

**US Army Corps
of Engineers**®

St. Paul District



July 1, 2016

Guidance for Offsite Hydrology/Wetland Determinations

This document replaces all previous Minnesota Board of Water and Soil Resources (BWSR) and St Paul District Corps of Engineers (District)-endorsed versions of guidance concerning wetland mapping conventions for agricultural land including: *Wetland Mapping Conventions for Cropland* (BWSR, USACE, NRCS, 1994); *Atypical Procedure: Offsite Hydrology Determination by Using Rainfall Data with Farm Services Agency Imagery* (BWSR 2006) and *Using Aerial Imagery to Assess Wetland Hydrology* (BWSR July 1, 2010).

This guidance incorporates new data sources, clarifies procedures and provides additional direction on interpreting results in concert with the 1987 *Corps of Engineers Wetland Delineation Manual* (87 Manual), *Regional Supplement to the Corps of Engineers Wetland Delineation Manual* (Regional Supplements), and the current version of *Guidance for Submittal of Delineation Reports to the St. Paul District Army Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota*. As with previous versions, this guidance is intended to provide a standardized, repeatable methodology for making wetland determinations in crop fields.

Section 1. Background

The technical background for using remote sensing data to identify wetland hydrology is found in Hydrology Tools for Wetland Determination and analysis, Chapter 19, Section 650.1911 of the *USDA Engineering Field Handbook* (2015). This reference is cited in the Great Plains, Midwest and Northcentral & Northeast Regional Supplements to the 87 Manual under Hydrology Indicators B7 (Inundation Visible on Aerial Imagery) and C9 (Saturation Visible on Aerial Imagery). In 1994, BWSR, the District and the Natural Resource Conservation Service (NRCS) collaborated on the development of wetland mapping conventions (Minnesota Mapping Conventions) to aid in the implementation of the wetland conservation provisions of the Federal Farm Bill and promote consistency between wetland determinations made under the *National Food Security Act Manual* and the 87 Manual. To address numerous changes in State and Federal wetland regulations as well as advances in the science and practical application of wetland delineation procedures, in July 2010 BWSR and the District issued *Using Aerial Imagery to Assess Wetland Hydrology*. More recently, changes to Federal law and United States Department of Agriculture (USDA) policy have resulted in changes to NRCS mapping conventions, now called *Minnesota Natural Resources Conservation Service State Offsite Methods* (SOSM), to the extent that determinations using SOSM are sometimes different than determinations made by methods employed by BWSR and the District. This guidance was issued to complement the current version of *Guidance for Submittal*

of Delineation Reports to the St. Paul District Army Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota and to clarify that wetland determinations on agricultural lands completed for compliance with the Wetland Conservation Act (WCA) or the Clean Water Act, Section 404 programs must follow the protocols outlined in this guidance. Hydrology Tools for Wetland Determination in the USDA handbook conveys three key messages: (a) multiple imagery sources from many years should be assessed, with at least five 5 years used for the determination; (b) imagery should be evaluated for antecedent moisture conditions; and (c) a procedure for field verification should be incorporated. The methodology described in this document incorporates these key elements and provides a specific methodology for those making wetland determinations in agricultural landscapes in Minnesota.

Section 2. Applicability

Although the procedures and data sources described in this document can be used in a variety of situations, they are most useful for interpreting wetland hydrology in agricultural areas. In general, review of aerial imagery for assessing wetland hydrology is more accurate in agricultural fields that are regularly planted with annually seeded row crops. The soil is bare early in the growing season and crops such as corn and soybeans are intolerant of poor soil drainage. These fields will often show signs of crop stress, standing water or drowned out crops in summer aerial imagery when wetland hydrology is present. An aerial imagery review for signs of crop stress due to wetness is typically not as reliable for fields planted in perennial forage crops compared to those planted to annual row crops, depending on a number of factors discussed later. There are also some situations where aerial imagery review can provide useful information in areas that are not cropped or hayed, such as pastures and naturally vegetated seasonally flooded/saturated wetlands (with appropriate caution). However, greater emphasis should be placed on other data sources (e.g. those listed in the 87 Manual and Regional Supplements) in these situations.

Example series of aerial images showing wetland hydrology signatures over **time**:



