Requirements for the
National Wetland Inventory Update of Minnesota

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Input on this document was provided through a web-based survey of users of wetland maps. In addition, thirteen of these map users were contacted for follow-up phone interviews (see appendix). Comments were also provided by the technical advisory committee for the Minnesota National Wetland Inventory Update. If you have questions regarding this document, please direct them to the DNR Wetland Monitoring Coordinator, Steve Kloiber at (651) 259-5164 or steve.kloiber@dnr.state.mn.us.

Acronyms Used

BWSR – Board of Water and Soil Resources

CRP – Conservation Reserve Program

DNR – Department of Natural Resources

FGDC – Federal Geographic Data Commission

HGM – **H**ydro**g**eo**m**orphic

LGU – Local government unit

LLWW – **L**andscape position, **l**andform, **w**ater flow path, and **w**aterbody type

MEPA – Minnesota Environmental Policy Act

NWI – National Wetland Inventory

RIM – Reinvest in Minnesota

RMSE – root mean square error

TMDL – Total Maximum Daily Load

TMU – Target mapping unit

WCA – Wetland Conservation Act

1. Problem Statement

Wetland inventories are an essential tool for effective wetland management, protection, and restoration. Such inventories provide baseline information for assessing the effectiveness of wetland policies and management actions. These data are used at all levels of government, as well as by private industry and non-profit organizations for wetland regulation and management, land use and conservation planning, environmental impact assessment, and natural resource inventories. The National Wetland Inventory (NWI) is the only spatially comprehensive wetland inventory for Minnesota.

Yet, there are a couple of issues with the original NWI data for Minnesota. First and foremost, the data are about 20 to 30 years out of date. Many changes in wetland extent and type have occurred since the original delineation. Changes in the extent of agricultural and urban development have resulted in loss of wetlands leading to inaccuracies in wetland inventory maps (**Figure 1.1**). On the other hand, changes in wetland policies and programs may have resulted in the creation of new wetlands. Without an up-to-date wetland inventory, it is difficult to address our wetland planning and management needs.

Second, various limitations in the original technology, methodology and source data resulted in an under representation of very small wetlands and forested wetlands. There are always constraints on the ability to map wetlands with complete accuracy; however, the portion of the state that was mapped with older 1:80,000 scale black and white imagery is a particular problem (**Figure 1.2**). Wetland maps in this area tend to be very conservative, missing many forested and drier-end emergent wetlands (LMIC 2007).

A comparison of the NWI data and the wetland data for 1802 random plots that were remapped in 2006 shows that for some wetland categories, such as deepwater habitat, there is general agreement between the older and newer data (**Figure 1.3a**) However, for other wetland types, such as forested and emergent, there are considerably more differences between the older and newer data (**Figure 1.3b and 1.3c**). These differences are a result of the combination of land use changes and methodology differences.

2. Regulatory and Programmatic Drivers

Environmental protection laws and conservation programs drive much of the need for wetland inventory maps. Two of the most significant laws are Minnesota Wetland Conservation Act and the Minnesota Environmental Protection Act.

2.1. Minnesota Wetland Conservation Act

To retain the benefits of wetlands and reach the goal of no-net-loss of wetlands, the Wetland Conservation Act (WCA) (MS 103G.222) requires anyone proposing to drain, fill, or excavate a wetland first to try to avoid disturbing the wetland; second, to try to minimize any impact on the wetland; and, finally, to replace any lost wetland acres, functions, and values. WCA is administered by a network of local and state agencies and organizations. State agencies include the Board of Soil and Water Resources and the Department of Natural Resources. Local agencies involved vary throughout the state, but may include cities, townships, soil and water conservation districts, watershed districts, watershed management organizations, and counties.

While WCA requires on-the-ground wetland delineations for boundary or type change applications, very often wetland inventory maps, like the NWI, are used in the initial phase of a project to screen for potential wetland impacts. A developer or consultant may use wetland inventory maps for assessing the feasibility of various development scenarios and for estimating the potential mitigation costs. State and local administrators use wetland inventory maps as a check against on-the-ground wetland delineations to identify areas that may have been missed.

2.2. Minnesota Environmental Policy Act

Minnesota's Environmental Policy Act (MEPA) (MS 116D.02 & MS 116D.04) established a formal process for investigating the environmental impacts of major development projects. The purpose of the review is to provide information about a project's environmental impacts before approvals or necessary permits are issued. The process operates according to rules adopted by the Environmental Quality Board, but is actually carried out by local government, state agencies, and joint powers organizations. Among the various impacts that must be assessed for major projects are the impacts to wetlands and other protected waters. In this case, on-the-ground wetland delineations are not usually required and wetland inventory maps, like NWI, are the only source of available information on wetland location and type. As with WCA, a developer or their consultant may use wetland inventory maps for assessing the feasibility of various development scenarios and estimating the potential mitigation costs. State and local administrators may use wetland inventory maps as a check on the Environmental Assessment Worksheet or Environmental Impact Statement prepared by the project owner or their consultant.

