would be affected.

## **4.1 Normal Lake Levels**

### **4.1.1 Winter to Spring: Seasonal Transition**

During a normal season the lakes are gradually brought up to summer minimum levels beginning February 1<sup>st</sup>. Depending on climatic conditions, the transition of the lakes to summer minimum levels may begin as early as the second week of January. Considerations for an early transition include frost depth, deviation from average snowfall, current snow depth, and the flow in the Yahara River. The lake level orders require that the lakes be at summer minimum levels following the first runoff event after March 1<sup>st</sup>. Once these levels have been achieved, the goal is to maintain the levels until mid to late April.

Bringing the lake levels up is a gradual process. The first action taken is to close the lock doors at the LaFollette Dam to begin to restrict flow. Once the flow out the dam and the elevation of Lake Kegonsa stabilize, which usually takes about a week, the gates are closed in gradual small increments to achieve summer minimum levels. Any modification to the LaFollette Dam requires that the City of Stoughton, operator of the Stoughton Dam, be notified.

Once the adjustments are made at the LaFollette Dam, a similar procedure is followed at the Babcock Dam. The lock doors are closed and the gates are adjusted. Since the hydraulic gradient is so low across the Babcock Dam, even in normal years, the closing of the lock doors and the closing of the gates may be delayed due to higher existing water levels in Lake Waubesa and Lake Monona.

The transition to summer minimum levels at the Tenney Dam are achieved by making small adjustments to the openings on the tainter gates. In addition, once the ice on Lake Mendota breaks up, the small gap under the lock doors that has been maintained through the winter is closed.

Meeting summer minimum levels by early March allows the best opportunity for fish, especially northern pike and walleye, to find and use habitats necessary for spawning, according to the WI DNR.

### **4.1.2 Summer**

Beginning in mid-April, adjustments are made to the lock and dam structures to raise the lake levels within the summer range. These adjustments coincide with the beginning of the recreational boating season. The goal is to maintain the lakes within the summer range to provide flexibility in dealing with both dry and wet periods.

### **4.1.3 Fall to Winter: Seasonal Transition**

To prepare for winter ice and snow pack conditions, the lakes are gradually lowered to summer minimum levels beginning in mid-October. The dams are opened beginning November 1<sup>st</sup> to achieve winter operating levels.



#### **4.1.4 Winter:**

The winter minimum levels contained in the lake level orders are an absolute minimum, therefore, the lakes are maintained above those levels. In general, the goal is to maintain all three lakes 0.2 feet above winter minimum levels. Low lake levels in the winter can adversely affect hibernating reptiles and amphibians and damage fish habitat.

In the winter, the tainter gates at the Tenney Dam may freeze, making them difficult to operate. To compensate for this a small 3-inch gap is maintained under both lock doors to keep them from freezing. This small gap allows for emergency operation, reduces ice damage on the lock doors, and allows for better management of flow and water levels.

During the winter months, the flow and lake levels are primarily controlled by the Tenney Dam, as the other lock and dams are usually completely open. A minimum opening on each gate of 0.3 feet is also maintained throughout the winter.

#### **4.2 High Lake Levels**

Lake levels are considered to be high when levels exceed or are expected to exceed the target levels specified in the WI DNR Orders. The management goal is to lower all lakes to below the regulatory maximum. Various operational strategies are implemented depending on lake levels throughout the system.

During periods of high lake levels the lock doors and dams at Babcock and LaFollette are fully opened to allow for maximum flow in the river and discharge from the system. The Tenney Dam is operated to minimize direct flooding impacts on Lake Monona with public infrastructure being the main concern. Flow out of Lake Mendota is reduced to give Lakes Monona and Waubesa an opportunity to drop in water elevation and gain additional capacity for any additional runoff events. Throughout periods of high water levels, the county is in constant communication with WI DNR engineers to develop a unified strategy for managing the Yahara Lakes system.

The operators of the Stoughton Dam are contacted to request that their dam be opened to maximize flow. The operators of the Stoughton Dam are not obligated to act upon the Director's request to increase flow and lower the storage pool, although the WI DNR does have the authority to issue emergency orders during high water level conditions to the dam operators.