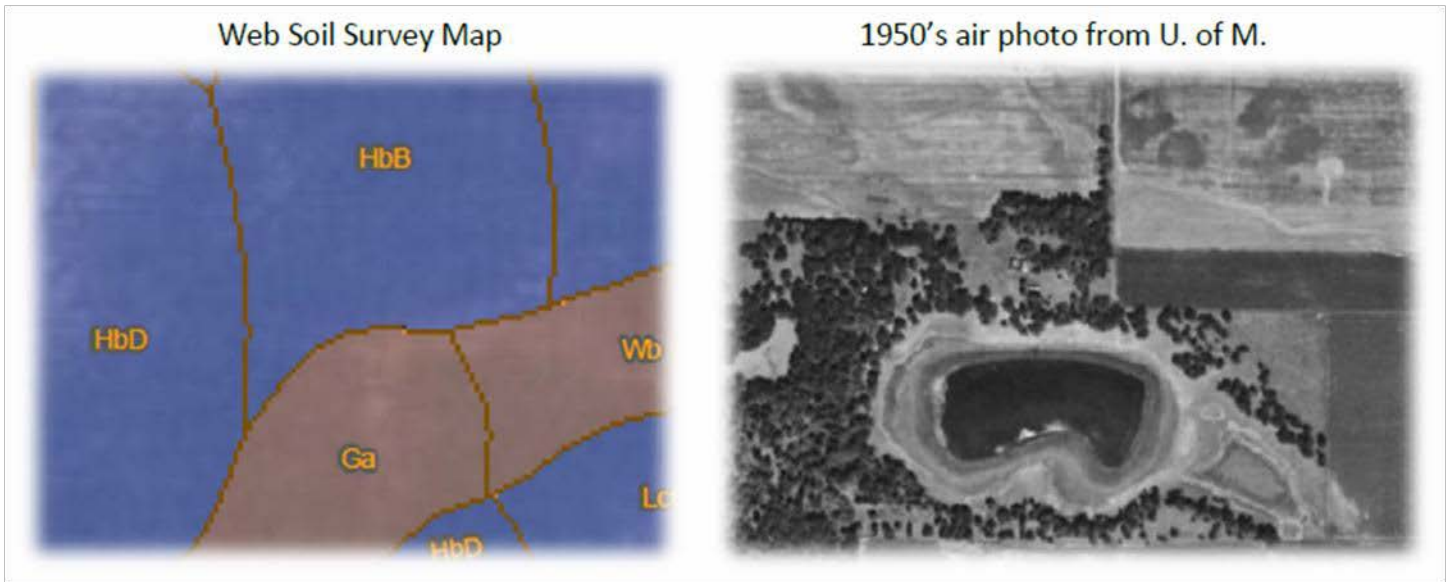
Section 3. Aerial Imagery Data Sources

Common sources of aerial imagery for Minnesota are listed in the table below.

Imagery Source	Notes
Annual Farm Service Agency (FSA) imagery	Available for most agricultural areas of the State from about 1980 to present. Many images only list the year taken, although more specific dates can sometimes be obtained by contacting the local FSA or Soil & Water Conservation District office.
Minnesota Department of Natural Resources (DNR) Landview Mapping Program	Free web-based mapping program that includes imagery from the 1930s thru 1970s for many areas of the State.
University of Minnesota John R. Borchert Map Library	Imagery from 1930s through 1980s for many areas of the State.
Google Earth *	Imagery coverage and years variable throughout the State. Date of imagery provided and spring aerial images are available for many areas.
ESRI ArcGIS Base Map Datasets	ArcGIS comes pre-linked to many free datasets, including some high resolution imagery.
Bing Maps *	Interesting “bird’s-eye view,” but dates of imagery not easily obtained.
Web Soil Survey	Imagery used as the base map for soil overlays include a range of dates. The date(s) can be found under “Map Information” on page 2 of printed soil maps.
Minnesota Geospatial Information Office (MnGeo)	Many historical images available including spring imagery statewide for 2009-14. Data accessible for use in ArcGIS software and via web-based mapping tools.
Local mapping resources	Counties, cities, watershed districts and other local government units may have aerial imagery available through their websites and/or by request.
Fee-based vendors	There are private vendors that provide aerial imagery for a fee.

**Imagery obtained from online and free sources should be saved (screenshot acceptable) or downloaded and provided to regulatory reviewers because their availability is subject to change.*

Although as many images as possible should be acquired to conduct a comprehensive review, images with the most utility are those where the specific date the image was taken is known and images that are clear (unobscured by clouds, shadows, etc.) and crisp with a wide range of contrast between dark and light portions of the image. Imagery of insufficient quality to evaluate the area of interest should be noted with an accompanying explanation of why it was not useful. An optimal set of aerial imagery for review would include images from many years under many different antecedent precipitation conditions. While a single aerial image used alone meets the requirement for a hydrology indicator (B7 Inundation Visible on Aerial Imagery) the strength of an interpretation for wetland hydrology increases with the number of images and data sources. Other mapping resources such as Light Detection and Ranging (LiDAR) remote sensing data, pictometry, radar, infrared, soil mapping, etc. should be obtained to aid in the interpretation of aerial imagery.