2.3. Other Drivers

Programs that regulate wetland impacts such as WCA and MEPA are only one component driving the need for wetland inventory maps. Conservation programs such as Reinvest in Minnesota (RIM), the Conservation Reserve Program (CRP), the Conservation Reserve Enhancement Program, and other programs seek, in part, to restore and protect wetlands through long-term or permanent easements or acquisition. These programs involve federal, state, and local agencies as well as non-profit organizations. Planning and prioritization for these programs often benefit from wetland inventory maps. Other organizations may also use wetland maps as a tool for guiding land management and wildlife management decisions.

Wetland inventory maps are also used to support a variety of state and local planning efforts. Counties and cities often need wetland inventory maps when developing local land use plans to help guide development away from sensitive areas. State agencies, counties, watershed districts, and watershed management organizations require wetland inventory maps when developing watershed management plans. These organizations need these maps when addressing needs for flood protection, water quality management, and restoration activities. Another related driver for wetlands mapping is the water quality management requirements of the Total Maximum Daily Load (TMDL) requirements of the Clean Water Act.

2.4. Estimate of Wetland Inventory Use

Nationally, there were over 50 million on-line user requests for NWI data for 2008. However, there is little direct data for just Minnesota on the number of people using wetland inventory maps, how frequently these maps are needed, and how much time they saved. Instead we rely here on surrogate data and surveys to assess the need for wetland inventory maps.

According to BWSR (2005), there is an average of about 17,800 landowner contacts each year to the WCA designated local government units regarding wetland issues. Many, if not most, of these contacts will involve a preliminary review of available wetland inventory maps. Add to this another approximately 200 environmental reviews for MEPA that also rely on wetland maps to assess potential environmental impacts (pers. comm. EQB staff). Also add to this an unknown number of uses for non-regulatory wetland conservation efforts and local planning.

The number of people requiring wetland inventory maps for Minnesota is not known, but users likely include the more than 350 local government units (LGUs) – cities, counties, watershed management organizations, soil and water conservation districts, and townships – that implement the WCA locally (BWSR 2005). It likely also includes most wetland professionals in Minnesota. The Minnesota Wetland Professional Association serves close to 200 members. Add to this wetland staff from various federal and state agencies, private consulting companies, academic institutions, and non-profit organizations. While there may be some overlap between these groups, it seems safe to say that there are probably close to 1000 people in Minnesota who would be routine users of an updated National Wetland Inventory.

3. No Action Risk

The biggest problem with the existing NWI is that it is out-of-date and no longer represents an accurate depiction of wetlands. The NWI figures heavily in wetland regulatory activity and environmental impact assessment. The "no action" risk associated with not updating the NWI is significant.

The biggest problem is with wetlands that are not depicted on the wetland inventory. Unmapped wetlands are not detected until later in the development process, when changing the project proposal becomes more costly. Or they are not detected at all, which potentially leads to unmitigated wetland loss. It is also a problem when wetland maps show wetlands that no longer exist. In this instance, effort is wasted and costs increase by assessing wetland impacts for a wetland that no longer exists.

4. User Requirements

User requirements were assessed using two approaches; a web-based survey and phone interviews. The results of the survey and interviews are summarized here. Full details are provided in Appendix A of this document.

4.1. User Survey

A web-based survey was conducted in December 2008. Broadcast e-mails announcing the survey were sent to all wetland professional contacts provided by the technical

advisory committee members for the NWI update. In addition, the survey announcement was sent out to the e-mail distribution list for the Wetland Professional Association and the e-mail distribution list for the Board of Water and Soil Resources.

4.1.1. Characterization of Users

There were 100 respondents to the survey. The bare majority of these respondents (52%) were employed with a state government agency. A substantial number were employed in the private sector (25%) or local government (15%). The rest were employed with the federal government, tribal government, research or educational institutions, and non-profit organizations. Professional roles for the respondents varied widely, with 53% describing themselves as wetland scientists and 46% describing themselves as wetland regulators or permit reviewers. Users were allowed to select more than one role. Other roles were generally cited at rates between 14% and 23%. Many of these respondents described themselves as intensive users of wetland maps with 64% of respondents using wetland maps weekly or daily.

