OPERATING AGREEMENT BETWEEN THE JACKSONVILLE DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS, THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT, THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT, THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, AND THE SUWANNEE RIVER WATER MANAGEMENT DISTRICT CONCERNING REGULATORY PROGRAMS FOR ACTIVITIES IN WETLANDS AND OTHER SURFACE WATERS, INCLUDING WATERS OF THE UNITED STATES

I. PARTIES, PURPOSE AND GOALS

A. The Parties

The Parties to this Agreement are the Jacksonville District of the United States Army Corps of Engineers (Corps), Florida Department of Environmental Protection (Department), Northwest Florida Water Management District (NWFWMD), South Florida Water Management District (SFWMD), St. Johns River Water Management District (SJRWMD), Southwest Florida Water Management District (SWFWMD), and Suwannee River Water Management District (SRWMD) (collectively referred to as "Districts"). Where the Department or a District has delegated responsibilities to a local government in accordance with section 373.441, Florida Statutes (F.S.), this Agreement shall also apply to those local governments that have been delegated such authority as of the effective date of this Agreement.

B. Purpose

The purpose of this Agreement is to coordinate the permitting, compliance and enforcement programs of the Parties concerning regulation of activities that affect waters of the United States (WOUS) under the jurisdiction of the Corps, and wetlands and other surface waters under the jurisdiction of the Department or the Districts within the state of Florida. This Agreement shall apply to Department of the Army permits ("DA Permits") issued by the Corps pursuant to Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act of 1899 or Section 103 of the Marine Protection, Research and Sanctuaries Act and to permits issued by the Districts or the Department pursuant to part IV of chapter 373, F.S. ("State permits"). This Agreement describes the interaction between the Parties and is subject to the respective laws and implementing regulations and policies of the Parties.

This Agreement supersedes the Agreement entered on November 30, 1998, entitled "Operating Agreement Between the U.S. Army Corps of Engineers, the Florida Department of Environmental Protection, the South Florida Water Management District, the St. Johns River Water Management District, the Southwest Florida Water Management District, and the Suwannee River Water Management District Concerning Regulatory Programs for Activities in Wetlands

and Other Surface Waters."

C. Goals

It is a goal of the Parties to this Agreement to effectuate efficient, streamlined regulatory programs that govern activities affecting wetlands and other surface waters, including jurisdictional WOUS. Towards this goal, the Parties have established joint application forms and agree, where possible, to coordinate the distribution and review of information received during the permit application review process. Other streamlining measures to be explored and further developed by the Parties include joint field inspections and pre-application meetings, coordinated, complementary enforcement efforts, and the Corps's state programmatic and regional general permits. Additionally, in order to further streamline the permitting process, the agencies agree to continue to jointly review the wetland delineation methodologies of the state and the Corps to identify any differences and explore ways to further resolve or overcome these differences. Further, the Parties may explore methods to integrate the principles of ecosystem management within their existing legal authority in order to achieve more effective environmental protection.

II. WATER QUALITY CERTIFICATION

By letter dated January 15, 1998, to the Secretary of the Department of Environmental Protection, the Governor of the State of Florida, under the authority in 33 U.S.C., Sections 1341 and 1362 (the Clean Water Act), and 40 C.F.R. 121.1(e), designated the Department as the agency responsible for certifying compliance with applicable state water quality standards for federal licenses or permits issued by the Corps under Section 404 of the Clean Water Act, 33 U.S.C. 1344. That letter granted the Department the authority to issue, deny, or waive certification of compliance with water quality standards, the authority to identify categories of activities for which water quality certification is waived, and the authority to establish categories of State permits or other authorizations for which the issuance (or denial) of the permit or authorization constitutes a certification (or denial of certification) that the permitted or authorized activity complies with (or fails to comply with) applicable state water quality standards. By letter dated February 2, 1998, to the Administrator of the Environmental Protection Agency, the Secretary of the Department of Environmental Protection, as delegated by the Governor of the State of Florida, designated certain permits under part IV of chapter 373, F.S., and other authorizations as constituting state certification of compliance with state water quality standards unless the permit or other authorization specifically states otherwise, established categories of activities for which water quality certification is waived, and delegated concurrent authority to issue, deny or waive water quality certifications to a District created under section 373.069, F.S., or to the head of a county, municipality or local government local pollution control program where such county, municipality, or local government pollution control program has received delegation of the permitting authority from the Department or a District under section 373.441, F.S. In accordance with these letters, the Parties agree to the following regarding water quality certification.

A. Grants or Waivers of Water Quality Certification

1. Each of the following will constitute the granting of water quality certification by the Department or Districts, unless a State permit is issued pursuant to the net improvement provisions for water quality provided by section 373.414(1)(b), F.S., or unless otherwise specifically stated in the State permit or authorization.

   (a) Noticed general environmental resource permits and wetland resource general permits under part IV of chapter 373, F.S.

   (b) Standard, general, standard general, individual, or conceptual approval environmental resource permits, and individual wetland resource permits issued under part IV of chapter 373, F.S.

   (c) Management and storage of surface waters permits for agricultural activities or agricultural water management systems issued under part IV of chapter 373, F.S.

   (d) Joint coastal permits issued under section 161.055 and part IV of chapter 373, F.S.

   (e) Individual and conceptual mitigation bank permits issued under part IV of chapter 373, F.S.

   (f) A written final order granting "certification" under one of the following siting acts by the Governor and Cabinet as the Siting Board, the Florida Land and Water Adjudicatory Commission, or by the Department of Environmental Protection, as appropriate:

      (1) The Florida Electric Power Plant Siting Act, sections 403.501- .519, F.S. (2011), as amended;

      (2) The Florida Transmission Line Siting Act, sections 403.501 - .5365, F.S., together with sections 403.537-.539, F.S. (2011), as amended; or

      (3) The Natural Gas Transmission Pipeline Siting Act, sections 403.9401-.9425, F.S. (2011), as amended.

   (g) Consent decrees, orders, or agreements issued by the Department, a District, or a delegated local government under section 373.441, F.S. (hereinafter the term "Department or District' shall also include local governments delegated in accordance with Section 373.441, F.S.), where such consent decree, order, or agreement authorizes activities which would otherwise require a permit under part IV of chapter 373, F.S.

2. Water quality certification will be considered waived for the following:

(a) Activities, other than agricultural activities or agricultural water management systems, exempt by rule or statute from the requirement to obtain an environmental resource permit and a wetland resource permit under part IV of chapter 373, F.S., including activities that fall below permitting thresholds;

(b) Agricultural activities or agricultural water management systems exempt by rule or statute from the requirement to obtain an environmental resource permit and a management and storage of surface waters permit under part IV of chapter 373, F.S., including activities that fall below permitting thresholds;

(c) Activities permitted or authorized, as described in Sections II. A. 1(a) through (g), when the permit or authorization is issued pursuant to the net improvement provisions for water quality provided by paragraph 373.414(1)(b), F.S.;

(d) Activities permitted or authorized in Sections II. A. 1(a) through (g) when the permit or authorization expressly waives water quality certification.

B. Denial of Water Quality Certification

Unless otherwise stated in the denial document, the denial of the State permit or authorization, listed in Section II.A.1. of this Agreement shall constitute denial of the state water quality certification. Where a final Department or District action on an application for a permit listed in Section II.A.1. of this Agreement cannot be made within the time frames specified in Section II.C. of this Agreement and the application otherwise does not meet the criteria for issuance of a permit, the Department or District may deny water quality certification for the activity described in the permit application in order to meet the time clock requirements in Section II.C.

C. Time Frames

Once the Department or the District determines that an application for a permit listed under Section II.A.1. of this Agreement is complete, the Department or District shall have 365 days to act on the certification, or the certification shall be considered waived.

D. Corps Nationwide Permits

For nationwide permits that have received water quality certification by the Department, or where water quality certification has been waived by the Department or District, no individual water quality certification is necessary. For those Corps nationwide permits that were conditioned upon individual review of the water quality certification by the Department or District, or that have been denied water quality certification by the Department or District, state water quality certification for an individual proposed activity shall be made in accordance with

Sections II. A - C.

III. COASTAL ZONE CONSISTENCY CONCURRENCE (CZCC)

In accordance with section 373.428, F.S., final agency action by the Department or District on a permit application submitted under part IV of chapter 373, F.S., that is subject to a consistency review under section 380.23, F.S., shall constitute the state's determination as to whether the activity is consistent with the federally approved Coastal Management Program. The Parties agree to the following procedures regarding coastal zone consistency determinations.

A. Determination of Concurrence

The following will constitute a finding of concurrence with the state's coastal zone management program for the activity authorized thereby:

1. Noticed general environmental resource permits and wetland resource general permits under part IV of chapter 373, F.S.;

2. Standard, general, standard general, individual, or conceptual approval environmental resource permits and individual wetland resource permits issued under part IV of chapter 373, F.S.;

3. Joint coastal permits issued under section 161.055 and part IV of chapter 373, F.S.;

4. Individual and conceptual mitigation bank permits issued under section 161.055 and part IV of chapter 373, F.S.; and

5. Management and storage of surface waters permits for agricultural activities or agricultural water management systems issued under part IV of chapter 373, F.S.

B. Determination of Inconsistency

The denial of a permit listed in Section III. A. of this Agreement shall constitute a finding that the activity is inconsistent with the state's coastal zone management program.

C. Time Frames

The time frame for a coastal zone concurrence begins upon a determination by the Department or the District that an application for a permit listed in Section III.A. of this Agreement is complete. The coastal zone consistency decision must be made within 180 days after the application is considered complete by the Department or District and in accordance with the procedures in 15 C.F.R. 930

Subpart D. At the end of 180 days, if a determination of coastal zone consistency has not been made, concurrence will be conclusively presumed, unless the applicant and the Department or District have agreed to waive the 180-day time clock pursuant to 15 C.F.R. 930.60(b).

D. Corps Nationwide Permits

For nationwide permits that have been determined to be consistent with the state's coastal zone management program, no individual coastal zone consistency concurrence determination is necessary. For those Corps nationwide permits where consistency with the state coastal zone management program is conditioned upon individual review of the coastal zone management consistency by the state of Florida, or has been denied by Florida, the final consistency concurrence determination for a proposed activity shall be made in accordance with Sections III A - C.

E. Exemptions

Pursuant to section 380.23(7), F.S., applications for federally permitted or licensed activities that qualify for an exemption under section 373.406 or 403.813(1), F.S., are not eligible to be reviewed for federal consistency with part IV of chapter 373, F.S. For purposes of this Agreement, the Corps or any designated Federal, State or local agency administering general permits on behalf of the Corps under 33 C.F.R. § 325.2(b)(2) may presume CZCC by operation of Section 380.23(7), F.S., for such exempt activities, provided the activity receives the applicable authorization to use and occupy state-owned submerged lands under chapter 253, F.S., and, as applicable, chapter 258, F.S., and the rules of the Florida Administrative Code adopted thereunder. For purposes of this agreement, the Corps or any designated Federal, State or local agency administering general permits on behalf of the Corps shall not be precluded from acting on the DA permit before the applicable authorization under chapter 253, F.S., and, as applicable, chapter 258, F.S., is obtained or granted, because it is understood such authorization must be obtained prior to persons using or occupying state-owned submerged lands.

IV. PERMIT APPLICATION COORDINATION

A. Joint Application Forms

The Parties have developed comprehensive, integrated joint permit application forms to initiate processing of permit applications required by each of the Parties. For activities that require a DA Permit and an environmental resource permit under part IV of chapter 373, F.S., the "Joint Application for Environmental Resource Permit/Authorization to Use State Lands/Federal Dredge and Fill Permit," the "Application for a Joint Coastal Permit," or the "Joint Application Forms and Instructions for Wetland Resource Alterations (Dredging & Filling) in the Waters of Florida" will be used. For activities that require a DA Permit and a wetland resource permit under the provisions of Section 373.4145(6) or

373.414(11) - (16), F.S., the "Joint Application For Works in the Waters of Florida" and the "Notice of Intent to Construct Works Pursuant to a Wetland Resource General Permit" will be used.

B. Processing of Applications

Except as provided below for E-permitting, for activities that do not qualify for processing as "green" under the State Programmatic General Permit, once a joint application, a request for permit modification, or a request for verification of exempt status is submitted by an applicant to the Department or District, the responsible agency (in accordance with the division of responsibilities in the Operating Agreements in effect between the Department and Districts) will, forward the following information to the Corps office with responsibility for processing the corresponding DA Permit application. All forwarded materials will include a Department or District application processing number

1. Forwarding Received Applications;

   Within five working days of receipt, the Department or District, as applicable, will forward to the Corps, either by mail or electronically via a mutually agreed upon protocol:

   (a) For WRP applications, a copy of the application, all submitted maps, drawings, and any other information accompanying the application or request;

   (b) For ERP applications, including mitigation banks, that have one or more of the following items provided or identified, one copy of the Notice of Receipt of the Application (Section C of the Joint Application) with its accompanying maps, drawings and any other information accompanying the application or request:

      (1) A completed Corps' Data Entry Sheet;

      (2) Any indication in the application that work is occurring, or appears to be occurring, in, on, or over wetlands and other surface waters.

      (3) A type of DA Permit or enforcement action is requested or is identified as pending, issued or denied at the location of the activity. The Corps number starts with an "SAJ" and the four digit year (prior to 1990 the number started with a two digit year); the number also may include staff initials.

      (4) An indication in the application that a member of the Corps has attended a pre-application meeting.

2. Forwarding of Applications and Material Received During Processing:

(a) For WRP and ERP applications, including mitigation banks, that meet the criteria of IV.B.1., the Department or District, as applicable, will, within five working days of sending to the applicant, forward one copy of all Requests for Additional Information (RAIs) to the Corps.

(b) For those applications not copied to the Corps in which either state or federal wetlands within the proposed activity or future phases are discovered during the evaluation, the Department or District, as applicable, will, within five working days of this discovery, forward the Corps one copy of the Notice of Receipt of the Application (Section C of the Joint Application) with its accompanying maps, drawings, and activity descriptions, together with a copy of any RAIs that have been generated.

(c) A copy of materials subsequently submitted. Individual Corps offices will coordinate with individual Department and District offices to identify the manner in which the Corps wants such documents forwarded to it.

3. Forwarding Modifications and Materials:

Within five working days of receipt of a modification request, the Department or District, as applicable, will forward to the Corps, either by mail or electronically via a mutually agreed upon protocol, a copy of the request with all attached maps, drawings, and any other information accompanying the request.

4. E-Permitting — For Department or District offices that electronically post applications, RAIs, modifications, and related materials to the Internet, an .ftp site, or another site accessible to the Corps, the Department or District shall first coordinate with the Corps to ensure the electronic posting procedure is compatible with the needs of the Corps. If the Department or the District's electronic posting procedure is not compatible with the Corps's requirements, the Department or District shall continue to mail materials to the Corps.

5. In those cases where the Corps receives a copy of the joint application, an application to modify a permit, a notice to use a noticed general permit, a request to verify qualification for an exemption, or a request to verify that an activity does not require a permit directly from an applicant, the Corps shall retain one copy of the application and all accompanying materials and send all other copies and materials to the appropriate office of the Department or District. The Corps shall include its processing number with this information.

6. The Department or District shall not be obligated to forward documents or materials to the Corps that are confidential under chapter 119, F.S. In such cases the Corps will request the applicant, permittee, or sponsor to provide such information directly to the Corps as needed.

7. In those cases where the Corps has made a "no permit required" (NPR) determination on an application that is under review by the Department or District,

the Corps will furnish a copy of the determination to the Department or District. The Corps will include the applicant's name, location, brief project name/description, and, if known, the Department or District application file number. The Department or District will no longer be required to provide information to the Corps subsequent to receiving this notification unless the project is modified to include additional impacts to wetlands or other surface waters.

C. Mitigation Bank and In-lieu Fee Review

1. Interagency Review Team

Interagency review of mitigation bank applications and establishment of in-lieu fee programs is required by 33 C.F.R. § 332.8(b) and serves to facilitate a more efficient and effective review of such applications. The Corps's District Engineer will establish an Interagency Review Team (IRT) to review documentation for the establishment and management of mitigation banks and in-lieu fee programs. He or his designated representative serves as Chair of the IRT. In cases where a mitigation bank or in-lieu fee program involves an activity that is proposed to satisfy state statutory requirements, it may be appropriate for either the Department or District to serve as Co-Chair of the IRT. For purposes of this Agreement, the "administering agency" is defined as a member of either the Department or the applicable District. The IRT may include representatives from tribal, state, and local regulatory and resource agencies when such agencies have authorities or mandates directly affecting, or affected by, the establishment, operation, or use of the mitigation bank or in-lieu fee program. The District Engineer will give full consideration to any comments and advice received within time limits specified at 33 C.F.R. § 332.8. The Department and the Districts will give full consideration to any comments and advice received within the time limits specified in chapter 120, F.S. The District Engineer retains final authority for the approval of the instruments and other documentation required by the Corps. The Department and the Districts retain final authority for the approval of state permits or other documentation required by the state.

2. Team Coordination

An application to the Department or Districts for a mitigation bank shall be coordinated with the Corps in accordance with the Permit Application Coordination section IV. B. of this Agreement. When the Corps receives a mitigation bank or in-lieu-fee prospectus or draft prospectus, copies shall be provided to the Department or applicable District, along with other IRT members. In addition, the IRT shall coordinate, review, and take action on the items required by 33 C.F.R. § 332.8.

D. Distribution of Agency Actions

For applications that meet the criteria of section IV.B.1, IV.B.2, or IV.B.3 above,

the Department or District, as applicable, will, within five working days of sending to the applicant/permittee, forward to the Corps a copy of all final permitting actions, including copies of permits, formal or major permit modifications, permit denials, application withdrawals, exemption verification letters, and the cover letter for formal determinations.

The Corps shall forward to the Department or Districts, as appropriate, copies of notices of intent to issue standard permits, final actions on standard permits, and "no permit required" determinations within five working days of taking such actions.

V. MITIGATION FINANCIAL ASSURANCE

A. When the type and amount of the financial assurance obtained or required by the Department or District for compensatory mitigation, including mitigation banks, as part of a permit issued under part IV of chapter 373, F.S., adequately addresses the financial assurance requirements of the Corps, the Corps may determine that additional financial assurance is not necessary for that compensatory mitigation project or mitigationbank.

B. The Corps's concurrence with the Department's or District's financial assurance mechanism shall be subject to the applicant, sponsor, or permittee agreeing to the following requirements:

1. The Corps shall notify the Department or District in all cases where the Corps is relying on the financial assurance mechanism accepted by the Department or District so that the Department or District can coordinate with the Corps prior to modification, amendment, partial release, termination, or revocation of the financial assurance instrument.

2. The financial assurance instrument shall be in place prior to commencement of the permitted activity.

3. Disbursements from these financial assurance instruments can only be made with direction and approval of the Department or District as applicable after prior notice has been given to the Corps in accordance with 4., below.

4. The Corps permit shall require that the permittee shall provide the Corps written notice at least 120 days in advance of any termination or revocation of any financial assurance instrument by the financial institution, and notice at least 30 days in advance of modifications, amendments, and partial releases.

C. If, at any time, the Corps determines that the type or amount of the financial assurance mechanism being proposed for a State permit under part IV of chapter 373, F.S., is not sufficient to meet the Corps' requirements for a DA Permit or a mitigation banking instrument or in-lieu fee instrument and those requirementsare

within the scope of such state permit, the Corps may require the applicant, sponsor, or permittee for the DA Permit to request that the Department or District modify the permit under part IV of chapter 373, F.S., as applicable, to require an additional amount or alternative type of financial assurance mechanism to meet the Corps' requirements. In such a case:

1. The financial assurance instrument shall be in place prior to commencing the permitted activity;

2. Prior to any disbursements under the financial assurance instruments, the Department or District shall coordinate with the Corps at least 30 days prior to such disbursement being made, but the final decision on the disbursement shall be made by the Department or District;

3. Notification of such disbursements shall be provided to the Corps within 10 days after the disbursement;

4. The Corps permit shall require that the permittee shall provide the Corps written notice at least 120 days in advance of any termination or revocation of any financial assurance instrument by the financial institution, and notice at least 30 days in advance of modifications, amendments, and partial releases.

Notwithstanding the above, the Department or District is not obligated to accept financial assurance mechanisms that are not required to satisfy the permit requirements under part IV of chapter 373, F.S.

D. If the Corps requires an alternative type or an additional amount of financial assurance to meet Corps mitigation requirements outside of the scope of the State permit, the Department or District is not obligated to be a party to any instrument related to that assurance.

VI. MITIGATION SITE PROTECTION

Long-term protection of a mitigation site or preservation to prevent secondary impacts for a State permit, mitigation bank instrument, or as the result of an enforcement action under part IV of chapter 373, F.S., may be provided through the conveyance of a conservation easement or restrictive covenants in accordance with Section 704.06,
F. S., or by transfer of title to the Department or District (hereinafter all referred to as "site protection instrument").

In accordance with 33 C.F.R. § 332.7(a)(1), when such a site protection instrument meets the Corps' requirements for mitigation site protection for the corresponding DA Permit for the same activities, the Corps may agree that the site protection instrument granted to the Department or District provides sufficient site protection, and not require an applicant, sponsor, or permittee to provide an amended, additional, or duplicative mitigation site protection instrument. When the Department or District accepts a site protection instrument in the form of a restrictive covenant or deed

restriction, the Corps may determine that an applicant needs to execute a conservation easement.

A. When the Department or District agrees to hold or amend a site protection instrument which provides rights to the Corps, the Department and District agree to accept a site protection instrument containing, or that is amended to contain, the following language, unless alternative language is needed on a case-specific basis:

> "WHEREAS, the U.S. Army Corps of Engineers Permit No._____(Corps Permit) authorizes certain activities in the waters of the United States and requires this site protection instrument over the lands identified in Exhibit XX as mitigation for such activities;
>
> "Rights of the U.S. Army Corps of Engineers ("Corps"): The Corps, as a third party beneficiary, shall have the right to enforce the terms and conditions of the site protection instrument, including:
>
> "1. The right to take action to preserve and protect the environmental value of the Property;
>
> "2. The right to prevent any activity on the Property that is inconsistent with the purpose of this instrument, and to require the restoration of areas or features of the Property that may be damaged by any inconsistent activity;
>
> "3. The right to enter upon and inspect the Property in a reasonable manner and at reasonable times to determine if Grantor or its successors and assigns are complying with the covenants and prohibitions contained in this instrument;
>
> "4. The right to enforce this instrument by injunction or proceed at law or in equity to enforce the provisions of this instrument and the covenants set forth herein, to prevent the occurrence of any of the prohibited activities hereinafter set forth, and the right to require Grantor, or its successors and assigns, to restore such areas or features of the Property that may be damaged by unauthorized activities; and
>
> "5. The Grantor, including their successors or assigns, shall provide the Corps at least 60 days advance notice in writing before any action is taken to amend, alter, release, or revoke this instrument. The Grantee shall provide reasonable notice and an opportunity to comment or object to the release or amendment to the U.S. Army Corps of Engineers. The Grantee shall consider any comments or objections from the U.S. Army Corps of Engineers when making the final decision to release or amend such a conservation easement."

B. When the Corps requires additional protection or additional mitigation lands for an

activity that has a corresponding State permit, mitigation bank instrument, or enforcement instrument under part IV of chapter 373, F.S., and the Department or the District is willing to accept the additional or amended site protection instrument, the instrument shall include the following additional provision:

> "The Grantor, including their successors or assigns, shall provide the Corps at least 60 days advance notice in writing before any action is taken to amend, alter, release, or revoke this instrument. The Grantee shall provide reasonable notice and an opportunity to comment or object to the release or amendment to the U.S. Army Corps of Engineers. The Corps, as third party beneficiary, must approve any amendment, alteration, release or revocation of this instrument, and must approve any proposed structures, work, or activities on the Property that require approval by the Grantee."

C. When the Department or District does not agree or is unable to modify the permit, mitigation bank instrument, or enforcement instrument under part IV of chapter 373, F.S., or any existing site protection instrument to include the additional mitigation land needed to meet the Corps's requirements, the Department or District may agree to accept a separate mitigation site protection instrument over the additional land. If the Department or District agrees to accept a separate mitigation site protection instrument over the additional land, the Department or District agree that the instrument shall be accepted with the following additional provision:

> "The Grantor, including their successors or assigns, shall provide the Corps at least 60 days advance notice in writing before any action is taken to amend, alter, release, or revoke this instrument. The Grantee shall provide reasonable notice and an opportunity to comment or object to the release or amendment to the U.S. Army Corps of Engineers. The Corps, as third party beneficiary, must approve any amendment, alteration, release or revocation of this instrument, and must approve any proposed structures, work, or activities on the Property that require approval by the Grantee."

D. In any case where the Department or District agrees to hold or amend a site protection instrument which provides rights to the Corps, as described above, the Corps shall notify the applicable Department or District office within 10 days of any discovery of a violation of the terms and conditions of the site protection instrument, and shall coordinate with the applicable Department or District office prior to requiring restoration of areas or features of the Property that were damaged by unauthorized activities so that any restoration activities receive applicable authorization required under part IV of chapter 373, F.S.

E. In the event a site protection instrument has already been recorded on behalf of the Department or District for the same activity that will be authorized under a corresponding DA Permit or mitigation bank or in-lieu fee instrument that does not include the "Rights of the Corps" language in VILA., above, the Corps may require the applicant, permittee, or sponsor to request that the Department or District

modify their respective permit, mitigation bank instrument or enforcement instrument with its associated site protection instrument to include that language.

F. The Department and the District do not agree to accept a site protection instrument on behalf of the Corps when there is no corresponding permit under part IV of chapter 373, F.S., for the activity that is subject to a DA permit.

G. In all cases, the Corps shall not request an applicant, permittee, or sponsor to record any site protection instrument granted to the Department or District without first coordinating with and obtaining a letter of concurrence from the applicable office of the Department or District; however, final approval of this request may be required from the District Governing Board. Failure to obtain such written concurrence shall result in any such recorded site protection instrument being considered an invalid conveyance of the interest to the Department or District.

H. In any case when the Corps requires the applicant, permittee, or sponsor to obtain an additional site protection instrument, the Corps agrees to take responsibility for all negotiations with the applicant, permittee, or sponsor associated with processing and preparation of the site protection instrument required by the Corps, including review of the title work. The Corps also shall take responsibility for all steps required to have the site protection instrument recorded, including any subsequent amendments or releases of any site protection instrument previously recorded on behalf of the Department or District, and for sending an original copy of the recorded site protection instrument, and any modifications and releases thereto, to the applicable Department or District office that serves the area in which the site protection instrument is recorded. The Corps also agrees to monitor for compliance and pursue needed enforcement, including litigation, to enforce the terms and conditions of the site protection instrument obtained over any lands that were not required to be protected under the permit, mitigation bank instrument, or enforcement instrument under part IV of chapter 373, F.S.

I. The Parties agree to coordinate in the event compliance monitoring of the protected lands identifies the need for enforcement.

VII. COMPLIANCE AND ENFORCEMENT

Upon discovery of an unauthorized or non-compliant activity in WOUS, wetlands, or other surface waters, the Party discovering the activity will notify the appropriate Party to this Agreement regarding the unauthorized or non-compliant activity. The Parties may coordinate their enforcement activities when appropriate in order to maximize limited agency resources and encourage compliance. Regardless of any coordination that may occur, each Party will maintain independent enforcement authority and discretion.

VIII. INTERAGENCY MEETINGS

A. Permitting Meetings

Subject to fiscal or travel restrictions, each Party agrees to host interagency permitting meetings on a rotating basis. The time and place of all the meetings will be addressed at the beginning of each calendar year. Because interagency meetings between the Parties and other agencies can serve as a good forum to aid communication, exchange information, conduct pre-application meetings, or to resolve outstanding permitting issues, each Party will endeavor to have a representative attend all interagency meetings.

B. Enforcement Meetings

Subject to fiscal or travel restrictions, representatives of the Parties' enforcement staff shall endeavor to meet at least annually. If possible, the meeting should take place at Enforcement Workshops hosted by the Department or District, but local meetings in areas of operation are also appropriate and encouraged. The meeting should address issues related to implementation of section VII of this Agreement.

C. Cross Training

The Parties agree to provide opportunities, when possible, for cross-training. This may take the form of: providing spaces in formally scheduled training courses; providing training sessions at each others' training events; providing personnel and opportunities for cross-training through developmental assignments; sharing interpretations of agency rules and procedures; and performing joint formal and informal training on other subjects of mutual interest.

IX. ELECTRONIC COORDINATION

To the extent practicable, the Parties agree to use electronic media for the transfer of data to facilitate information exchange. The Parties agree to participate in future efforts to enhance electronic communication necessary to achieve their regulatory missions.

X. DELEGATED PROGRAMS

Where the Department or Districts delegate to a local government all or a portion of the permitting or enforcement authority under part IV of chapter 373, F.S., the delegation agreement shall include a provision that the local government shall be subject to all the terms and conditions of this Agreement, although the Corps, with the concurrence of the delegating agency, may allow deviations from these terms and conditions.

XI. EFFECTIVE DATE

This Agreement shall take effect upon execution by all the Parties. In witness whereof, the Parties hereto have caused this Agreement to be executed by their duly authorized representatives on the latest day and year provided below.

XII. TERMINATION

Any Party who wishes to terminate this Agreement with or without cause shall provide 60 days prior written notice to the other Parties. The notice submitted by the Corps shall be signed by the District Engineer of the Jacksonville District. The notice submitted by a District shall be signed by the Chair of the Governing Board. The notice submitted by the Department shall be signed by the Secretary. By mutual agreement of all Parties, the 60 day notice period may be reduced. Within 30 days of a notice of intent to terminate this Agreement, all Parties shall make good faith efforts to preserve the Agreement by attempting to resolve any basis for the termination. This Agreement also may be terminated by future agreements between the Parties that which expressly supersede this Agreement.

Herschel T. Vinyard Jr.
Secretary
Florida Department of
Environmental Protection

4/4/12
Date

Lad Daniels
Chair, Governing Board
St. Johns River Water
Management District

4/10/12
Date

Joe Collins
Chair, Governing Board
South Florida Water
Management District

4/12/2012
Date

Donald J. Quincey, Jr.
Chair, Governing Board
Suwannee River Water
Management District

8-14-12
Date

Hugh M. Gramling
Vice Chair, Governing Board
Southwest Florida Water
Management District

5/22/12
Date

Alan M. Dodd
Colonel, U. S. Army
District Commander

9-4-12
Date

George Roberts
Chair, Governing Board
Northwest Florida Water
Management District

4/30/12
Date

(This Appendix is not incorporated by reference; Effective Date: October 2026)

APPENDIX F

Bald and Golden Eagle Protection Act

16 USC 668-668d
Bald and Golden Eagle Protection Act

SUBCHAPTER II—PROTECTION OF BALD AND GOLDEN EAGLES

Release date: 2004-04-30

- § 668. Bald and golden eagles
- § 668a. Taking and using of the bald and golden eagle for scientific, exhibition, and religious purposes
- § 668b. Enforcement provisions
- § 668c. Definitions
- § 668d. Availability of appropriations for Migratory Bird Treaty Act

§ 668. Bald and golden eagles

(a) Prohibited acts; criminal penalties
Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as provided in this subchapter, shall knowingly, or with wanton disregard for the consequences of his act take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, or whoever violates any permit or regulation issued pursuant to this subchapter, shall be fined not more than $5,000 or imprisoned not more than one year or both: Provided, That in the case of a second or subsequent conviction for a violation of this section committed after October 23, 1972, such person shall be fined not more than $10,000 or imprisoned not more than two years, or both: Provided further, That the commission of each taking or other act prohibited by this section with respect to a bald or golden eagle shall constitute a separate violation of this section: Provided further, That one-half of any such fine, but not to exceed $2,500, shall be paid to the person or persons giving information which leads to conviction: Provided further, That nothing herein shall be construed to prohibit possession or transportation of any bald eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to June 8, 1940, and that nothing herein shall be construed to prohibit possession or transportation of any golden eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to the addition to this subchapter of the provisions relating to preservation of the golden eagle.
(b) Civil penalties
Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as provided in this subchapter, shall take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner, any bald eagle, commonly known as the American eagle, or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, or whoever violates any permit or regulation issued pursuant to this subchapter, may be assessed a civil penalty by the Secretary of not more than $5,000 for each such violation. Each violation shall be a separate offense. No penalty shall be assessed unless such person is given notice and opportunity for a hearing with respect to such violation. In determining the amount of the penalty, the gravity of the violation, and the demonstrated good faith of the person charged shall be considered by the Secretary. For good cause shown, the Secretary may remit or mitigate any such penalty. Upon any failure to pay the penalty assessed under this section, the Secretary may request the Attorney General to institute a civil action in a district court of the United States for any district in which such person is found or resides or transacts business to collect the penalty and such court shall have jurisdiction to hear and decide any such action. In hearing any such action, the court must sustain the Secretary's action if supported by substantial evidence.
(c) Cancellation of grazing agreements
The head of any Federal agency who has issued a lease, license, permit, or other agreement authorizing the grazing of domestic livestock on Federal lands to any person who is convicted of a violation of this subchapter or of any permit or regulation issued hereunder may immediately cancel each such lease, license, permit, or other agreement. The United States shall not be liable for the payment of any compensation, reimbursement, or damages in connection with the cancellation of any lease, license, permit, or other agreement pursuant to

16 USC 668-668d
Bald and Golden Eagle Protection Act

this section.