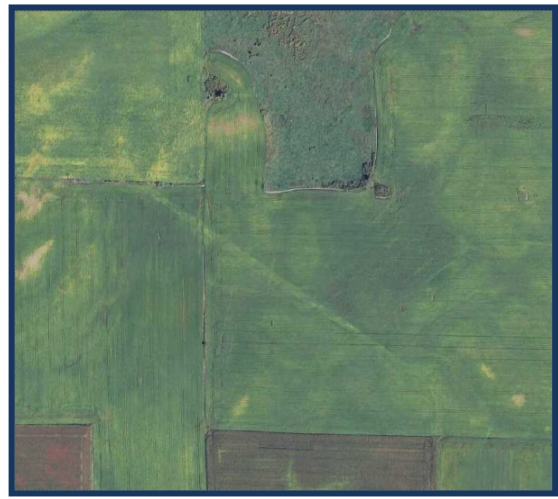
Section 4. Timing of Imagery

Past guidance documents do not specify months or time periods of imagery to use for making wetland determinations. This is primarily because the only reasonably available image source was mid to late season aerial photographs taken for the Federal Farm Services Agency (FSA). This imagery is purposefully taken during the agricultural growing season which does not necessarily coincide with the typically longer and earlier growing season defined for wetlands. Now that more imagery sources are available from various time periods, a more comprehensive review is possible and expected. Reviewing images taken during the early portion of the growing season combined with mid and late growing season images is recommended. Imagery from outside the growing season may be used if its limitations are recognized and considered in context with imagery taken during the growing season. In general, hydrology assessments are stronger when multiple years of imagery taken at different times during the growing season are examined. It is important to know the specific date of each image used in the review. If the date of a particular image is unknown, it can sometimes be approximated based on landscape conditions such as crop field vegetative cover/vigor, leaf canopy cover, evidence of crop harvest/haying and other characteristics visible on the image that correlate to certain seasons/times of year.

Example series of aerial images showing wetland hydrology signatures over **season**:



May 2010 (Normal Antecedent Precipitation)
 Note: Wet signatures from bare soil



July 2010 (Dry Antecedent Precipitation)
 Note: Wet signatures from dark green photo tones

Section 5. Precipitation Data

All aerial imagery should be evaluated in the context of antecedent moisture conditions as per *Evaluating Antecedent Precipitation Conditions* (BWSR, May 2015) available on the BWSR website. The standard method for evaluating antecedent moisture conditions involves comparing precipitation totals from the three months prior to the date of the image with 30-year normal amounts (1981-2010), calculating a weighted multi-month score and determining a climate condition (dry, normal, wet).

Sample results from the Minnesota Climatology Office:

Precipitation Worksheet Using Gridded Database

Precipitation data for target wetland location:
 county: **Watonwan** township number: **107N**
 township name: **Madelia** range number: **30W**
 nearest community: **Perth** section number: **2**

Aerial photograph or site visit date:
Saturday, June 15, 2013

(values are in inches)	first prior month: May 2013	second prior month: April 2013	third prior month: March 2013
estimated precipitation total for this location:	3.72	4.91	2.41
there is a 30% chance this location will have less than: *	2.34	1.77	1.30
there is a 30% chance this location will have more than: *	3.92	3.36	2.26
type of month: dry normal wet	normal	wet	wet
monthly score	3 * 2 = 6	2 * 3 = 6	1 * 3 = 3
multi-month score: 6 to 9 (dry) 10 to 14 (normal) 15 to 18 (wet)	15 (Wet)		

Section 6. Evaluation Procedure

The procedure below provides step-by-step instructions for reviewing aerial imagery and making a wetland determination. The process and steps can vary depending on site-specific characteristics, the intended purpose of the evaluation or level of the wetland delineation and the experience of the reviewer. To complete an evaluation the following are needed:

- Recent air photo for sketching and labeling evaluation areas (base map)
- Aerial imagery and associated antecedent precipitation evaluation to determine climate condition
- Offsite mapping resources (soils map, NWI, topography, etc.)
- “Wetland Hydrology from Aerial Imagery - Recording Form” (Exhibit 1 – page 14)
- “Wetland Determination from Aerial Imagery” (Exhibit 2 – page 15)

6.1 Evaluation Steps:

1. Outline the boundary of the area that is being assessed on a base map of appropriate scale. A recent air photo taken during a wet climate condition is generally a good base map that shows most potential wetland areas. Overlaying topographic and/or hydric soil information on the air photo will help to further discern and label potential wetland areas. Enter imagery information (date, source, climate condition) on the Recording Form (Exhibit 1). All reasonably available imagery must be evaluated. Spring imagery should be evaluated if available. In instances where there is limited available imagery, evaluating a minimum of five years of imagery taken during normal climate conditions is required to draw meaningful conclusions. If five normal years are not available, an equal number of wet and dry years from the respective spring or summer period should be added to the assessment.
2. Review soils data for the presence of hydric soils, NWI map, aerial imagery taken during wet climatic conditions, topography maps (LiDAR preferred), and any other wetland mapping resources to identify potential wetland areas for further evaluation.
3. Conduct a quick review of aerial imagery to determine the frequency of wetland signatures in a particular area and determine which areas warrant a comprehensive review. The reviewer may choose to perform a comprehensive review of all potential wetland areas depending on the scope, complexity, purpose and timeframe of the analysis.
4. Assign an identifying label (such as a, b, c) to each evaluation area on the base map and enter it as an “Area” on the Exhibit 1 Recording Form (See Appendix 1 for example).
5. Review each area on each image and note observations in accordance with labels described in this document (see next section on Evaluating Aerial Images). Compare observations among different climate conditions and different times of year. Observe any known or obvious wetland or upland areas on the image and use them as a reference for evaluating questionable areas.
6. Using the Exhibit 1 Recording Form, tally the number of years of imagery with normal climate conditions that exhibited wetland signatures (“hits”) for each evaluation area making sure that areas labeled on the base map are cross-referenced correctly to areas identified on the form. If multiple images from the same year are examined, a wetland signature on any one image should be considered a “hit” for that year unless the image is not representative of hydrologic conditions as appropriately justified and noted.

7. For each evaluation area, determine if hydric soils are present and if the area is identified as a wetland on the NWI map or any other publically available local or regional wetland maps.
8. Using the decision matrix in Exhibit 2, determine if field verification is required for any areas and proceed accordingly. Record field verification results in Table 1 of the Exhibit 2 Recording Form and complete the remainder of the table to make a wetland determination for each area.