4.1.2. Assessment of Existing NWI Data

A clear majority of respondents (77%) state that the existing NWI data do not meet their needs. However, 51% of respondents have used NWI data to derive some type of map or report product. By far, the most common reason cited for dissatisfaction with NWI is that wetlands are missing and that the data are out-of-date (90%). Another important issue for respondents was that the scale of the existing NWI is considered to coarse (66%) and it misses too many small wetlands.

4.1.3. User Stated Needs

The most commonly desired uses for wetland maps are to support wetland regulation activities (91%), environmental impact analysis (66%), and land use or land development planning (64%). Other closely related uses including flood management and transportation planning were cited around 40% of the time. The next tier of uses, at around 30%, includes wildlife management and recreational uses.

The most common response for how frequently wetland maps should be updated was every 5 years (53%). Combining this with those respondents who cited less frequent updates, it appears that an update frequency of every 5 years would satisfy 94% of users, while an update frequency of every 10 years would only satisfy 41% of users (**Figure 2.1**).

Looking at the issues of scale and resolution, the most frequent response for the smallest size wetland that users believe needed to be mapped was 1/10 of an acre (46%). This was the smallest option presented in the question, so the true mode may not have been bracketed. However, a plurality of respondents (56%) would be satisfied with mapping wetlands down to ¼ of an acre (**Figure 2.2**). Most respondents thought that the base imagery for wetland mapping should be either 1-foot resolution (37%) or 2-foot resolution (36%). Using 2-foot resolution base imagery would meet the requirements of 63% of users.

The preferred format of the deliverable is digital data for use on desktop application (94%) or online maps (39%) and most respondents would like to see a combination of vector and raster data (66%).

An open-ended question was included in the web survey to allow users to provide specific suggestions for improving the NWI that were not captured in the other survey questions. Full responses for this question can be found in the appendix. Several of the responses to this question reinforce the conclusion that improving the update frequency and increasing the mapping resolution are important issues for users. Another common response theme was to improve the NWI by adding additional attribute information. Suggestions for additional attribute information include Ralph Tiner's LLWW system (Tiner 2003), Stewart and Kantrud's classification system (Stewart and Kantrud 1971), Eggers and Reed's classification system (Eggers and Reed 1987), a hydrogeomorphic (HGM) classification system, functional assessments for larger wetlands, a designation for restored or constructed wetlands, and the unique identifier from the DNR's Public Water Inventory (PWI). A few respondents also voiced a desire for having the updated NWI field checked. Others mentioned the need to develop a system for maintaining the data.

4.2. User Interviews

User interviews were conducted by phone with a selection of respondents from the web survey. Those contacted for interviews are listed in the appendix.

4.2.1. Wetland Inventory Uses

User interviews confirm that administration of the Wetland Conservation Act rules and other related regulatory programs is a major driver for the need for wetland inventory maps. The NWI is frequently used as a starting point for the wetland delineations required under WCA or for screening for potential wetland impacts under MEPA. Consultants often rely on NWI as one factor to consider when estimating costs for a delineation project. The WCA rules specifically require including a figure showing the NWI maps for a wetland delineation project. LGU administrators and state agency staff involved with overseeing wetland programs frequently rely on NWI to evaluate reports from wetland delineators. While a few LGUs have developed their own updated wetland inventory maps, for most, the NWI is the only wetland inventory map available.

Another commonly cited use for the NWI was as a key input for locally developed wetland inventories by cities, counties, or watershed districts or watershed management organizations. These local inventories often use NWI as a starting point to develop a more up-to-date inventory and to expand upon the wetland information by incorporating data on wetland functions and values. There was some difference of opinion among government agencies with their own local wetland inventory about whether an updated statewide NWI would be of use to them. Some felt that it would be unnecessary; others said they would still welcome having an updated statewide NWI.

Other uses cited for the NWI included as a tool for identifying wetland monitoring locations, as an input into hydrologic and hydrogeologic models (e.g. water table maps), as an important historical reference for wetland loss, or for identifying potential wetland restoration opportunities. NWI may also be useful for local authorities when reviewing

plans for locating new septic systems (preventing installation of malfunctioning septic systems) or new structures (avoiding chronic wet basement problems).

4.2.2. Problems and Impacts

The problems cited by interviewees were largely the same as those indicated on the web-based survey; however, the emphasis placed on these problems shifted somewhat. In the web survey, the most commonly cited problem was that the maps were out of date. During the interviews, most respondents emphasized the issue of missing wetlands. Through further discussion, it became obvious that these problems are linked. The bottom line for most users is that they need to have an accurate representation of wetland occurrence on the landscape. Inaccuracies in the mapped representation of wetland can come about because of shortcomings in the mapping methods (such as the under mapping of forested wetlands, farmed wetlands, or small wetlands) or they can come about because land use management activities have resulted in gains or losses in wetlands.