§ 668a. Taking and using of the bald and golden eagle for scientific, exhibition, and religious purposes

Whenever, after investigation, the Secretary of the Interior shall determine that it is compatible with the preservation of the bald eagle or the golden eagle to permit the taking, possession, and transportation of specimens thereof for the scientific or exhibition purposes of public museums, scientific societies, and zoological parks, or for the religious purposes of Indian tribes, or that it is necessary to permit the taking of such eagles for the protection of wildlife or of agricultural or other interests in any particular locality, he may authorize the taking of such eagles pursuant to regulations which he is hereby authorized to prescribe: Provided, That on request of the Governor of any State, the Secretary of the Interior shall authorize the taking of golden eagles for the purpose of seasonally protecting domesticated flocks and herds in such State, in accordance with regulations established under the provisions of this section, in such part or parts of such State and for such periods as the Secretary determines to be necessary to protect such interests: Provided further, That bald eagles may not be taken for any purpose unless, prior to such taking, a permit to do so is procured from the Secretary of the Interior: Provided further, That the Secretary of the Interior, pursuant to such regulations as he may prescribe, may permit the taking, possession, and transportation of golden eagles for the purposes of falconry, except that only golden eagles which would be taken because of depredations on livestock or wildlife may be taken for purposes of falconry: Provided further, That the Secretary of the Interior, pursuant to such regulations as he may prescribe, may permit the taking of golden eagle nests which interfere with resource development or recovery operations.

§ 668b. Enforcement provisions

(a) Arrest; search; issuance and execution of warrants and process
Any employee of the Department of the Interior authorized by the Secretary of the Interior to enforce the provisions of this subchapter may, without warrant, arrest any person committing in his presence or view a violation of this subchapter or of any permit or regulations issued hereunder and take such person immediately for examination or trial before an officer or court of competent jurisdiction; may execute any warrant or other process issued by an officer or court of competent jurisdiction for the enforcement of the provisions of this subchapter; and may, with or without a warrant, as authorized by law, search any place. The Secretary of the Interior is authorized to enter into cooperative agreements with State fish and wildlife agencies or other appropriate State authorities to facilitate enforcement of this subchapter, and by said agreements to delegate such enforcement authority to State law enforcement personnel as he deems appropriate for effective enforcement of this subchapter. Any judge of any court established under the laws of the United States, and any United States magistrate judge may, within his respective jurisdiction, upon proper oath or affirmation showing probable cause, issue warrants in all such cases.
(b) Forfeiture
All bald or golden eagles, or parts, nests, or eggs thereof, taken, possessed, sold, purchased, bartered, offered for sale, purchase, or barter, transported, exported, or imported contrary to the provisions of this subchapter, or of any permit or regulation issued hereunder, and all guns, traps, nets, and other equipment, vessels, vehicles, aircraft, and other means of transportation used to aid in the taking, possessing, selling, purchasing, bartering, offering for sale, purchase, or barter, transporting, exporting, or importing of any bird, or part, nest, or egg thereof, in violation of this subchapter or of any permit or regulation issued hereunder shall be subject to forfeiture to the United States.
(c) Customs laws applied
All provisions of law relating to the seizure, forfeiture, and condemnation of a vessel for violation of the customs laws, the disposition of such vessel or the proceeds from the sale thereof, and the remission or mitigation of such forfeitures, shall apply to the seizures and forfeitures incurred, or alleged to have been incurred, under the provisions of this subchapter, insofar as such provisions of law are applicable and not

16 USC 668-668d
Bald and Golden Eagle Protection Act

inconsistent with the provisions of this subchapter: Provided, That all powers, rights, and duties conferred or imposed by the customs laws upon any officer or employee of the Treasury Department shall, for the purposes of this subchapter, be exercised or performed by the Secretary of the Interior or by such persons as he may designate.

§ 668c. Definitions

As used in this subchapter "whoever" includes also associations, partnerships, and corporations; "take" includes also pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb; "transport" includes also ship, convey, carry, or transport by any means whatever, and deliver or receive or cause to be delivered or received for such shipment, conveyance, carriage, or transportation.

§ 668d. Availability of appropriations for Migratory Bird Treaty Act

Moneys now or hereafter available to the Secretary of the Interior for the administration and enforcement of the Migratory Bird Treaty Act of July 3, 1918 [16 U.S.C. 703 et seq.], shall be equally available for the administration and enforcement of this subchapter.

APPENDIX G

USFWS Habitat Management Guidelines for the Wood Stork in the Southeast Region

HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION



B-1

HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

Prepared by

John C. Ogden
Acting Program Manager
Wildlife Research
Everglades National Park

for the

Southeast Region
U.S. Fish and Wildlife Service

January 1990

Cover design by
Florida Power & Light Company
Miami, Florida

HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

Introduction

A number of Federal and state laws and/or regulations prohibit, cumulatively, such acts as harrassing, disturbing, harming, molesting, pursuing, etc., wood storks, or destroying their nests (see Section VII). Although advisory in nature, these guidelines represent a biological interpretation of what would constitute violations of one or more of such prohibited acts. Their purpose is to maintain and/or improve the environmental conditions that are required for the survival and well-being of wood storks in the southeastern United States, and are designed essentially for application in wood stork/human activity conflicts (principally land development and human intrusion into stork use sites). The emphasis is to avoid or minimize detrimental human-related impacts on wood storks. These guidelines were prepared in consultations with state wildlife agencies and wood stork experts in the four southeastern states where the wood stork is listed as Endangered (Alabama, Florida, Georgia, South Carolina).

General

The wood stork is a gregarious species, which nests in colonies (rookeries), and roosts and feeds in flocks, often in association with other species of long-legged water birds. Storks that nest in the southeastern United States appear to represent a distinct population, separate from the nearest breeding population in Mexico. Storks in the southeastern U.S. population have recently (since 1980) nested in colonies scattered throughout Florida, and at several central-southern Georgia and coastal South Carolina sites. Banded and color-marked storks from central and southern Florida colonies have dispersed during non-breeding seasons as far north as southern Georgia, and the coastal counties in South Carolina and southeastern North Carolina, and as far west as central Alabama and northeastern Mississippi. Storks from a colony in south-central Georgia have wintered between southern Georgia and southern Florida. This U.S. nesting population of wood storks was listed as endangered by the U.S. Fish and Wildlife Service on February 28, 1984 (*Federal Register* 49(4):7332-7335).

Wood storks use freshwater and estuarine wetlands as feeding, nesting, and roosting sites. Although storks are not habitat specialists, their needs are exacting enough, and available habitat is limited enough, so that nesting success and the size of regional populations are closely regulated by year-to-year differences in the quality and quantity of suitable habitat. Storks are especially sensitive to environmental conditions at feeding sites; thus, birds may fly relatively long distances either daily or between regions annually, seeking adequate food resources.

All available evidence suggests that regional declines in wood stork numbers have been largely due to the loss or degradation of essential wetland habitat. An understanding of the qualities of good stork habitat should help to focus protection efforts on those sites

that are seasonally important to regional populations of wood storks. Characteristics of feeding, nesting, and roosting habitat, and management guidelines for each, are presented here by habitat type.

I. **Feeding habitat.**

A major reason for the wood stork decline has been the loss and degredation of feeding habitat. Storks are especially sensitive to any manipulation of a wetland site that results in either reduced amounts or changes in the timing of food availability.

Storks feed primarily (often almost exclusively) on small fish between 1 and 8 inches in length. Successful foraging sites are those where the water is between 2 and 15 inches deep. Good feeding conditions usually occur where water is relatively calm and uncluttered by dense thickets of aquatic vegetation. Often a dropping water level is necessary to concentrate fish at suitable densities. Conversely, a rise in water, especially when it occurs abruptly, disperses fish and reduces the value of a site as feeding habitat.

The types of wetland sites that provide good feeding conditions for storks include: drying marshes or stock ponds, shallow roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, and depressions in cypress heads or swamp sloughs. In fact, almost any shallow wetland depression where fish tend to become concentrated, either through local reproduction or the consequences of area drying, may be used by storks.

Nesting wood storks do most of their feeding in wetlands between 5 and 40 miles from the colony, and occasionally at distances as great as 75 miles. Within this colony foraging range and for the 110-150 day life of the colony, and depending on the size of the colony and the nature of the surrounding wetlands, anywhere from 50 to 200 different feeding sites may be used during the breeding season.

Non-breeding storks are free to travel much greater distances and remain in a region only for as long as sufficient food is available. Whether used by breeders or non-breeders, any single feeding site may at one time have small or large numbers of storks (1 to 100+), and be used for one to many days, depending on the quality and quantity of available food. Obviously, feeding sites used by relatively large numbers of storks, and/or frequently used areas, potentially are the more important sites necessary for the maintenance of a regional population of birds.

Differences between years in the seasonal distribution and amount of rainfall usually mean that storks will differ between years in where and when they feed. Successful nesting colonies are those that have a large number of feeding site options, including sites that may be suitable only in years of rainfall extremes. To maintain the wide range of feeding site options requires that many different wetlands, with both relatively short and long annual hydroperiods, be preserved. For example, protecting only the larger wetlands, or those with longer annual hydroperiods, will result in the eventual loss of smaller, seemingly less important wetlands. However, these small scale wetlands are crucial as the only available feeding sites during the wetter periods when the larger habitats are too deeply flooded to be used by storks.

II. **Nesting habitat.**

Wood storks nest in colonies, and will return to the same colony site for many years so long as that site and surrounding feeding habitat continue to supply the needs of the birds. Storks require between 110 and 150 days for the annual nesting cycle, from the period of courtship until the nestlings become independent. Nesting activity may begin as early as December or as late as March in southern Florida colonies, and between late February and April in colonies located between central Florida and South Carolina. Thus, full term colonies may be active until June-July in south Florida, and as late as July-August at more northern sites. Colony sites may also be used for roosting by storks during other times of the year.

Almost all recent nesting colonies in the southeastern U.S. have been located either in woody vegetation over standing water, or on islands surrounded by broad expanses of open water. The most dominant vegetation in swamp colonies has been cypress, although storks also nest in swamp hardwoods and willows. Nests in island colonies may be in more diverse vegetation, including mangroves (coastal), exotic species such as Australian pine (*Casuarina*) and Brazilian Pepper (*Schinus*), or in low thickets of cactus (*Opuntia*). Nests are usually located 15-75 feet above ground, but may be much lower, especially on island sites when vegetation is low.

Since at least the early 1970's, many colonies in the southeastern U.S. have been located in swamps where water has been impounded due to the construction of levees or roadways. Storks have also nested in dead and dying trees in flooded phosphate surface mines, or in low, woody vegetation on mounded, dredge islands. The use of these altered wetlands or completely "artificial" sites suggests that in some regions or years storks are unable to locate natural nesting habitat that is adequately flooded during the normal breeding season. The readiness with which storks will utilize water impoundments for nesting also suggests that colony sites could be intentionally created and maintained through long-term site management plans. Almost all impoundment sites used by storks become suitable for nesting only fortuitously, and therefore, these sites often do not remain available to storks for many years.

In addition to the irreversible impacts of drainage and destruction of nesting habitat, the greatest threats to colony sites are from human disturbance and predation. Nesting storks show some variation in the levels of human activity they will tolerate near a colony. In general, nesting storks are more tolerant of low levels of human activity near a colony when nests are high in trees than when they are low, and when nests contain partially or completely feathered young than during the period between nest construction and the early nestling period (adults still brooding). When adult storks are forced to leave their nests, eggs or downy young may die quickly (<20 minutes) when exposed to direct sun or rain.

Colonies located in flooded environments must remain flooded if they are to be successful. Often water is between 3 and 5 feet deep in successful colonies during the nesting season. Storks rarely form colonies, even in traditional nesting sites, when they are dry, and may abandon nests if sites become dry during the nesting period. Flooding in colonies may be most important as a defense against mammalian predators. Studies of stork colonies in Georgia and

Florida have shown high rates of raccoon predation when sites dried during the nesting period. A reasonably high water level in an active colony is also a deterrent against both human and domestic animal intrusions.

Although nesting wood storks usually do most feeding away from the colony site (>5 miles), considerable stork activity does occur close to the colony during two periods in the nesting cycle. Adult storks collect almost all nesting material in and near the colony, usually within 2500 feet. Newly fledged storks, near the end of the nesting cycle, spend from 1-4 weeks during the fledging process flying locally in the colony area, and perched in nearby trees or marshy spots on the ground. These birds return daily to their nests to be fed. It is essential that these fledging birds have little or no disturbance as far our as one-half mile within at least one or two quadrants from the colony. Both the adults, while collecting nesting material, and the inexperienced fledglings, do much low, flapping flight within this radius of the colony. At these times, storks potentially are much more likely to strike nearby towers or utility lines.

Colony sites are not necessarily used annually. Regional populations of storks shift nesting locations between years, in response to year-to-year differences in food resources. Thus, regional populations require a range of options for nesting sites, in order to successfully respond to food availability. Protection of colony sites should continue, therefore, for sites that are not used in a given year.

III. Roosting habitat.

Although wood storks tend to roost at sites that are similar to those used for nesting, they also use a wider range of site types for roosting than for nesting. Non-breeding storks, for example, may frequently change roosting sites in response to changing feeding locations, and in the process, are inclined to accept a broad range of relatively temporary roosting sites. Included in the list of frequently used roosting locations are cypress "heads" or swamps (not necessarily flooded if trees are tall), mangrove islands, expansive willow thickets or small, isolated willow "islands" in broad marshes, and on the ground either on levees or in open marshes.

Daily activity patterns at a roost vary depending on the status of the storks using the site. Non-breeding adults or immature birds may remain in roosts during major portions of some days. When storks are feeding close to a roost, they may remain on the feeding grounds until almost dark before making the short flight. Nesting storks traveling long distances (>40 miles) to feeding sites may roost at or near the latter, and return to the colony the next morning. Storks leaving roosts, especially when going long distances, tend to wait for mid-morning thermals to develop before departing.

IV. Management zones and guidelines for feeding sites.

To the maximum extent possible, feeding sites should be protected by adherence to the following protection zones and guidelines:

A. There should be no human intrusion into feeding sites when storks are present. Depending upon the amount of screening vegetation, human activity should be no closer than between 300 feet (where solid vegetation screens exist) and 750 feet (no vegetation screen).

B. Feeding sites should not be subjected to water management practices that alter traditional water levels or the seasonally normal drying patterns and rates. Sharp rises in water levels are especially disruptive to feeding storks.

C. The introduction of contaminants, fertilizers, or herbicides into wetlands that contain stork feeding sites should be avoided, especially those compounds that could adversely alter the diversity and numbers of native fishes, or that could substantially change the characteristics of aquatic vegetation. Increase in the density and height of emergent vegetation can degrade or destroy sites as feeding habitat.

D. Construction of tall towers (especially with guy wires) within three miles, or high power lines (especially across long stretches of open country) within one mile of major feeding sites should be avoided.

V. Management zones and guidelines for nesting colonies.

A. Primary zone: This is the most critical area, and must be managed according to recommended guidelines to insure that a colony site survives.

1. Size: The primary zone must extend between 1000 and 1500 feet in all directions from the actual colony boundaries when there are no visual or broad aquatic barriers, and never less than 500 feet even when there are strong visual or aquatic barriers. The exact width of the primary zone in each direction from the colony can vary within this range, depending on the amount of visual screen (tall trees) surrounding the colony, the amount of relatively deep, open water between the colony and the nearest human activity, and the nature of the nearest human activity. In general, storks forming new colonies are more tolerant of existing human activity, than they will be of new human activity that begins after the colony has formed.

2. Recommended Restrictions:

a. Any of the following activities within the primary zone, at any time of the year, are likely to be detrimental to the colony:

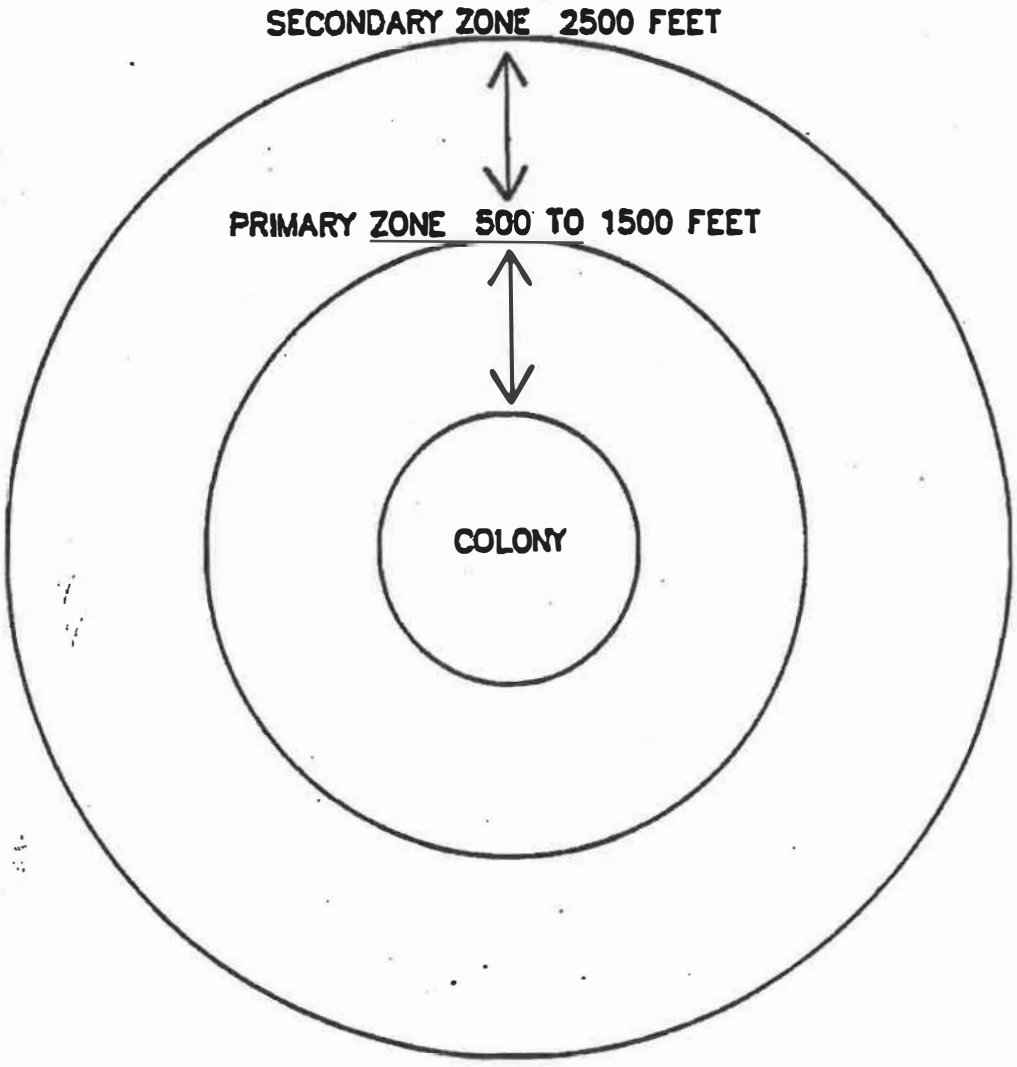
(1) Any lumbering or other removal of vegetation, and

(2) Any activity that reduces the area, depth, or length of flooding in wetlands under and surrounding the colony, except where periodic (less than annual) water control may be required to maintain the health of the aquatic, woody vegetation, and

(3) The construction of any building, roadway, tower, power line, canal, etc.

b. The following activities within the primary zone are likely to be detrimental to a colony if they occur when the colony is active:

(1) Any unauthorized human entry closer than 300 feet of the colony, and


SECONDARY ZONE 2500 FEET
PRIMARY ZONE 500 TO 1500 FEET
COLONY

(2) Any increase or irregular pattern in human activity anywhere in the primary zone, and

(3) Any increase or irregular pattern in activity by animals, including livestock or pets, in the colony, and

(4) Any aircraft operation closer than 500 feet of the colony.

B. Secondary Zone: Restrictions in this zone are needed to minimize disturbances that might impact the primary zone, and to protect essential areas outside of the primary zone. The secondary zone may be used by storks for collecting nesting material, for roosting, loafing, and feeding (especially important to newly fledged young), and may be important as a screen between the colony and areas of relatively intense human activities.

1. Size: The secondary zone should range outward from the primary zone 1000-2000 feet, or to a radius of 2500 feet of the outer edge of the colony.

2. Recommended Restrictions:

a. Activities in the secondary zone which may be detrimental to nesting wood storks include:

(1) Any increase in human activities above the level that existed in the year when the colony first formed, especially when visual screens are lacking, and

(2) Any alteration in the area's hydrology that might cause changes in the primary zone, and

(3) Any substantial (>20 percent) decrease in the area of wetlands and woods of potential value to storks for roosting and feeding.

b. In addition, the probability that low flying storks, or inexperienced, newly-fledged young will strike tall obstructions, requires that high-tension power lines be no closer than one mile (especially across open country or in wetlands) and tall trans-mission towers no closer than 3 miles from active colonies. Other activities, including busy highways and commercial and residential buildings may be present in limited portions of the secondary zone at the time that a new colony first forms. Although storks may tolerate existing levels of human activities, it is important that these human activities not expand substantially.

VI. Roosting site guidelines.

The general characteristics and temporary use-patterns of many stork roosting sites limit the number of specific management recommendations that are possible:

A. Avoid human activities within 500-1000 feet of roost sites during seasons of the year and times of the day when storks may be present. Nocturnal activities in active roosts may be especially disruptive.

B. Protect the vegetative and hydrological characteristics of the more important roosting sites--those used annually and/or used by flocks of 25 or more storks. Potentially, roosting sites may, some day, become nesting sites.

VII. Legal Considerations.

A. Federal Statutes

The U.S. breeding population of the wood stork is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act). The population was listed as endangered on February 28, 1984 (49 Federal *Register* 7332); wood storks breeding in Alabama, Florida, Georgia, and South Carolina are protected by the Act.

Section 9 of the Endangered Species Act of 1973, as amended, states that it is unlawful for any person subject to the jurisdiction of the United States to take (defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.") any listed species anywhere within the United States.

The wood stork is also federally protected by its listing (50 CFR 10.13) under the Migratory Bird Treaty Act (167 U.S.C. 703-711), which prohibits the taking, killing or possession of migratory birds except as permitted.

B. State Statutes

1. State of Alabama

Section 9-11-232 of Alabama's Fish, Game, and Wildlife regulations curtails the possession, sale, and purchase of wild birds. "Any person, firm, association, or corporation who takes, catches, kills or has in possession at any time, living or dead, any protected wild bird not a game bird or who sells or offers for sale, buys, purchases or offers to buy or purchase any such bird or exchange same for anything of value or who shall sell or expose for sale or buy any part of the plumage, skin, or body of any bird protected by the laws of this state or who shall take or willfully destroy the nests of any wild bird or who shall have such nests or eggs of such birds in his possession, except as otherwise provided by law, shall be guilty of a misdemeanor...

Section 1 of the Alabama Nongame Species Regulation (Regulation 87-GF-7) includes the wood stork in the list of nongame species covered by paragraph (4). " It shall be unlawful to take, capture, kill, possess, sell, trade for anything of monetary value, or offer to sell or trade for anything of monetary value, the following nongame wildlife species (or any parts or reproductive products of such species) without a scientific collection permit and written permission from the Commissioner, Department of Conservation and Natural Resources...."

2. State of Florida

Rule 39-4.001 of the Florida Wildlife Code prohibits "taking, attempting to take; pursuing, hunting, molesting, capturing, or killing (collectively defined as "taking"), transporting, storing, serving, buying, selling,

APPENDIX H

National Bald Eagle Management Guidelines

NATIONAL BALD EAGLE MANAGEMENT GUIDELINES

U.S. Fish and Wildlife Service

May 2007

TABLE OF CONTENTS

INTRODUCTION 1
LEGAL PROTECTIONS FOR THE BALD EAGLE 2
The Bald and Golden Eagle Protection Act 2
The Migratory Bird Treaty Act 3
State laws and regulations 3
Where do bald eagles nest? 4
When do bald eagles nest? 5
Chronology of typical reproductive activities of bald eagles in the United States 6
How many chicks do bald eagles raise? 7
What do bald eagles eat? 7
The impact of human activity on nesting bald eagles 7
The impact of human activity on foraging and roosting bald eagles 8
RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES 9
Existing Uses 10
ACTIVITY-SPECIFIC GUIDELINES 10
Alternate nests 11
Temporary Impacts 11
RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES 14
ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES 15
CONTACTS 16
GLOSSARY 17
RELATED LITERATURE 19

INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The MBTA and the Eagle Act protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service (Service) developed these National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The Guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute "disturbance," which is prohibited by the Eagle Act.

The Guidelines are intended to:

(1) Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law,

(2) Advise landowners, land managers and the general public of the potential for various human activities to disturb bald eagles, and

(3) Encourage additional nonbinding land management practices that benefit bald eagles (see Additional Recommendations section).

While the Guidelines include general recommendations for land management practices that will benefit bald eagles, the document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. Many States and some tribal entities have developed state-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles.

Adherence to the Guidelines herein will benefit individuals, agencies, organizations, and companies by helping them avoid violations of the law. However, the Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles.

The U.S. Fish and Wildlife Service strongly encourages adherence to these guidelines to ensure that bald and golden eagle populations will continue to be sustained. The Service realizes there may be impacts to some birds even if all reasonable measures are taken to avoid such impacts. Although it is not possible to absolve individuals and entities from liability under the Eagle Act or the MBTA, the Service exercises enforcement discretion to focus on those individuals, companies, or agencies that take migratory birds without regard for the consequences of their actions and the law, especially when conservation measures, such as these Guidelines, are available, but have not been implemented. The Service will prioritize its enforcement efforts to focus on those individuals or entities who take bald eagles or their parts, eggs, or nests without implementing appropriate measures recommended by the Guidelines.

The Service intends to pursue the development of regulations that would authorize, under limited circumstances, the use of permits if "take" of an eagle is anticipated but unavoidable. Additionally, if the bald eagle is delisted, the Service intends to provide a regulatory mechanism to honor existing (take) authorizations under the Endangered Species Act (ESA).

During the interim period until the Service completes a rulemaking for permits under the Eagle Act, the Service does not intend to refer for prosecution the incidental "*take*" of any bald eagle under the MBTA or Eagle Act, if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the ESA or a permit issued under the authority of section 10(a)(1)(B) of the ESA.

The Guidelines are applicable throughout the United States, including Alaska. The primary purpose of these Guidelines is to provide information that will minimize or prevent violations only of *Federal* laws governing bald eagles. In addition to Federal laws, many states and some smaller jurisdictions and tribes have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines. If you are planning activities that may affect bald eagles, we therefore recommend that you contact both your nearest U.S. Fish and Wildlife Service Field Office (see the contact information on p.16) and your state wildlife agency for assistance.

LEGAL PROTECTIONS FOR THE BALD EAGLE

The Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." "Disturb" means:

> "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

A violation of the Act can result in a criminal fine of $100,000 ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony.

The Migratory Bird Treaty Act
The MBTA (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors. Implementing regulations define "take" under the MBTA as "pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect."

Copies of the Eagle Act and the MBTA are available at: http://permits.fws.gov/ltr/ltr.shtml.

State laws and regulations
Most states have their own regulations and/or guidelines for bald eagle management. Some states may continue to list the bald eagle as endangered, threatened, or of special concern. If you plan activities that may affect bald eagles, we urge you to familiarize yourself with the regulations and/or guidelines that apply to bald eagles in your state. Your adherence to the Guidelines herein does not ensure that you are in compliance with state laws and regulations because state regulations can be more specific and/or restrictive than these Guidelines.

NATURAL HISTORY OF THE BALD EAGLE

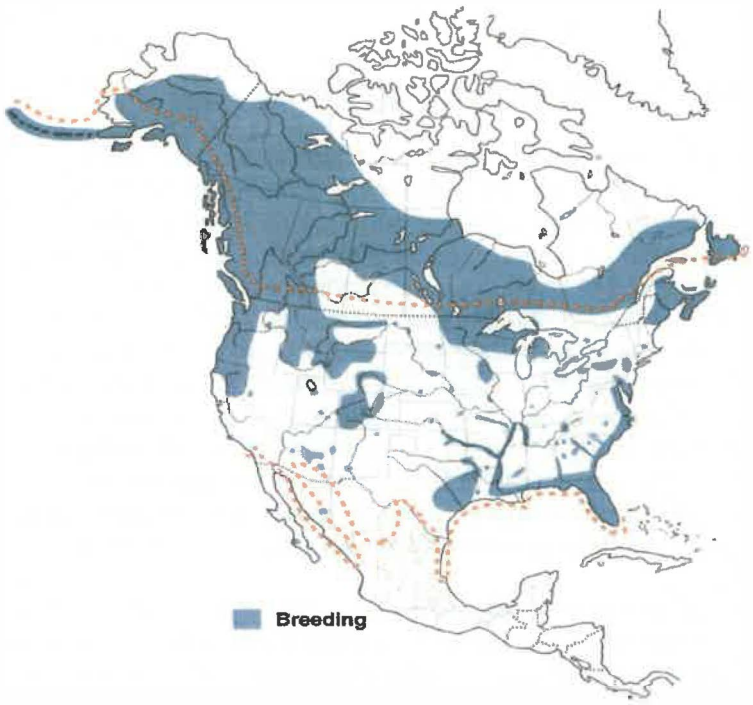
Bald eagles are a North American species that historically occurred throughout the contiguous United States and Alaska. After severely declining in the lower 48 States between the 1870s and the 1970s, bald eagles have rebounded and re-established breeding territories in each of the lower 48 states. The largest North American breeding populations are in Alaska and Canada, but there are also significant bald eagle populations in Florida, the Pacific Northwest, the Greater Yellowstone area, the Great Lakes states, and the Chesapeake Bay region. Bald eagle distribution varies seasonally. Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Migrants frequently concentrate in large numbers at sites where food is abundant and they often roost together communally. In some cases, concentration areas are used year-round: in summer by southern eagles and in winter by northern eagles.

Juvenile bald eagles have mottled brown and white plumage, gradually acquiring their dark brown body and distinctive white head and tail as they mature. Bald eagles generally attain adult plumage by 5 years of age. Most are capable of breeding at 4 or 5 years of age, but in healthy populations they may not start breeding until much older. Bald eagles may live 15 to 25 years in the wild. Adults weigh 8 to 14 pounds (occasionally reaching 16 pounds in Alaska) and have wingspans of 5 to 8 feet. Those in the northern range are larger than those in the south, and females are larger than males.

Where do bald eagles nest?

Breeding bald eagles occupy "territories," areas they will typically defend against intrusion by other eagles. In addition to the active nest, a territory may include one or more alternate nests (nests built or maintained by the eagles but not used for nesting in a given year). The Eagle Act prohibits removal or destruction of both active and alternate bald eagle nests. Bald eagles exhibit high nest site fidelity and nesting territories are often used year after year. Some territories are known to have been used continually for over half a century.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage. Shoreline trees or snags located in reservoirs provide the visibility and accessibility needed to locate aquatic prey. Eagle nests are constructed with large sticks, and may be lined with moss, grass, plant stalks, lichens, seaweed, or sod. Nests are usually about 4-6 feet in diameter and 3 feet deep, although larger nests exist.



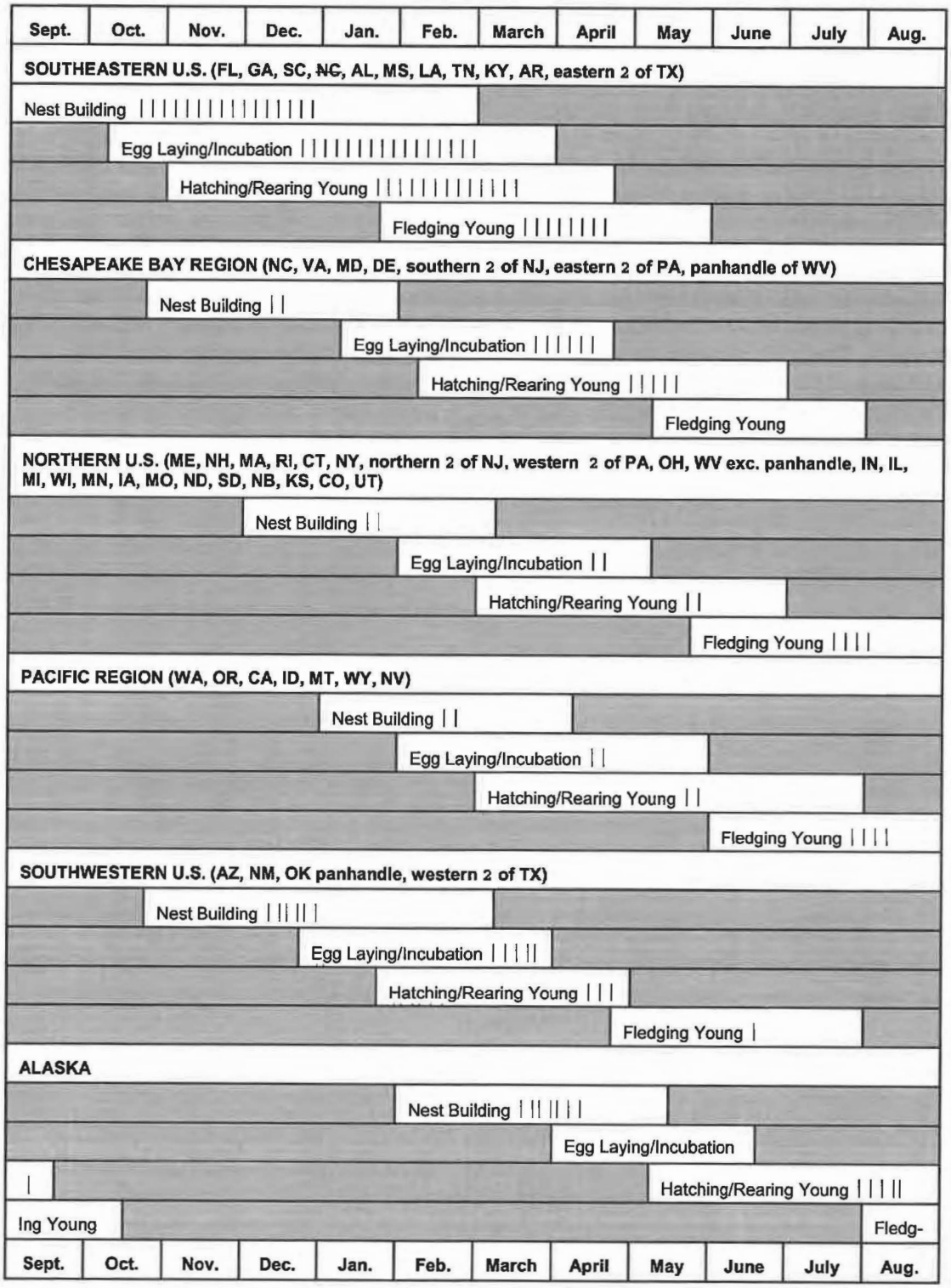
Copyright *Birds of North America*, 2000

The range of breeding bald eagles in 2000 (shaded areas). This map shows only the larger concentrations of nests; eagles have continued to expand into additional nesting territories in many states. The dotted line represents the bald eagle's wintering range.