Notes:

The “presence of hydric soils” referenced in Step 2 and Exhibit 2 can be determined from the “Hydric Rating by Map Unit Feature” under “Land Classifications” from the Web Soil Survey. “Not Hydric” is the only category considered to not have hydric soils.

All imagery used in the review must be included and/or otherwise made available for regulatory review.

If the aerial imagery assessment was completed as part of a wetland delineation that requires an onsite inspection, complete data sheets from the appropriate Regional Supplement must be included as well as other applicable information per the current version of *Guidance for Submittal of Delineation Reports to the St. Paul District Army Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota*.

Section 7. Evaluating Aerial Images

Characteristics of aerial imagery that relate to the presence/absence of wetland hydrology are collectively referred to as “signatures” and those signatures that are correlated to the presence of wetland hydrology are generally referred to as “wetland signatures.” The term “hits” is often used when referring to the number of images with wetland signatures in a series of images that were reviewed for the presence/absence of wetland hydrology. Commonly recognized signatures and their associated label are as follows:

CS – Crop Stress

A type of wetland signature. Refers to differences in the vegetative vigor of planted crops as compared to surrounding conditions due to wetness. Often seen as a different color than surrounding vegetation of the same type.

The yellowish green color of moisture-stressed vegetation in the center of the photo contrasts with the surrounding healthier vegetation. Tracks made by field equipment are visible from when farm machinery was run through saturated soils.





DO – Drowned Out

A type of wetland signature. Refers to areas that appear to have been tilled through and planted to annual crops, but all or part of the crop has been drowned out.

This is typical of early growing season hydrology after the crops have been planted. Boundaries of drowned out areas are typically jagged as some plants survive due to micro-topography created by the planting equipment.



NC – Not Cropped

A type of wetland signature. Areas within or contiguous with crop fields that appear to be bare or have natural vegetative cover rather than annual crops.

These areas are avoided by the operators of large planting equipment because of wetness.

Their boundaries are often “squared-up” or have smooth, rounded edges. Operators will often spray these wet areas with herbicide and mow or disk them later in the growing season to prevent weed growth.



SW – Standing Water

A type of wetland signature. Surface water is visible on the image.

The area is usually darker than the drier bare soil surrounding it. In some cases tillage lines will show up as the water recedes.



WS – Wetland Signature



A term used to indicate the presence of a wetland in non-cropped areas based on vegetative cover. To use it, the observer should be familiar with the vegetative cover associated with a particular signature.

Certain characteristic wetland vegetation types (such as reed canary grass or cattails) in certain landscapes can be readily identified and interpreted as a wetland signature.

Note: WS can also be used to indicate wetland hydrology in areas that have greener vegetation during dry conditions.

NV – Normal Vegetative Cover or NSS – No Soil Wetness

These labels indicate that a wetland signature is not present. Refers to a potential wetland area that cannot be readily distinguished from the known surrounding upland, or an area that is distinguishable from the surrounding upland due to factors other than wetness. The NV term should be used when the area is vegetated, NSS when the area is bare soil.

This photo shows the same area depicted in the example for the SW label only under different climate conditions. The lighter areas in this photo are due to droughty conditions and not wetness. This illustrates the value of assessing multiple years of imagery under varying climate conditions.



AP – Altered Pattern

A type of wetland signature. Refers to a detectable difference in cropping patterns due to wetness. These altered patterns are often the result of delaying the planting of crops in saturated soils prior to or during the early portion of the growing season.

Agricultural producers may manage fields for business reasons not related to wetness. It is important to use this label only when the altered cropping pattern is believed to be associated with wetness. This may require examining topographic and soils maps and looking for other clues. For example, in the photo to the right there is a slightly yellowed area jutting out into the green cropped field which hints that the altered cropping pattern is due to wetness.



SS – Soil Wetness Signature

A type of wetland signature. Images taken during the early portion of the growing season may show dark photo tones in areas where the soils are saturated. This can be accompanied with standing water in the wetland.

It is important to ensure that the growing season is in progress when the images are taken. In the infrared photo example to the left, you can see that most of the grassy areas are bright red indicating that the growing season has started.

Section 8. Multiple Signatures and False Images

Multiple signature notations such as CS/DO or NC/SW can be used to more accurately describe areas on images that exhibit multiple wetland hydrology signatures. It is sometimes beneficial to review aerial imagery taken during or following periods of low precipitation or drought. Signs of wetness during these periods may include darker vegetation tones and colors in potential wetland areas contrasted with lighter colors and tones in surrounding areas. In those instances the general “WS” notation can be utilized if it is accompanied by an explanation in the associated report or on the review data form.