The goal during high lake levels is to maintain Lake Mendota at an elevation not to exceed 852.8 ft. to prevent Tenney Dam from overtopping. If it appears that Tenney Dam may breach, the gates will be opened to protect the structure, in accordance with the Emergency Action Plan (EAP). If this happens, Lake Monona will experience rising water levels that may result in significant property damage, but catastrophic failure of the lock and dam will be avoided.

When a large storm or runoff event is predicted the county establishes direct communication with the National Weather Service's Sullivan office to obtain the most up to date forecast. In addition the weather service provides the probability that the event will occur. Based on the forecast, operational changes may be made prior to a storm's arrival.

In the event a large storm has occurred or high probability of an event is imminent, the flow may be increased out of Lake Mendota to provide for greater flood storage in Mendota. The strategy is to discharge runoff out of Lake Monona before Lake Mendota crests. Since Lake Mendota's watershed is large, it usually takes more than two days for the lake to crest, whereas Lake Monona usually crests within 24-hours following a storm event. Once Lake Mendota does crest, the flow out of the lake is reduced to protect Lake Monona.

Normally the water levels on Lakes Monona and Waubesa are within 0.2 feet of each other, but during high flow events, flow restrictions on the Yahara River keep Lake Monona as much as 0.8 feet higher than Lake Waubesa. Once the flows have subsided, the difference in elevation between the lakes returns to normal.

The County Executive, in consultation with the LWRD and Emergency Management Department staff, may activate the Emergency Operations Center to assist with the county's response to the storm event. Each lock and dam structure has an Emergency Action Plan (EAP) that outlines the necessary actions to be taken at each risk determination level.

#### **4.2.1 Slow-no-wake**

On the Yahara Lakes, Dane County has in effect a slow-no-wake ordinance, which goes beyond the minimum state boating requirements.

The ordinance establishes a 200-ft slow-no-wake zone along the entire shorelines of Lakes Mendota, Monona, Waubesa, and Kegonsa. Within that zone, boaters must not travel faster than slow-no-wake speed, which means the minimum speed at which a motorized watercraft is able to move and maintain adequate steering control.

An exception is made to accommodate water skiing on Lake Monona from Law Park to a point 1000 feet due north of the intersection of John Nolen Drive and Lakeside Street. Buoys and ski jump ramps mark this area and the adjacent shoreline is armored with large stone rip rap.

In addition, the entire surface of Lake Monona is a slow-no-wake zone from sunset to midnight on the date when the Rhythm and Booms fireworks display is held along John Nolan Drive in the City of Madison.

The slow-no-wake requirements were created to minimize conflict between various user groups, avoid accidents or lessen their severity, protect human life, provide safe swimming zones, assure and encourage multiple use of surface waters, reduce shoreline erosion, protect fish spawning areas, and protect wetlands and other sensitive areas.

Emergency orders are slow-no-wake restrictions that are in addition to normal 200-ft slow-no-wake restrictions. They are declared when there is high water or other hazardous circumstances posing a threat to life or property.

Dane County Chapter 72, "Regulating Boating on Yahara Lakes" establishes the authority for Slow No Wake Declarations on the Yahara Lakes.

Ch 72.08 (3)(a) states, “During periods of high water or other hazardous circumstances posing a threat to life or property, the County Executive, with the approval of the Sheriff and County Board Chair, may declare all or any portion of the surface area of Lakes Mendota, Monona, Waubesa and Kegonsa as a slow-no-wake zone.”

Land and Water Resources Department and Sheriff Department staff make a recommendation to the County Executive, Sheriff and County Board Chair for slow-no-wake consideration. Factors considered by LWRD staff include but not limited to are:

- Forecast for rising water levels
- Existing water levels in the Yahara Lakes
- Season and vegetative growth in Yahara River Basin
- Presence or potential for navigational hazards as a result of high water

Water levels where LWRD staff will make a recommendation to declare or rescind a slow-no-wake are shown in Table 3. A recommendation to declare a designation would only occur if the water levels are increasing and the elevation in Table 3 has been surpassed. Recommendations to remove a designation would occur if the water levels have fallen below the levels shown in Table 3 for at least five consecutive days.