When do bald eagles nest?
Nesting activity begins several months before egg-laying. Egg-laying dates vary throughout the U.S., ranging from October in Florida, to late April or even early May in the northern United States. Incubation typically lasts 33-35 days, but can be as long as 40 days. Eaglets make their first unsteady flights about 10 to 12 weeks after hatching, and fledge (leave their nests) within a few days after that first flight. However, young birds usually remain in the vicinity of the nest for several weeks after fledging because they are almost completely dependent on their parents for food until they disperse from the nesting territory approximately 6 weeks later.

The bald eagle breeding season tends to be longer in the southern U.S., and re-nesting following an unsuccessful first nesting attempt is more common there as well. The following table shows the timing of bald eagle breeding seasons in different regions of the country. The table represents the range of time within which the majority of nesting activities occur in each region and does not apply to any specific nesting pair. Because the timing of nesting activities may vary within a given region, you should contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16) and/or your state wildlife conservation agency for more specific information on nesting chronology in your area.

Chronology of typical reproductive activities of bald eagles in the United States.



How many chicks do bald eagles raise?
The number of eagle eggs laid will vary from 1-3, with 1-2 eggs being the most common. Only one eagle egg is laid per day, although not always on successive days. Hatching of young occurs on different days with the result that chicks in the same nest are sometimes of unequal size. The overall national fledging rate is approximately one chick per nest, annually, which results in a healthy expanding population.

What do bald eagles eat?
Bald eagles are opportunistic feeders. Fish comprise much of their diet, but they also eat waterfowl, shorebirds/colonial waterbirds, small mammals, turtles, and carrion. Because they are visual hunters, eagles typically locate their prey from a conspicuous perch, or soaring flight, then swoop down and strike. Wintering bald eagles often congregate in large numbers along streams to feed on spawning salmon or other fish species, and often gather in large numbers in areas below reservoirs, especially hydropower dams, where fish are abundant. Wintering eagles also take birds from rafts of ducks at reservoirs and rivers, and congregate on melting ice shelves to scavenge dead fish from the current or the soft melting ice. Bald eagles will also feed on carcasses along roads, in landfills, and at feedlots.

During the breeding season, adults carry prey to the nest to feed the young. Adults feed their chicks by tearing off pieces of food and holding them to the beaks of the eaglets. After fledging, immature eagles are slow to develop hunting skills, and must learn to locate reliable food sources and master feeding techniques. Young eagles will congregate together, often feeding upon easily acquired food such as carrion and fish found in abundance at the mouths of streams and shallow bays and at landfills.

The impact of human activity on nesting bald eagles
During the breeding season, bald eagles are sensitive to a variety of human activities. However, not all bald eagle pairs react to human activities in the same way. Some pairs nest successfully just dozens of yards from human activity, while others abandon nest sites in response to activities much farther away. This variability may be related to a number of factors, including visibility, duration, noise levels, extent of the area affected by the activity, prior experiences with humans, and tolerance of the individual nesting pair. The relative sensitivity of bald eagles during various stages of the breeding season is outlined in the following table.

Nesting Bald Eagle Sensitivity to Human Activities

Phase	Activity	Sensitivity to Human Activity	Comments
I	Courtship and Nest Building	Most sensitive period; likely to respond negatively	Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites.
II	Egg laying	Very sensitive period	Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season.
III	Incubation and early nestling period (up to 4 weeks)	Very sensitive period	Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements.
IV	Nestling period, 4 to 8 weeks	Moderately sensitive period	Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival.
V	Nestlings 8 weeks through fledging	Very sensitive period	Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die.

If agitated by human activities, eagles may inadequately construct or repair their nest, may expend energy defending the nest rather than tending to their young, or may abandon the nest altogether. Activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them.

The impact of human activity on foraging and roosting bald eagles

Disruption, destruction, or obstruction of roosting and foraging areas can also negatively affect bald eagles. Disruptive activities in or near eagle foraging areas can interfere with feeding, reducing chances of survival. Interference with feeding can also result in reduced productivity (number of young successfully fledged). Migrating and wintering bald eagles often congregate at specific sites for purposes of feeding and sheltering. Bald eagles rely on established roost sites because of their proximity to sufficient food sources. Roost sites are usually in mature trees where the eagles are somewhat sheltered from the wind and weather. Human activities near or within communal roost sites may prevent eagles

from feeding or taking shelter, especially if there are not other undisturbed and productive feeding and roosting sites available. Activities that permanently alter communal roost sites and important foraging areas can altogether eliminate the elements that are essential for feeding and sheltering eagles.

Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles. The circumstances that might result in such an outcome are difficult to predict without detailed site-specific information. If your activities may disturb roosting or foraging bald eagles, you should contact your local Fish and Wildlife Service Field Office (see page 16) for advice and recommendations for how to avoid such disturbance.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES

In developing these Guidelines, we relied on existing state and regional bald eagle guidelines, scientific literature on bald eagle disturbance, and recommendations of state and Federal biologists who monitor the impacts of human activity on eagles. Despite these resources, uncertainties remain regarding the effects of many activities on eagles and how eagles in different situations may or may not respond to certain human activities. The Service recognizes this uncertainty and views the collection of better biological data on the response of eagles to disturbance as a high priority. To the extent that resources allow, the Service will continue to collect data on responses of bald eagles to human activities conducted according to the recommendations within these Guidelines to ensure that adequate protection from disturbance is being afforded, and to identify circumstances where the Guidelines might be modified. These data will be used to make future adjustments to the Guidelines.

To avoid disturbing nesting bald eagles, we recommend (1) keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees.

The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where there are little or no forested or topographical buffers, such as in many western states, distance alone must serve as the buffer. Consequently, in open areas, the distance between the activity and the nest may need to be larger than the distances recommended under Categories A and B of these guidelines (pg. 12) if no landscape buffers are present. The height of the nest above the ground may also ameliorate effects of human activities; eagles at higher nests may be less prone to disturbance.

In addition to the physical features of the landscape and nest site, the appropriate size for the distance buffer may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation

to feeding and roosting areas used by the eagles. Increased competition for nest sites may lead bald eagles to nest closer to human activity (and other eagles).

Seasonal restrictions can prevent the potential impacts of many shorter-term, obtrusive activities that do not entail landscape alterations (e.g. fireworks, outdoor concerts). In proximity to the nest, these kinds of activities should be conducted only outside the breeding season. For activities that entail both short-term, obtrusive characteristics and more permanent impacts (e.g., building construction), we recommend a combination of both approaches: retaining a landscape buffer *and* observing seasonal restrictions.

For assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, we encourage you to contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16).

Existing Uses

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles. For example: a pair of eagles may begin nesting in an area and subsequently be disturbed by activities associated with an annual outdoor flea market, even though the flea market has been held annually at the same location. In such situations, human activity should be adjusted or relocated to minimize potential impacts on the nesting pair.

ACTIVITY-SPECIFIC GUIDELINES

The following section provides the Service=s management recommendations for avoiding bald eagle disturbance as a result of new or intermittent activities proposed in the vicinity of bald eagle nests. Activities are separated into 8 categories (A – H) based on the nature and magnitude of impacts to bald eagles that usually result from the type of activity. Activities with similar or comparable impacts are grouped together.

In most cases, impacts will vary based on the visibility of the activity from the eagle nest and the degree to which similar activities are already occurring in proximity to the nest site. Visibility is a factor because, in general, eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest structure in areas with open vistas, in contrast to areas where the view is shielded by rolling topography, trees, or other screening factors. The recommendations also take into account the existence of similar activities in the area because the continued presence of nesting bald eagles in the vicinity of the existing activities indicates that the eagles in that area can tolerate a greater degree of human activity than we can generally expect from eagles in areas that experience fewer human impacts. To illustrate how these factors affect the likelihood of disturbing eagles, we have incorporated the recommendations for some activities into a table (categories A and B).

First, determine which category your activity falls into (between categories A – H). If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity represented.

If your activity is under A or B, our recommendations are in table form. The vertical axis shows the degree of visibility of the activity from the nest. The horizontal axis (header row) represents the degree to which similar activities are ongoing in the vicinity of the nest. Locate the row that best describes how visible your activity will be from the eagle nest. Then, choose the column that best describes the degree to which similar activities are ongoing in the vicinity of the eagle nest. The box where the column and row come together contains our management recommendations for how far you should locate your activity from the nest to avoid disturbing the eagles. The numerical distances shown in the tables are the closest the activity should be conducted relative to the nest. In some cases we have included additional recommendations (other than recommended *distance* from the nest) you should follow to help ensure that your activity will not disturb the eagles.

Alternate nests

For activities that entail permanent landscape alterations that may result in bald eagle disturbance, these recommendations apply to both active and alternate bald eagle nests. Disturbance becomes an issue with regard to alternate nests if eagles return for breeding purposes and react to land use changes that occurred while the nest was inactive. The likelihood that an alternate nest will again become active decreases the longer it goes unused. If you plan activities in the vicinity of an alternate bald eagle nest and have information to show that the nest has not been active during the preceding 5 breeding seasons, the recommendations provided in these guidelines for avoiding disturbance around the nest site may no longer be warranted. The nest itself remains protected by other provisions of the Eagle Act, however, and may not be destroyed.

If special circumstances exist that make it unlikely an inactive nest will be reused before 5 years of disuse have passed, and you believe that the probability of reuse is low enough to warrant disregarding the recommendations for avoiding disturbance, you should be prepared to provide all the reasons for your conclusion, including information regarding past use of the nest site. Without sufficient documentation, you should continue to follow these guidelines when conducting activities around the nest site. If we are able to determine that it is unlikely the nest will be reused, we may advise you that the recommendations provided in these guidelines for avoiding disturbance are no longer necessary around that nest site.

This guidance is intended to minimize disturbance, as defined by Federal regulation. In addition to Federal laws, most states and some tribes and smaller jurisdictions have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines.

Temporary Impacts

For activities that have temporary impacts, such as the use of loud machinery, fireworks displays, or summer boating activities, we recommend seasonal restrictions. These types of activities can generally be carried out outside of the breeding season without causing disturbance. The recommended restrictions for these types of activities can be lifted for alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched (depending on the distance between the alternate nest and the active nest).

In general, activities should be kept as far away from nest trees as possible; loud and disruptive activities should be conducted when eagles are not nesting; and activity between the nest and the nearest foraging area should be minimized. If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity addressed, or contact your local U.S. Fish and Wildlife Service Field Office for additional guidance.

If you believe that special circumstances apply to your situation that increase or diminish the likelihood of bald eagle disturbance, or if it is not possible to adhere to the guidelines, you should contact your local Service Field Office for further guidance.

Category A:
Building construction, 1 or 2 story, with project footprint of ½ acre or less.
Construction of roads, trails, canals, power lines, and other linear utilities.
Agriculture and aquaculture – new or expanded operations.
Alteration of shorelines or wetlands.
Installation of docks or moorings.
Water impoundment.

Category B:
Building construction, 3 or more stories.
Building construction, 1 or 2 story, with project footprint of more than ½ acre.
Installation or expansion of marinas with a capacity of 6 or more boats.
Mining and associated activities.
Oil and natural gas drilling and refining and associated activities.

	If there is no similar activity within 1 mile of the nest	***If there is similar activity closer than 1 mile from the nest***
If the activity will be visible from the nest	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
If the activity will not be visible from the nest	Category A: 330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season. Category B: 660 feet.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season.

The numerical distances shown in the table are the closest the activity should be conducted relative to the nest.

Category C. Timber Operations and Forestry Practices

- Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.

- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.

- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Appropriate Federal and state biologists should be consulted before any prescribed burning is conducted during the breeding season.

- Avoid construction of log transfer facilities and in-water log storage areas within 330 feet of the nest.

Category D. Off-road vehicle use (including snowmobiles). No buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.

Category E. Motorized Watercraft use (including jet skis/personal watercraft). No buffer is necessary around nest sites outside the breeding season. During the breeding season, within 330 feet of the nest, (1) do not operate jet skis (personal watercraft), and (2) avoid concentrations of noisy vessels (e.g., commercial fishing boats and tour boats), except where eagles have demonstrated tolerance for such activity. Other motorized boat traffic passing within 330 feet of the nest should attempt to minimize trips and avoid stopping in the area where feasible, particularly where eagles are unaccustomed to boat traffic. Buffers for airboats should be larger than 330 feet due to the increased noise they generate, combined with their speed, maneuverability, and visibility.

Category F. Non-motorized recreation and human entry (e.g., hiking, camping, fishing, hunting, birdwatching, kayaking, canoeing). No buffer is necessary around nest sites outside the breeding season. If the activity will be visible or highly audible from the nest, maintain a 330-foot buffer during the breeding season, particularly where eagles are unaccustomed to such activity.

Category G. Helicopters and fixed-wing aircraft.
Except for authorized biologists trained in survey techniques, avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

Category H. Blasting and other loud, intermittent noises.
Avoid blasting and other activities that produce extremely loud noises within 1/2 mile of active nests, unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area. This recommendation applies to the use of fireworks classified by the Federal Department of Transportation as Class B explosives, which includes the larger fireworks that are intended for licensed public display.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES

1. Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.

2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.

3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.

4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.

5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES

The following are additional management practices that landowners and planners can exercise for added benefit to bald eagles.

1. Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.

2. Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.

3. To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.

4. Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.

5. Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.

6. Immediately cover carcasses of euthanized animals at landfills to protect eagles from being poisoned.

7. Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.

8. Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.

9. Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bioaccumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

CONTACTS

The following U.S. Fish and Wildlife Service Field Offices provide technical assistance on bald eagle management:

Alabama	Daphne	(251) 441-5181
Alaska	Anchorage	(907) 271-2888
	Fairbanks	(907) 456-0203
	Juneau	(907) 780-1160
Arizona	Phoenix	(602) 242-0210
Arkansas	Conway	(501) 513-4470
California	Arcata	(707) 822-7201
	Barstow	(760) 255-8852
	Carlsbad	(760) 431-9440
	Red Bluff	(530) 527-3043
	Sacramento	(916) 414-6000
	Stockton	(209) 946-6400
	Ventura	(805) 644-1766
	Yreka	(530) 842-5763
Colorado	Lakewood	(303) 275-2370
	Grand Junction	(970) 243-2778
Connecticut	(See New Hampshire)	
Delaware	(See Maryland)	
Florida	Panama City	(850) 769-0552
	Vero Beach	(772) 562-3909
	Jacksonville	(904) 232-2580
Georgia	Athens	(706) 613-9493
	Brunswick	(912) 265-9336
	Columbus	(706) 544-6428
Idaho	Boise	(208) 378-5243
	Chubbuck	(208) 237-6975
Illinois/Iowa	Rock Island	(309) 757-5800
Indiana	Bloomington	(812) 334-4261
Kansas	Manhattan	(785) 539-3474
Kentucky	Frankfort	(502) 695-0468
Louisiana	Lafayette	(337) 291-3100
Maine	Old Town	(207) 827-5938
Maryland	Annapolis	(410) 573-4573
Massachusetts	(See New Hampshire)	
Michigan	East Lansing	(517) 351-2555
Minnesota	Bloomington	(612) 725-3548
Mississippi	Jackson	(601) 965-4900
Missouri	Columbia	(573) 234-2132
Montana	Helena	(405) 449-5225
Nebraska	Grand Island	(308) 382-6468
Nevada	Las Vegas	(702) 515-5230
	Reno	(775) 861-6300
New Hampshire	Concord	(603) 223-2541
New Jersey	Pleasantville	(609) 646-9310
New Mexico	Albuquerque	(505) 346-2525
New York	Cortland	(607) 753-9334
	Long Island	(631) 776-1401
North Carolina	Raleigh	(919) 856-4520
	Asheville	(828) 258-3939
North Dakota	Bismarck	(701) 250-4481
Ohio	Reynoldsburg	(614) 469-6923
Oklahoma	Tulsa	(918) 581-7458
Oregon	Bend	(541) 383-7146
	Klamath Falls	(541) 885-8481
	La Grande	(541) 962-8584
	Newport	(541) 867-4558
	Portland	(503) 231-6179
	Roseburg	(541) 957-3474
Pennsylvania	State College	(814) 234-4090
Rhode Island	(See New Hampshire)	
South Carolina	Charleston	(843) 727-4707
South Dakota	Pierre	(605) 224-8693
Tennessee	Cookeville	(931) 528-6481
Texas	Clear Lake	(281) 286-8282
Utah	West Valley City	(801) 975-3330
Vermont	(See New Hampshire)	
Virginia	Gloucester	(804) 693-6694
Washington	Lacey	(306) 753-9440
	Spokane	(509) 891-6839
	Wenatchee	(509) 665-3508
West Virginia	Elkins	(304) 636-6586
Wisconsin	New Franken	(920) 866-1725
Wyoming	Cheyenne	(307) 772-2374
	Cody	(307) 578-5939

National Office
U.S. Fish and Wildlife Service
Division of Migratory Bird Management
4401 North Fairfax Drive, MBSP-4107
Arlington, VA 22203-1610
(703) 358-1714
http://www.fws.gov/migratorybirds

State Agencies

To contact a state wildlife agency, visit the Association of Fish & Wildlife Agencies' website at http://www.fishwildlife.org/where_us.html

GLOSSARY

The definitions below apply to these National Bald Eagle Management Guidelines:

Communal roost sites – Areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

Disturb – To agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

In addition to immediate impacts, this definition also covers impacts that result from human-caused alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

Fledge – To leave the nest and begin flying. For bald eagles, this normally occurs at 10-12 weeks of age.

Fledgling – A juvenile bald eagle that has taken the first flight from the nest but is not yet independent.

Foraging area – An area where eagles feed, typically near open water such as rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (i.e., rangelands, barren land, tundra, suburban areas, etc.) where other prey species (e.g., rabbit, rodents) or carrion (such as at landfills) are abundant.

Landscape buffer – A natural or human-made landscape feature that screens eagles from human activity (e.g., strip of trees, hill, cliff, berm, sound wall).

Nest – A structure built, maintained, or used by bald eagles for the purpose of reproduction. An **active** nest is a nest that is attended (built, maintained or used) by a pair of bald eagles during a given breeding season, whether or not eggs are laid. An **alternate** nest is a nest that is not used for breeding by eagles during a given breeding season.

Nest abandonment – Nest abandonment occurs when adult eagles desert or stop attending a nest and do not subsequently return and successfully raise young in that nest for the duration of a breeding season. Nest abandonment can be caused by altering habitat near a nest, even if the alteration occurs prior to the breeding season. Whether the eagles migrate during the non-breeding season, or remain in the area throughout the non-breeding season, nest abandonment can occur at any point between the time the eagles return to the nesting site for the breeding season and the time when all progeny from the breeding season have

dispersed.

Project footprint – The area of land (and water) that will be permanently altered for a development project, including access roads.

Similar scope – In the vicinity of a bald eagle nest, an existing activity is of similar scope to a new activity where the types of impacts to bald eagles are similar in nature, and the impacts of the existing activity are of the same or greater magnitude than the impacts of the potential new activity. Examples: (1) An existing single-story home 200 feet from a nest is similar in scope to an additional single-story home 200 feet from the nest; (2) An existing multi-story, multi-family dwelling 150 feet from a nest has impacts of a greater magnitude than a potential new single-family home 200 feet from the nest; (3) One existing single-family home 200 feet from the nest has impacts of a lesser magnitude than three single-family homes 200 feet from the nest; (4) an existing single-family home 200 feet from a communal roost has impacts of a lesser magnitude than a single-family home 300 feet from the roost but 40 feet from the eagles' foraging area. The existing activities in examples (1) and (2) are of similar scope, while the existing activities in example (3) and (4) are not.

Vegetative buffer – An area surrounding a bald eagle nest that is wholly or largely covered by forest, vegetation, or other natural ecological characteristics, and separates the nest from human activities.

RELATED LITERATURE

Andrew, J.M. and J.A. Mosher. 1981. Bald eagle nest site selection and nesting habitat in Maryland. Journal of Wildlife Management 46:382-390.

Anonymous. 1977. Bald Eagle Habitat Management Guidelines, Forest Service – California Region. U.S Forest Service, San Francisco, CA.

Anthony, R.G. 2001. Low productivity of bald eagles on Prince of Wales Island, southeast Alaska. Journal of Raptor Research 35:1-8.

Anthony, R.G., R.W. Frenzel, F.B. Isaacs, and M.G. Garrett. 1994. Probable causes of nesting failures in Oregon's bald eagle population. Wildlife Society Bulletin 22:576-582.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. Journal of Wildlife Management 53:148-158.

Arizona Game and Fish Department. 1999. Bald Eagle Conservation Assessment and Strategy (draft).

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute, Raptor Research Foundation, Washington, D.C.

Bangs, E.E., T.N. Bailey and V.D. Berns. Ecology of nesting bald eagles on the Kenai National Wildlife Refuge, Alaska. (USFWS staff)

Becker, J.M. 2002. Response of wintering bald eagles to industrial construction in southeastern Washington. Wildlife Society Bulletin 30:875-878.

Brauning, D.W. and J.D. Hassinger. 2000. Pennsylvania Recovery and Management Plan for the Bald Eagle (draft). Pennsylvania Game Commission. Harrisburg, PA.

Brown, B.T., G.S. Mills, C. Powels, W.A. Russell, G.D. Therres and J.J. Pottie. 1999. The influence of weapons-testing noise on bald eagle behavior. Journal of Raptor Research 33:227-232.

Brown, B.T. and L.E. Stevens. 1997. Winter bald eagle distribution is inversely correlated with human activity along the Colorado River, Arizona. Journal of Raptor Research31:7-10.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. Journal of Wildlife Management 55:282-290.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Nonbreeding bald eagle communal and solitary roosting behavior and roost habitat on the northern Chesapeake Bay. Journal of Wildlife Management 55:273-281.

Chandler, SK., J.D. Fraser, D.A. Buehler and J.K.D. Seegar. 1995. Perch trees and shoreline development as predictors of bald eagle distribution on the Chesapeake Bay. Journal of Wildlife Management 59:325-332.

Cline, K. 1985. Bald Eagles in the Chesapeake: A Management Guide for Landowners. National Wildlife Federation. Washington, D.C.

Dell, D.D. and P.J. Zwank. 1986. Impact of a high-voltage transmission line on a nesting pair of southern bald eagles in southeast Louisiana. Journal of Raptor Research 20(3/4):117-119.

Dunwiddie, P.W. and R.C. Kuntz. 2001. Long-term trends of bald eagles in winter on the Skagit River, Washington. Journal of Wildlife Management 65(2):290-299.

Fletcher, R.J. et. al. 1999. Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. Journal of Raptor Research 33(3):233-239.

Fraser, J.D. 1981. The breeding biology and status of the bald eagle on the Chippewa National Forest. PhD. Dissertation, University of Minnesota.

Fraser, J.D., LD. Frenzel and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49(3):585-592.

Garrett, M.G., J.W. Watson, and R.G. Anthony. 1993. Bald eagle home range and habitat use in the Columbia River Estuary. Journal of Wildlife Management 57(1):19-27.

Gerrard J.M. and G.R. Bortolotti. 1988. The Bald Eagle: Haunts and Habits of a Wilderness Monarch. Smithsonian Institution Press. Washington, D.C.

Grier, J.W. 1969. Bald eagle behavior and productivity responses to climbing to nests. Journal of Wildlife Management 33:961-966.

Grier, J.W. and J.E. Guinn. 2003. Bald eagle habitats and responses to human disturbance in Minnesota. Report to the Minnesota Department of Natural Resources.

Grubb, T.G. 1976. Survey and analysis of bald eagle nesting in western Washington. M.S. thesis, Univ. of Washington, Seattle.

Grubb, T.G. and R.M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Grubb, T.G., W.L. Robinson and W.W. Bowerman. 2002. Effects of watercraft on bald eagles nesting in Voyagers National Park, Minnesota. Wildlife Society Bulletin 30:156-161.

Grubb, T.G. and W.W. Bowerman. 1997. Variations in breeding bald eagle response to jets, light planes and helicopters. Journal of Raptor Research 31:213-222.

Grubb, T.G., W.W. Bowerman, A.J. Bath, J.P. Giesy, D.V.C. Weseloh. 2003. Evaluating Great Lakes bald eagle nesting habitat with Bayesian inference. RMRS-RP-45. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, 10 pp.

Hansen, J.A. 1977. Population dynamics and night roost requirements of bald eagles wintering in the Nooksack River Valley, WA. Huxley College of Environmental Studies, Western Washington State College, Bellingham, WA. (Problem Series)

Hansen, J.A., M.V. Stalmaster and J.R. Newman. 1980. Habitat characteristics, function, and destruction of bald eagle communal roosts in western Washington. Huxley college of Environmental Studies, Western Washington University.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of bald eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis Inc., Santa Cruz, California.

Isaacs, F.B and R.G. Anthony. 1987. Abundance, foraging, and roosting of bald eagles wintering in the Harney Basin, Oregon. Northwest Science 61(2), pp. 114-121.

Juenemann, B.G. 1973. Habitat evaluations of selected bald eagle nest sites on the Chippewa National Forest. M.S. thesis, University of Minnesota, Minneapolis.

Keister, G.P., R.G. Anthony and E.J. O'Neill. 1987. Use of communal roosts and foraging area by bald eagles wintering in the Klamath Basin. Journal of Wildlife Management 51(2):415-420.

Knight, R. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Linscombe, J.T., T.J. Hess, Jr., and V.L. Wright. 1999. Effects of seismic operations on Louisiana's nesting bald eagles. Proceedings of the Southeastern Association of Fish and Wildlife Agencies. 54:235-242.

Maine (State of) Inland Fisheries and Wildlife Rules. Chapter 8.05 Essential Habitat for Species Listed as Threatened or Endangered.

Mathisen, J.E. 1968. Effects of human disturbance on nesting bald eagles. Journal of Wildlife Management 32(1): 1-6.

McGarigal, K., R.G. Anthony and F.B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115:1-47.

McKay, K.J., J.W. Stravers, B.R. Conklin, U. Konig, S. Hawks, C.J. Kohrt, J.S. Lundh and G.V. Swenson. 2001. Potential human impacts on bald eagle reproductive success along the Upper Mississippi River.

McKewan, L.C. and D.H. Hirth. 1979. Southern bald eagle productivity and nest site selection. Journal of Wildlife Management 43:585-594.

Millsap, B.A. Status of wintering bald eagles in the conterminous 48 States. 1986. Wildlife Society Bulletin 14:433-440.

Millsap, B.A, T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. In Press. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. Journal of Wildlife Management 68(4).

Montana Bald Eagle Working Group. 1986. Montana Bald Eagle Management Plan. Department of the Interior, Bureau of Land Management. Billings, MT.

Nesbitt, S.A., M.J. Folk and D.A. Wood. 1993. Effectiveness of bald eagle habitat protection guidelines in Florida. Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies.

Newman, J.R., W.H. Brennan and L.M. Smith. 1977. Twelve-year changes in nesting patterns of bald eagles on San Juan Island, Washington. The Murrelet 58(2)37-39.

Postapulsky, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Pages 21-31 *in* F.N. Hammerstrom, Jr., B.E. Harrell, and R.R. Olendorff, eds. Management of raptors. Raptor Res. Found., Vermillion, S.D.

Rodgers, J.A. and Schwikert, S.T. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4): 437-443.

Russell, D. 1980. Occurrence and human disturbance sensitivity of wintering bald eagles on the Sauk and Suiattle Rivers, Washington. In R.L. Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 165-174.

Shapiro, A.E., F. Montalbano, and D. Mager. 1982. Implications of construction of a flood control project upon bald eagle nesting activity. Wilson Bulletin 94(1), pp. 55-63.

Skagen, S.K. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. In R.L.Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 231-241.

Skagen, S.K., R.L. Knight and G.J.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1:215-225. (Internet)

Stalmaster, M.V. 1976 Winter ecology and effects of human activity on bald eagles in the Nooksack River Valley, Washington. MS Thesis, Western Washington State College, Bellingham.

Stalmaster, M.V. 1980. Management strategies for wintering bald eagles in the Pacific Northwest. Proceedings of the Washington Bald Eagle Symposium, pp 49-67.

Stalmaster, M.V. and J.L. Kaiser. 1998. Effects of recreational activity on wintering bald eagles. Wildlife Monographs 137:1-46.

Stalmaster, M.V. and J.L. Kaiser. 1997. Flushing responses of wintering bald eagles to military activity. Journal of Wildlife Management 61:1307-1313.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. Journal of Wildlife Management 42:506-513.

Steenhof, K. 1978. Management of Wintering Bald Eagles. FWS/OBS-78/79. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C.

Steidl, R.J. and R.G. Anthony. 2000. Experimental Effects of Human Activity on Breeding Bald Eagles. Ecological Applications 10(1), pp. 258-268.

Therres, G.D., M.A. Byrd and D.S. Bradshaw. 1993. Effects of development on nesting bald eagles: case studies from Chesapeake Bay. Transactions of the North American Wildlife and Natural Resources Conference 58:62-69.

U.S. Fish and Wildlife Service. 1979. Bald Eagle Management Guidelines: Oregon – Washington. Portland. OR.

U.S. Fish and Wildlife Service. 1983. Northern States bald eagle recovery plan. Appendices E, F, and G. U.S. Fish and Wildlife Service, Region 6, Denver, CO.

U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S Fish and Wildlife Service, Region 4. Atlanta, GA.

U.S. Fish and Wildlife Service. 1993. Bald Eagle Basics. Anchorage, AK.

U.S. Fish and Wildlife Service. 1993. Habitat Management Guidelines for Bald Eagles in Texas. Austin, TX.

U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries. 2001. Bald Eagle Protection Guidelines for Virginia. Gloucester and Richmond, VA.

Watson, J.W. 1993. Responses of nesting bald eagles to helicopter surveys. Wildlife Society Bulletin 21:171-178.

Watson, J.W. 2004. Responses of nesting bald eagles to experimental pedestrian activity. Journal of Raptor Research 38:295-305.

Wood, P.B. 1999. Bald eagle response to boating activity in northcentral Florida. Journal of Raptor Research 33:97-101.

Wood, P.B., T.C. Edwards Jr. and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. Journal of Wildlife Management 53(2):441-449.

Young, L.S. 1980. A quantitative evaluation of human disturbance impacts on breeding eagle ecology of bald eagles in the San Juan Islands, Washington. Washington Department of Game, Olympia.

APPENDIX I

Mine Stormwater Management Systems

APPENDIX I

Mine Stormwater Management Systems

1. Applicability

This Appendix is applicable only for mines for which the Department has permitting, compliance, and enforcement responsibilities under the interagency operating agreements adopted under Rule 62-113.100, F.A.C., but is not applicable to borrow pits. See paragraphs 2.0(a)12 and 61 of Volume I for more specific definitions of "borrow pits" and "mines," respectively.

Applicants are advised that future changes in land use or development of the project area, subsequent to mining operations and reclamation, may necessitate changes to the stormwater management system and associated operation, maintenance, and monitoring requirements.

2. Design Options and Considerations

1. A mine stormwater management system must be designed to accomplish the water quantity and quality objectives specified in Rule 62-330.301(1), F.A.C. These objectives may be addressed through the following two design options: 1) containment of a specified volume and/or 2) compliance with the stormwater treatment and attenuation criteria provided in the Applicant's Handbook Volume II of the water management district (WMD) where the mine will be located.

2. An industrial wastewater (IW) facility permit, issued in accordance with Chapter 62-620, F.A.C., constitutes authorization to discharge to waters of the state under the National Pollutant Discharge Elimination System (NPDES) Program in accordance with Section 403.0885, F.S. The water quantity and quality objectives of Rule 62-330.301(1), F.A.C., as described in this appendix, with the exception of water elevation (see Part 2.3.b. below) shall be presumed to be met within the physical boundary of an active IW management system that is permitted under Chapter 62-620, F.A.C., prior to commencement of construction on the basis that the IW permit establishes the following:

    1. The total areal extent of the NPDES system.
    2. The designated discharge outfalls and points within the NPDES system.
    3. Specific conditions regarding effluent limitations; standards and prohibitions at outfalls and discharge points; discharge sampling, reporting requirements, and corrective measures.
    4. Best management practices, pollution prevention procedures, and standard operating procedures for wastewater management.

3. Design considerations intended to meet the objectives of Rule 62-330.301(1), F.A.C., are presented below regarding containment, water elevations, stormwater runoff pretreatment, water and soil quality, and karstic subsurface.

    a. Containment

    Stormwater runoff that is directly or indirectly conveyed to a mine pit may be managed through containment measures to meet water quantity and quality objectives. An above-grade internal or perimeter berm is an acceptable design method to provide containment.