It is essential to have an understanding of land use and landscape conditions associated with the site being evaluated in order to accurately interpret aerial imagery. There are often instances where the wetland signatures described above appear for reasons other than wetness. For example, crops in areas of high alkalinity may experience yellowing due to iron deficiency (iron chlorosis) rather than wetness. Crops in coarse-textured soils

can appear stressed due to lack of moisture and nutrients rather than wetness. Some areas within agricultural fields located on drained organic soils may appear on aerial imagery as having wetland signatures. However, these distinct areas may be an artifact of peat depth (the deeper the peat, the darker the color) or a reflection of the increased moisture retention capability of organic compared to adjacent mineral soils. Areas planted to winter wheat may appear stressed or drowned out due to severe winter weather conditions outside the growing season such as high fall/winter precipitation or severe freezing. Additionally, observed cropping patterns that are consistent with a wetland signature may in fact be the result of decisions made by the landowner or manager for business reasons not related to wetness. In bare soil images, dark, or wet-appearing photo tone from early growing season may not be indicative of wetland hydrology due to aspect¹, high soil organic matter in intermediate topographic positions, or the effect of crop residue preventing the soil from warming and drying.

When encountering situations like those described above, it is important that the observer clearly explain and justify their interpretation of images on the review form and/or in an associated report.

Section 9. Assessing Vegetation Using Aerial Imagery

While the methodology described in this guidance document is primarily for determining wetland hydrology, imagery can also be used to identify and delineate plant community types and areas of similar vegetation in an evaluation area. Aerial imagery is especially useful for identifying and delineating areas dominated by invasive cattails or reed canary grass as shown in Figure 1. Color infrared imagery in particular can be used to distinguish several plant communities as shown in the Figure 2.

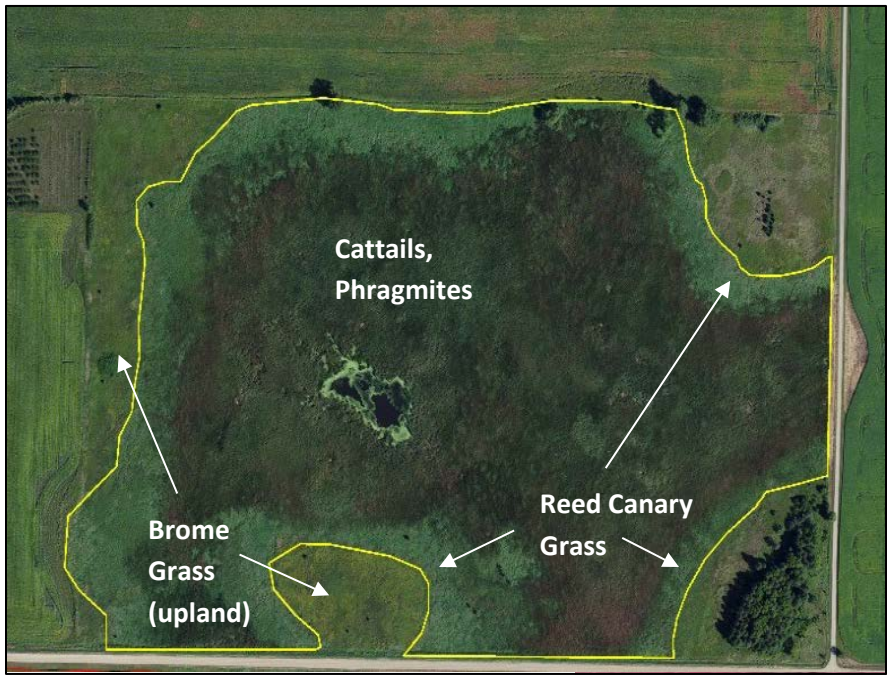


Figure 1

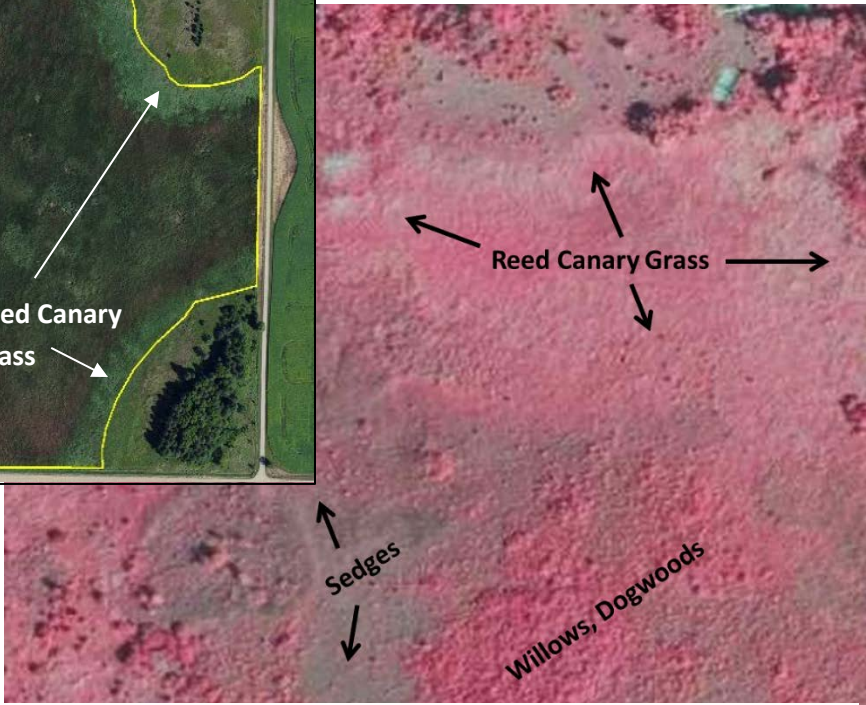


Figure 2

¹ Aspect refers to the compass direction that a slope faces, viewed down slope. North-facing slopes stay cool and wet longer than south-facing slopes.