**Table 3. Land and Water Resources Department Elevations to Declare or Rescind Slow-No-Wake**

<b>Lake</b>	<b>Declare Elevation</b>	<b>Rescind Elevation</b>
Mendota	851.8	851.2
Monona	847.2	846.6
Waubesa	846.8	846.2
Kegonsa	844.5	844.2

Other considerations such as protection to property, recreational impacts, and safety are also taken into account before a designation is made. Below is a table of water level ranges where slow-no-wake declarations have been declared and rescinded. While these ranges are not intended to be ‘absolutes’ they are intended to be a reference for staff when making a recommendation of consideration.

**Table 4. Historical Elevation Range for Slow-No-Wake Declaration**

<b>Lake</b>	<b>Slow-No-Wake Declared</b>	<b>Slow-No-Wake Rescinded</b>
Mendota	851.45 – 852.73	850.42 – 851.12
Monona	846.10 – 847.44	845.05 – 847.09
Waubesa	846.02 – 846.90	845.14 – 846.42
Kegonsa	844.07 – 845.01	843.43 – 844.22

Emergency orders can increase the slow-no-wake zone from the normal 200 feet to 500 feet from a shoreline, or even mandate that an entire lake be slow-no-wake. There is little evidence that increasing the slow-no-wake zone from 200 feet to 500 feet provides any additional protection to the shoreline.

## 4.2.2 Critical Flood Levels

The EAP's for the county-owned lock and dam structures contain critical flood elevations where actions must be taken. For security reasons, these elevations are not public information. Other recognized critical flood elevations are for the City of Monona and City of Madison isthmus area. Dane County is aware of some critical elevations that impact private property/homes and public infrastructure. These critical elevations have changed in recent years due to actions from homeowners to flood proof and municipalities to raise roads and other infrastructure.

## 4.3 Low Lake Levels

During periods of low lake levels the primary goal is to maintain a 4.9 ft. differential between Lakes Mendota and Monona and the minimum WI DNR ordered flow (10 cfs) in the Yahara River below the Babcock Dam. Since discrepancies are often seen in the flow gages during low flow, both the Babcock and Exchange Street flow gages are monitored. Flow in the river is primarily controlled through operation of the Tenney Dam.

The WI DNR water level orders require the dams on the Yahara River to release the following low flows:

1. Lake Mendota – April 1 through May 15 – one tainter gate open at 0.3 feet; Remainder of the year – at least 4 cfs
2. Lake Waubesa – April 1 through May 15 – at least 50 cfs; Remainder of the year – at least 10 cfs
3. Lake Kegonsa – Minimum flow amount is not stated but requires operation coordination of the Lake Mendota, Lake Waubesa, Lake Kegonsa and Stoughton Dams by Dane County Parks Commission. Practically that means between 10 to 15 cfs.
4. Stoughton – Minimum of 15 cfs

During drought conditions lake levels may drop below their ordered minimum levels due to the requirement to pass flow. As much water as possible is stored within the lakes to maintain navigability, but sustaining levels may be difficult due to the large amount of water lost to evaporation during dry periods. In addition, when rainfall does occur after a dry period, the amount of runoff delivered to the lake will be reduced due to dry antecedent soil conditions. During the winter months, navigation is not a priority for managing low lake levels.

The West Campus Cogeneration Facility, owned jointly by MG&E and the University of Wisconsin, draws make-up water from Lake Mendota. To compensate for this water supply withdrawal, flow in the Yahara River may be supplemented by water well pumping during times of low flow, which originally was expected to occur approximately 3 to 4 months every 3 to 4 years. This well is located at the Madison Metropolitan Sewerage District treatment plant and would discharge water into Lake Waubesa.

In the event the minimum flow of 10 cfs cannot be maintained below the Babcock Dam through dam operation, the WI DNR will be contacted to discuss turning on the emergency pump. The decision to operate the pump to maintain river flow lies with the WI DNR. To date, the pump has never been needed.