    Containment will be presumed if the mine pit and/or the above-grade berms have sufficient available storage capacity for a given volume and freeboard at all times throughout the life of the mine. The required storage capacity shall be calculated using the larger of two design storm events: 1) the 25-year 24-hour design storm event or 2) the required design storm event specified in the Applicant's Handbook Volume II of the WMD where the mine will be located. A minimum of three feet of freeboard is

recommended for mine pit lakes having fetch lengths of one mile or less. A wave run-up analysis is necessary to determine the appropriate freeboard for a mine pit lake having a fetch length greater than one mile. The freeboard must be measured from the final stage elevation of the applicable WMD's design storm event using the seasonal high water table as the initial stage elevation of the design storm event. The applicant shall demonstrate recovery of the storage capacity for back-to-back required design storm events if the freeboard will be less than three feet. Alternate reasonable assurance may be provided to demonstrate that overtopping will not occur below the required storage capacity.

In lieu of freeboard, stormwater runoff may be discharged through a permanent structure at an elevation above the final stage elevation of the applicable design storm event using the seasonal high water table as the initial stage elevation of the design storm. Discharge design criteria shall be as specified in the applicable WMD's Applicant's Handbook Volume II. The applicant shall demonstrate that offsite discharges shall not cause adverse water quantity impacts to receiving waters and adjacent lands, adverse flooding to onsite or offsite property, adverse impacts to existing surface water storage and conveyance capabilities, or adverse secondary or cumulative impacts to water resources, by itself or in combination with pre-existing activities.

b. Water Elevations

Dewatering and subsurface excavation have the potential to adversely affect surface water and groundwater elevations. The applicant shall provide reasonable assurance that such adverse effects will not occur by providing a water elevation drawdown or budget analysis or other engineering methodologies (such as recharge through a trench), to demonstrate that the project activity will not adversely affect wetland hydroperiods or cause adverse flooding and environmental impacts to the property of others as a result of changes to water elevations. To provide this assurance, the Department shall require the permittee to take certain measures, as necessary, such as installing piezometers and staff gauges, and monitoring them on a permitted interval. To the extent that an existing water use permit or consumptive use permit addresses the foregoing, such permit may provide reasonable assurance that the stormwater management system will meet these objectives.

c. Stormwater Runoff Pretreatment

If a mine pit is owned entirely by one person other than the state, surface water quality standards do not apply within that mine pit lake*, except with respect to potential discharges to offsite surface waters and groundwater. Except for activities permitted under 62-620, F.A.C., as provided in paragraph 2.2. above, "contact" runoff that may reasonably be expected to contain potentially-hazardous pollutants may require treatment prior to entering the mine pit or other stormwater management systems. Runoff from entrance roads, parking areas, processing areas, petroleum product storage areas, solid waste storage areas, and equipment maintenance or washdown areas may contain potentially-hazardous pollutants. However, areas associated with material processing, such as washing associated with grading and sorting of sand or limestone extracted from the site, are not considered potential sources of pollutants, provided that no chemicals, except Department-approved water conditioners or pH adjusters, are added to the process water used for transporting, washing, or processing the sand or limestone. Such sources of pollution may require separate management systems to prevent direct discharges to the mine pit, other stormwater management systems, offsite property, or any waters of the state. The applicant is also advised to contact the Department's Industrial Wastewater Program regarding the need and requirements for an IW permit.

d. Water and Soil Quality

Evaluation of the ambient surface water, if present, and groundwater quality is required. Typically, to evaluate the ambient groundwater quality, sampling will be required at 5-foot depth intervals to approximately five feet below the proposed depth of extraction. An alternative sampling interval will be considered, based on available lithologic data and mine depths, when requested by the applicant. Compliance water quality monitoring shall be required, as necessary, on a permitted interval to provide reasonable assurance based on the site-specific conditions and the proposed activities. Representative soil characterization shall be required, as necessary, for areas of the property that may be contaminated with potentially-hazardous substances. Such areas may include existing or historical agricultural areas where potentially-hazardous substances may have been used, fuel storage and fueling areas, and hazardous waste areas within the proposed project area. Existing soil characterization reports and agency determination letters may be submitted in support of an application. Sampling shall be conducted in accordance with the current version of DEP's Standard Operating Procedures (DEP-SOP-001/01), as incorporated by reference in Rule 62-160.800, F.A.C.

e. Karstic Subsurface

The breaching of confining layers or conduit features in karstic or other highly permeable materials, such as limestone, dolomitic limestone, or dolostone, presents a greater potential for direct discharge of untreated stormwater pollutants into groundwater. The applicant must provide reasonable assurance that groundwater quality standards will not be violated by mining activities that have the potential to penetrate confining layers or flow conduits in karst-sensitive areas. Runoff from entrance roads, parking areas, processing areas, petroleum product storage areas, solid waste storage areas, and equipment maintenance or washdown areas may contain potentially-hazardous pollutants. However, areas associated with material processing, such as washing associated with grading and sorting of sand or limestone extracted from the site, are not considered potential sources of pollutants, provided that no chemicals, except Department-approved water conditioners or pH adjusters, are added to the process water used for transporting, washing, or processing the sand or limestone. Stormwater that is treated by a stormwater management system designed, constructed, and operated in accordance with the applicable Volume II of this handbook, *prior to discharge to the mine excavation*, shall be presumed to not cause or contribute to a water quality violation. The applicant may propose alternative measures demonstrating that stormwater runoff entering the mine pit will not result in offsite exceedances in water quality standards.

* *Applicants are advised that a mine pit lake that is subject to federal jurisdiction as a water of the United States may require federal authorization, prior to use for stormwater treatment or other wastewater treatment purposes.*

3. Pre-Application Contact Information

Applicants are strongly advised to request a pre-application meeting with the Department's Mining & Mitigation Program to discuss sample locations, depths, parameters, and frequencies, prior to performing any sampling or installation of piezometers or monitoring wells. The Mining & Mitigation Program's contact information is as follows:

Department of Environmental Protection
Bob Martinez Center
2600 Blair Stone Road, Mail Station 3577
Tallahassee, Florida 32399-2400

APPENDIX I

Mine Stormwater Management Systems

MiningAndMitigation@dep.state.fl.us
Telephone: (850) 245-7554
Alternate telephone: (850) 245-8335 (Division of Water Resource Management) Fax Number: (850) 245-8356
Website: https://floridadep.gov/water/mining-mitigation

Chapter 62-340, F.A.C.
Data Form Guide

Wetland and Other Surface Water Delineation
Version: August 2018 ©

From the Staff of
Wetland Evaluation and Training
Submerged Lands and Environmental Resources Coordination

(This Appendix is not incorporated by reference; Effective Date: October 2026)

Florida Department of Environmental Protection

Table of Contents **Page**

Appendix A: subsection 62-340.450(1), (2), (3), F.A.C. 3
Chapter 62-340, F.A.C.
62-340.100 Intent 19
62-340.200 Definitions 19
62-340.300 Delineation of Wetlands 21
62-340.400 Selection of Appropriate Vegetative Stratum 23
62-340.450 Vegetative Index 23
62-340.500 Hydrologic Indicators 24
62-340.550 Wetland Hydrology 25
62-340.600 Surface Waters 25
62-340.700 Exemptions for Treatment or Disposal Systems 26
62-340.750 Exemptions for Surface Waters or Wetlands Created by Mosquito Control Activities 27
Field Identification of Hydric Soils 28
Estimating Seasonal High Saturation (SHWT depth) 28
Stand Alone D-test Indicators 29
Field Determination of Soil Indicator Texture 30
Tips for Texturing Soils with High Organic Content ("Rub Tests") 31
Tips for Approximating Composition of Soil ("Decant Tests") 31
Tips for Determining Boundary Types of Features in Soil 32
Tips for Determining Contrast Between Soil Colors 32
Round 10X % Coating Charts 34
Feature % Volume Charts 35
Tips for Determining Shapes of Features in Soil 40
Tips for Determining Areal Extents of Plants 40
Map of Land Resource Regions 41
Map of Major Land Resource Areas 42
Hydric Soil Field Indicators for LRRs: P T U 43
Hydric Soil Field Indicators Starting Depth Summary Table 49
Hydric Soil Field Indicators Simplified Checklist 50
Glossary from NRCS Field Indicators of Hydric Soils 57
Surface Water Definitions 62
Appendix B: Histosol and Histic Epipedon Definitions 63
Root Size Estimation Chart and Quantity Classes 63
NRCS Hydric Soil Technical Notes #4 & #13 64
Appendix C: Hydric Soils Criteria and Technical Standard 65
Supplemental Soil Data 66
FNAI Natural Communities of Florida List 66
Appendix A2: Common Name Listing of Vegetative Index 67
Recommended 5-Step Field Wetland Delination Procedure 86
Required and Suggested Field Equipment 86

The content of this guide was compiled by members of the Florida Department of Environmental Protection, Submerged Lands and Environmental Resources Coordination, Wetland Evaluation and Training Team. The express purpose of this document is to provide guidance to regulatory staff in order to maintain consistency in the applied field methodologies for wetland delineation pursuant to Chapter 62-340, F.A.C. The information contained in this guide was garnered from various sources pertinent to the field application of wetland delineation methodology outlined in Chapter 62-340, F.A.C. FDEP does

not warrant data provided by other sources for accuracy or for any particular use that may require accurate information. This guide is for information purposes only.

Appendix A: subsection 62-340.450(1), (2), (3), F.A.C.

Vegetative Index Plant List

Botanical Name/ Common Name/ Wetland Status

Abildgaardia ovata flat-spike rush FACW
Acacia auriculiformis ear-leaved acacia FAC
Acer negundo box-elder FACW
Acer rubrum red maple FACW
Acer saccharinum silver maple OBL
Acoelorraphe wrightii paurotis palm OBL
Acrostichum spp. leather fern OBL
Aeschynomene indica India joint-vetch FACW
Aeschynomene pratensis meadow joint-vetch OBL
Agalinis aphylla scale-leaf false-foxglove FACW
Agalinis linifolia flax-leaf false-foxglove OBL
Agalinis maritima saltmarsh false-foxglove OBL
Agalinis pinetorum (*A. pulchella*) false-foxglove FACW
Agalinis purpurea large purple false-foxglove FACW
Agarista populifolia hobble-bush FACW
Agrostis stolonifera redtop FACW
Aletris spp. colic-root FAC
Alisma subcordatum subcordate water-plantain OBL
Alnus serrulata hazel alder OBL
Alopecurus carolinianus tufted foxtail FAC
Alternanthera maritima beach alternanthera FACW - Keys only
Alternanthera paronychioides smooth chaff-flower FAC - Keys only
Alternanthera philoxeroides alligator-weed OBL
Alternanthera sessilis sessile alligator-weed OBL
Amaranthus australis southern amaranth OBL
Amaranthus cannabinus tidemarsh amaranth OBL
Amaranthus floridanus Florida amaranth OBL
Ammannia spp. toothcup OBL
Amorpha fruticosa indigo-bush FACW
Amphicarpum muhlenbergianum blue maidencane FACW
Amsonia rigida stiff slimpod FACW
Amsonia tabernaemontana eastern slimpod FACW
Anagallis pumila Florida pimpernel FAC
Andropogon arctatus (Campbell) savannah bluestem FAC
Andropogon brachystachys (Campbell) short-spike bluestem FAC
Andropogon gerardii (Campbell) big bluestem FAC
Andropogon glomeratus (Campbell) bushy bluestem FACW
Andropogon liebmanii var. ***pungensis*** (Campbell) (***A. mohrii***) Mohr's bluestem FACW
Andropogon perangustatus (Campbell) slim bluestem FAC
Andropogon virginicus (Campbell) broom-sedge FAC
Annona glabra pond apple OBL
Anthaenantia rufa purple silky-scale FACW
Apteria aphylla nodding nixie FACW
Ardisia spp. marlberry FAC
Arenaria godfreyi Godfrey's stitchwort FACW
Arisaema spp. jack-in-the-pulpit; green-dragon FACW

Aristida affinis long-leaf three-awn grass OBL
Aristida purpurascens (s.l.) wand-like three-awn grass FACW
Aristida rhizomophora rhizomatous three-awn grass FAC
Aristida spiciformis three-awn bottlebrush FAC
Aristida stricta pineland three-awn grass FAC
Armoracia aquatica lakecress OBL
Arnoglossum diversifolium variable-leaf indian-plantain FACW
Arnoglossum ovatum egg-leaf indian-plantain FACW
Arnoglossum sulcatum indian-plantain, Georgia OBL
Aronia arbutifolia red chokeberry FACW
Arundinaria gigantea giant cane FACW
Arundo donax giant reed FAC
Asclepias connivens large-flower milkweed FACW
Asclepias incarnata swamp milkweed OBL
Asclepias lanceolata fen-flower milkweed OBL
Asclepias longifolia long-leaf milkweed FACW
Asclepias pedicellata savannah milkweed FACW
Asclepias perennis aquatic milkweed OBL
Asclepias rubra red milkweed OBL
Asclepias viridula southern milkweed FACW
Aster carolinianus climbing aster OBL
Aster chapmanii savannah aster FACW
Aster dumosus bushy aster FAC
Aster elliottii Elliott's aster OBL
Aster eryngiifolius coyote-thistle aster FACW
Aster lateriflorus calico aster FACW
Aster spinulosus bog aster FACW
Aster subulatus saltmarsh aster OBL
Aster tenuifolius saltmarsh aster OBL
Aster umbellatus flat-top white aster FAC
Aster vimineus small white aster FACW
Athyrium filix-femina subarctic lady fern FACW
Atriplex patula halberd-leaf saltbush FACW
Avicennia germinans black mangrove OBL
Axonopus spp. carpet grass FAC
Baccharis angustifolia false-willow OBL
Baccharis dioica broom-bush false-willow FAC
Baccharis glomeruliflora groundsel tree FAC
Baccharis halimifolia eastern false-willow FAC
Bacopa spp. water-hyssop OBL
Balduina atropurpurea purple honeycomb-head FACW
Balduina uniflora one-flower honeycomb-head FACW
Bartonia spp. screwstem FACW
Batis maritima saltwort OBL
Betula nigra river birch OBL
Bidens bipinnata Spanish needles U
Bidens pilosa white beggar-ticks FAC
Bidens spp. beggar-ticks OBL
Bigelowia nudata rayless golden-rod FACW
Blechnum serrulatum swamp fern FACW
Boehmeria cylindrica small-spike false-nettle OBL

Boltonia spp. boltonia FACW
Borrichia spp. sea oxeye OBL
Brachiaria purpurascens paragrass FACW
Bucida buceras gregory wood FAC
Bumelia celastrina coastal bumelia FAC
Bumelia lycioides buckthorn bumelia FAC
Bumelia reclinata bumelia FAC
Burmannia spp. burmannia OBL
Byrsonima lucida locust-berry FAC - Keys only
Cacalia suaveolens sweet-scent indian-plantain FACW
Calamovilfa curtissii Curtiss' reed grass FACW
Callitriche spp. water-starwort OBL
Calopogon spp. grass-pinks FACW
Calycocarpum lyonii cupseed FACW
Campanula americana American bellflower FAC
Campanula floridana bellflower OBL
Canna spp. canna OBL
Canna x generalis common canna FAC
Caperonia spp. caperonia FACW
Capparis flexuosa caper-tree FACW
Cardamine bulbosa bitter-cress OBL
Cardamine pensylvanica spring-cress OBL
Carex atlantica prickly bog sedge OBL
Carex comosa bearded sedge OBL
Carex crinita fringed sedge OBL
Carex crus-corvi raven-foot sedge OBL
Carex decomposita cypress-knee sedge OBL
Carex elliottii Elliott's sedge OBL
Carex folliculata long sedge OBL
Carex gigantea large sedge OBL
Carex howei Howe's sedge OBL
Carex hyalinolepis sedge, shoreline sedge OBL
Carex leptalea bristly-stalk sedge OBL
Carex louisianica Louisiana sedge OBL
Carex lupulina hop sedge OBL
Carex lurida shallow sedge OBL
Carex spp. sedges FACW
Carex stipata stalk-grain sedge OBL
Carex walteriana Walter's sedge OBL
Carphephorus carnosus pineland chaffhead FACW
Carphephorus odoratissimus vanilla plant FAC
Carphephorus paniculatus deer-tongue FAC
Carphephorus pseudoliatris bristle-leaf chaffhead FACW
Carpinus caroliniana American hornbeam FACW
Carya aquatica water hickory OBL
Casuarina spp. casuarina FAC
Cayaponia quinqueloba five-lobe cayaponia FAC
Celtis laevigata sugar-berry; hackberry FACW
Centella asiatica coinwort FACW
Cephalanthus occidentalis buttonbush OBL
Cestrum diurnum day jessamine FAC

Chamaecyparis thyoides Atlantic white cedar OBL
Chaptalia tomentosa sunbonnet; pineland daisy FACW
Chasmanthium latifolium spanglegrass FAC
Chasmanthium sessiliflorum long-leaf Chasmanthium FAC
Chasmanthium spp. spanglegrass FACW
Chiococca spp. snowberry FAC
Chrysobalanus icaco cocoplum FACW
Cicuta spp. water-hemlock OBL
Cirsium lecontei Leconte's thistle FACW
Cirsium muticum swamp thistle OBL
Cirsium nuttallii Nuttall's thistle FACW
Cladium spp. sawgrass OBL
Cleistes divaricata rosebud OBL
Clethra alnifolia sweet pepper bush FACW
Cliftonia monophylla buckwheat-tree FACW
Colocasia esculenta elephant's ear OBL
Colubrina asiatica Asian snakewood FAC
Commelina erecta sandhill dayflower U
Commelina spp. dayflower FACW
Conocarpus erectus buttonwood FACW
Conoclinium coelestinum mistflower FAC
Coreopsis falcata sickle tickseed FACW
Coreopsis floridana Florida tickseed FACW
Coreopsis gladiata southeastern tickseed FACW
Coreopsis integrifolia ciliate-leaf tickseed FACW
Coreopsis leavenworthii Leavenworth's tickseed FACW
Coreopsis linifolia Texas tickseed FACW
Coreopsis nudata Georgia tickseed OBL
Coreopsis tripteris tall tickseed FAC
Cornus amomum silky dogwood OBL
Cornus foemina swamp dogwood FACW
Crataegus aestivalis mayhaw OBL
Crataegus marshallii parsley haw FACW
Crataegus viridis green haw FACW
Crinum americanum southern swamp-lily OBL
Croton elliottii Elliott's croton FACW
Ctenitis submarginalis brown-hair comb fern FACW
Ctenium spp. toothache grass FACW
Cupaniopsis anacardioides carrotwood FAC
Cuphea aspera common waxweed FACW
Cuphea carthagenensis Columbia waxweed FAC
Cyperus alternifolius alternate-leaf flatsedge OBL
Cyperus articulatus jointed flatsedge OBL
Cyperus cuspidatus coastal-plain flatsedge FAC
Cyperus difformis variable flatsedge OBL
Cyperus distinctus marshland flatsedge OBL
Cyperus drummondii flatsedge OBL
Cyperus entrerianus flatsedge OBL
Cyperus erythrorhizos red-root flatsedge OBL
Cyperus esculentus flatsedge FAC
Cyperus filiculmis sandhill flatsedge U

Cyperus giganteus flatsedge FAC
Cyperus globulosus Baldwin's flatsedge FAC
Cyperus haspan sheathed flatsedge OBL
Cyperus huarmensis black knotty-root flatsedge FAC
Cyperus lanceolatus epiphytic flatsedge OBL
Cyperus metzii flatsedge FAC
Cyperus ovularis flatsedge U
Cyperus papyrus papyrus flatsedge OBL
Cyperus reflexus flatsedge U
Cyperus refractus flatsedge U
Cyperus retrofractus flatsedge U
Cyperus retrorsus flatsedge FAC
Cyperus rotundus purple flatsedge FAC
***Cyperus* spp.** flatsedge FACW
Cyperus tetragonus flatsedge U
Cypselea humifusa panal FAC
Cyrilla racemiflora swamp cyrilla FAC
Decodon verticillatus swamp-loosestrife OBL
Dichondra caroliniensis pony-foot FAC
Dichromena colorata starbrush white-top sedge FACW
Dichromena floridensis Everglades white-top sedge FACW
Dichromena latifolia giant white-top sedge OBL
Dicliptera brachiata wild mudwort FACW
Digitaria pauciflora everglades grass FACW
Digitaria serotina dwarf crabgrass FAC
Diodia virginiana button-weed FACW
Dionaea muscipula Venus' flytrap FACW
Diospyros virginiana common persimmon FAC
Distichlis spicata seashore saltgrass OBL
Drosera brevifolia dwarf sundew FACW
Drosera capillaris pink sundew FACW
Drosera filiformis thread-leaf sundew OBL
Drosera intermedia spoon-leaf sundew OBL
Drosera tracyi Gulf coast sundew OBL
Drymaria cordata West Indian chickweed FAC
Dryopteris ludoviciana southern shield-fern FACW
Dulichium arundinaceum three-way sedge OBL
Dyschoriste humistrata swamp dyschoriste FACW
***Echinochloa* spp.** jungle-rice; cockspur grass FACW
***Echinodorus* spp.** burhead OBL
Eclipta alba yerba de Tajo FACW
***Eleocharis* spp.** spikerush OBL
Elyonurus tripsacoides Pan-American balsam-scale FACW
Elytraria caroliniensis Carolina scaly-stem FAC
Equisetum hyemale horsetail FACW
***Eragrostis* spp.** lovegrass FAC
Erechtites hieraciifolia fireweed FAC
Erianthus brevibarbis short-beard plumegrass FACW
Erianthus giganteus sugarcane plumegrass OBL
Erianthus strictus narrow plumegrass OBL
Erigeron quercifolius fleabane FAC

Erigeron vernus early whitetop fleabane FACW
Eriocaulon spp. pipewort OBL
Eriochloa spp. cupgrass FACW
Erithalis fruticosa black torchwood FAC
Ernodea littoralis golden-creeper FAC - Keys only
Eryngium aquaticum corn snakeroot OBL
Eryngium baldwinii Baldwin's coyote-thistle FAC
Eryngium integrifolium blue-flower coyote-thistle FACW
Eryngium prostratum creeping coyote-thistle FACW
Eryngium yuccifolium rattlesnake master FACW
Erythrodes querceticola low erythrodes FACW
Eulophia alta wild coco FACW
Eupatoriadelphus fistulosus joe-pye-weed FACW
Eupatorium leptophyllum marsh thoroughwort OBL
Eupatorium leucolepis white-bract thoroughwort FACW
Eupatorium mikanioides semaphore thoroughwort FACW
Eupatorium perfoliatum boneset FACW
Eupatorium spp. thoroughworts FAC
Euphorbia humistrata (*Chamaesyce humistrata*) spreading broomspurge FACW
Euphorbia inundata Florida spurge FACW
Euphorbia polyphylla many-leaved spurge FACW
Eustachys glauca (*Chloris glauca*) saltmarsh fingergrass FACW
Eustachys petraea fingergrass FAC
Eustoma exaltatum prairie-gentian FACW
Euthamia spp. bushy goldenrod FAC
Evolvulus convolvuloides evolvulus FACW
Evolvulus sericeus silky bindweed FACW
Ficus aurea Florida strangler fig FAC
Fimbristylis annua annual fringe-rush FACW
Fimbristylis puberula Vahl's hairy fringe-rush FACW
Fimbristylis spathacea hurricane-grass FAC
Fimbristylis spp. fringe-rush OBL
Flaveria bidentis yellowtop FAC
Flaveria floridana yellowtop FACW
Flaveria linearis yellowtop FACW
Flaveria trinervia yellowtop FAC
Forestiera acuminata swamp privet FACW
Forestiera segregata Florida privet FAC
Fothergilla gardenii dwarf witch-alder FACW
Fraxinus americana white ash U
Fraxinus spp. ash OBL
Fuirena spp. umbrella-sedge OBL
Galium tinctorium stiff marsh bedstraw FACW
Gaylussacia dumosa dwarf huckleberry FAC
Gaylussacia frondosa dangleberry FAC
Gaylussacia mosieri woolly-berry FACW
Gentiana spp. gentian FACW
Gleditsia aquatica water-locust OBL
Gleditsia triacanthos honey-locust FACW
Glyceria striata fowl mannagrass OBL
Gordonia lasianthus loblolly bay FACW

Gratiola hispida hispid hyssop FAC
Gratiola spp. hedgehyssop FACW
Guapira discolor blolly FAC - Keys only
Habenaria spp. rein orchid FACW
Halesia diptera silver-bell FACW
Harperocallis flava Harper's beauty FACW
Hartwrightia floridana Florida hartwrightia FACW
Hedychium coronarium ginger FACW
Helenium amarum pasture sneezeweed FAC
Helenium spp. sneezeweed FACW
Helianthus agrestis southeastern sunflower FACW
Helianthus angustifolius swamp sunflower FACW
Helianthus carnosus lakeside sunflower FACW
Helianthus floridanus Florida sunflower FAC
Helianthus heterophyllus wetland sunflower FACW
Helianthus simulans muck sunflower FACW
Heliotropium curassavicum seaside heliotrope FAC
Heliotropium polyphyllum heliotrope FAC
Heliotropium procumbens four-spike heliotrope FACW
Hemicarpha spp. dwarf-bulrush FACW
Heteranthera reniformis kidney-leaf mud-plantain OBL
Hibiscus aculeatus rosemallow FACW
Hibiscus coccineus scarlet rosemallow OBL
Hibiscus grandiflorus swamp rosemallow OBL
Hibiscus laevis halberd-leaf rosemallow OBL
Hibiscus moscheutos swamp rosemallow OBL
Hibiscus tiliaceus sea rosemallow FAC
Hydrochloa caroliniensis watergrass OBL
Hydrocleis nymphoides water-poppy OBL
Hydrocotyle ranunculoides floating pennywort OBL
Hydrocotyle spp. pennywort FACW
Hydrolea spp. false-fiddle-leaf OBL
Hygrophila spp. hygrophila OBL
Hymenachne amplexicaulis trompetilla OBL
Hymenocallis spp. spider-lily OBL
Hypericum chapmanii Chapman's St. John's-wort OBL
Hypericum cumulicola scrub St. John's-wort U
Hypericum drummondii Drummond's St. John's-wort U
Hypericum edisonianum Edison's St. John's-wort OBL
Hypericum fasciculatum marsh St. John's-wort OBL
Hypericum gentianoides pineweed U
Hypericum hypericoides St. Andrew's cross FAC
Hypericum lissophloeus smooth-bark St. John's-wort OBL
Hypericum microsepalum small-sepal St. John's-wort U
Hypericum nitidum Carolina St. John's-wort OBL
Hypericum prolificum shrubby St. John's-wort U
Hypericum punctatum dotted St. John's-wort U
Hypericum reductum Atlantic St. John's-wort U
Hypericum spp. St. John's-wort FACW
Hypericum tetrapetalum four-petal St. John's-wort FAC
Hypolepis repens bead fern FACW

Hypoxis spp. yellow stargrasses FACW
Hyptis alata musky mint FACW
Ilex amelanchier sarvis holly OBL
Ilex cassine dahoon holly OBL
Ilex coriacea bay-gall holly FACW
Ilex decidua deciduous holly FACW
Ilex myrtifolia myrtle holly OBL
Ilex opaca var.***opaca*** American holly FAC
Ilex verticillata winterberry OBL
Ilex vomitoria yaupon holly FAC
Illicium floridanum Florida anise OBL
Illicium parviflorum star anise FACW
Impatiens capensis spotted touch-me-not OBL
Iris spp. iris OBL
Iris verna dwarf iris U
Isoetes spp. quillwort OBL
Itea virginica virginia willow OBL
Iva frutescens marsh elder OBL
Iva microcephala little marsh elder FACW
Jacquinia keyensis joewood FAC
Juncus marginatus rush FACW
Juncus spp. rush OBL
Juncus tenuis rush FAC
Justicia brandegeana shrimp plant U
Justicia spp. water-willow OBL
Kalmia latifolia mountain laurel FACW
Kosteletzkya pentasperma coastal mallow FAC
Kosteletzkya virginica seashore mallow OBL
Lachnanthes caroliniana redroot FAC
Lachnocaulon anceps white-head bogbutton FACW
Lachnocaulon beyrichianum southern bogbutton FACW
Lachnocaulon digynum pineland bogbutton OBL
Lachnocaulon engleri Engler's bogbutton OBL
Lachnocaulon minus Small's bogbutton OBL
Laguncularia racemosa white mangrove OBL
Laportea canadensis Canada wood-nettle FACW
Leersia spp. cutgrass OBL
Leitneria floridana corkwood OBL
Leptochloa spp. sprangle-top FACW
Leptochloa virgata tropic sprangle-top FAC
Leucothoe spp. dog-hobble FACW
Liatris garberi Garber's gayfeather FACW
Liatris gracilis blazing star FAC
Liatris spicata spiked gayfeather FAC
Lilaeopsis spp. lilaeopsis OBL
Lilium catesbaei southern red lily FAC
Lilium iridollae panhandle lily OBL
Limnobium spongia frogbit OBL
Limnophila spp. marshweed OBL
Limonium carolinianum sea-lavender OBL
Lindera benzoin northern spicebush FACW

Lindera melissifolia southern spicebush OBL
Lindernia crustacea Malayan false-pimpernel FAC
Lindernia spp. false-pimpernel FACW
Linum carteri Carter's flax FACW
Linum floridanum Florida yellow flax FAC
Linum medium stiff yellow flax FAC
Linum striatum ridged yellow flax FACW
Linum westii West's flax OBL
Liparis elata (*L. nervosa*) tall liparis OBL
Lipocarpha spp. lipocarpha FACW
Liquidambar styraciflua sweetgum FACW
Liriodendron tulipifera tulip tree FACW
Listera spp. twayblade FACW
Litsea aestivalis pondspice OBL
Lobelia cardinalis cardinal flower OBL
Lobelia floridana Florida lobelia OBL
Lobelia spp. lobelia FACW
Lophiola americana golden-crest FACW
Ludwigia hirtella hairy seedbox FACW
Ludwigia maritima seaside seedbox FACW
Ludwigia spp. ludwigia; water-primrose OBL
Ludwigia suffruticosa headed seedbox FACW
Ludwigia virgata savanna seedbox FACW
Lycium carolinianum Christmas berry OBL
Lycopodium spp. clubmoss FACW
Lycopus spp. bugleweed OBL
Lyonia ligustrina maleberry FAC
Lyonia lucida fetter-bush FACW
Lyonia mariana fetter-bush FACW
Lysimachia spp. loosestrife OBL
Lythrum spp. marsh loosestrife OBL
Macbridea spp. birds-in-a-nest FACW
Macranthera flammea flameflower OBL
Magnolia virginiana var. ***australis*** sweetbay magnolia OBL
Malaxis spicata Florida adder's-mouth OBL
Manilkara bahamensis wild dilly FAC - Keys only
Manisuris cylindrica pitted jointgrass FAC
Manisuris spp. jointgrass FACW
Marshallia graminifolia grass-leaf barbara's-buttons FACW
Marshallia tenuifolia slim-leaf barbara's-buttons FACW
Maxillaria crassifolia hidden orchid OBL
Maytenus phyllanthoides Florida mayten FAC
Mecardonia spp. mecardonia FACW
Melaleuca quinquenervia punk tree FAC
Melanthera nivea squarestem FACW
Melanthium virginicum Virginia bunchflower OBL
Melochia corchorifolia chocolate-weed FAC
Metopium toxiferum poison wood FAC
Micranthemum spp. baby tears OBL
Micromeria brownei (*Satureja brownei*) Brown's savory OBL
Mimosa pigra black mimosa FAC

Mimulus alatus monkey-flower OBL
Mitreola spp. hornpod FACW
Monanthochloe littoralis keygrass OBL
Morinda royoc Keys rhubarb FACW - Keys only
Morus rubra red mulberry FAC
Muhlenbergia capillaris muhly grass OBL
Muhlenbergia expansa cutover muhly FAC
Muhlenbergia schreberi nimblewill FACW
Murdannia spp. dewflower FAC
Myosurus minimus tiny mouse-tail FAC
Myrica cerifera southern bayberry FAC
Myrica heterophylla evergreen bayberry FACW
Myrica inodora odorless bayberry FACW
Myrsine guianensis guiana myrsine FAC
Nasturtium spp. water-cress OBL
Nelumbo spp. water-lotus OBL
Nemastylis floridana fall-flowering pleatleaf FACW
Nemophila aphylla small-flower baby-blue-eyes FACW
Nephrolepis spp. sword ferns FAC
Neyraudia reynaudiana silk reed FAC
Nuphar luteum yellow cow-lily OBL
Nymphaea spp. water-lily OBL
Nymphoides spp. floating-hearts OBL
Nyssa aquatica water tupelo OBL
Nyssa ogeche ogeechee tupelo OBL
Nyssa sylvatica var. ***biflora*** swamp tupelo OBL
Oldenlandia spp. water bluets FACW
Onoclea sensibilis sensitive fern FACW
Oplismenus setarius woods grass FAC
Orontium aquaticum golden club OBL
Oryza sativa cultivated rice FAC
Osmunda cinnamomea cinnamon fern FACW
Osmunda regalis royal fern OBL
Oxypolis spp. water drop-wort OBL
Panicum abscissum (Hall) cut-throat grass FACW
Panicum anceps beaked panicum FAC
Panicum commutatum panicum FAC
Panicum dichotomiflorum fall panicum FACW
Panicum dichotomum panicum FACW
Panicum ensifolium panic grass OBL
Panicum erectifolium erect-leaf witchgrass OBL
Panicum gymnocarpon savannah panicum OBL
Panicum hemitomon maiden-cane OBL
Panicum hians gaping panicum FAC
Panicum longifolium tall thin panicum OBL
Panicum pinetorum panicum FACW
Panicum repens torpedo grass FACW
Panicum rigidulum red-top panicum FACW
Panicum scabriusculum woolly panicum OBL
Panicum scoparium panicum FACW
Panicum spretum panicum FACW