Section 10. Variables Affecting the Reliability of Image Interpretation

Several variables associated with the landscape conditions of the particular area being reviewed can influence the reliability of aerial imagery interpretation for wetland hydrology. These variables include the overall tolerance of vegetation to flooding or saturation, average vegetative stem density/canopy coverage, and topography.

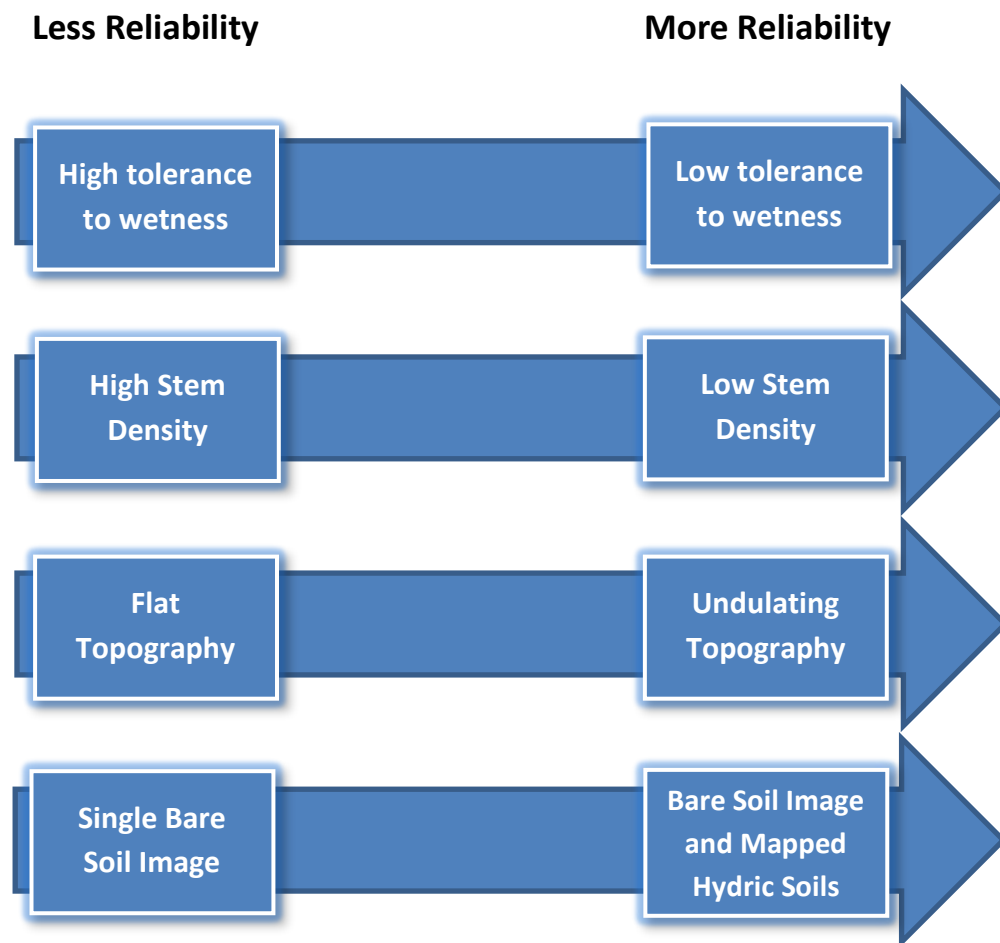
Tolerance to Flooding/Saturation: The relative tolerance of a particular type of vegetation to flooding and saturation should be considered when reviewing an image for wetland hydrology signatures. Wetland hydrology interpretations based on the presence/absence of wetland signatures in fields planted with species that are less tolerant to prolonged flooding or saturation will typically be more reliable than interpretations in fields planted with more water tolerant species. For example, concluding that an area is not wetland based on a lack of wetland hydrology signatures in a field planted to a turf grass that has a high tolerance for flooding/saturation may require other corroborating data/information to support such a conclusion. Conversely, the lack of wetland hydrology signatures in an area regularly planted to a forage crop that has a low tolerance to flooding/saturation (such as alfalfa) provides a stronger basis to conclude that wetland hydrology is not present. Information on the tolerance of crop and hay species to flooding and saturation can be obtained from sources such as the University of Minnesota Extension and published agronomy studies. Some information on vegetation tolerance to flooding or saturation can be deduced from the assigned wetland indicator status of the species (i.e., a FACW species is more tolerant to flooding and saturation than a FACU species).

Stem Density/Canopy Coverage: The ability to discern a wetland signature on an aerial image is dependent in part on the average stem density or canopy coverage of the planted crop. In general, the lower the stem density, the easier it is to discern the effects of prolonged flooding/saturation from an aerial view because bare soil will be visible where individual plants die from moisture-related stress. In contrast, when stem densities are high and plants overlap, the effects of moisture-related stress on individual plants will tend to be masked by healthier plants.

Topography: Wetland signatures in areas with flat topography tend to be less evident than in areas with more pronounced topography. In particular, the effects of crop stress or high soil moisture combined with contrasting soil types in more pronounced depressions are often readily discernable as shown below.