#### **4.4 Aquatic Plant Harvesting**

Dane County is required to follow WI DNR Aquatic Plant Harvesting Permits for each water body. In general terms, the permits allow the county to remove just enough vegetation to provide adequate navigational channels to open water. Aquatic plant harvesting priorities are also influenced by the amount of flow in the river and lake levels.

Targeted, aggressive aquatic plant harvesting during high lake levels has a significant positive impact on water flow and maintaining lake levels. Aquatic plant harvesting in Squaw Bay and the channel to Lake Waubesa is important while aquatic plant harvesting between Lake Waubesa and Lake Kegonsa is critical. Harvesting aquatic plants is the main tool to maintain high flows and lower lake levels.

Aquatic plant growth is monitored for the entire length of the system and aquatic plant harvesting plans are determined based on field observation, streamflow data, and ability to get harvesters into different reaches. The most critical stretch is immediately below Babcock Dam and through Lower Mud Lake.

The United States Geological Survey (USGS) makes streamflow measurements of the Yahara River and determines the impact of aquatic plants on the stage discharge relationship. These measurements not only determine the flow of water volume in cubic feet per second (cfs), but also the impact of aquatic plant growth on the flow of the river. The county uses these measurements, as well as the Exchange Street gage, to measure the success of the aquatic plant harvesting effort.

During high water conditions, the first priority for harvesting is assigned to the Yahara River between Lakes Waubesa and Kegonsa. The county utilizes an aquatic plant scout who monitors plant growth and flow restrictions on a weekly basis. Based on the scout's report, harvesters are deployed where aquatic plant growth is restricting flow. Harvesting is confined to the deepest part of the river channel in order to maximize water flow downstream.

## **5 Communication**

### **5.1 System Operators**

Adjustments to the Tenney Lock and Dam are made by the Lock Tenders, Park Rangers, and the Lakes Management Crew, at the request of the LWRD Director.

### **5.2 Notification Protocol**

The LWRD is in regular communication with the WI DNR regarding water level management. LWRD also communicates all adjustments for the LaFollette Dam with the Stoughton Dam Operator. The LWRD also coordinates with the Cities of Monona and Madison when an increase in flow out of Lake Mendota may raise Lake Monona water levels to a point that infrastructure would be affected.