Panicum strigosum panicum FAC
Panicum tenerum bluejoint panicum OBL
Panicum tenue panicum FAC
Panicum verrucosum warty panicum FACW
Panicum virgatum switchgrass FACW
Parietaria spp. pellitory FAC
Parnassia spp. grass-of-Parnassus OBL
Paspalidium geminatum water panicum OBL
Paspalum acuminatum brook paspalum FACW
Paspalum boscianum bull paspalum FACW
Paspalum conjugatum sour paspalum FAC
Paspalum dilatatum dallisgrass FAC
Paspalum dissectum mudbank paspalum OBL
Paspalum distichum joint paspalum OBL
Paspalum fimbriatum Panama paspalum FAC
Paspalum floridanum Florida paspalum FACW
Paspalum laeve field paspalum FACW
Paspalum monostachyum gulf paspalum OBL
Paspalum plicatulum brown-seed paspalum FAC
Paspalum praecox early paspalum OBL
Paspalum pubiflorum hairy-seed paspalum FACW
Paspalum repens water paspalum OBL
Paspalum setaceum thin paspalum FAC
Paspalum urvillei vasey grass FAC
Pavonia spicata mangrove mallow FACW
Peltandra spp. arum; spoon flower OBL
Pennisetum purpureum elephant ear grass FAC
Penthorum sedoides ditch stonecrop OBL
Pentodon pentandrus Hall's pentodon OBL
Persea palustris swamp bay OBL
Phalaris spp. canary grass FAC
Philoxerus vermicularis silverhead FACW
Phragmites australis common reed OBL
Phyla spp. frog-fruit FAC
Phyllanthus caroliniensis Carolina leaf-flower FACW
Phyllanthus liebmannianus Florida leaf-flower FACW
Phyllanthus urinaria water leaf-flower FAC
Physostegia godfreyi Godfrey's dragon-head OBL
Physostegia leptophylla slender-leaf dragon-head OBL
Physostegia purpurea purple dragon-head FACW
Physostegia virginiana false dragon-head FACW
Pieris phillyreifolia climbing fetter-bush FACW
Pilea spp. clearweed FACW
Pinckneya bracteata (*P. pubens*) fever-tree OBL
Pinguicula spp. butterwort OBL
Pinus glabra spruce pine FACW
Pinus serotina pond pine FACW
Piriqueta caroliniana piriqueta FAC
Pisonia rotundata pisonia FAC - Keys only
Pithecellobium keyense blackbead FAC - Keys only
Pithecellobium unguis-cati catclaw FAC - Keys only

Planera aquatica planer tree OBL
Platanthera spp. fringed orchid OBL
Platanus occidentalis sycamore FACW
Pleea tenuifolia rush-featherling OBL
Pluchea spp. camphor-weed FACW
Pogonia ophioglossoides rose pogonia OBL
Polygala cymosa tall milkwort OBL
Polygala leptostachys sandhill milkwort U
Polygala lewtonii scrub milkwort U
Polygala polygama racemed milkwort U
Polygala spp. milkwort FACW
Polygala verticillata whorled milkwort U
Polygonum argyrocoleon silversheath smartweed U
Polygonum spp. smartweed OBL
Polygonum virginianum jumpseed FACW
Polypogon spp. rabbit-foot grass FAC
Polypremum procumbens rustweed FAC
Pontederia cordata pickerelweed OBL
Ponthieva racemosa shadow-witch FACW
Populus deltoides eastern cottonwood FACW
Populus heterophylla swamp cottonwood OBL
Proserpinaca spp. mermaid-weed OBL
Psidium cattleianum strawberry guava FAC
Psilocarya spp. baldrush OBL
Psychotria spp. wild coffee FAC
Pteris tripartita giant brake FACW
Ptilimnium capillaceum mock bishop-weed FACW
Pycnanthemum nudum coastal-plain mountain-mint FACW
Quercus laurifolia laurel oak FACW
Quercus lyrata overcup oak OBL
Quercus michauxii swamp chestnut oak FACW
Quercus nigra water oak FACW
Quercus pagoda cherry-bark oak FACW
Quercus phellos willow oak FACW
Randia aculeata box briar FAC - Keys only
Ranunculus spp. butter-cup FACW
Reimarochloa oligostachya Florida reimar grass FACW
Reynosia septentrionalis darling plum FAC - Keys only
Rhapidophyllum hystrix needle palm FACW
Rhexia parviflora white meadow-beauty OBL
Rhexia salicifolia panhandle meadow-beauty OBL
Rhexia spp. meadow-beauty FACW
Rhizophora mangle red mangrove OBL
Rhododendron viscosum swamp azalea FACW
Rhodomyrtus tomentosus downy rose-myrtle FAC
Rhynchospora cephalantha clustered beakrush OBL
Rhynchospora chapmanii Chapman's beakrush OBL
Rhynchospora corniculata short-bristle beakrush OBL
Rhynchospora decurrens swamp-forest beakrush OBL
Rhynchospora divergens spreading beakrush OBL
Rhynchospora grayi Gray's beakrush U

Rhynchospora harperi Harper's beakrush OBL
Rhynchospora intermedia pinebarren beakrush U
Rhynchospora inundata horned beakrush OBL
Rhynchospora macra large beakrush OBL
Rhynchospora megalocarpa giant-fruited beakrush U
Rhynchospora microcarpa southern beakrush OBL
Rhynchospora miliacea millet beakrush OBL
Rhynchospora mixta mingled beakrush OBL
Rhynchospora oligantha few-flower beakrush OBL
Rhynchospora spp. beakrush FACW
Rhynchospora stenophylla Chapman's beakrush OBL
Rhynchospora tracyi Tracy's beakrush OBL
Rorippa spp. yellow-cress OBL
Rosa palustris swamp rose OBL
Rotala ramosior toothcup OBL
Roystonea spp. royal palm FACW
Rubus spp. blackberries FAC
Rudbeckia fulgida orange coneflower FACW
Rudbeckia graminifolia grass-leaf coneflower FACW
Rudbeckia laciniata cut-leaf coneflower FACW
Rudbeckia mohrii Mohr's coneflower OBL
Rudbeckia nitida shiny coneflower FACW
Ruellia brittoniana Britton's wild-petunia FAC
Ruellia caroliniensis wild-petunia FAC
Ruellia noctiflora night-flowering wild-petunia FACW
Rumex spp. dock FACW
Sabal minor dwarf palmetto FACW
Sabal palmetto cabbage palm FAC
Sabatia bartramii Bartram's rose-gentian OBL
Sabatia calycina coast rose-gentian OBL
Sabatia dodecandra large rose-gentian OBL
Sabatia spp. rose-gentian FACW
Sacciolepis indica glenwood grass FAC
Sacciolepis striata American cupscale OBL
Sachsia polycephala sachsia FACW
***Sagittaria* spp.** arrowhead OBL
Salicornia spp. glasswort OBL
Salix spp. willow OBL
Sambucus canadensis elderberry FAC
Samolus spp. water pimpernel OBL
Sapium sebiferum Chinese tallow-tree FAC
Sarracenia minor hooded pitcher-plant FACW
Sarracenia spp. pitcher-plant OBL
Saururus cernuus lizard's tail OBL
Schinus terebinthifolius Brazilian pepper-tree FAC
Schizachyrium spp. bluestem FAC
Schoenolirion croceum sunny bells FACW
Schoenolirion elliottii sunny bells FACW
Schoenus nigricans black-sedge FACW
Scirpus spp. bulrush OBL
Scleria spp. nutrush FACW

Sclerolepis uniflora one-flower hardscale FACW
Scoparia dulcis sweet broom FAC
Scutellaria floridana skullcap FAC
Scutellaria integrifolia rough skullcap FAC
Scutellaria lateriflora blue skullcap OBL
Scutellaria racemosa skullcap OBL
Sebastiania fruticosa gulf sebastian-bush FAC
Selaginella apoda meadow spike-moss FACW
Senecio aureus golden ragwort OBL
Senecio glabellus butterweed OBL
Sesbania spp. rattle-bush FAC
Sesuvium spp. sea-purslane FACW
Setaria geniculata bristle grass FAC
Setaria magna foxtail OBL
Seymeria cassioides black senna FAC
Sisyrinchium atlanticum eastern blue-eye-grass FACW
Sisyrinchium capillare blue-eye-grass FACW
Sisyrinchium mucronatum Michaux's blue-eye-grass FACW
Sium suave water-parsnip OBL
Solanum bahamense canker-berry FACW
Solanum erianthum shrub nightshade FACW
Solidago elliottii Elliott's goldenrod OBL
Solidago fistulosa marsh goldenrod FACW
Solidago leavenworthii Leavenworth's goldenrod FACW
Solidago patula rough-leaf goldenrod OBL
Solidago rugosa wrinkled goldenrod FAC
Solidago sempervirens seaside goldenrod FACW
Solidago stricta willow-leaf goldenrod FACW
Sophora tomentosa coast sophora FACW
Sparganium americanum burreed OBL
Spartina alterniflora saltmarsh cordgrass OBL
Spartina bakeri sand cordgrass FACW
Spartina cynosuroides big cordgrass OBL
Spartina patens saltmeadow cordgrass FACW
Spartina spartinae gulf cordgrass OBL
Spergularia marina saltmarsh sandspurry OBL
Spermacoce glabra smooth button-plant FACW
Sphagnum spp. sphagnum moss OBL
Sphenoclea zeylanica chicken-spike FACW
Sphenopholis pensylvanica swamp wedgescale OBL
Sphenostigma coelestinum Bartram's ixia FACW
Spigelia loganioides pink-root FACW
Spilanthes americana creeping spotflower FACW
Spiranthes spp. ladies'-tresses FACW
Sporobolus floridanus Florida dropseed FACW
Sporobolus virginicus seashore dropseed OBL
Stachys lythroides hedgenettle OBL
Staphylea trifolia American bladdernut FACW
Stenandrium floridanum stenandrium FACW
Stenanthium gramineum eastern feather-bells FACW
Stillingia aquatica corkwood OBL

Stillingia sylvatica var. ***tenuis*** marsh queen's-delight FAC
Stipa avenacioides Florida needle grass FACW
Stokesia laevis stokesia FACW
Strumpfia maritima strumpfia FACW - Keys only
Styrax americana snowbell; storax OBL
Suaeda spp. sea-blite OBL
Suriana maritima bay-cedar FAC
Syngonanthus flavidulus bantam-buttons FACW
Syzygium spp. Java plum FAC
Taxodium ascendens pond cypress OBL
Taxodium distichum bald cypress OBL
Teucrium canadense American germander FACW
Thalia geniculata thalia; fire flag OBL
Thalictrum spp. meadow-rue FACW
Thelypteris spp. shield fern FACW
Thespesia populnea seaside mahoe FAC
Thrinax radiata Florida thatch palm FAC - Keys only
Tilia americana American basswood FACW
Tofieldia racemosa coastal false-asphodel OBL
Toxicodendron vernix poison sumac FACW
Trachelospermum difforme climbing-dogbane FACW
Tradescantia fluminensis trailing spiderwort FAC
Trema spp. trema FAC
Trepocarpus aethusae aethusa-like trepocarpus FACW
Triadenum spp. marsh St. John's-wort OBL
Trianthema portulacastrum horse-purslane FACW
Tridens ambiguus savannah tridens FACW
Tridens strictus long-spike tridens FACW
Triglochin striata arrow-grass OBL
Triphora spp. nodding pogonias FACW
Tripsacum dactyloides eastern gama grass FAC
Typha spp. cattail OBL
Ulmus rubra slippery elm U
Ulmus spp. elm FACW
Urechites lutea wild allamanda FACW
Utricularia spp. bladderwort OBL
Uvularia floridana Florida bellwort FACW
Vaccinium corymbosum highbush blueberry FACW
Vaccinium elliottii Elliott's blueberry FAC
Verbena scabra sandpaper vervain FACW
Verbesina chapmanii Chapman's crownbeard FACW
Verbesina heterophylla diverse-leaf crownbeard FACW
Verbesina virginica white crownbeard FAC
Vernonia angustifolia narrow-leaf ironweed U
Vernonia spp. ironweed FACW
Veronica anagallis-aquatica water speedwell OBL
Veronicastrum virginicum culver's-root FACW
Viburnum dentatum arrow-wood FACW
Viburnum nudum possum-haw viburnum FACW
Viburnum obovatum walter viburnum FACW
Vicia acutifolia four-leaf vetch FACW

Vicia floridana Florida vetch FACW
Vicia ocalensis Ocala vetch OBL
Viola affinis Leconte's violet FACW
Viola esculenta edible violet FACW
Viola lanceolata lance-leaf violet OBL
Viola primulifolia primrose-leaf violet FACW
Websteria confervoides water-meal OBL
Wedelia trilobata creeping ox-eye FAC
Woodwardia areolata chainfern OBL
Woodwardia virginica chainfern FACW
Xanthorhiza simplicissima shrubby yellow-root FACW
Xanthosoma sagittifolium elephant ear FACW
Xyris caroliniana Carolina yellow-eyed grass FACW
Xyris jupicai tropical yellow-eyed grass FACW
Xyris spp. yellow-eyed grass OBL
Yeatesia viridiflora green-flower yeatesia FACW
Zephyranthes atamasco atamasco lily FACW
Zigadenus densus crow poison FACW
Zigadenus glaberrimus atlantic deathcamas FACW
Zizania aquatica wildrice OBL
Zizaniopsis miliacea southern wildrice OBL

Any plant not specifically listed is considered an upland plant except vines, aquatic plants, and any plant species not introduced into the State of Florida as of the effective date of Chapter 62-340, F.A.C. (Effective Date July 1, 1994)

Chapter 62-340, F.A.C.
Delineation of the Landward Extent of Wetlands and Surface Waters

62-340.100 Intent.
62-340.200 Definitions.
62-340.300 Delineation.
62-340.400 Selection of Appropriate Vegetative Stratum.
62-340.450 Vegetative Index.
62-340.500 Hydrologic Indicators.
62-340.550 Wetland Hydrology.
62-340.600 Surface Waters.
62-340.700 Exemptions for Treatment or Disposal Systems.
62-340.750 Exemption for Surface Waters or Wetlands Created by Mosquito Control Activities.

62-340.100 Intent.

(1) This rule's intent is to provide a unified statewide methodology for the delineation of the extent of wetlands and surface waters to satisfy the mandate of Section 373.421, F.S. This delineation methodology is intended to approximate the combined landward extent of wetlands as determined by a water management district and the Department immediately before the effective date of this rule. Before implementing the specific provisions of this methodology, the regulating agency shall attempt to identify wetlands according to the definition for wetlands in subsection 373.019(27), F.S., and subsection 62-340.200(19), F.A.C., below. The landward extent of wetlands shall be determined by the dominance of plant species, soils and other hydrologic evidence indicative of regular and periodic inundation or saturation. In all cases, attempts shall be made to locate the landward extent of wetlands visually by on site inspection, or aerial photointerpretation in combination with ground truthing, without quantitative sampling. If this cannot be accomplished, the quantitative methods in paragraph 62-301.400(1)(c), F.A.C., shall be used unless the applicant or petitioner and regulating agency agree, in writing, on an alternative method for quantitatively analyzing the vegetation on site. The methodology shall not be used to delineate areas which are not wetlands as defined in subsection 62-340.200(19), F.A.C., nor to delineate as wetlands or surface waters areas exempted from delineation by statute or agency rule.

2) The Department shall be responsible for ensuring statewide coordination and consistency in the delineation of surface waters and wetlands pursuant to this rule, by providing training and guidance to the Department, Districts, and local governments in implementing the methodology.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.100.

62-340.200 Definitions.

When used in this chapter, the following terms shall mean:

(1) "**Aquatic plant**" means a plant, including the roots, which typically floats on water or requires water for its entire structural support, or which will desiccate outside of water.

(2) "**Canopy**" means the plant stratum composed of all woody plants and palms with a trunk four inches or greater in diameter at breast height, except vines.

(3) "**Diameter at Breast Height (DBH)**" means the diameter of a plant's trunk or main stem at a height of 4.5 feet above the ground.

(4) "**Facultative plants**" means those plant species listed in subsection 62-340.450(3), F.A.C., of this chapter. For the purposes of this rule, facultative plants are not indicators of either wetland or upland conditions.

(5) "**Facultative Wet plants**" means those plant species listed in subsection 62-340.450(2), F.A.C., of this chapter.

(6) "**Ground Cover**" means the plant stratum composed of all plants not found in the canopy or subcanopy, except vines and aquatic plants.
(7) "**Ground truthing**" means verification on the ground of conditions on a site.
(8) "**Hydric Soils**" means soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile.
(9) "**Hydric Soil Indicators**" means those indicators of hydric soil conditions as identified in *Soil and Water Relationships of Florida's Ecological Communities* (Florida Soil Conservation ed. Staff 1992).
(10) "**Inundation**" means a condition in which water from any source regularly and periodically covers a land surface.
(11) "**Obligate plants**" means those plant species listed in subsection 62-340.450(1), F.A.C., of this chapter.
(12) "**Regulating agency**" means the Department of Environmental Protection, the water management districts, state or regional agencies, local governments, and any other governmental entities.
(13) "**Riverwash**" means areas of unstabilized sandy, silty, clayey, or gravelly sediments. These areas are flooded, washed, and reworked by rivers or streams so frequently that they may support little or no vegetation.
(14) "**Saturation**" means a water table six inches or less from the soil surface for soils with a permeability equal to or greater than six inches per hour in all layers within the upper 12 inches, or a water table 12 inches or less from the soil surface for soils with a permeability less than six inches per hour in any layer within the upper 12 inches.
(15) "**Seasonal High Water**" means the elevation to which the ground and surface water can be expected to rise due to a normal wet season.
(16) "**Subcanopy**" means the plant stratum composed of all woody plants and palms, exclusive of the canopy, with a trunk or main stem with a DBH between one and four inches, except vines.
(17) "**Upland plants**" means those plant species, not listed as Obligate, Facultative Wet, or Facultative by this rule, excluding vines, aquatic plants, and any plant species not introduced into the State of Florida as of the effective date of this rule.
(18) "**U.S.D.A.-S.C.S.**" means the United States Department of Agriculture, Soil Conservation Service.
(19) "**Wetlands**," as defined in subsection 373.019(27), F.S., means those areas that are inundated or saturated by surface water or ground water at a frequency and a duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above. These species, due to morphological, physiological, or reproductive adaptations, have the ability to grow, reproduce or persist in aquatic environments or anaerobic soil conditions. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.200.

62-340.300 Delineation of Wetlands.

The landward extent (i.e., the boundary) of wetlands as defined in subsection 62-340.200(19), F.A.C., shall be determined by applying reasonable scientific judgment to evaluate the dominance of plant species, soils, and other hydrologic evidence of regular and periodic inundation and saturation as set forth below. In applying reasonable scientific judgment, all reliable information shall be evaluated in

determining whether the area is a wetland as defined in subsection 62-340.200(19), F.A.C.

(1) Before using the wetland delineation methodology described below, the regulating agency shall attempt to identify and delineate the landward extent of wetlands by direct application of the definition of wetlands in subsection 62-340.200(19), F.A.C., with particular attention to the vegetative communities which the definition lists as wetlands and non-wetlands. If the boundary cannot be located easily by use of the definition in subsection 62-340.200(19), F.A.C., the provisions of this rule shall be used to locate the landward extent of a wetland. In applying the provisions of this rule, the regulating agency shall attempt to locate the landward extent of wetlands visually by on site inspection, or aerial photointerpretation in combination with ground truthing.

(2) The landward extent of a wetland as defined in subsection 62-340.200(19), F.A.C., shall include any of the following areas:

(a) Those areas where the aereal extent of obligate plants in the appropriate vegetative stratum is greater than the areal extent of all upland plants in that stratum, as identified using the method in Rule 62-340.400, F.A.C., and either:

1. The substrate is composed of hydric soils or riverwash, as identified using standard U.S.D.A.-S.C.S. practices for Florida, including the approved hydric soil indicators, except where the hydric soil is disturbed by a nonhydrological mechanical mixing of the upper soil profile and the regulating agency establishes through data or evidence that hydric soil indicators would be present but for the disturbance;

2. The substrate is nonsoil, rock outcrop-soil complex, or the substrate is located within an artificially created wetland area; or

3. One or more of the hydrologic indicators listed in Rule 62-340.500, F.A.C., are present and reasonable scientific judgment indicates that inundation or saturation is present sufficient to meet the wetland definition of subsection 62-340.200(19), F.A.C.

(b) Those areas where the areal extent of obligate or facultative wet plants, or combinations thereof, in the appropriate stratum is equal to or greater than 80% of all the plants in that stratum, excluding facultative plants, and either:

1. The substrate is composed of hydric soils or riverwash, as identified using standard U.S.D.A.-S.C.S. practices for Florida, including the approved hydric soil indicators, except where the hydric soil is disturbed by a nonhydrologic mechanical mixing of the upper soil profile and the regulating agency establishes through data or evidence that hydric soil indicators would be present but for the disturbance;

2. The substrate is nonsoil, rock outcrop-soil complex, or the substrate is located within an artificially created wetland area; or

3. One or more of the hydrologic indicators listed in Rule 62-340.500, F.A.C., are present and reasonable scientific judgment indicates that inundation or saturation is present sufficient to meet the wetland definition of subsection 62-340.200(19), F.A.C.

(c) Those areas, other than pine flatwoods and improved pastures, with undrained hydric soils which meet, in situ, at least one of the criteria listed below. A hydric soil is considered undrained unless reasonable scientific judgment indicates permanent artificial alterations to the on site hydrology have resulted in conditions which would not support the formation of hydric soils.

1. Soils classified according to United States Department of Agriculture's *Keys to Soil Taxonomy* (4th ed. 1990) as Umbraqualfs, Sulfaquents, Hydraquents, Humaquepts, Histosols (except Folists), Argiaquolls, or Umbraquults.

2. Saline sands (salt flats-tidal flats).

3. Soil within a hydric mapping unit designated by the U.S.D.A.-S.C.S. as frequently flooded or depressional, when the hydric nature of the soil has been field verified using the U.S.D.A.-S.C.S. approved hydric soil indicators for Florida. If a permit applicant, or a person petitioning for a formal determination pursuant to subsection 373.421(2), F.S., disputes the boundary of a frequently flooded or depressional mapping unit, the applicant or petitioner may request that the regulating agency, in cooperation with the U.S.D.A.-S.C.S., confirm the boundary. For the purposes of subsection 120.60(2), F.S., a request for a boundary confirmation pursuant to this subparagraph shall have the same effect as a timely request for additional information by the regulating agency. The regulating agency's receipt of

the final response provided by the U.S.D.A.-S.C.S. to the request for boundary confirmation shall have the same effect as a receipt of timely requested additional information.

4. For the purposes of this paragraph only, "pine flatwoods" means a plant community type in Florida occurring on flat terrain with soils which may experience a seasonal high water table near the surface. The canopy species consist of a monotypic or mixed forest of long leaf pine or slash pine. The subcanopy is typically sparse or absent. The ground cover is dominated by saw palmetto with areas of wire grass, gallberry, and other shrubs, grasses, and forbs, which are not obligate or facultative wet species. Pine flatwoods do not include those wetland communities as listed in the wetland definition contained in subsection 62-340.200(19), F.A.C., which may occur in the broader landscape setting of pine flatwoods and which may contain slash pine. Also for the purposes of this paragraph only, "improved pasture" means areas where the dominant native plant community has been replaced with planted or natural recruitment of herbaceous species which are not obligate or facultative wet species and which have been actively maintained for livestock through mechanical means or grazing.

(d) Those areas where one or more of the hydrologic indicators listed in Rule 62-340.500, F.A.C., are present, and which have hydric soils, as identified using the U.S.D.A.-S.C.S. approved hydric soil indicators for Florida, and reasonable scientific judgment indicates that inundation or saturation is present sufficient to meet the wetland definition of subsection 62-340.200(19), F.A.C. These areas shall not extend beyond the seasonal high water elevation.

(3)(a) If the vegetation or soils of an upland or wetland area have been altered by natural or man-induced factors such that the boundary between wetlands and uplands cannot be delineated reliably by use of the methodology in subsection 62-340.300(2), F.A.C., as determined by the regulating agency, and the area has hydric soils or riverwash, as identified using standard U.S.D.A.-S.C.S. practices for Florida, including the approved hydric soil indicators, except where the hydric soil is disturbed by a non hydrologic mechanical mixing of the upper soil profile and the regulating agency establishes through data or evidence that hydric soil indicators would be present but for the disturbance, then the most reliable available information shall be used with reasonable scientific judgment to determine where the methodology in subsection 62-340.300(2), F.A.C., would have delineated the boundary between wetlands and uplands. Reliable available information may include, but is not limited to, aerial photographs, remaining vegetation, authoritative site-specific documents, or topographical consistencies.

(b) This subsection shall not apply to any area where regional or site-specific permitted activity, or activities which did not require a permit, under Sections 253.123 and 253.124, F.S. (1957), as subsequently amended, the provisions of Chapter 403, F.S. (1983), relating to dredging and filling activities, Chapter 84-79, Laws of Florida, and Part IV of Chapter 373, F.S., have altered the hydrology of the area to the extent that reasonable scientific judgment, or application of the provisions of Section 62-340.550, F.A.C., indicate that under normal circumstances the area no longer inundates or saturates at a frequency and duration sufficient to meet the wetland definition in subsection 62-340.200(19), F.A.C.

(c) This subsection shall not be construed to limit the type of evidence which may be used to delineate the landward extent of a wetland under this chapter when an activity violating the regulatory requirements of Sections 253.123 and 253.124, F.S. (1957), as subsequently amended, the provisions of Chapter 403, F.S. (1983), relating to dredging and filling activities, Chapter 84-79, Laws of Florida, and Part IV of Chapter 373, F.S., has disturbed the vegetation or soils of an area.

(4) The regulating agency shall maintain sufficient soil scientists on staff to provide evaluation or consultation regarding soil determinations in applying the methodologies set forth in subsection 62-340.300(2) or (3), F.A.C. Services provided by the U.S.D.A.-S.C.S., or other competent soil scientists, under contract or agreement with the regulating agency, may be used in lieu of, or to augment, agency staff.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.300.

62-340.400 Selection of Appropriate Vegetative Stratum.
Dominance of plant species, as described in paragraphs 62-340.300(2)(a) and 62-340.300(2)(b), F.A.C., shall be determined in a plant stratum (canopy, subcanopy, or ground cover). The top stratum shall be used to determine dominance unless the top stratum, exclusive of facultative plants, constitutes less than 10 percent areal extent, or unless reasonable scientific judgment establishes that the indicator status of the top stratum is not indicative of the hydrologic conditions on site. In such cases, the stratum most indicative of on site hydrologic conditions, considering the seasonal variability in the amount and distribution of rainfall, shall be used. The evidence concerning the presence or absence of regular and periodic inundation or saturation shall be based on in situ data. All facts and factors relating to the presence or absence of regular and periodic inundation or saturation shall be weighed in deciding whether the evidence supports shifting to a lower stratum. The presence of obligate, facultative wet, or upland plants in a lower stratum does not by itself constitute sufficient evidence to shift strata, but can be considered along with other physical data in establishing the weight of evidence necessary to shift to a lower stratum. The burden of proof shall be with the party asserting that a stratum other than the top stratum should be used to determine dominance. Facultative plants shall not be considered for purposes of determining appropriate strata or dominance.
Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.400.

62-340.450 Vegetative Index.
(1) Obligate Species (See Appendix A)
(2) Facultative Wet Species (See Appendix A)
(3) Facultative Species (See Appendix A)
(4) Nomenclature. Use of plants in this rule is based solely on the scientific names. Common names are included in the above lists for information purposes only. The following references shall be used by the regulating agency to resolve any uncertainty about the nomenclature or taxonomy of any plant listed by a given scientific name in this section: R. Godfrey, Trees, Shrubs and Woody Vines of Northern Florida and Adjacent Georgia & Alabama (Univ. Ga. Press, Athens 1988) and D. Lellinger, Ferns & Fern-Allies of the United States & Canada (Smithsonian Institution Press, Washington D.C. 1985) for all species covered by these references. For all other listed scientific names the following references will be followed unless the species list in this section designates a different authority next to an individual species name: R. Godfrey & J. Wooten, Aquatic and Wetland Plants of Southeastern United States: Monocotyledons (Univ. Ga. Press, Athens 1979); R. Godfrey & J. Wooten, Aquatic and Wetland Plants of Southeastern United States: Dicotyledons (Univ. Ga. Press, Athens 1979); D. & H. Correll, Flora of the Bahama Archipelago (A.R. Gantner, Germany 1982). When the species list in this section designates a different authority next to an individual species name, the regulating agency shall resolve any ambiguity in nomenclature by using the name identified in D. Hall, The Grasses of Florida (Doctoral Dissertation, Univ. of Fla., Gainesville 1978); or C. Campbell, Systematics of the Andropogon Virginicus Complex (GRAMINEAE), 64 Journal of the Arnold Arboretum 171-254 (1983).
Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.450.

62-340.500 Hydrologic Indicators.
The indicators below may be used as evidence of inundation or saturation when used as provided in Rule 62-340.300, F.A.C. Several of the indicators reflect a specific water elevation. These specific water elevation indicators are intended to be evaluated with meteorological information, surrounding topography and reliable hydrologic data or analyses when provided, to ensure that such indicators reflect inundation or saturation of a frequency and duration sufficient to meet the wetland definition in subsection 62-340.200(19), F.A.C., and not rare or aberrant events. These specific water elevation indicators are not intended to be extended from the site of the indicator into surrounding areas when reasonable scientific judgment indicates that the surrounding areas are not wetlands as defined in

subsection 62-340.200(19), F.A.C.

(1) **Algal mats**. The presence or remains of nonvascular plant material which develops during periods of inundation and persists after the surface water has receded.
(2) **Aquatic mosses or liverworts on trees or substrates**. The presence of those species of mosses or liverworts tolerant of or dependent on surface water inundation.
(3) **Aquatic plants**. Defined in subsection 62-340.200(1), F.A.C.
(4) **Aufwuchs**. The presence or remains of the assemblage of sessile, attached or free-living, nonvascular plants and invertebrate animals (including protozoans) which develop a community on inundated surfaces.
(5) **Drift lines and rafted debris**. Vegetation, litter, and other natural or manmade material deposited in discrete lines or locations on the ground or against fixed objects, or entangled above the ground within or on fixed objects in a form and manner which indicates that the material was waterborne. This indicator should be used with caution to ensure that the drift lines or rafted debris represent usual and recurring events typical of inundation or saturation at a frequency and duration sufficient to meet the wetland definition of subsection 62-340.200(19), F.A.C.
(6) **Elevated lichen lines**. A distinct line, typically on trees, formed by the water-induced limitation on the growth of lichens.
(7) **Evidence of aquatic fauna**. The presence or indications of the presence of animals which spend all or portions of their life cycle in water. Only those life stages which depend on being in or on water for daily survival are included in this indicator.
(8) **Hydrologic data**. Reports, measurements, or direct observation of inundation or saturation which support the presence of water to an extent consistent with the provisions of the definition of wetlands and the criteria within this rule, including evidence of a seasonal high water table at or above the surface according to methodologies set forth in *Soil and Water Relationships of Florida's Ecological Communities* (Florida Soil Conservation Staff 1992).
(9) **Morphological plant adaptations**. Specialized structures or tissues produced by certain plants in response to inundation or saturation which normally are not observed when the plant has not been subject to conditions of inundation or saturation.
(10) **Secondary flow channels**. Discrete and obvious natural pathways of water flow landward of the primary bank of a stream watercourse and typically parallel to the main channel.
(11) **Sediment deposition**. Mineral or organic matter deposited in or shifted to positions indicating water transport.
(12) **Vegetated tussocks or hummocks**. Areas where vegetation is elevated above the natural grade on a mound built up of plant debris, roots, and soils so that the growing vegetation is not subject to the prolonged effects of soil anoxia.
(13) **Water marks**. A distinct line created on fixed objects, including vegetation, by a sustained water elevation.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.500.

62-340.550 Wetland Hydrology.

A wetland delineation using the methodology described above, can be refuted by either reliable hydrologic records or site specific hydrologic data which indicate that neither inundation for at least seven consecutive days, nor saturation for at least twenty consecutive days, occurs during conditions which represent long-term hydrologic conditions. Hydrologic records or site specific hydrologic data must be of such a duration, frequency, and accuracy to demonstrate that the records or data are representative of the long-term hydrologic conditions, including the variability in quantity and seasonality of rainfall. When sufficient amounts of either reliable hydrologic records or site specific hydrologic data are not available to prove that the wetland area of concern does not inundate or saturate as described above, a site-specific field-verified analytic or numerical model may be used to demonstrate that the wetland area no longer inundates or saturates regularly or periodically under typical

long-term hydrologic conditions. Before initiating the use of a model to evaluate if a wetland delineation should be refuted based on hydrologic conditions, the applicant or petitioner shall first meet with the appropriate regulating agency and reach an agreement on the terms of study, including data collection, the specific model, model development and calibration, and model verification. If the data, analyses, or models are deemed inadequate based on the hydrologic conditions being addressed, the regulating agency shall provide a case-by-case review of the applicability of any data, analyses, or models and shall provide specific reasons, based on generally accepted scientific and engineering practices, why they are inadequate.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211 FS. History–New 7-1-94, Formerly 17-340.550.