More corroborating data may be necessary to make reasonable conclusions when the reliability of imagery review results is negatively affected by one or more of these variables. The following illustration provides a generalized summary of the effect of these variables on the reliability of an aerial imagery review for wetland hydrology.



Section 11. Reference Areas

Comparing areas of known wetland and upland to areas being evaluated for wetland hydrology signatures on the same image can help with interpretations. Reference areas should be in a similar landscape position as the area being evaluated and ideally have the same soil type(s). If used in the review, reference areas should be identified on the evaluation base map, and an explanation of how they were used to interpret each image and/or area should be provided on the Recording Form and/or associated delineation report where applicable.

Section 12. Documenting Drainage and Normal Circumstances

If drainage activity is located in or near the assessment area, it is important to note the locations and extent of the drainage infrastructure (e.g. tile inlets, or lines, ditches or outlets). This information may be needed to explain why hydrology is lacking when other mapping resources indicate the presence of wetlands (such as the presence of hydric soils).

In instances where hydrologic changes have occurred over time, the results of the review may need to be grouped and analyzed relevant to changing conditions. For example, an area may exhibit wetland signatures in a number of images prior to tile installation or repair, followed by a lack of wetland signatures in images taken after the work was completed. Conversely, aerial images of an area taken after the failure of a tile line (rupture, plugging, etc.) may have wetland signatures after the failure, but images taken before the tile failure may lack wetland signatures. In these instances, the reviewer should show the results of the analysis using all images as well as the results using only the images preceding or following a known change in site conditions. It is necessary to characterize the “normal circumstances” of the site to justify the appropriate data set to use in

making a determination. (Refer to *Regional Supplements to the 87 Manual* and current version of *Guidance for Submittal of Delineation Reports to the St. Paul District Army Corps of Engineers and Wetland Conservation Act Local Governmental Units in Minnesota* for information on determining normal circumstances).

Section 13. Routine Level 1 Delineations

Depending on the purpose of the delineation, a routine Level 1 delineation, which does not require a field visit, may be acceptable. Table 1 on Exhibit 2 can be used to document a wetland using information gathered as part of the offsite hydrology review. Please refer to *Wetland Delineations: Choosing the Appropriate Method* (BWSR, 2010) for more information on when a Level 1 is appropriate.

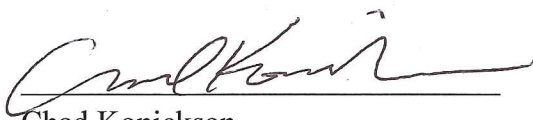
Section 14. Important Final Points

Except for Level 1 delineations, the results of an aerial imagery review are not necessarily the final determination as to whether or not an area is a wetland. The results should be compared with other data, including onsite observations, to support final conclusions. The results of a review of aerial imagery should not be used to override or “trump” site-specific data to the contrary, but instead should be weighed alongside it in cases where onsite data is inconclusive.

For a wetland boundary and type WCA Decision and/or projects seeking a delineation concurrence from the US Army Corps of Engineers, a permit application will likely not be issued based on a Level 1 delineation or a hydrology-only determination. The aforementioned jointly-issued delineation guidance should be consulted for additional information.

Section 15. Agency Contacts

- | | |
|--|---|
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Appendix 1

A Step by Step Example of using the Evaluation Procedures for Hydrology/Wetland Determinations

Step 1: Outline assessment area on a base map.



The map should show the entire assessment area at a scale adequate to interpret cropping patterns and other relevant details for interpreting imagery for wetland hydrology.

Use lines of appropriate thickness and color to make the assessment area readily visible. A green line in the above example would be difficult to discern against the green background.

Steps 2 and 3: Use soils data, NWI map, aerial imagery taken during a wet climate condition, topographic Maps and other resources to identify potential wetland areas for review.