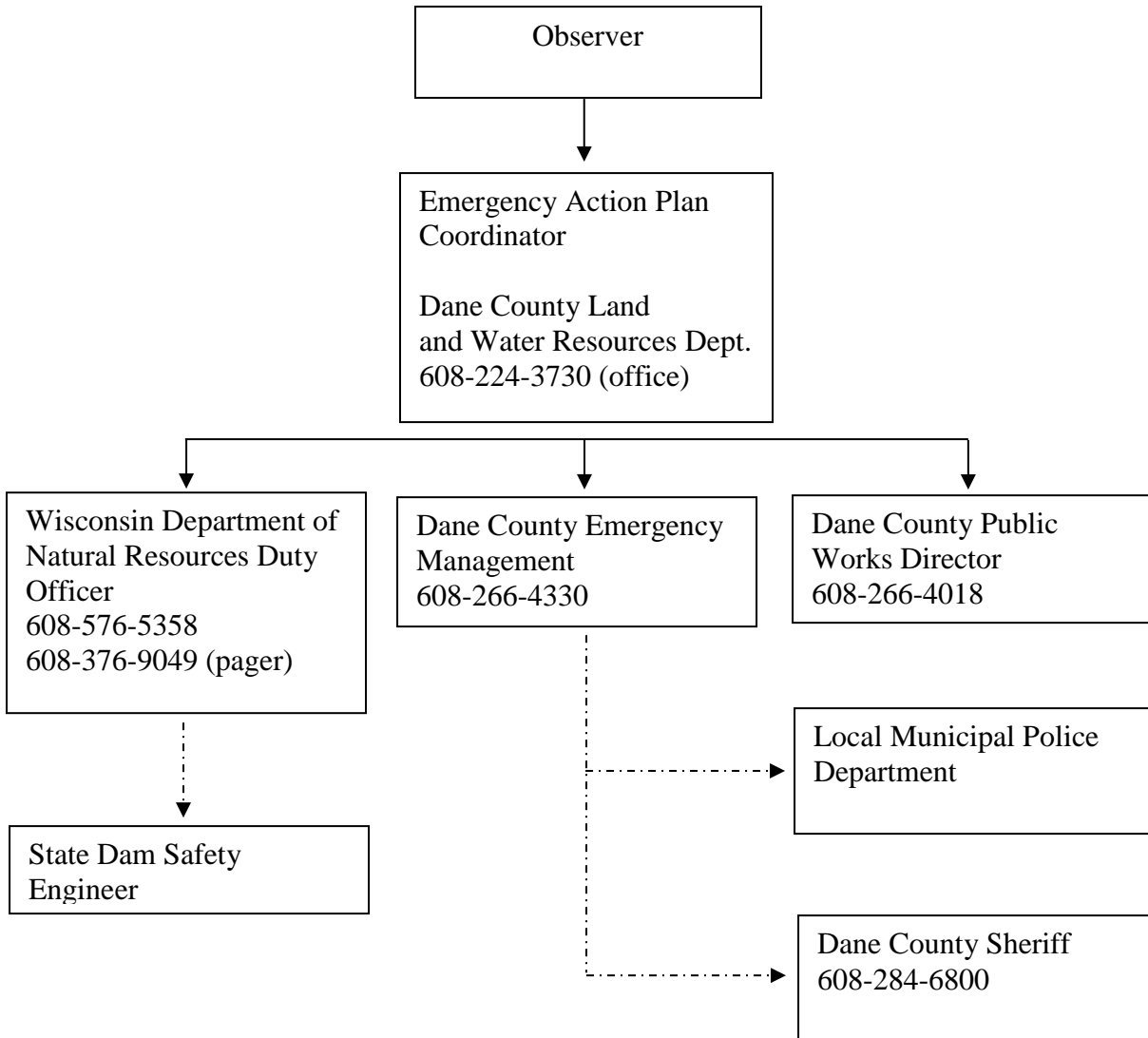
Communication is very important when flow in the river and the lake levels are high. The city engineers in the Cities of Madison and Monona are constantly kept abreast of the current water

levels and operational plan. This allows the cities to make preparations for anticipated higher than normal lake levels. In addition, the LWRD sends a weekly email to community officials and technical staff in municipalities along the Yahara River system to notify them of the current and planned operational strategy.

The following figures specify the notification protocol at increasing levels of emergency.