Another aspect of this issue that became more apparent through the interviews is that the influence of the different types of inaccuracies varies spatially across the state. For example, forested wetlands were under mapped due to the difficulty of identifying these wetlands from aerial photography, but in particular for an area of northeastern Minnesota that was mapped with smaller scale black and white imagery. Farmed wetlands, went largely unmapped in the initial NWI, leading to an under representation of this class which most prominently affects the southwestern one-third of the state. And wetland gains and losses due to development are more prevalent near the major growth centers of the state, while relatively little wetland change is likely in the state and federal public lands of northern Minnesota.

The end result of these inaccuracies, regardless of the cause, is the same: increased time and costs spent by all parties. One of the most obvious examples of this impact is the situation where a consultant has relied on the NWI to provide a cost proposal to a client. If the NWI drastically under represents wetlands for the area, the consultant will need to spend additional unplanned time in the field delineation effort. Administrators at the state and local level also expend additional time verifying wetland presence. While most professionals seem to be aware of these shortcomings and have tried to account for them in the practice, problems still occur. In the worst-case scenario, wetlands not mapped by the NWI are at greater risk for falling through regulatory cracks and being lost without replacement.

Another problem cited in the follow-up interviews was positional errors for the wetland boundaries. Most of those interviewed did not think that positional errors were a major issue, but a few people described instances where there appears to be a geographic shift in the NWI data when compared to some of the available modern digital aerial ortho-photography.

4.2.3. Desired Improvements

The most commonly requested improvement was to increase the accuracy so that all wetlands that exist on the landscape (or as many as possible) are represented on the updated NWI maps. Other requested improvements were to include other wetland classification systems (such as Eggers and Reed 1987), ensure that wetland boundaries

align with the aerial photos, incorporate addition attributes (such as HGM or LLWW), and to include a unique wetland basin identifier (similar to the PWI number).

5. Review of Federal Geographic Wetland Standard

The Federal Geographic Data Committee (FGDC) has distributed a final draft wetland mapping standard in September 2008 (FGDC 2008). This standard, as applied to Minnesota, is briefly summarized here.

The FGDC wetland mapping standard specifies a requirement that source imagery and base imagery for wetland mapping should have a resolution of 1 meter or better (equivalent to a 1:12,000 scale map). It defines source imagery as the imagery used for interpreting wetlands and base imagery as a spatially consistent set of orthorectified imagery used for wetland overlays. Source imagery should be color-infrared, according to this standard. It also recommends, but does not require that source imagery should be stereoscopic, and/or acquired during leaf-off conditions. Base imagery should have a horizontal accuracy that ensures a root mean square error (RMSE) of 5 meters or less.

Wetlands classification should follow the standard given in Wetlands and Deepwater Habitats of the United States (http://www.fws.gov/stand/standards/cl_wetl.html) (see also Cowardin et al. 1979). The minimum standard for the completeness of the wetland classification is: ecological system, subsystem (except Palustrine systems), class, subclass (for forested, scrub-shrub, and emergent classes), water regime, and special modifiers (where applicable). The minimum standard for deepwater habitat classification is: system, subsystem, class, and water regime.

The target mapping unit (TMU) is the smallest wetland consistently mapped and should be 0.5 acres or smaller. The feature level classification accuracy should correctly identify at least 98% of the wetlands at or above the TMU that appear on the imagery, referred to as the producer's accuracy. The attribute accuracy should be 85% or higher. The horizontal accuracy of the wetland delineation shall be consistent with the horizontal accuracy of the base imagery (RMSE $\leq$ 5 meters).

> Ninety-eight percent of all wetlands visible on an image, at the size of the TMU or larger shall be mapped regardless of the origin – FGDC Draft Wetlands Mapping Standard – September 2008

To meet the requirements of the FGDC standard, the data must be verified and quality checked by the U.S. Fish and Wildlife Service (USFWS). These checks include topological checks to ensure the internal consistency of the data structure (e.g. polygons are closed, no duplicate features, no overlaps, etc.), checks to ensure the data is properly edge-matched to ensure consistent data across tile boundaries, and checks on attributes to ensure that all assigned attributes are consistent with the standard and are valid.

For further details, refer to the full FGDC wetland mapping standard (FGDC 2008).