62-340.600 Surface Waters.

(1) For the purposes of Section 373.421, F.S., surface waters are waters on the surface of the earth, contained in bounds created naturally or artificially, including, the Atlantic Ocean, the Gulf of Mexico, bays, bayous, sounds, estuaries, lagoons, lakes, ponds, impoundments, rivers, streams, springs, creeks, branches, sloughs, tributaries, and other watercourses. However, state water quality standards apply only to those waters defined in subsection 403.031(13), F.S.

(2) The landward extent of a surface water in the State for the purposes of implementing Section 373.414, F.S., shall be the more landward of the following:

(a) Wetlands as located by Rule 62-340.300, F.A.C., of this chapter;

(b) The mean high water line elevation for tidal water bodies;

(c) The ordinary high water line for non-tidal natural water bodies;

(d) The top of the bank for artificial lakes, borrow pits, canals, ditches and other artificial water bodies with side slopes of 1 foot vertical to 4 feet horizontal or steeper, excluding spoil banks when the canals and ditches have resulted from excavation into the ground; or

(e) The seasonal high water line for artificial lakes, borrow pits, canals, ditches, and other artificial water bodies with side slopes flatter than 1 foot vertical to 4 feet horizontal along with any artificial water body created by diking or impoundment above the ground.

(3) Determinations made pursuant to paragraphs (2)(b) and (2)(c) shall be for regulatory purposes and are not intended to be a delineation of the boundaries of lands for the purposes of title.

Specific Authority 373.421 FS. Law Implemented 373.421, 373.4211, 403.031(13) FS. History–New 7-1-94, Formerly 17-340.600.

62-340.700 Exemptions for Treatment or Disposal Systems.

(1) Alteration and maintenance of the following shall be exempt from the rules adopted by the department and the water management districts to implement subsections 373.414(1) through 373.414(6), 373.414(8) and 373.414(10), F.S.; and subsection 373.414(7), F.S., regarding any authority to apply state water quality standards within any works, impoundments, reservoirs, and other watercourses described in this subsection and any authority granted pursuant to Section 373.414, F.S. (1991):

(a) Works, impoundments, reservoirs, and other watercourses constructed and operated solely for wastewater treatment or disposal in accordance with a valid permit reviewed or issued under Rules 62-28.700, 62-302.520, F.A.C., Chapters 62-17, 62-600, 62-610, 62-640, 62-650, 62-660, 62-670, 62-671, 62-673, or 62-701, F.A.C., or Section 403.0885, F.S., or rules implementing Section 403.0885, F.S., except for treatment wetlands or receiving wetlands permitted to receive wastewater pursuant to Chapter 62-611, F.A.C., or Section 403.0885, F.S., or its implementing rules;

(b) Works, impoundments, reservoirs, and other watercourses constructed solely for wastewater treatment or disposal before a construction permit was required under Chapter 403, F.S., and operated solely for wastewater treatment or disposal in accordance with a valid permit reviewed or issued under Rules 62-28.700, 62-302.520, F.A.C., Chapters 62-17, 62-600, 62-610, 62-640, 62-650, 62-660, 62-670, 62-671, 62-673, or 62-701, F.A.C., or Section 403.0885, F.S., or rules implementing Section 403.0885,

F.S., except for treatment wetlands or receiving wetlands permitted to receive wastewater pursuant to Chapter 62-611, F.A.C., or Section 403.0885, F.S., or its implementing rules;

(c) Works, impoundments, reservoirs, and other watercourses of less than 0.5 acres in combined area on a project-wide basis, constructed and operated solely for stormwater treatment in accordance with a noticed exemption under Chapter 62-25, F.A.C., or a valid permit issued under Chapters 62-25 (excluding Rule 62-25.042), 62-330, 40B-4, 40C-4, 40C-42 (excluding Rule 40C-42.0265), 40C-44, 40D-4, 40D-40, 40D-45, or 40E-4, F.A.C., except those permitted as wetland stormwater treatment systems; or

(d) Works, impoundments, reservoirs, and other watercourses of less than 0.5 acres in combined area on a project-wide basis, constructed and operated solely for stormwater treatment before a permit was required under Chapters 62-25, 40B-4, 40C-4, 40C-42, 40C-44, 40D-4, 40D-40, 40D-45, or 40E-4, F.A.C.

(2) Alteration and maintenance of the following shall be exempt from the rules adopted by the department and the water management districts to implement subsections 373.414(1), 373.414(2)(a), 373.414(8), and 373.414(10), F.S.; and subsections 373.414(3) through 373.414(6), F.S.; and subsection 373.414(7), F.S., regarding any authority to apply state water quality standards within any works, impoundments, reservoirs, and other watercourses described in this subsection and any authority granted pursuant to Section 373.414, F.S. (1991), except for authority to protect threatened and endangered species in isolated wetlands:

(a) Works, impoundments, reservoirs, and other watercourses of 0.5 acre or greater in combined area on a project-wide basis, constructed and operated solely for stormwater treatment in accordance with a noticed exemption under Chapter 62-25, F.A.C., or a valid permit issued under Chapters 62-25 (excluding Rule 62-25.042), 62-330, 40B-4, 40C-4, 40C-42 (excluding Rule 40C-42.0265), 40C-44, 40D-4, 40D-40, 40D-45, 40E-4, except those permitted as wetland stormwater treatment systems; or

(b) Works, impoundments, reservoirs, and other watercourses of 0.5 acres or greater in combined area on a project-wide basis, constructed and operated solely for stormwater treatment before a permit was required under Chapters 62-25, 40B-4, 40C-4, 40C-42, 40C-44, 40D-4, 40D-40, 40D-45, or 40E-4, F.A.C.

(3) The exemptions in subsections 62-340.700(1) and (2) shall not apply to works, impoundments, reservoirs or other watercourses that

(a) Are currently wetlands which existed before construction of the stormwater treatment system and were incorporated in it;

(b) Are proposed to be altered through expansion into wetlands or other surface waters; or

(c) Are wetlands created, enhanced, or restored as mitigation for wetland or surface water impacts under a permit issued by the Department or a water management district.

(4) Alterations and maintenance of works, impoundments, reservoirs, and other watercourses exempt under this subsection shall not be considered in determining whether any wetland permitting threshold is met or exceeded under part IV of Chapter 373, F.S.

(5) Works, impoundments, reservoirs, and other watercourses exempt under this subsection, other than isolated wetlands in systems described in subsection 62-340.700(2), F.A.C., above, shall not be delineated under Section 373.421, F.S.

(6) This exemption shall not affect the application of state water quality standards, including those applicable to Outstanding Florida Waters, at the point of discharge to waters as defined in subsection 403.031(13), F.S.

(7) As used in this subsection, "solely for" means the reason for which a work, impoundment, reservoir, or other watercourse is constructed and operated; and such construction and operation would not have occurred but for the purposes identified in subsection 62-340.700(1) or 62-340.700(2), F.A.C. Furthermore, the phrase does not refer to a work, impoundment, reservoir, or other watercourse constructed or operated for multiple purposes. Incidental uses, such as occasional recreational uses, will not render the exemption inapplicable, so long as the incidental uses are not part of the original planned purpose of the work, impoundment, reservoir, or other watercourse. However, for those works,

impoundments, reservoirs, or other watercourses described in paragraphs 62-340.700(1)(c) and 62-340.700(2)(a), F.A.C., use of the system for flood attenuation, whether originally planned or unplanned, shall be considered an incidental use, so long as the works, impoundments, reservoirs, and other watercourses are no more than 2 acres larger than the minimum area required to comply with the stormwater treatment requirements of the district or department. For the purposes of this subsection, reuse from a work, impoundment, reservoir, or other watercourse is part of treatment or disposal.
Specific Authority 373.414(9) FS. Law Implemented 373.414(9) FS. History–New 7-1-94, Formerly 17-340.700.

62-340.750 Exemption for Surface Waters or Wetlands Created by Mosquito Control Activities.
Construction, alteration, operation, maintenance, removal, and abandonment of stormwater management systems, dams, impoundments, reservoirs, appurtenant works, or works, in, on or over lands that have become surface waters or wetlands solely because of mosquito control activities undertaken as part of a governmental mosquito control program, and which lands were neither surface waters nor wetlands before such activities, shall be exempt from the rules adopted by the department and water management districts to implement subsections 373.414(1) through 373.414(6), 373.414(8), and 373.414(10), F.S.; and subsection 373.414(7), F.S., regarding any authority granted pursuant to Section 373.414, F.S. (1991). Activities exempted under this section shall not be considered in determining whether any wetland permitting threshold is met or exceeded under part IV of Chapter 373, F.S. This exemption shall not affect the regulation of impacts on other surface waters or wetlands, or the application of state water quality standards to waters as defined in subsection 403.031(13), F.S., including standards applicable to Outstanding Florida Waters.
Specific Authority 373.414(9) FS. Law Implemented 373.414(9) FS. History–New 7-1-94, Formerly 17-340.750.

See The Florida Wetlands Delineation Manual for further clarification.

Data Form Guide Notes:
Tips from NRCS Field Indicators of Hydric Soils in the United States Version 8.1, 2017:

- As long as the soil meets the definition of a hydric soil, the lack of an indicator does not preclude the soil from being hydric.
- Concentrate sampling efforts near the wetland edge and, if these soils are hydric, assume that soils in the wetter, interior portions also are hydric. The indicators were developed mostly to identify the boundary of hydric soil areas and generally work best on the margins. Not all of the obviously wetter hydric soils will be identified by the indicators.

SOIL AND WATER RELATIONSHIPS OF FLORIDA'S ECOLOGICAL COMMUNITIES
July, 1992 Adapted

Field Identification of Hydric Soils

Hydric Soil Indicator Concept

The Hydric Soil Indicator concept is based on the premise that hydric soils develop and exhibit characteristic morphologies that result from repeated periods of saturation and/or inundation for more than a few days. Saturation or inundation when combined with anaerobic microbiological activity in the soil causes a depletion of oxygen. This anaerobiosis promotes biogeochemical processes such as the accumulation of organic matter and the reduction, translocation, and/or accumulation of iron and other reducible elements. These processes result in characteristic morphologies which persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils.

Hydric soil indicators are formed predominantly by the accumulation or loss of iron, manganese, sulfur, or carbon compounds. The presence of hydrogen sulfide gas (rotten egg odor) is a strong indicator of a hydric soil, but this indicator is found in only the wettest sites containing sulfur.

Hydric Soil Indicator Identification Procedure

To document a hydric soil, dig a hole and describe the soil profile to a depth of approximately 50 cm (20 inches). Using the completed soil description specify which of the Hydric Soil Indicators have been matched. Deeper examination of soil may be required where Hydric Soil Indicators are not easily seen within 50 cm (20 in.) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations. Examination to less than 50 cm (20 in.) may suffice in soils with surface horizons of organic material or mucky mineral material because these shallow organic accumulations only occur in hydric soils. Depths used in are measured from the muck or mineral soil surface unless otherwise indicated. All colors refer to moist Munsell colors.

Estimating Seasonal High Saturation

Introduction

Seasonal High Water Table (SHWT) is the shallowest depth to free water that stands in an unlined borehole or where the soil moisture tension is zero for a significant period (more than a few weeks). The depth to the estimated SHWT is the used soil interpretation in Florida. This method of estimating SHWT applies only to areas lacking hydrologic modifications. Hydrologic modifications such as ditches and dikes can make the soil either wetter or drier.
By observing soil features, SHWT predictions can be made for hydric soils as well as other soils.

Field Identification of SHWT

The procedure for field Identification of SHWT is based on the assumption that, when soils are wet enough, for a long enough duration to develop SHWT, they should exhibit certain visible properties

that are to be used to determine on-site SHWT. All SHWT determinations should be based on field observations of moist soils.

Procedure

SHWT is determined by examining soils with a hydric soil indicator in a freshly dug pit for the SHWT indicators listed below. Presence of the shallowest of the SHWT indicators listed below indicates the depth to SHWT.

1. Soils with the following hydric soil indicators have SHWT at or above the surface:
   A1 (Histosol or Histel), A2 (Histic Epipedon), A3 (Black Histic), A4 (Hydrogen Sulfide), A7 (5 cm Mucky Mineral), A8 (Muck Presence) or A9 (1 cm Muck), S4 (Sandy Gleyed Matrix), and F2 (Loamy Gleyed Matrix).
2. Soils with the following hydric soil indicators have SHWT within 6 inches of the surface:
   A5 (Stratified Layers), A6 (Organic Bodies), A11 (Depleted Below Dark Surface), A12 (Thick Dark Surface), S5 (Sandy Redox), S6 (Stripped Matrix), S7 (Dark Surface), S8 (Polyvalue Below Surface), S9 (Thin Dark Surface), F10 (Marl), and F13 (Umbric Surface).
   Depth to SHWT is the depth at which all requirements of a particular indicator are met. For example, if S6 (Stripped Matrix) starts at 4 inches, depth to SHWT is 4 inches or if S7 (Dark Surface) starts at the soil surface, depth to SHWT is the soil surface.
3. Soils with the following hydric soil indicators have SHWT within 12 inches of the surface:
   F3 (Depleted Matrix), F6 (Redox Dark Surface), and F7 (Depleted Dark Surface). Depth to SHWT is the depth at which all requirements of a particular indicator are met.
   For example, if F3 (Depleted Matrix) starts at 8 inches, depth to SHWT is 8 inches.
4. Soils with the following hydric soil indicators lack significant saturation but are inundated for long or very long duration:
   F8 (Redox Depressions) and F12 (Iron/Manganese Masses).

Data Form Guide Note:
A stand alone D Test soil field indicator is both a hydric soil field indicator and a hydrologic indicator.

The hydric soil field indicators below indicate SHWT at or above the surface, and therefore may also be used as evidence of hydrologic data under subsection 62-340.500(8), F.A.C. per Soil and Water Relationships of Florida's Ecological Communities (Florida Soil Conservation Staff 1992 Adapted)**:**

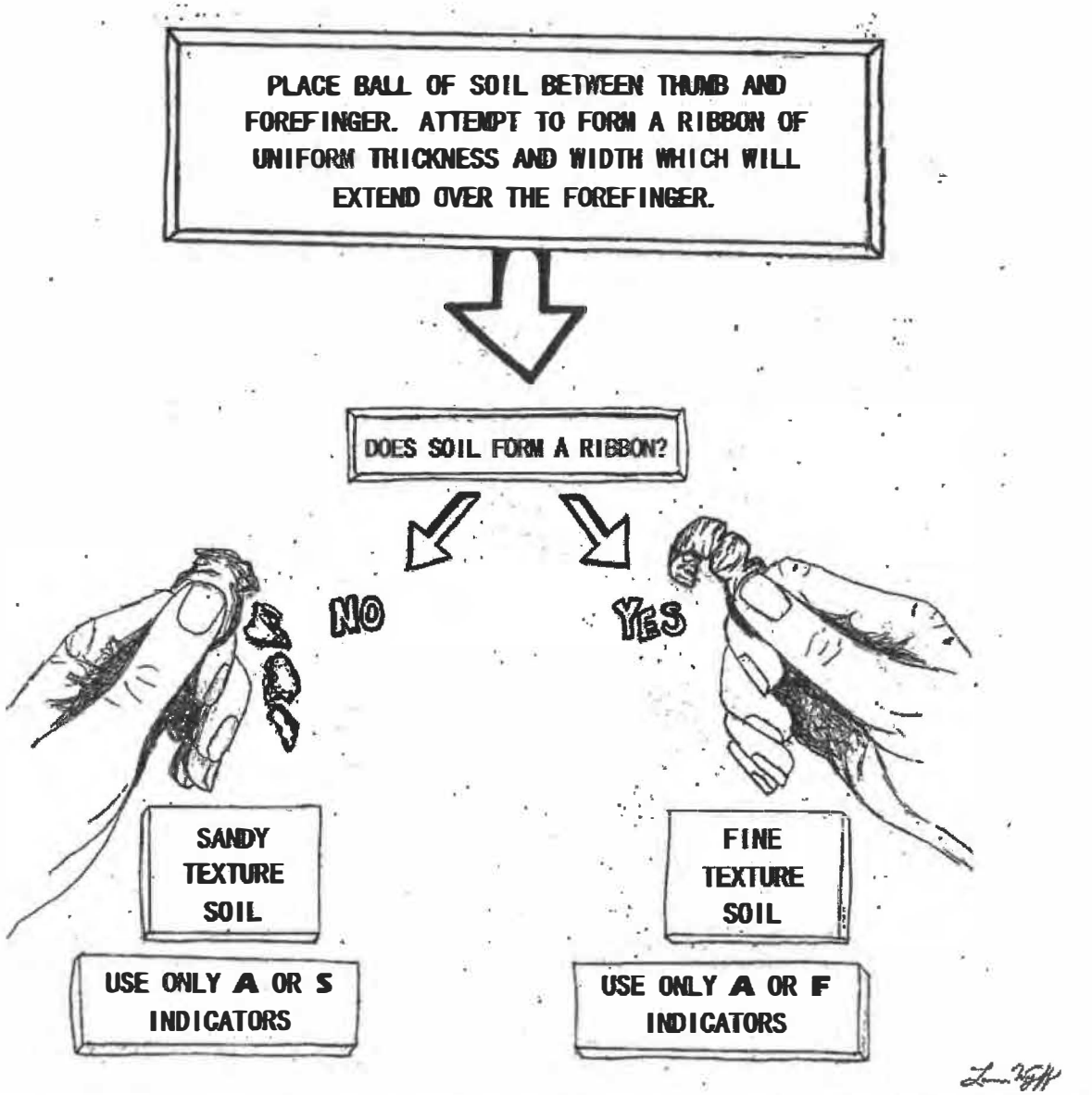
A1 – Histosol or Histel
A2 – Histic Epipedon
A3 – Black Histic
A4 – Hydrogen Sulfide
A7 – 5 cm Mucky Mineral
A8 – Muck Presence
A9 – 1 cm Muck
S4 – Sandy Gleyed Matrix
F2 – Loamy Gleyed Matrix

Or **any NRCS hydric soil field indicator** in which all requirements of that indicator are met starting at the soil surface (see SHWT Procedure above)

The hydric soil field indicator below is also a hydrologic indicator under subsection 62-340.500(11), F.A.C. evidence of sediment deposition:

A5 - Stratified Layers

Field Determination of Soil Indicator Texture



Soil Textures and Their Hydric Soil Indicator Prefix Designations:

A - All texture soils "All soils" refers to soils with any USDA soil texture, including muck, mucky peat, and peat

S - Sandy texture soils (soils that will not ribbon) "Sandy soils" refers to those soils with a USDA soil texture of loamy fine sand and coarser, and does not include muck, mucky peat, or peat.

F - Fine texture soils (soils that will ribbon) "Loamy and clayey soils" refers to those soils with

USDA soil texture of loamy very fine sand and finer, and does not include muck, mucky peat, or peat.

Tips for Determining Texture of Soil Materials High in Organic Carbon

"Five Rub Texture Test"

If soil appears dark, gently (minimal pressure) rub wet soil material between forefinger and thumb and note how it feels.

# of Rubs	Feeling	Texture
≤ 2	Gritty	Sandy Mineral[1]
2	Greasy	*Continue to next rows*
3 to ≤ 5	Gritty	Sandy Mucky Mineral[1]
3 to ≤ 5	Plastic[2]	Check % Organic Carbon[3] to determine if Fine Mineral[1] or Fine Mucky Mineral[1]
5	Greasy	Muck[1]

[1] Results of this test only indicate texture; check NRCS hydric soil field indicators to determine if all requirements of an indicator are met

[2] Plastic: able to be molded or deformed into various shapes by moderate pressure

[3] Sufficiency of organic carbon* can be approximated using the "Color Test"[4]
**not to be confused with organic coating*

"Ten Rub Fiber Test"

If soil material is all or nearly all organic, firmly rub a moist sample 10 times in the palm of one hand with the thumb of the other and estimate proportion of fibers visible with a hand lens.

Proportion of visible fibers[5]	Organic soil texture
Less than 1/6 (<17%)	Sapric (Muck)
1/6 to 3/4 (17% - 75%)	Hemic (Mucky Peat)
More than 3/4 (>75%)	Fibric (Peat)

[5] Live roots are not considered

Tips for Approximating Composition of Soil

"Decant Tests"

Place a pea sized amount of soil in cupped palm of hand. Holding spray bottle close (~3 in.), thoroughly wet soil, filling but not overflowing palm.

↓

Break apart soil material to make a souplike suspension of particles.

↓

[4]"Color Test"

Keeping solution in palm, note its color. (Helps to determine if suspended particles are organic or fine mineral.)

- Black/Brown → Organic Material
- Gray/Cloudy → Clay and/or Silt

↓

"Sand Content Test"

Gently decant liquid solution while keeping solid material in palm.

↓

Spray, muddle, examine, drain, and repeat until solution runs nearly clear.

↓

Spread remaining soil material across palm. Compare amount of sand in relation to original pea sized clump, considering relative loss of fine soil material (clay and silt) indicated by the "Color

Test", to approximate organic vs. mineral (sand, silt, clay) content. See Fig. 7 pg. 60 for dry weight soil texture ratio requirements.

Tips for Determining Boundary Types of Features in Soil

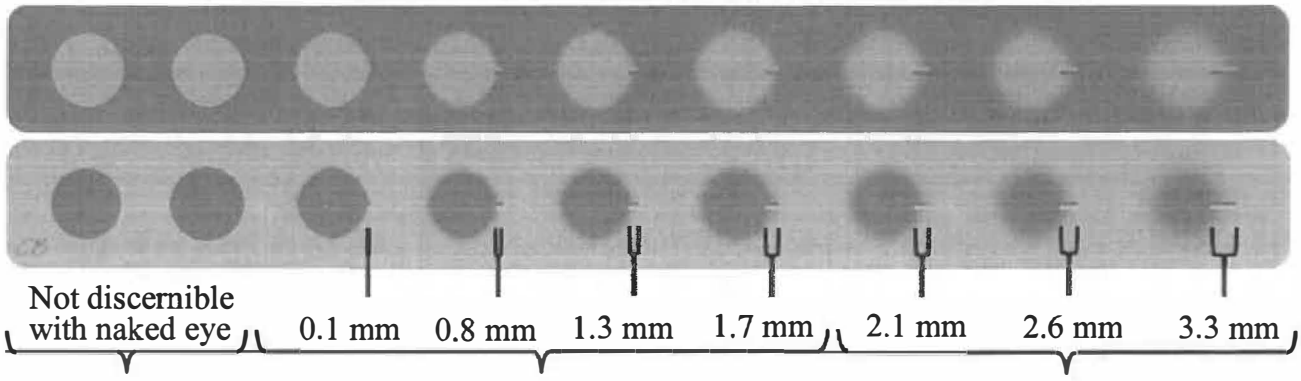


Figure 1: Diagram for determining boundary types of features in the matrix.

Tips for Determining Contrast Between Soil Colors

ΔHue	ΔValue	ΔChroma	Contrast
	≤2	≤1	Faint
	≤2	>1 to <4	Distinct
0	>2 to <4	<4	Distinct
	any	≥4	Prominent
	≥4	any	Prominent
	≤1	≤1	Faint
	≤1	>1 to <3	Distinct
1	>1 to <3	<3	Distinct
	any	≥3	Prominent
	≥3	any	Prominent
	0	0	Faint
	0	>0 to <2	Distinct
2	>0 to <2	<2	Distinct
	any	≥2	Prominent
	≥2	any	Prominent
3+	any	any	Prominent

Table 1: Chart of delta hue (Figure 2), delta value, and delta chroma required for each level of color contrast. The last column in each row states what level of contrast exists between two colors when the Δhue, Δvalue, and Δchroma criteria within that row are met.

***Note: If both colors have value ≤3 and chroma ≤2, the contrast is faint, regardless of the change in hue.**

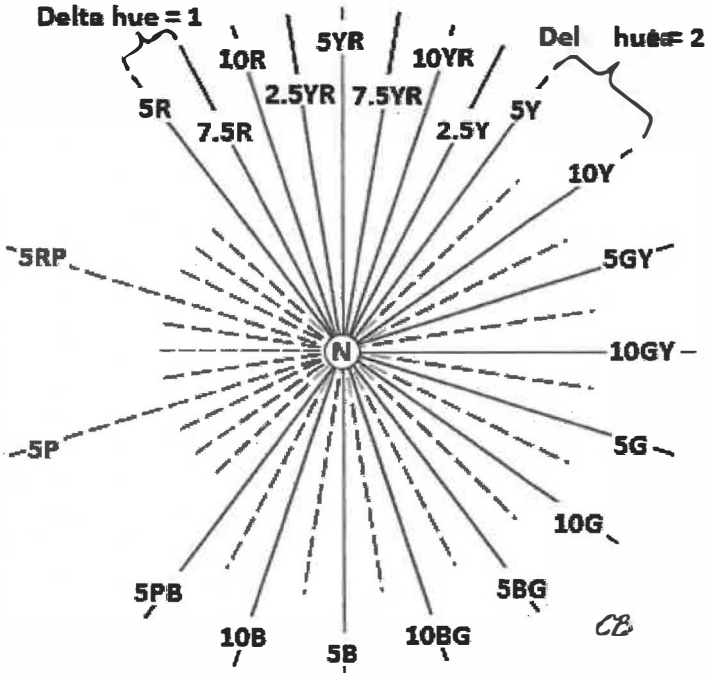


Figure 2: Relationships among the hues of the Munsell Color System. Solid lines represent hues contained in the *Munsell Soil Color Charts* (2009). Dotted lines represent all other possible 2.5 unit steps. Moving from one hue line to the adjacent hue line represents a delta hue of 1 (2.5 units). Moving from hue N to any other hue the delta hue is 1.

Adapted from the *Soil Survey Manual* (Soil Survey Staff, 1993)

Tips for Determining Contrast Between Soil Colors (continued)

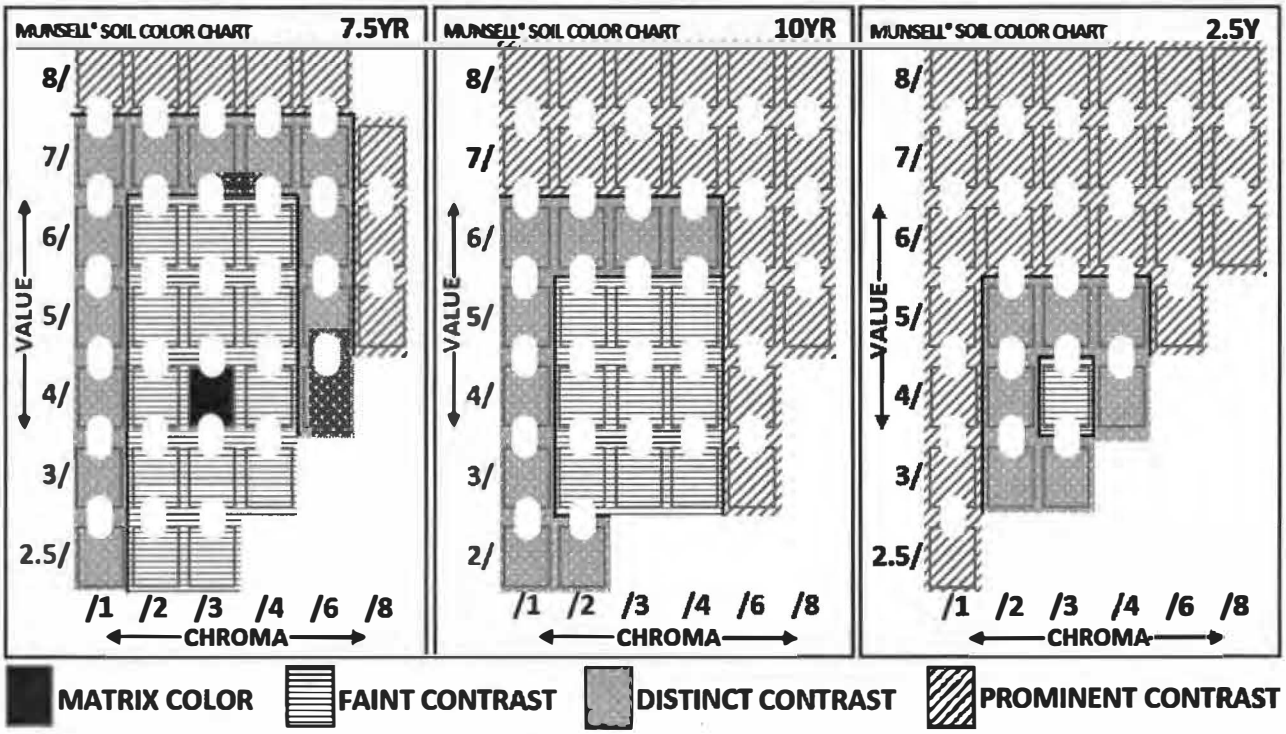


Figure 3: Using the 7.5 YR 4/3 color chip as an example matrix color, an illustration of faint, distinct, and prominent contrast between colors in relation to the matrix color in the *Munsell Soil Color Charts* (2009).

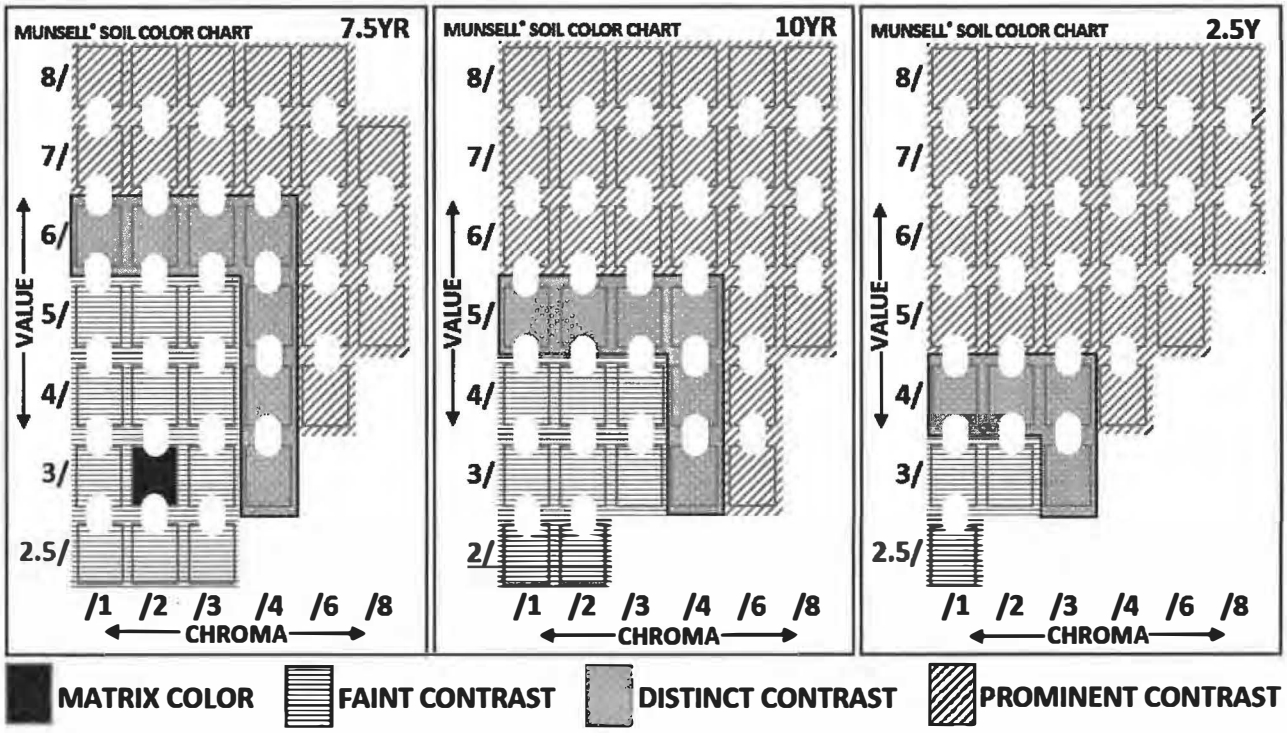
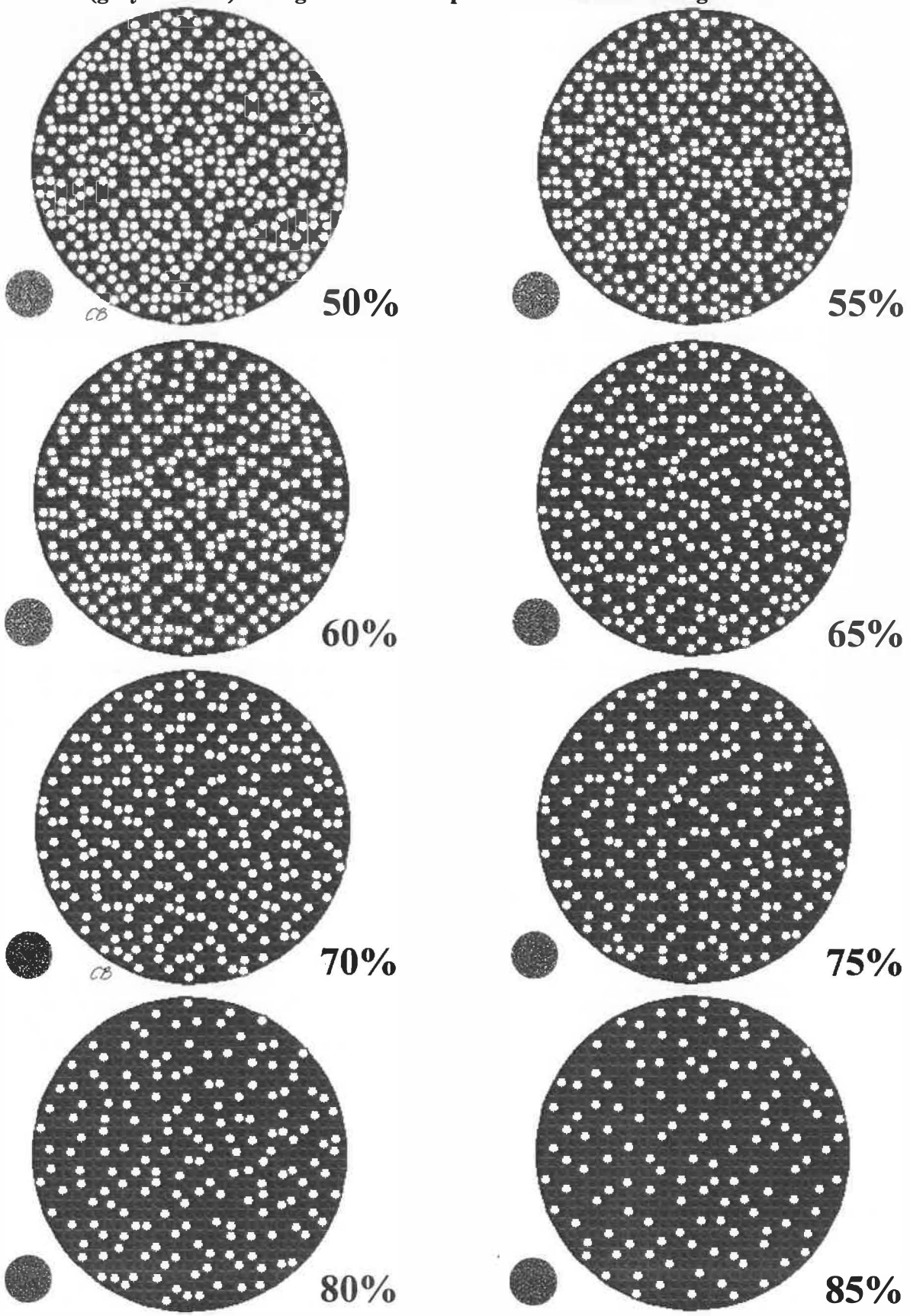
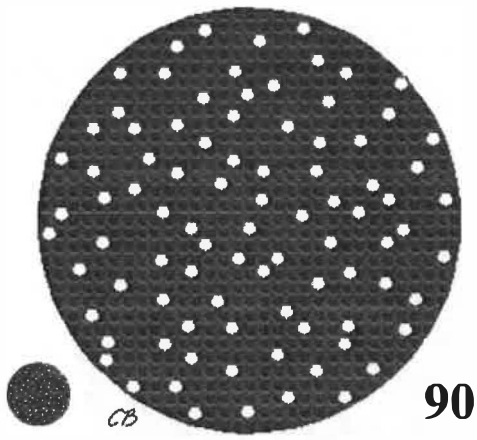


Figure 4: Using the 7.5 YR 3/2 color chip as an example matrix color, an illustration of faint, distinct, and prominent contrast between colors in relation to the matrix color in the *Munsell Soil Color Charts* (2009). Note that because the matrix has value ≤3 and chroma ≤2, all other colors with value ≤3 and chroma ≤2 are faintly contrasting despite the change in hue.