Topographic Maps



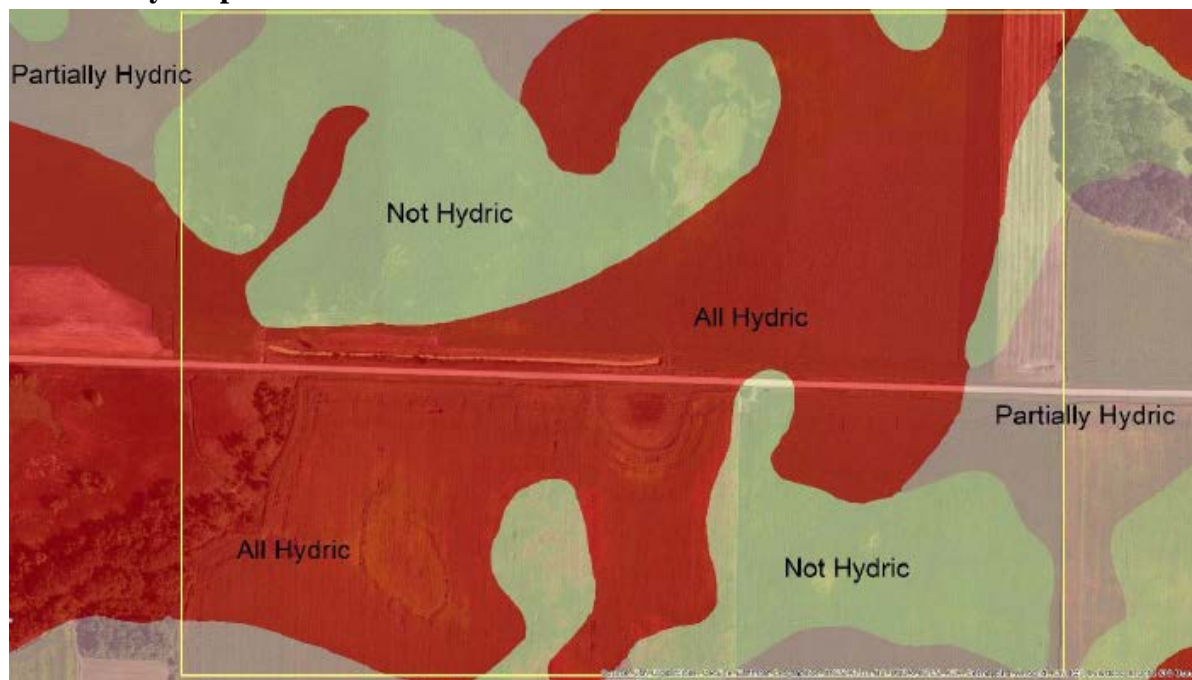
Use topographic maps to identify depressions and floodplains that may have wetland hydrology. Topographic maps using LiDAR data are preferred over USGS topo quads.

National Wetland Inventory (NWI) Map



The NWI map shows previously identified wetlands, however, the presence/absence of an area on the map is not definitive as to whether or not wetland hydrology is present.

Soil Survey Map



Areas identified as “All Hydric” and “Partially Hydric” indicate potential wetland areas. Not all hydric soils are wetlands because drainage features such as tile and ditches can alter hydrology. It is important to identify drainage features that could potentially affect the assessment area.

Image taken during a wet climate condition



Images taken during wet climate conditions are often the best source of information for identifying potential wetlands. If an area has wetland hydrology, it will most likely be visible during wet conditions, although other areas that do not have wetland hydrology may also have wetland signatures during wet conditions.

Step 4: Select and label areas to evaluate for wetland hydrology and enter them on the Recording Form.

Exhibit 1

Field data sheet reference (if applicable): _____

Wetland Hydrology from Aerial Imagery – Recording Form

Project Name: Offsite Hydro Example Date: 5/26/15 County: Any

Investigator: _____ Legal Description (T, R, S): 199 85 2

Summary Table

Date Image Taken (M-D-Y)	Image Source	Climate Condition (wet, dry, normal)	Image Interpretation(s)				
			Area: <u>1</u>	Area: <u>2</u>	Area: <u>3</u>	Area:	Area:



A base map should clearly show and label areas evaluated for wetland hydrology using the methodology described in this document. The base map, completed recording forms and images used should be included in an associated wetland delineation report.

Step 5: Fill in date, source and climate condition for each image on the Recording Form. Use the “Precipitation Worksheet Using Gridded Database” function on the Minnesota Climatology Office website (<http://climate.umn.edu>).

Summary Table

Date Image Taken (M-D-Y)	Image Source	Climate Condition (wet, dry, normal)	Image Interpretation(s)				
			Area: 1	Area: 2	Area: 3	Area:	Area:
7/81	USDA	normal					
7/82	USDA	normal					
7/88	USDA	dry					
8/93	USDA	wet					
6/98	USDA	normal					
6/2000	USDA	normal					
7/2003	USDA	normal					
4/2011	MN LIMC	wet					
7/2013	USDA	wet					

Review images for wetland signatures and record observations using the notations described in this document.

Summary Table

Date Image Taken (M-D-Y)	Image Source	Climate Condition (wet, dry, normal)	Image Interpretation(s)				
			Area: 1	Area: 2	Area: 3	Area:	Area:
7/81	USDA	normal	NC	NC	NC		
7/82	USDA	normal	NV	CS	NV		
7/88	USDA	dry	NV	NV	NV		
8/93	USDA	wet	WS	DO	NC		
6/98	USDA	normal	NV	DO	NV		
6/2000	USDA	normal	NV	CS	CS		
7/2003	USDA	normal	NV	NV	NV		
4/2011	MN LIMC	wet	SS	SS	SS		
7/2013	USDA	wet	CS	NC	CS		

Step 6: Tally the number of years of imagery with normal climate conditions that exhibited wetland signatures.

Normal Climate Condition	Area: 1	Area: 2	Area: 3	Area:	Area:
Number	5	5	5		
Number with wet signatures	1	4	2		
Percent with wet signatures	20%	80%	40%		

Steps 7 and 8: Using the decision matrix in Table 1 of Exhibit 2 Recording Form, determine if field verification is required, conduct field review as necessary and complete wetland determination for each area.

Table 1.

Area	Hydric Soils Present	Identified on NWI or other wetland map	Percent with wet signatures from Exhibit 1	Other hydrology indicators present ¹	Wetland?
1	yes	no	20%	N/A	no
2	yes	no	80%	N/A	yes
3	no	no	40%	yes	yes

¹ Answer "N/A" if field verification is not required and was not conducted.