6. Uncertainties and Assumptions

One area of uncertainty regarding this project is how well the user needs are understood. Reading the aggregated results of the user needs survey; it would appear that users have

high expectations. Users want very-high resolution base imagery, they want very small wetlands mapped, and they want the inventory updated at least every five years. Combine this with the goal of a producer's accuracy of 98% from the federal wetland mapping standard and the bar is set very high indeed. Meeting all these requirements would have a potentially significant impact on the project cost. However, there is some uncertainty whether these statements represent the true business need for a wetland inventory, represent a conflation of multiple business needs, or represent a desire to have the best available data regardless of the actual need and cost.

The assumption is that these statements reflect the conflation of at least two separate data needs for wetland mapping information. The first need is for a regulatory screening tool to identify potential wetland impacts during the planning phase of a project. This tool should be up-to-date and spatially comprehensive. In addition, to serving as a regulatory screening tool, an updated wetland inventory also serves several other purposes. The second need is for highly accurate wetland boundary information and detailed assessment of wetland functions and values to be used for regulatory permit requirements. This second level of information does not need to be spatially comprehensive, but only created on a case-by-case basis for specific sites proposed for development. This level of detail is not usually needed in areas of the state that are not under consideration for development.

Another area of uncertainty is the fundamental uncertainty about the boundary delineation of wetlands. The distinction between wetland and upland is based upon a detailed assessment of soils, plants, and hydrology. This assessment relies on the preponderance of evidence from multiple factors and professional judgment. In addition, these factors are not static in time. Often there is a degree of interpretation required to assess what the wetland boundary would be under typical, long-term climate conditions when observations can only be made over a very short time window with a limited set of climate conditions.

In addressing boundary uncertainty, the assumption is that locating precise wetland boundaries for all wetlands across the entire state is neither technically feasible nor is it entirely necessary. In fact, the language of the WCA states that wetland boundary delineation performed for the WCA be done using "field" data. And while a sample of wetlands from a statewide wetland inventory can be field verified, it would be cost-prohibitive and unnecessary to field verify all wetland boundaries.

7. Desired Outcome

Based on the information gathered through this assessment, the desired outcome would be to have an NWI that is as current as possible with a reasonably high accuracy for indicating where wetlands of all sizes and types occur. Most respondents to the survey indicated that the wetland inventory should be updated every five years. In follow-up discussions, the reason cited for this update frequency was the belief that land use and hydrology changes over long periods would render the map inaccurate. However, these changes do not necessarily occur in a spatially uniform manner. Some areas of the state experience more rapidly changing conditions than others. The underlying need is that the wetland inventory maps need to be an accurate depiction of the current state of wetlands. However, there does not appear to be a strong consensus on the priority for highly precise wetland boundaries for a statewide wetland inventory.

It would be desirable to have the updated wetland inventory for Minnesota meet the federal requirements for mapping wetland so the data could be included in the National Wetland Inventory Database. Specific minimum requirements include:

- 98% of wetlands larger than ½-acre that are visible on source imagery should be mapped
- Wetlands as small as 1/10th of an acre should be mapped, whenever possible
- Wetland classification accuracy should also be verified against a sample of field-checked sites and the results of this accuracy assessment should be published as part of the metadata
- A system should be developed to keep the data up-to-date
- Wetlands should be classified according to the Cowardin (1979) classification system
- The data should be provided digitally in vector format to the public in both downloadable datasets and online maps
- Wetland boundaries should be properly aligned with a concurrent, high-resolution imagery dataset and the imagery should be made publicly available along with the wetland inventory maps

Additionally, incorporating the following value-added options should be considered if they do not add significantly to the cost of the project.

- A wetland probability model in raster (grid) format
- Additional attributes describing the hydrogeomorphic setting such as landscape position, landform, water flow path, and waterbody type
- Provide a classification crosswalk to alternative wetland classification systems including Eggers and Reed (1987)
- A unique identification system for wetland basins, building upon the public waters inventory system

8. Benefits

One of the key benefits of having up-to-date wetland inventory maps is the time saved by regulatory review or planning programs. Up-to-date wetland inventory maps provide a readily available tool for screening for potential wetland impacts and for efficiently directing any field review efforts that are required. Using a conservative estimate of an average of 1 hour saved for each regulatory review (WCA or MEPA), the total time saved per year would be about 18,000 hours. Using a professional hourly rate of $50/hr, this translates into $900,000 saved each year just for regulatory reviews.

Another key benefit includes the avoidance of wetland impacts. Wetland inventory maps are used to help avoid wetland losses through a variety of regulations and programs. For example, BWSR (2005) indicates that 30% of initial WCA inquiries are resolved without a wetland impact and that on average about 3,400 acres of wetland impacts are avoided each year. The cost of replacing wetlands varies widely, but even under the most

conservative estimate the cost saved by avoiding wetland impacts is well over a $3 million per year. Not all of these impact avoidances can be directly attributed to having up-to-date wetland inventory maps, but clearly these maps play an important role in implementing regulatory programs.