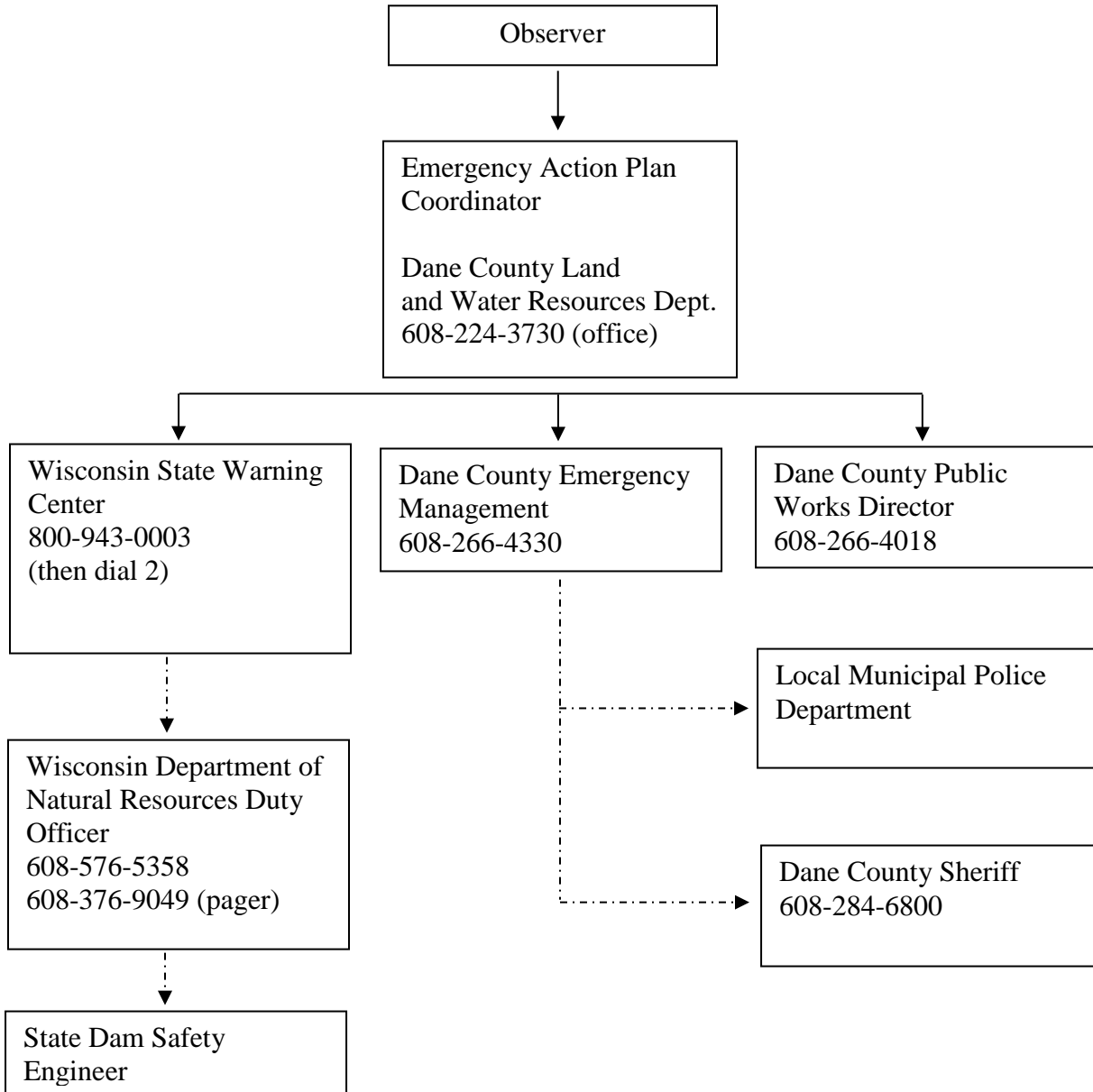
# Emergency Level 1 Notifications

Non-emergency  
Unusual event, slowly developing, high water



# Emergency Level 2 Notifications

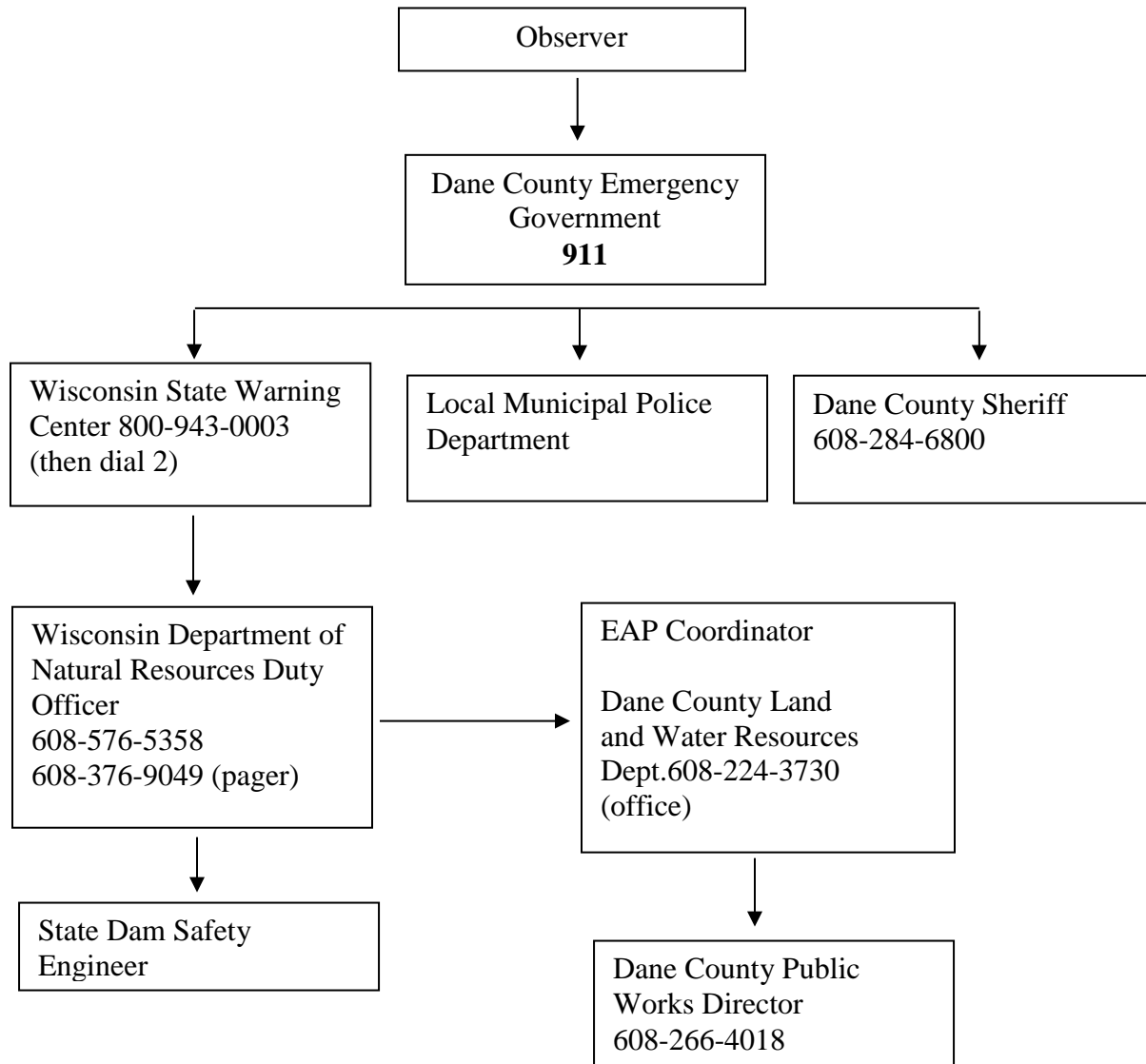
Emergency Event  
Potential dam failure; rapidly developing





# Emergency Level 3 Notifications

Emergency and Urgent Event  
Dam failure is imminent or in progress



### **5.3 Public Outreach and Notification**

LWRD's primary mechanism for public communication is its lake level management web page: <https://lwrд.сountyofdane.com/Lake-Levels>

At that webpage are general statistics about the Yahara lakes, links to WI DNR's lake level orders, the ability to search and graph historic lake level data (going back to 1916), lake management updates (a brief description of lock and dam status and other management practices in place, such as aquatic plant harvesting), and information about any emergency slow-no-wake designations.

In addition, LWRD frequently educates the public about the practices and challenges of lake level management through press releases and media coverage, public presentations at various county committee meetings, conferences, and through meetings with organizations and area residents.

### **5.4 Record Keeping**

LWRD keeps daily logs of structural adjustments, precipitation, and corresponding lake levels. LWRD also retains files of dam and lock inspections and improvements and records of aquatic plant harvesting.

## **6 Improving Lake Level Management**

The Land and Water Resources Department strives to manage the Yahara River Lakes in accordance with the WI DNR Lake Level Orders while balancing the needs of all lake users. While it is not always possible to maintain lake levels within the regulatory orders, the best management may be achieved when the system is well understood and the best operation strategies can be implemented at the best time. In an effort to make the best decisions at the best time the Land and Water Resources Department is continually identifying ways to address needs for improved knowledge base, control structures and management tools.

Many of the lake level management decisions are made based on precipitation driven runoff events. Without better tools for predicting the spatial and temporal distribution of forecasted rain events it is difficult to take any preemptive action to manage lakes during high water levels. With a better understanding of the watershed and its response to rainfall, better management decisions may be possible.

### Appendices

- I. Lake Level Orders
- II. Bridges Spanning the Yahara River Lakes System