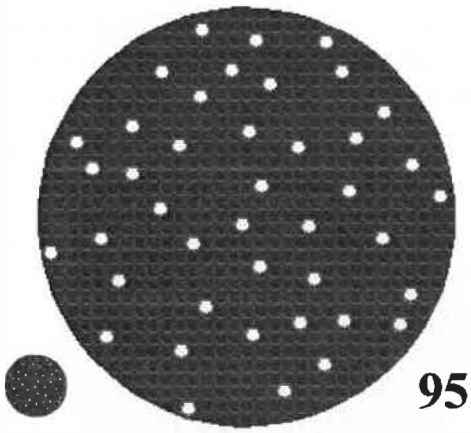
Estimating Percent Organic Coating

The round diagrams represent the appearance of uncoated (clear or white) sand grains versus coated (gray to black) sand grains within a ped face as viewed through a 10X hand lens.





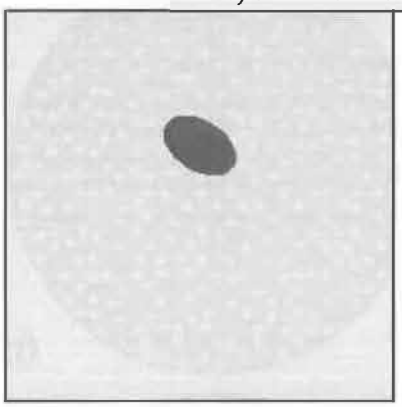
90%

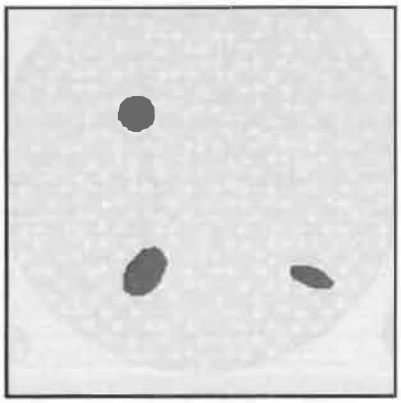


95%

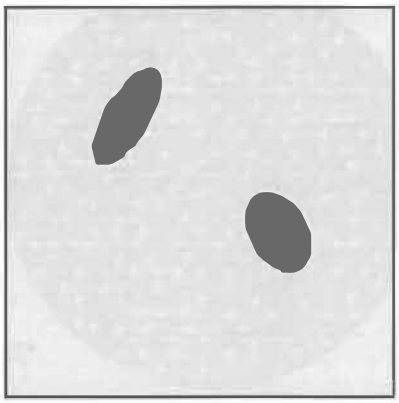
Estimating Percent Volume

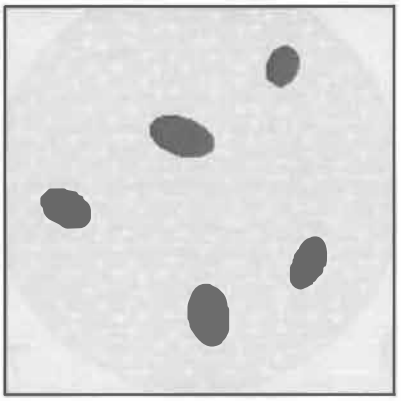
The squares represent part of a grid drawn on the soil profile to estimate volume of light areas, dark areas, or redox concentrations of larger and smaller sizes.



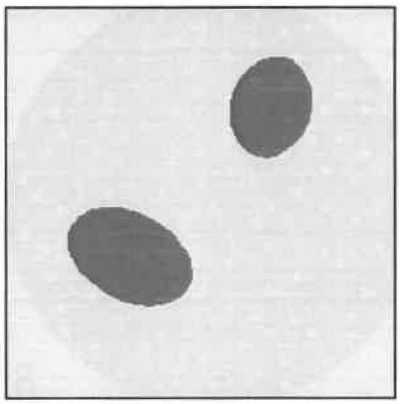


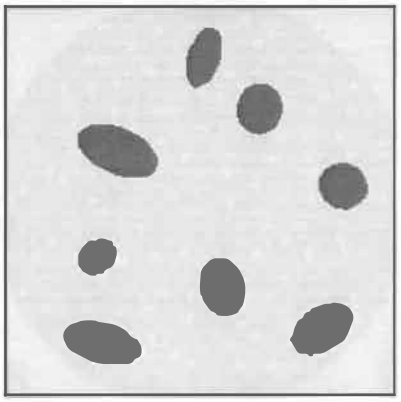
2%



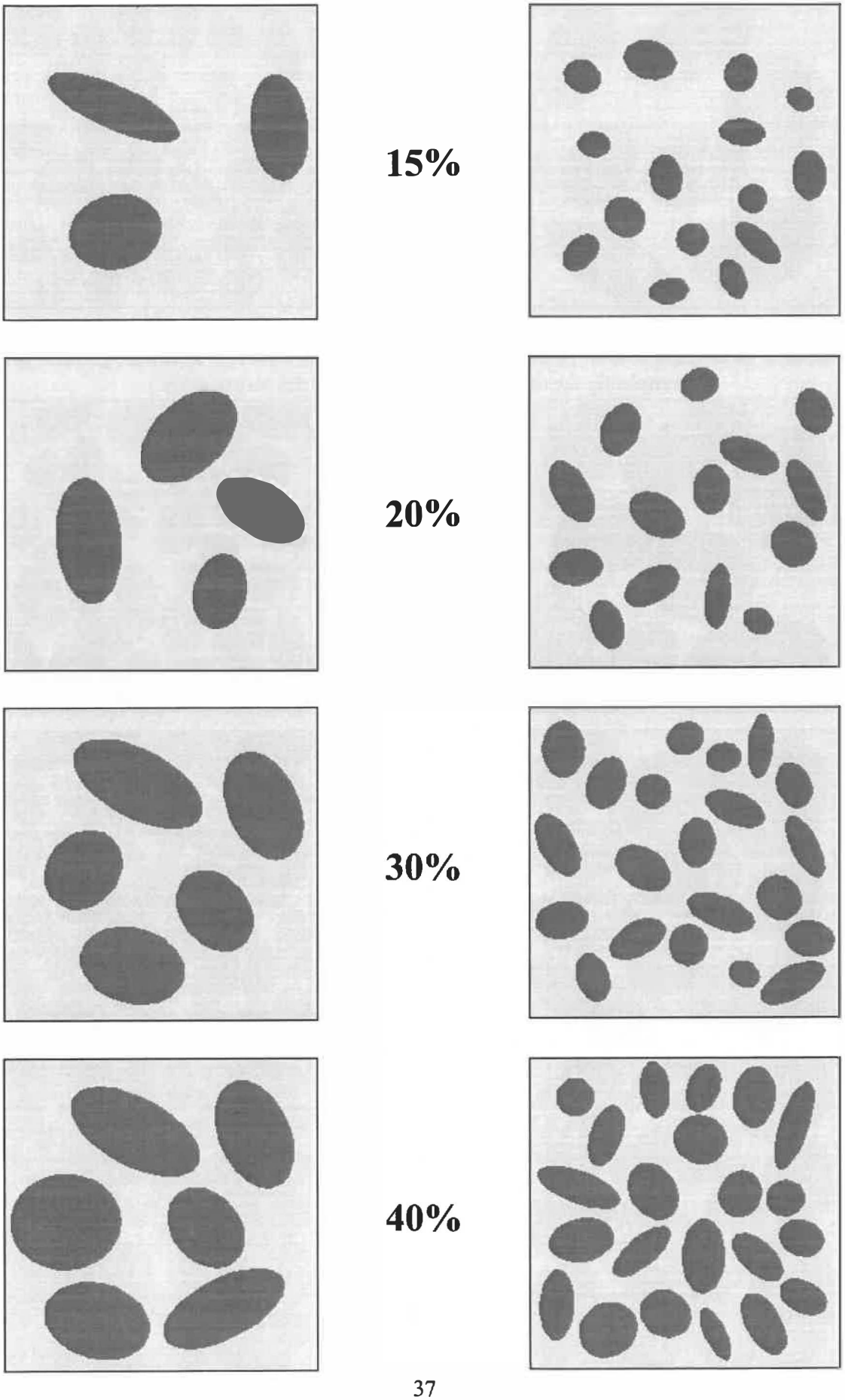


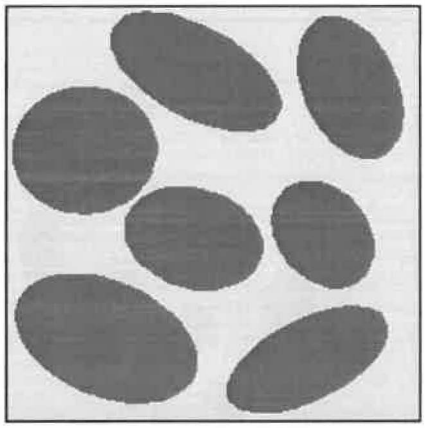
5%



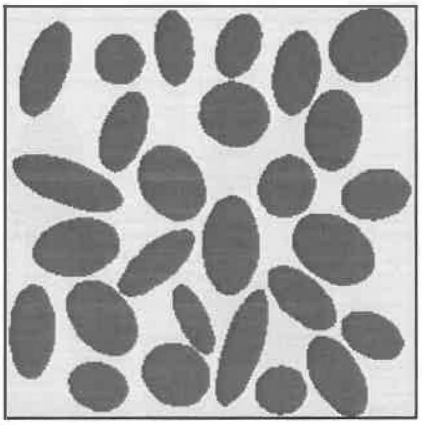


10%

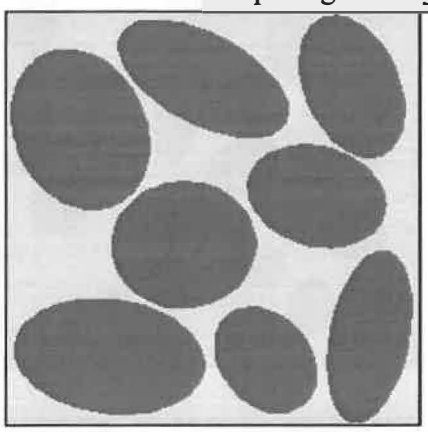

15%
20%
30%
40%



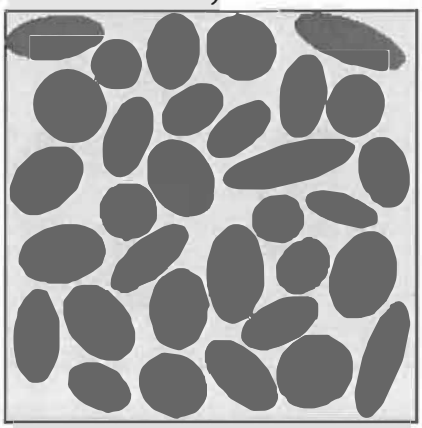
50%

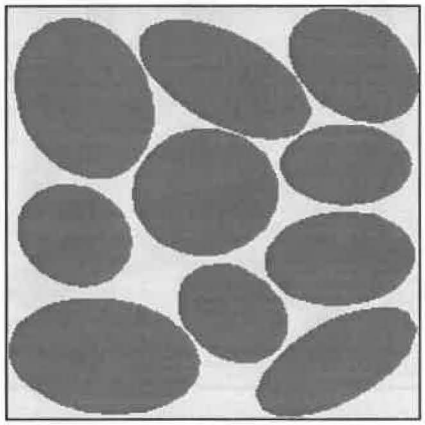


(Note: when a feature (e.g. stripped areas) composes more than 50% of the volume, its color is considered to be the matrix color of the soil profile. When more than two colors are present, the color composing the majority of the volume is the matrix color.)

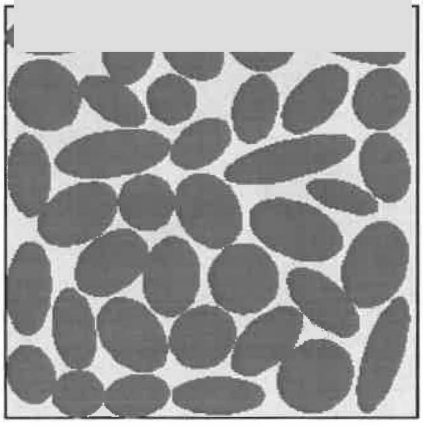


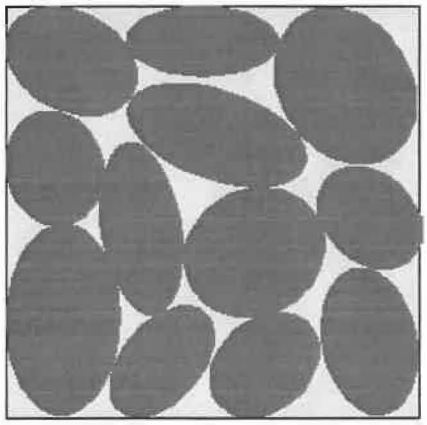
60%



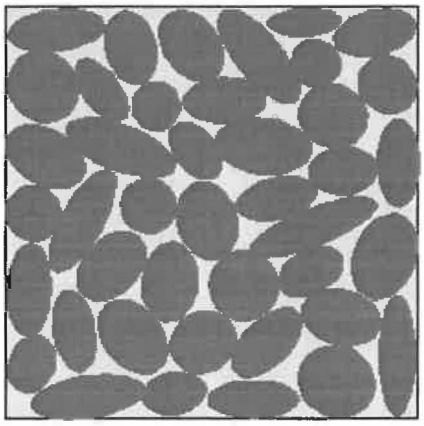


70%

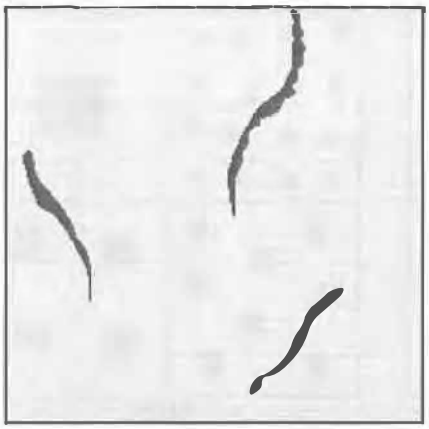




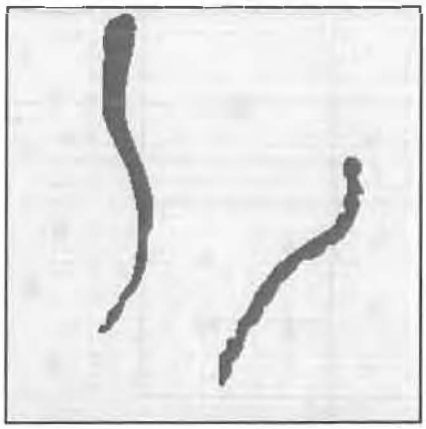
80%



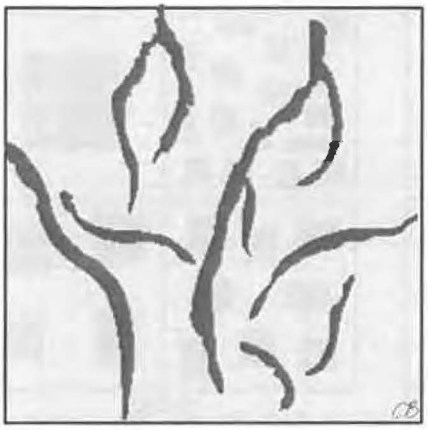
The squares represent part of a grid drawn on the soil profile to estimate volume of plant fibers, oxidized rhizospheres, or other linear features.



2%



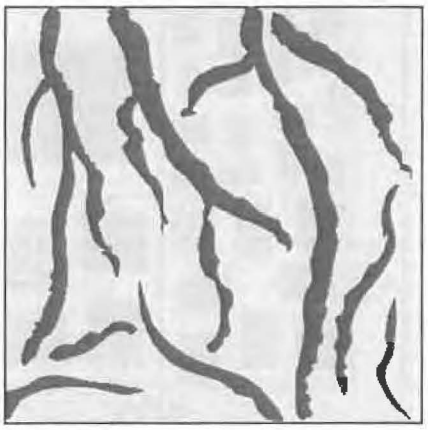
5%



10%



17%



20%



30%

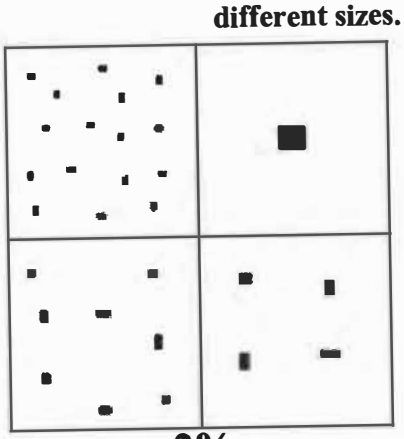


40%

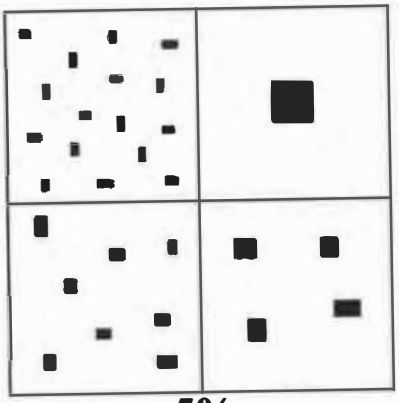


50%

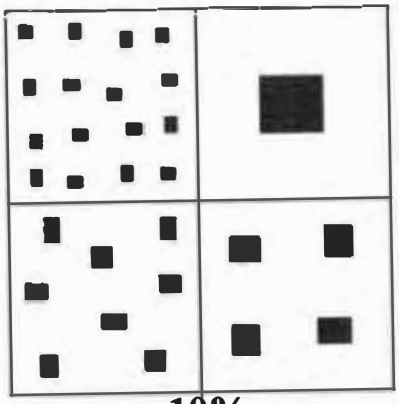
Each square is divided into quarters which depict the same percent volume using features of different sizes. These can also represent areal extents for plants.



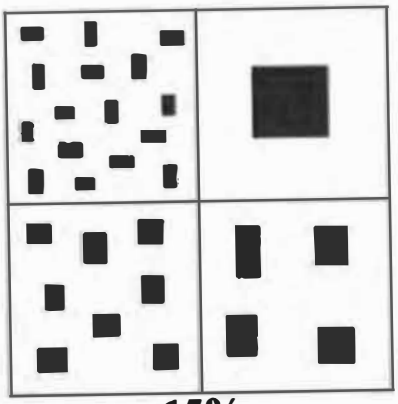
2%



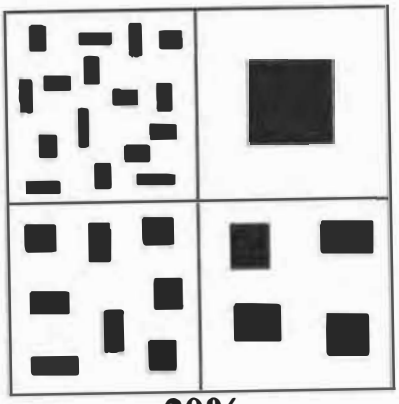
5%



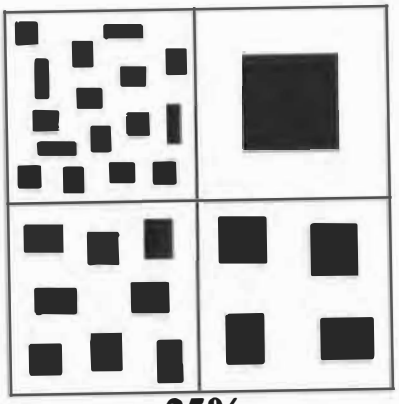
10%



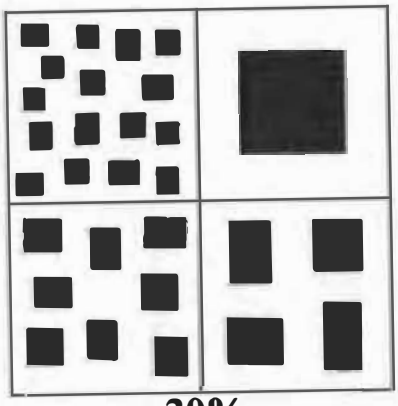
15%



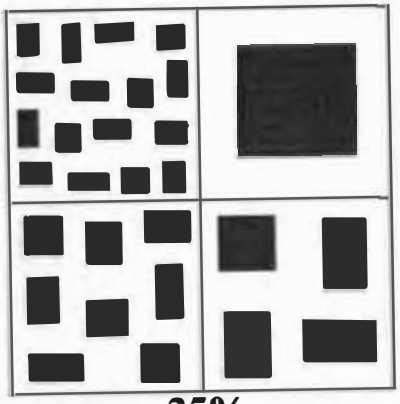
20%



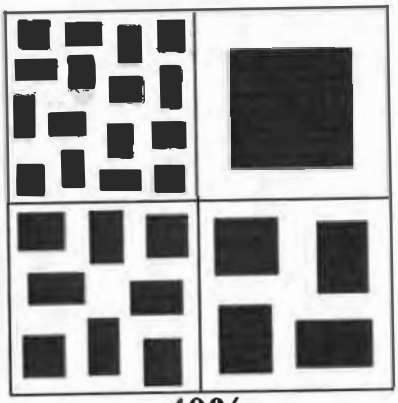
25%



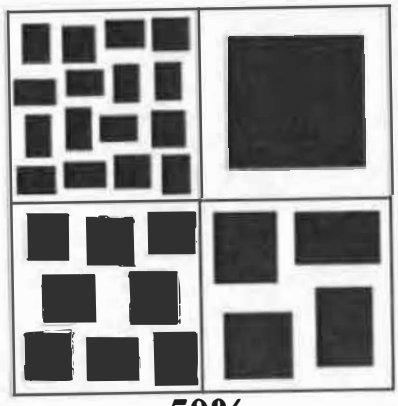
30%



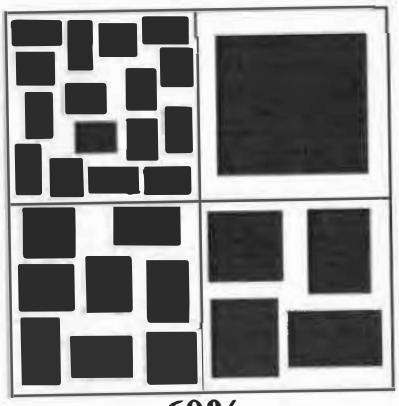
35%



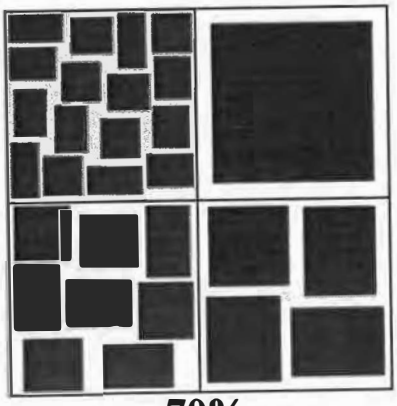
40%



50%

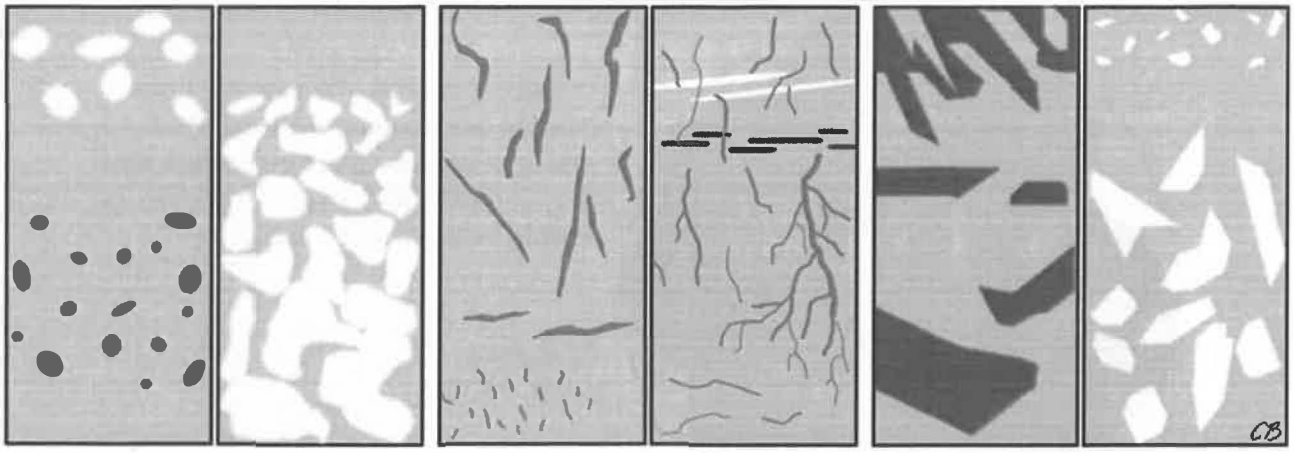


60%



70%

Tips for Determining Shapes of Features in Soil



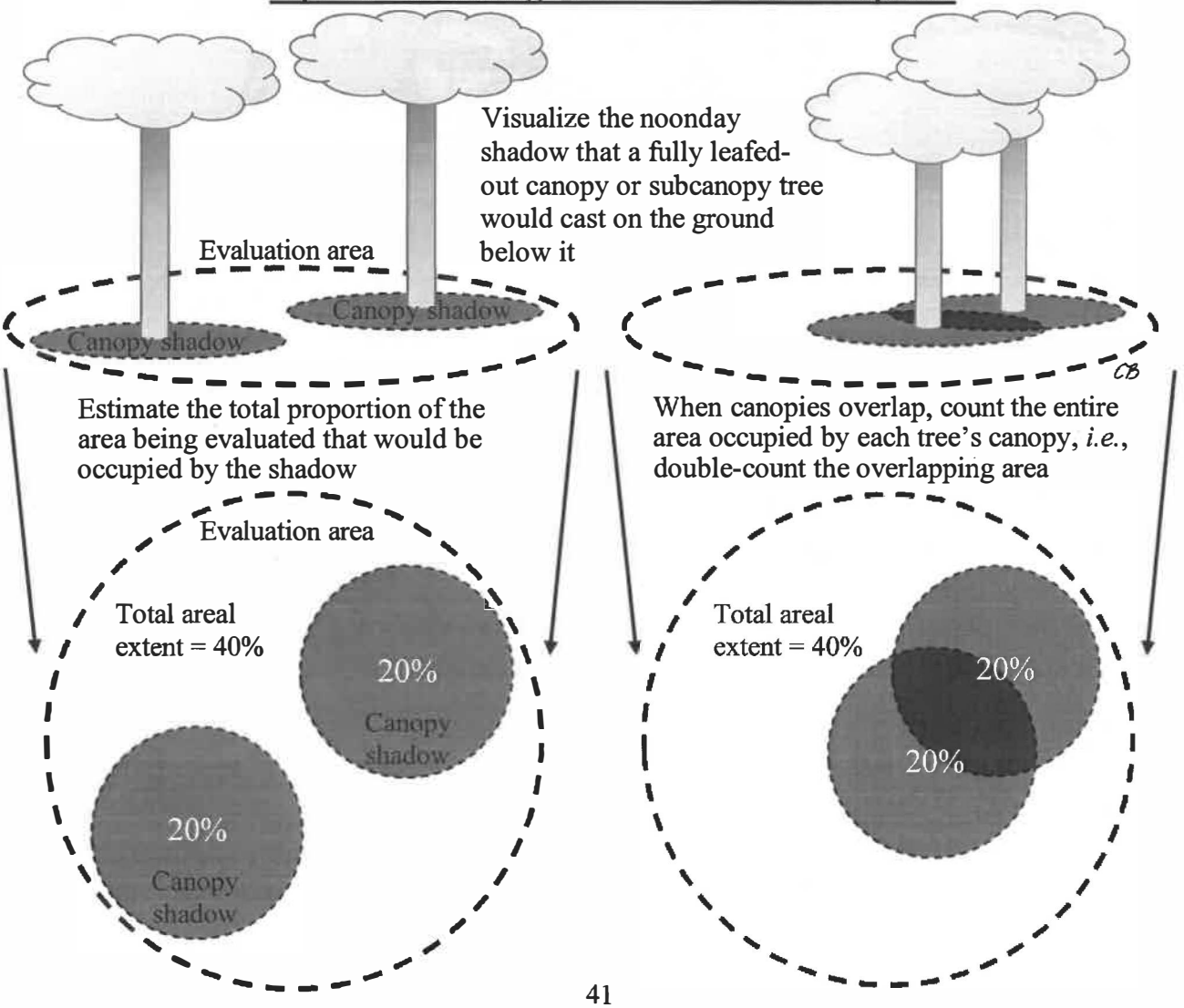
Rounded
Features with generally curved outlines (do not have to be circular; often amorphous)

Linear
Features that are generally long & narrow (typically associated with roots or burrows, sometimes mixing or deposition)

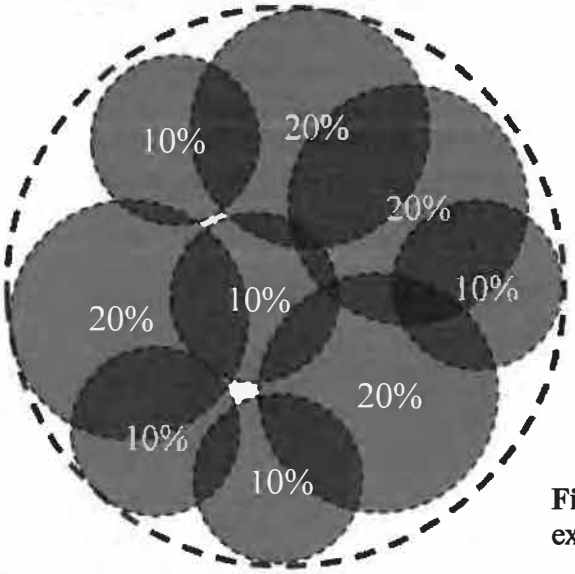
Angular
Features with generally straight outlines & defined angles (often resulting from physical mixing of soils)

Figure 5: Diagram for determining shape categories of features in the matrix.