9. Constraints

There are several constraints on implementing an update of the NWI to meet the desired outcome.

Funding – The update of the NWI is likely to require considerable funding resources. The initial cost estimate for a statewide update is $7,000,000. To date, the funding directly available for this project is $550,000 through a grant from the Environmental and Natural Resources Trust Fund. Some additional funds have been obtained from project partners for imagery acquisition. Without adequate and consistent funding, this project will be difficult, if not impossible, to implement.

Technical Feasibility – There is often an inherent technical trade-off between some of the key desired outcomes for this project. For example, small wetlands tend to be more difficult to accurately map. Lowering the threshold for the minimum mapping unit will likely increase mapping costs and decrease overall accuracy. Advances in mapping technology may mitigate this trade-off, but they are not likely to eliminate it.

Resource Availability – Another potential constraint to updating the NWI is the availability of the labor resources needed, if the project is implemented using a traditional photo-interpretation approach. The original NWI was created using manual wetland delineation by photo-interpreters. Even many of the more recent projects still use photo-interpreters to map wetlands. Data on labor requirements suggest that 25 to 30 full-time equivalent employees would be needed to complete an update in six years. Since the work often relies on part-time college students, this translates into hiring, training, and overseeing the efforts of a large contingent of photo-interpreters. Other mapping efforts have taken advantage of automated mapping technology to greatly reduce the labor requirement; however, most of the published reports from these efforts suggest that fully automating the classification process may entail a significant reduction in accuracy (Islam et al. 2008).

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11. Appendix A

11.1. Wetland Map End User Survey

Q1. What is your primary organizational affiliation? (Check one)

Answer Options	Response Percent	Response Count
Private sector business / consultant	24.7%	22
Land owner / farmer / real estate developer	0.0%	0
Local government	15.7%	14
State government	51.7%	46
Research	3.4%	3
Education	3.4%	3
Non-profit	1.1%	1
Private individual (other than land owner)	0.0%	0
Comments		13
	answered question	89
	skipped question	12

Q2. What is your personal/professional role with respect to wetlands? (Check all that apply)

Answer Options	Response Percent	Response Count
Regulator / permit reviewer	46.9%	46
Regulated / permittee	20.4%	20
Land manager	14.3%	14
Conservationist	19.4%	19
Planner / policy analyst	18.4%	18
Wetland scientist	52.0%	51
Geographer / mapping specialist	18.4%	18
Recreational (fisherman, hunter, outdoorsman)	22.4%	22
Comments		8
	answered question	98
	skipped question	3

Q3. How frequently do you deal with wetland issues? (Check one)

Answer Options	Response Percent	Response Count
Nearly every day	54.5%	54
Every week	26.3%	26
A couple of times a month	15.2%	15
Once a month	4.0%	4
Once a year or less	0.0%	0
	answered question	99
	skipped question	2

Q4. How often do you use wetland maps? (Check one)

Answer Options	Response Percent	Response Count
Nearly every day	28.7%	29
Once or twice a week	35.6%	36
A couple of times a month	23.8%	24
Once a month	9.9%	10
Once a year or less	2.0%	2
	answered question	101
	skipped question	0

Q5. Which of the following uses of wetland maps apply to you? (Check all that apply)

Answer Options	Response Percent	Response Count
Wetland regulation	90.7%	88
Flood management	39.2%	38
Wildlife management	28.9%	28
Land use / land development planning	63.9%	62
Environmental impact analysis	66.0%	64
Farmland management	21.6%	21
Transportation planning	40.2%	39
Forest harvest planning	7.2%	7
Education	24.7%	24
Recreation (fishing, hunting, birding)	29.9%	29
Comments		10
	answered question	97
	skipped question	4

Q6. Does the National Wetland Inventory data meet your needs? (Check one)

Answer Options	Response Percent	Response Count
Yes	23.0%	23
No	76.0%	76
Don't know, I've never used it	1.0%	1
	answered question	100
	skipped question	1

Q7. Do you have other data and/or reports that are derived from the National Wetlands Inventory? (Check one)

Answer Options	Response Percent	Response Count
Yes	50.0%	50
No	32.0%	32
Don't know.	18.0%	18
	answered question	100
	skipped question	1

Q8. If National Wetland Inventory does not meet your needs, why not? (Check all that apply)

Answer Options	Response Percent	Response Count
Wetlands are missing from the map (out-of-date or never mapped)	89.5%	77
The scale is too coarse or it doesn't capture small enough wetlands	66.3%	57
I need the data to be simplified	5.8%	5
I need more information about wetland variability over time (e.g. water level fluctuations)	32.6%	28
The descriptive data do not provide enough information	30.2%	26
Comments		21
	answered question	86
	skipped question	15

Q9. If you use wetland maps from a source other than NWI, what is its origin? (Check all that apply)

Answer Options	Response Percent	Response Count
Not applicable, I only use NWI	31.1%	23
Created or enhanced by consultant	41.9%	31
Created or enhanced by city	36.5%	27
Created or enhanced by watershed organization	41.9%	31
Created or enhanced by county	48.6%	36
Comments		29
	answered question	74
	skipped question	27

Q10. Which figure best represents the reoslution needs for wetland mapping?

For reference the wetland shown in this figure is about ¼ of an acre.

Answer Options	Response Percent	Response Count
a. 1-foot	37.0%	37
b. 2-foot	37.0%	37
c. 4-foot	18.0%	18
d. 8-foot	6.0%	6
e. 16-foot	2.0%	2
	answered question	100
	skipped question	1

Q11. What is the smallest wetland that you need to have mapped? (Check one)

Answer Options	Response Percent	Response Count
10-acre	1.0%	1
5-acre	1.0%	1
1-acre	8.2%	8
½-acre	8.2%	8
¼-acre	35.1%	34
1/10-acre	46.4%	45
	answered question	97
	skipped question	4

Q12. What format do you prefer to use for wetland maps? (Check all that apply)

Answer Options	Response Percent	Response Count
Digital GIS data on desktop	94.0%	94
Online maps	40.0%	40
Paper maps	19.0%	19
Comments		5
	answered question	100
	skipped question	1

Q13. Which of the following figures best represents the way you would like to have wetland maps presented?

(Check one)

Answer Options	Response Percent	Response Count
Vector	31.6%	31
Raster	2.0%	2
Both	66.3%	65
	answered question	98
	skipped question	3

Q14. How frequently should wetland maps be updated? (Check one)

Answer Options	Response Percent	Response Count
Seasonally	0.0%	0
Yearly	6.1%	6
Every 5 years	53.5%	53
Every 10 years	25.3%	25
Every 20 years	7.1%	7
Don't know	8.1%	8
	answered question	99
	skipped question	2

Q15. If you obtain wetland map data from an online source, what is your primary source? (Check one)

Answer Options	Response Percent	Response Count
DNR Deli available at http://deli.dnr.state.mn.us/	64.6%	51
DNR Landview available at http://www.dnr.state.mn.us/maps/landview.html	8.9%	7
The National Map viewer available at http://nmviewogc.cr.usgs.gov/viewer.htm	1.3%	1
The US Fish and Wildlife Wetland Mapper available at http://wetlandsfws.er.usgs.gov/wtlnds/launch.html	25.3%	20
Comments		10
	answered question	79
	skipped question	22

Q16. Do you have suggestions to improve the wetland data so that it better meets your need?

Answer Options	Response Count
	36
answered question	36
skipped question	65

11.2. Full Text Responses to Question 16

16. Do you have suggestions to improve the wetland data so that it better meets your need?

1 An interactive process should be developed between BWSR, DNR and the COE that makes use of the reviewed and approved wetland delineations submitted to LGU's and the COE. These are prepared by (for the most part) by certified wetland professionals and reviewed and approved by other certified professionals. The deleiantions are surveyed so the boundaries are accurate. Most delineatoirs and engineers use digital technology so the results could easily be used to update NWI maps on a "realtime" basis. I have met with BWSR, FWS and COE and all agree that this would be a useful idea. Implementation could be achieved fairly easily from what I've been told. It mainly requires a system of input quality control and steps to educate delineators on involvemnt and participation.

2 Better resolution, better digitization accuracy standards

3 Biggest need for NWI is to update it using more recent information. Inclusion of smaller basins would be nice, but not critical. Removal of basins no longer present is more important. Consider adding an attribute that notes if the basin is also a Public Water. Consider adding Eggers and Reed classification? Drop the upland classification on the shapefiles.

4 Cass County has poor underlying mapping, ie USGS quads that should also be updated. This may be the case in parts of Crow WIng County too and others?

5 Consistent use of Cowardin's classification system throughout the state (e.g., modifiers, subclass designations); addition of more wetland attributes such as Tiner's landscape position, landform, waterflow path, and waterbody type (LLWW); incorporate Governor's GIS Council "Basin" Standard for lakes and depressional wetlands (e.g., Basin ID field could be used to dissolve Cowardin classes into distinct waterbodies where appropriate)

6 Cowardin System is the standard required for use by federal agencies and recomended for use by others. A commitment by federal and,or state governements is needed to fund imagery acquisition and data creation. This would ensure consistently accurate data. As stated above, the Cowardin System has inherent flexibility to incorporate data address a variety of resource information needs.

7 Functional assessments of large (>10 acres) intact Protected Waters basins would be nice to have.

8 Get the F&W to show comparable data!

9 Give us more high res aerials for base theme coverage

10 I delineate very small wetland areas but would not expect a large project to capture everything. It should be emphasized that this does not replace a delineation, sometimes landowners get confused.

11 I have been working on wetlands for about one year, at this juncture, these responses and experience is limited.

12 I think periodic updateing of the maps is critical, however I realize it is costly. I think colaborating with all agencies to ensure all databases of wetland information are included (e.g., NRCS has GIS layers of WRP easements and mitigated wetlands, that would provide "type" information).

13 If NWI is updated, it would be helpful to designate restored basins vs. natural basins. We need a statewide shapefile showing wetlands restored through DNR, NRCS, SWCD's etc.

14 If possible mapping conventions to show all drainage facilities. Minimize or eliminate omission errors for small wetlands (especially PEMA/Type I wetlands) Obtain information from various agencies, entities and include mapping conventions to show which wetlands maybe protected by various programs i.e. WMAs, WPAs, Wetland Easements, TNC, MN DNR Protected Waters, etc. One of the most important factors in producing good wetland maps is to acquire aerial photography in mid to late April during an above average runoff year.

15 Include LLWW coding by Ralph Tiner

16 Include Stewart and Kanturd classification in addition to Cowardin classification. The Stewart and Kantrud classification system is uniquely designed for Prairie Pothole Wetlands.

17 It needs to be up to date!! 5 years is feasible and is the max lag time because of all the development and hydrological changes that occur on the landscape over time.

18 It would be nice to have a system that allows users to provide updated information to the wetland GIS data. For example, I know of a type 3 wetland that doesn't show up in NWI.

19 Maintenance is the biggest issue. Maps should be be updated via permitting reults

20 Make sure that the file formats are also compatible with free GIS software like MapWindowGIS (http://www.mapwindow.com/)

21 Map during early spring hydrology. Improve mapping of agricultural wetlands.

22 Maps by county coords.

23 Need to have wetlands display more accurately in space, not off by more than 20 ft or 50 ft. Hopefully, someone will use the periodic updates to track wetland 'health' over time; how they change as development/ disturbance increases. And how buffers make a difference.

24 One statewide layer as opposed to quad layers

25 Overall pretty good, just needs to be updated. Perhaps better mapping in agricultural settings.

26 Provide latest versions all in one location

27 Scale and resolution are really the factors. The city just collects much more data than what is on the FWS map.

28 Simple labels that aren't codes

29 Smaller scale of digitizing: <1:2000 Finer detail and higher resolution.

30 Some way to correlate with hydric soils potential, to see if there are auxiliary issues to consider for environmental analysis.

31 The main things are a digital or online format, more up to date, and a little more detailed.

32 The most important will be updating the data so that it is accurate/current. Increasing the scale is also important. Labels that correspond to the new WCA community type descriptions would be helpful.

33 There needs to be significantly more ground truthing in MN to improve reliability so that maps can be more reliable and not just guides. Map updates should be done at a predictable time intervals.

34 Upland areas need not be included in the data set. Use multiple wetland classification systems (i.e. HGM, Eggers and Reed, etc.).

35 Wetland mapping methods should no longer rely purely on remote sensing as the only method of interpretation and data gathering. Field checking is essential, even if much of the land can not be accessed. If the agencies plan on updating existing data with only remotely sensed data, then I strongly believe this will be a waste of time and taxpayer money.

36 Will it be feasible to field check boundaries???? Will updated boundaries just be based on soils and aerials?

11.3. Map Users Contacted for Follow-Up Interviews

Name	Affiliation
John Anderson	St. Mary's University / Geospatial Services
Ben Meyer	Bonestroo
Jed Chesnut	WSB Engineering
Rob Peterson	West Central Environmental Consultants
Nick Rowse	US Fish & Wildlife Service
David Thill	Hennepin County
Jyneen Thatcher	Washington Conservation District
Leslie Stovring	City of Eden Prairie
Allen Schmitz	Minnesota Department of Transportation
Joan Weyandt	Board of Water and Soil Resources
John Genet	Minnesota Pollution Control Agency
Randy Bradt	Minnesota DNR / Division of Waters
Rick Gitar	Fond du Lac Reservation