Tips for Estimating Areal Extent of Plant Species



Tips for Estimating Areal Extent of Plant Species (continued)

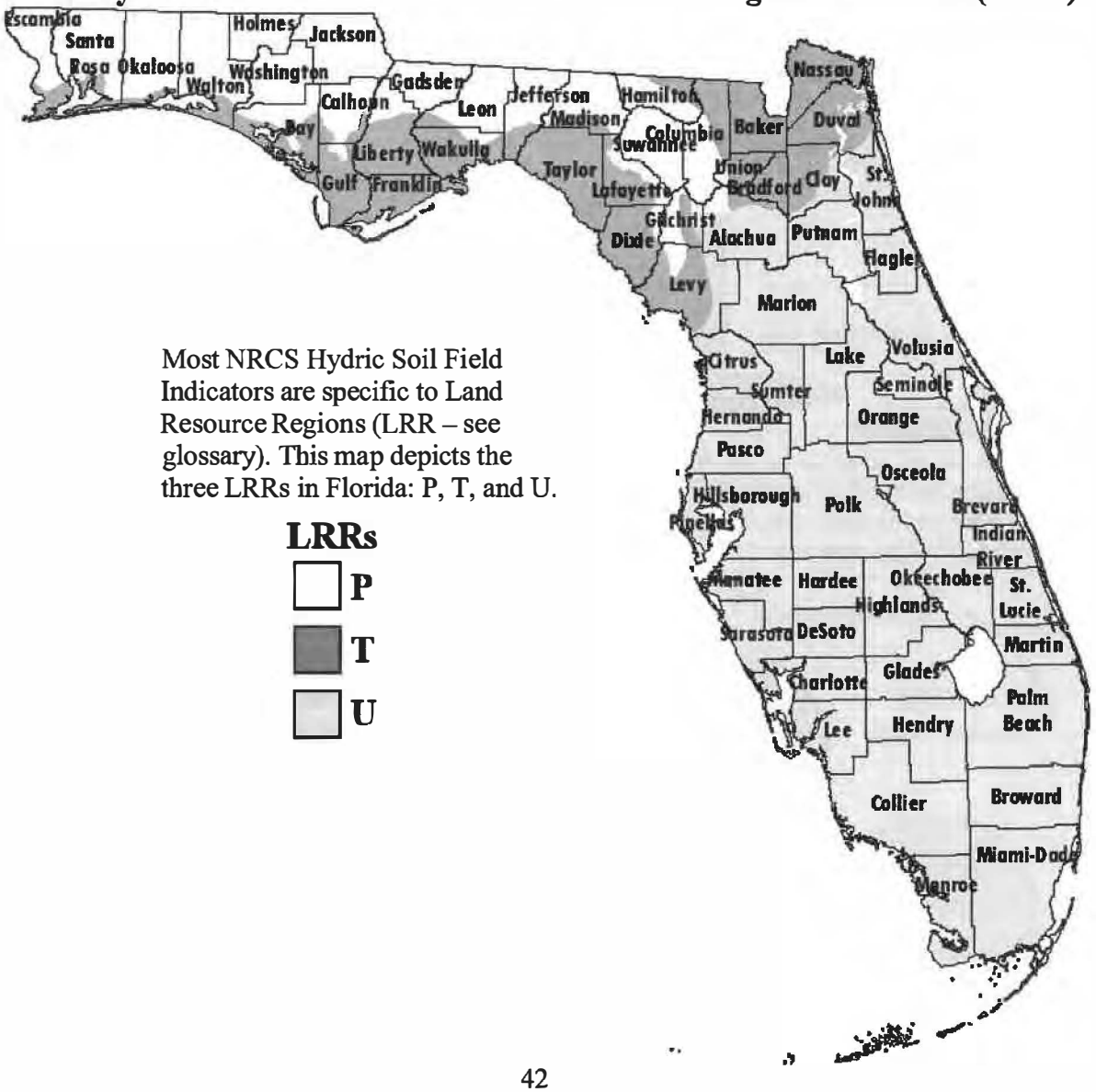


In a dense canopy where many trees overlap one another, the total areal extent of species in the evaluation area may exceed 100%, even if open sky is visible between some canopies

Total areal extent = 130%

Figure 6: Diagrams for estimating the areal extents of plants within an evaluation area.

NRCS Hydric Soil Field Indicators Land Resource Regions of Florida (LRRs)



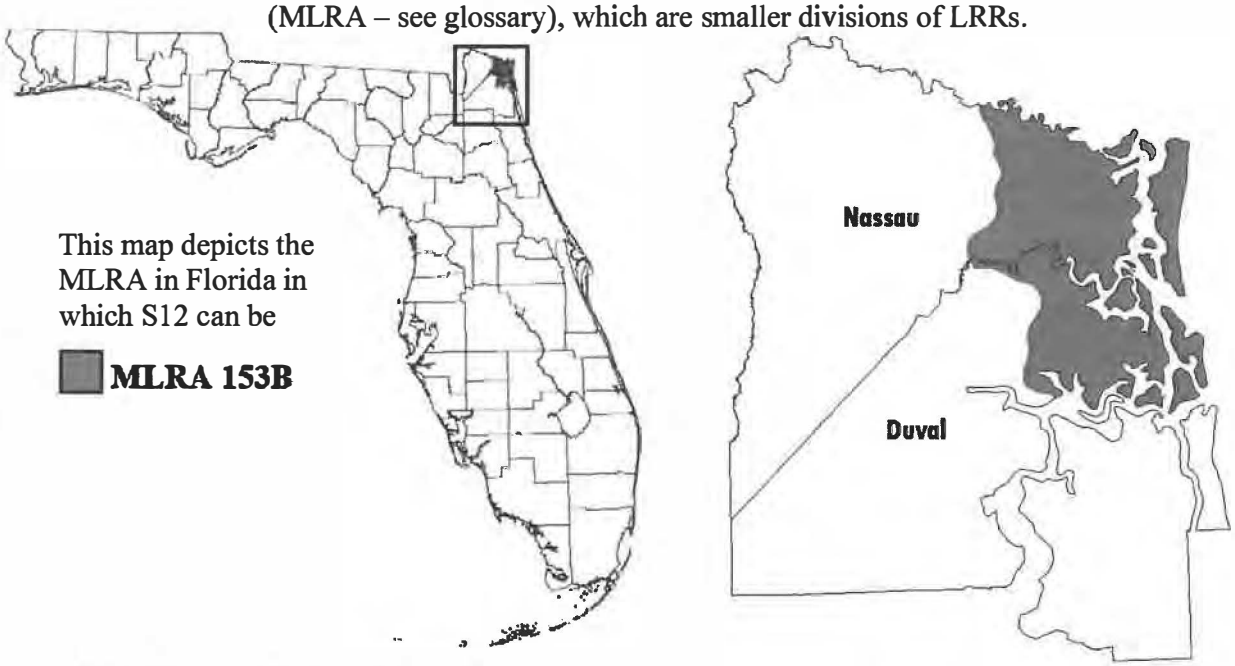
Most NRCS Hydric Soil Field Indicators are specific to Land Resource Regions (LRR – see glossary). This map depicts the three LRRs in Florida: P, T, and U.

LRRs

- P
- T
- U

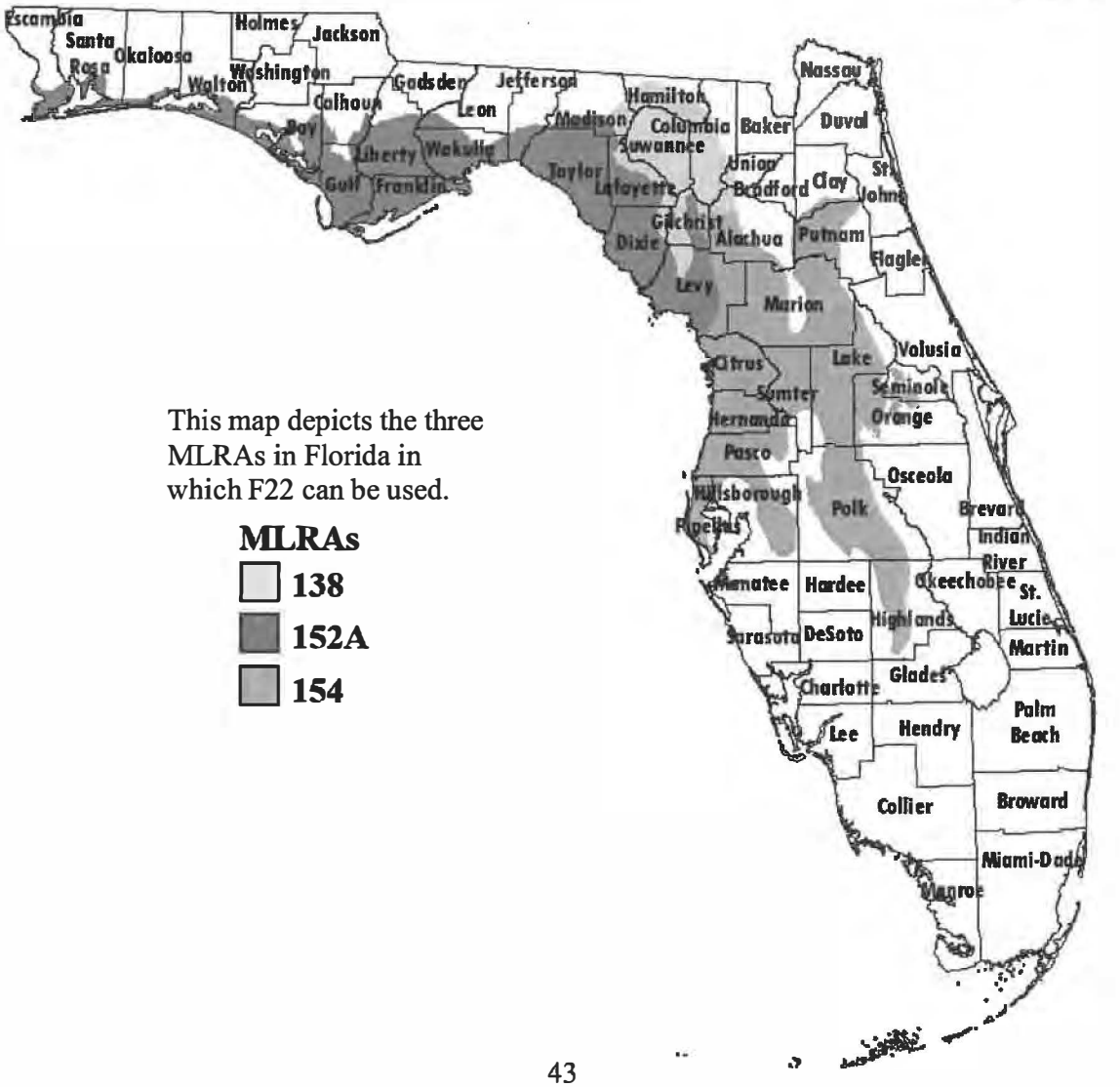
Major Land Resource Areas (MLRAs)

Two Hydric Soil Field Indicators in Florida (S12 and F22) are specific to Major Land Resource Areas (MLRA – see glossary), which are smaller divisions of LRRs.



This map depicts the MLRA in Florida in which S12 can be

MLRA 153B



This map depicts the three MLRAs in Florida in which F22 can be used.

MLRAs

138

152A

154

Hydric Soil Field Indicators:

Adapted from **Field Indicators of Hydric Soils in the United States, Version 8.1 (USDA NRCS, 2017)** to include Florida-specific indicators per Rule 62-340.300(2)(a)1., (b)1., (c)3., and (d), F.A.C.

These indicators are subdivided by prefix:
A – for All texture soils
S – for Sandy texture soils
F – for Fine texture soils
LRR or MLRA – refer to the "Land Resource Region" or the "Major Land Resource Area" in which the indicator may be used

Data Form Guide Notes
Soil profile documentation: The top of the uppermost muck (sapric) or mineral surface is the soil surface/0 inch depth for purposes of Chapter 62-340, F.A.C. Other materials, such as peat (fibric) or mucky peat (hemic) are documented by a "+" before the thickness in inches of each additional layer above the soil surface. (For example: +4 – 0 inches mucky peat, 0 – 3 inches muck)

Overlying layer(s) requirement: All mineral layers above any of the layers meeting the requirements of any indicators, except S6, F8, and F12, must have a dominant chroma of 2 or less, or the thickness of the layer(s) with a dominant chroma of more than 2 is less than 6 inches.

----------*For use in All texture soils*----------

A1. Histosol - LRR: **P, T, U**
Note: This is a stand alone D-Test indicator
Classifies as a Histosol (except Folist).
User Notes: In a Histosol, typically 40 cm (16 inches) or more of the upper 80 cm (32 inches) is organic soil material. Organic soil materials have organic-carbon contents (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. These materials include muck (sapric soil material), mucky peat (hemic soil material), and peat (fibric soil material). See *Keys to Soil Taxonomy* (Soil Survey Staff, 2014) for a complete definition.

A2. Histic Epipedon - LRR: **P, T, U**
Note: This is a stand alone D-Test indicator
A histic epipedon underlain by mineral soil material with chroma of 2 or less.
User Notes: Most histic epipedons are surface horizons 20 cm (8 inches) or more thick of organic soil material. Aquic conditions or artificial drainage is required. See *Keys to Soil Taxonomy* (Soil Survey Staff, 2014) for a complete definition.

A3. Black Histic - LRR: **P, T, U**
Note: This is a stand alone D-Test indicator
A layer of peat, mucky peat, or muck 20 cm (8 inches) or more thick that starts at a depth of ≤ 15 cm (6 inches) from the soil surface; has hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less; and is underlain by mineral soil material with chroma of 2 or less.
User Notes: Unlike indicator A2, this indicator does not require proof of aquic conditions or artificial drainage.

A4. Hydrogen Sulfide - LRR: **P, T, U**
Note: This is a stand alone D-Test indicator
A hydrogen sulfide odor starting at a depth ≤ 30 cm (12 inches) from the soil surface.
User Notes: This "rotten egg smell" indicates that sulfate-sulfur has been reduced and therefore the soil is anaerobic.

A5. Stratified Layers - LRR: **P, T, U**

Note: This is a stand alone D-Test indicator (qualifies as sediment deposition)

Several stratified layers starting at a depth ≤ 15 cm (6 inches) from the soil surface. At least one of the layers has value of 3 or less and chroma of 1 or less, or it is muck, mucky peat, peat, or a mucky modified mineral texture. The remaining layers have chroma of 2 or less. For any sandy material that constitutes the layer with value of 3 or less and chroma of 1 or less, at least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked.

User Notes: Use of this indicator may require assistance from a trained soil scientist with local experience. A stratified layer is depositional and not pedogenic. The minimum organic-carbon content of at least one layer of this indicator is slightly less than is required for indicator A7 (5 cm Mucky Mineral). An undisturbed sample must be observed. Individual strata are dominantly less than 2.5 cm (1 inch) thick. A hand lens is an excellent tool to aid in the identification of this indicator. Many alluvial soils have stratified layers at greater depths; these soils do not meet the requirements of this indicator. Many alluvial soils have stratified layers at the required depths but do not have chroma of 2 or less; these do not meet the requirements of this indicator. The stratified layers occur in any soil texture.

A6. Organic Bodies - LRR: **P, T, U**

Presence of 2 percent or more organic bodies of muck or a mucky modified mineral texture starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User Notes: Organic bodies typically occur at the tips of fine roots. In order to meet the Organic Bodies indicator, the organic carbon content in organic bodies must meet the requirements of muck or mucky modified textures. The size of the organic body is not specifically defined, but the bodies are commonly 1 to 3 cm (0.5 to 1 inch) in diameter. Many organic bodies do not have the required content of organic carbon and as a result do not meet this indicator. For example, organic bodies of mucky peat (hemic material) and/or peat (fibric material) do not meet the requirements of this indicator, nor does material consisting of partially decomposed root tissue. The Organic Bodies indicator includes the indicator previously named "accretions" (Florida Soil Survey Staff, 1992).

A7. 5 cm Mucky Mineral - LRR: **P, T, U**

Note: This is a stand alone D-Test indicator

A layer of mucky modified mineral soil material 5 cm (2 inches) or more thick, starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User Notes: "Mucky" is a USDA texture modifier for mineral soils. The content of organic carbon is at least 5 percent and ranges to as high as 18 percent. The percentage required depends on the clay content of the soil; the higher the clay content, the higher the content of organic carbon required. For example, a mucky fine sandy soil contains between 5 and 12 percent organic carbon. When the amount of clay is increased as in a mucky sandy loam, the organic carbon content increases to between 7 and 14 percent.

A8. Muck Presence - LRR: **U**

Note: This is a stand alone D-Test indicator

A layer of muck with value of 3 or less and chroma of 1 or less, starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User Notes: The presence of muck of any thickness at a depth ≤ 15 cm (6 inches) is the only requirement. Normally, this expression of anaerobiosis is at the soil surface; however, it may occur at any depth ≤ 15 cm (6 inches). Muck is sapric soil material with a minimum content of organic carbon that ranges from 12 to18 percent, depending on the content of clay. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to prevent the identification of plant parts. Mucky peat (hemic material) and/or peat (fibric material) do not qualify. Generally, muck is black and has a "greasy" feel; sand grains should not be evident.

A9. 1 cm Muck - LRR: **P, T**

Note: This is a stand alone D-Test indicator

A layer of muck 1 cm (0.5 inch) or more thick with value of 3 or less and chroma of 1 or less and starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User Notes: Unlike indicator A8 (Muck Presence), this indicator has a minimum thickness requirement of 1 cm. Normally, this expression of anaerobiosis is at the soil surface; however, it may occur at any depth ≤ 15 cm (6 inches). Muck is sapric soil material with a minimum content of organic carbon that ranges from12 to18 percent, depending on the content of clay. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to limit the recognition of plant parts. Mucky peat (hemic material) and/or peat (fibric material) do not qualify. Generally, muck is black and has a "greasy" feel; sand grains should not be evident.

A11. Depleted Below Dark Surface - LRR: **P, T, U**

A layer with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less, starting at a depth ≤ 30 cm (12 inches) from the soil surface, and having a minimum thickness of either:

a. 15 cm (6 inches), or

b. 5 cm (2 inches) if the 5 cm consists of fragmental soil material.

Organic, loamy, or clayey layer(s) above the depleted or gleyed matrix must have value of 3 or less and chroma of 2 or less starting at a depth ≤15 cm (6 inches) from the soil surface and extend to the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix must have value of 3 or less and chroma of 1 or less starting at a depth ≤15 cm (6 inches) from the soil surface and extend to the depleted or gleyed matrix. Viewed through a 10x or 15x hand lens, at least 70 percent of the visible sand particles must be masked with organic material. Observed without a hand lens, the sand particles appear to be close to 100 percent masked.

User Notes: This indicator often occurs in Mollisols but also applies to soils with umbric epipedons and dark colored ochric epipedons. For soils with dark colored epipedons more than 30 cm (12 inches) thick, use indicator A12. A depleted matrix requires value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, or 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

A12. Thick Dark Surface - LRR: **P, T, U**

A layer at least 15 cm (6 inches) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 30 cm (12 inches) of the surface. The layer(s) above the depleted or gleyed matrix and starting at a depth ≤ 15 cm (6 inches) from the soil surface must have value of 2.5 or less and chroma of 1 or less to a depth of at least 30 cm (12 inches) and value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. In any sandy material above the depleted or gleyed matrix, at least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked.

User Notes: This indicator applies to soils that have a black layer 30 cm (12 inches) or more thick and have value of 3 or less and chroma of 1 or less in any remaining layers directly above a depleted or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions. A depleted matrix requires value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, or 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings.

----------***For use in Sandy texture soils***----------

S4. Sandy Gleyed Matrix - LRR: **P, T, U**

Note: This is a stand alone D-Test indicator

A gleyed matrix that occupies 60 percent or more of a layer starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User Notes: Gley colors are not synonymous with gray colors. They are the colors on the gley color pages in the Munsell color book (X-Rite, 2009) that have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and value of 4 or more. For this indicator, the gleyed matrix only has to be present at a depth ≤ 15 cm (6 inches) from the surface. Soils with gleyed matrices are saturated for periods of a significant duration; as a result, there is no thickness requirement for the layer.

S5. Sandy Redox - LRR: **P, T, U**

A layer starting at a depth ≤ 15 cm (6 inches) from the soil surface that is at least 10 cm (4 inches) thick and has a matrix with 60 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

User Notes: "Distinct" and "prominent" are defined in the Glossary. Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas, 1994). Included within the concept of redox concentrations are iron-manganese bodies occurring as soft masses with diffuse boundaries. Common (2 to less than 20 percent) or many (20 percent or more) redox concentrations are required (USDA, NRCS, 2002). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.

This is a very common indicator of hydric soils and is often used to identify the hydric/nonhydric soil boundary in sandy soils.

S6. Stripped Matrix - LRR: **P, T, U**

A layer starting at a depth ≤ 15 cm (6 inches) from the soil surface in which iron-manganese oxides and/or organic matter have been stripped from the matrix and the primary base color of the soil material has been exposed. The stripped areas and translocated oxides and/or organic matter form a faintly contrasting pattern of two or more colors with diffuse boundaries. The stripped zones are 10 percent or more of the volume and are rounded.

User Notes: This indicator includes the indicator previously named "polychromatic matrix" as well as the term "streaking." Common or many areas of stripped (unmasked) soil materials are required. The stripped areas are typically 1 to 3 cm (0.5 to 1 inch) in size but may be larger or smaller. Commonly, the stripped areas have value of 5 or more and chroma of 2 or less, and the unstripped areas have chroma of 3 and/or 4. The matrix (predominant color) may not have the material with chroma of 3 and/or 4. The mobilization and translocation of oxides and/or organic matter is the important process and should result in a splotchy pattern masked and unmasked soil areas. This may be a difficult pattern to recognize and is more evident when a horizontal slice is observed.

S7. Dark Surface - LRR: **P, T, U**

A layer 10 cm (4 inches) thick, starting at a depth less than or equal to the upper 15 cm (6 inches) of the soil surface, with a matrix value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked. The matrix color of the layer directly below the dark layer must have the same colors as those described above or any color that has chroma of 2 or less.

User Notes: An undisturbed sample must be observed. Many wet soils have a ratio of about 50 percent soil particles that are masked with organic matter and about 50 percent unmasked soil particles, giving the soils a salt-and-pepper appearance. Where the coverage is less than 70 percent, a Dark Surface indicator does not occur.

S8. Polyvalue Below Surface - LRR: **T, U**

A layer with value of 3 or less and chroma of 1 or less starting at a depth ≤ 15 cm (6 inches) from the soil surface. At least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked. Directly below this layer, 5 percent or more of the soil volume has value of 3 or less and chroma of 1 or less, and the remainder of the soil volume has value of 4 or more and chroma of 1 or less to a depth of 30 cm (12 inches) or to the spodic horizon, whichever is less.

User Notes: This indicator applies to soils with a very dark gray or black surface or near-surface layer that is less than 10 cm (4 inches) thick and is underlain by a layer in which organic matter has been differentially distributed within the soils by water movement. The mobilization and translocation of organic matter result in splotchy coated and uncoated soil.

S9. Thin Dark Surface - LRR: **T, U**

A layer 5 cm (2 inches) or more thick, starting at a depth ≤ 15 cm (6 inches) from the soil surface, with value of 3 or less and chroma of 1 or less. At least 70 percent of the visible soil particles must be masked with organic material, viewed through a 10x or 15x hand lens. Observed without a hand lens, the particles appear to be close to 100 percent masked. This layer is underlain by a layer or layers with value of 4 or less and chroma of 1 or less to a depth of 30 cm (12 inches) or to the spodic horizon, whichever is less.

User Notes: This indicator applies to soils with a very dark gray or black near-surface layer that is at least 5 cm (2 inches) thick and is underlain by a layer in which organic matter has been carried downward by flowing water. The mobilization and translocation of organic matter result in an even distribution of organic matter in the eluvial (E) horizon. The chroma of 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator commonly occurs in hydric Spodosols, but a spodic horizon is not required.

S12. Barrier Islands 1 cm Muck - MLRA: **153B**

In the swale portion of dune-and-swale complexes of barrier islands, a layer of muck 1 cm (0.5 inch) or more thick with value of 3 or less and chroma of 2 or less and starting at a depth ≤ 15 cm (6 inches) from the soil surface.

User notes: This indicator is similar to A9 but allows chroma of greater than 1, but not greater than 2. The indicator is limited to dune-and-swale complexes on barrier islands.

---***For use in Fine texture soils***---

F2. Loamy Gleyed Matrix - LRR: **P, T, U**

Note: This is a stand alone D-Test indicator

A gleyed matrix that occupies 60 percent or more of a layer starting at a depth ≤ 30 cm (12 inches) from the soil surface.

User Notes: Gley colors are not synonymous with gray colors. They are the colors on the gley color pages of the Munsell color book (X-Rite, 2009). They have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and value of 4 or more. The gleyed matrix only has to be present at a depth ≤ 30 cm (12 inches) from the surface. Soils with gleyed matrices are saturated for periods of a significant duration; as a result, there is no thickness requirement for the layer.

F3. Depleted Matrix - LRR: **P, T, U**

A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

a. **5 cm (2 inches) if the 5 cm starts at a depth ≤ 10 cm (4 inches) from the soil surface, or**
b. **15 cm (6 inches), starting at a depth ≤ 25 cm (10 inches) from the soil surface.**

User Notes: A depleted matrix requires a value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colors of 4/1, 4/2, or 5/2. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. The low-chroma matrix must be the result of wetness and not a weathering or parent material feature.

F6. Redox Dark Surface - LRR: **P, T, U**

A layer that is at least 10 cm (4 inches) thick, starting at a depth ≤ 20 cm (8 inches) from the mineral soil surface, and has:

a. **Matrix value of 3 or less and chroma of 1 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or**
b. **Matrix value of 3 or less and chroma of 2 or less and 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.**

User Notes: This is a very common indicator used to delineate wetland soils that have a dark surface layer. Redox concentrations in mineral soils with a high content of organic matter and a dark surface layer are commonly small and difficult to see. The organic matter masks some or all of the concentrations that may be present. Careful examination is required to see what are commonly brownish redox concentrations in the darkened materials. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist condition for redox features to become visible. Soils that are wet because of ponding or have a shallow, perched layer of saturation may have any color below the dark surface. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark colored surface layer when applying this indicator.

F7. Depleted Dark Surface - LRR: **P, T, U**

Redox depletions with value of 5 or more and chroma of 2 or less in a layer that is at least 10 cm (4 inches) thick, starting at a depth ≤ 20 cm (8 inches) from the mineral soil surface, and has:

a. **Matrix value of 3 or less and chroma of 1 or less and 10 percent or more redox depletions, or**
b. **Matrix value of 3 or less and chroma of 2 or less and 20 percent or more redox depletions.**

User Notes: Care should be taken not to mistake mixing of an E or calcic horizon into the surface layer for depletions. The "pieces" of E and calcic horizons are not redox depletions. Knowledge of local conditions is required in areas where E and/or calcic horizons may be present. In soils that are wet because of subsurface saturation, the layer directly below the dark surface layer should have a depleted or gleyed matrix. Redox depletions should have associated redox concentrations that occur as Fe pore linings or masses within the depletion(s) or surrounding the depletion(s).

F8. Redox Depressions - LRR: **P, T, U**

In closed depressions subject to ponding, 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 5 cm (2 inches) or more thick and starts at a depth ≤ 10 cm (4 inches) from the soil surface.

User Notes: This indicator occurs on depressional landforms, such as vernal pools, playa lakes, rainwater basins, "Grady" ponds, and potholes. It does not occur in microdepressions (approximately 1 m) on convex or plane landscapes.

F10. Marl - LRR: **U**

A layer of marl with value of 5 or more and chroma 2 or less starting at a depth ≤ 10 cm (4 inches) from the soil surface.

User Notes: Marl is a limnic material deposited in water by precipitation of CaCO3 by algae as defined in *Soil Taxonomy* (Soil Survey Staff, 1999). It has a Munsell value of 5 or more and reacts with dilute HCl to evolve CO2. Marl is not the carbonatic substrate material associated with limestone bedrock. Some soils have materials with all of the properties of marl, except for the required Munsell value.

These soils are hydric if the required value is present at a depth ≤ 10 cm (4 inches) from the soil surface. Normally, this indicator occurs at the soil surface.

F12. Iron/Manganese Masses - LRR: P, T
On flood plains, a layer 10 cm (4 inches) or more thick with 40 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft iron-manganese masses with diffuse boundaries. The layer starts at a depth ≤ 20 cm (8 inches) from the soil surface. Iron-manganese masses have value and chroma of 3 or less. Most commonly, they are black. The thickness requirement is waived if the layer is the mineral surface layer.
User Notes: These iron-manganese masses generally are small (2 to 5 mm in size) and have value and chroma of 3 or less. They can be dominated by manganese and therefore have a color approaching black. The low matrix chroma must be the result of wetness and not be a weathering or parent material feature. Iron-manganese masses should not be confused with the larger and redder iron nodules associated with plinthite or with concretions that have sharp boundaries. This indicator occurs on flood plains along rivers, such as the Apalachicola, Congaree, Mobile, Savannah, and Tennessee Rivers.

F13. Umbric Surface - LRR: P, T, U
In depressions and other concave landforms, a layer 25 cm (10 inches) or more thick, starting at a depth ≤ 15 cm (6 inches) from the soil surface, in which the upper 15 cm (6 inches) has value of 3 or less and chroma of 1 or less and in which the lower 10 cm (4 inches) has the same colors as those described above or any other color that has chroma of 2 or less.
User Notes: The thickness requirements may be slightly less than those for an umbric epipedon. Microlows (approximately 1 m) are not considered to be concave landforms. Umbric surfaces in the higher landscape positions, such as side slopes dominated by Humic Dystrudepts, are excluded.

F22. Very Shallow Dark Surface - MLRA: 138, 152A, 154
In depressions and flood plains subject to frequent ponding and/or flooding, one of the following must be observed:

a. **If bedrock occurs between 15 cm (6 inches) and 25 cm (10 inches) of the soil surface, a layer at least 15 cm (6 inches) thick starting at a depth ≤ 10 cm (4 inches) from the soil surface with value 2.5 or less and chroma 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has chroma 2 or less. Or,**
b. **If bedrock occurs at a depth ≤ 15 cm (6 inches) from the soil surface, more than half of the soil thickness must have value 2.5 or less and chroma 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma 2 or less.**

NRCS Hydric Soil Field Indicators
Deepest Starting Depth Summary Table

Depth (in)	Indicator
0	A2
< 3	F22(b)
4	F3(a), F8, F10, F22(a)
6	A3, A5, A6, A7, A8, A9, A11, A12, S4, S5, S6, S7, S8, S9, S12, F13
8	F6, F7, F12
10	F3(b)
12	A4, F2
16	A1

Hydric Soil Field Indicators Simplified Checklist:

Hydric Soil Field Indicators Simplified Checklist is adapted from Field Indicators of Hydric Soils in the United States, Version 8.1 (USDA NRCS, 2017) using Florida-specific indicators per Rule 62-340.300(2)(a)1., (b)1., (c)3., and (d), F.A.C. The checklist is composed of Yes/No questions for each indicator. If any question in an indicator is answered No then the indicator is not met. If all of the questions for an indicator are answered Yes then the indicator is met.

Data Form Guide Notes:

Mineral soil texture refers to either sandy, fine, or mucky mineral textures.

Adjacent layers within a soil profile description may be combined to meet a hydric soil field indicator's layer thickness requirements provided the adjacent layers share the required properties referred to in the indicator (*E.g.*, 2 inches of sandy mucky mineral soil and 3 inches of sand with ≥70% organic coating may be combined to meet S7 provided both layers have matrix values of 3 or less and chromas of 1 or less.)

----------***For use in All texture soils***----------

A1. Histosol

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of organic soil material (peat, mucky peat, and/or muck soil texture)
- ✓ Does the layer(s) satisfy either **Option A or B**

  A. Layer(s) is 16 inches or more thick
  AND
  Starts ≤16 inches from the ground surface (ground surface begins at the peat, mucky peat, muck, or mineral surface)

  B. Organic soil material layer(s) constitutes 2/3 or more of the total thickness of the soil from the ground surface to a layer dense or cemented enough to inhibit root growth (e.g. bedrock, sandstone)
  AND
  Total combined thickness of any mineral soil texture layer(s) between the ground surface and the dense/cemented layer is 4 inches or less

- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:

  A. There are no mineral soil layers above this indicator

  B. All mineral soil above this indicator has a dominant chroma of 2 or less

  C. There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

- ❖ See Appendix B for complete requirements to classify as a Histosol

A2. Histic Epipedon

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of organic soil material (peat, mucky peat, and/or muck soil texture)
- ✓ Did the layer(s) form near the ground surface (ground surface begins at the peat, mucky peat, muck, or mineral surface)
- ✓ Is the layer(s) 8 to 16 inches thick
- ✓ Is the layer(s) underlain by mineral soil texture with chroma of 2 or less
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:

  A. There are no mineral soil layers above this indicator

  B. All mineral soil above this indicator has a dominant chroma of 2 or less

  C. There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

- ❖ See Appendix B for complete requirements to classify as a histic epipedon

A3. Black Histic

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of organic soil material (peat, mucky peat, and/or muck soil texture)
- ✓ Does the layer(s) have matrix hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less
- ✓ Is the layer(s) 8 inches or more thick
- ✓ Does the layer(s) start ≤ 6 inches from the ground surface (ground surface begins at the peat, mucky peat, muck, or mineral surface)
- ✓ Is the layer(s) underlain by mineral soil texture with chroma of 2 or less

A4. Hydrogen Sulfide

Note: This is a stand alone D-Test indicator

- ✓ Is there a hydrogen sulfide odor (rotten egg smell)
- ✓ Does the hydrogen sulfide odor start ≤ 12 inches from the soil surface
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:
  - **A.** There are no mineral soil layers above this indicator
  - **B.** All mineral soil above this indicator has a dominant chroma of 2 or less
  - **C.** There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

A5. Stratified Layers

Note: This is a stand alone D-Test indicator (as sediment deposition)

- ✓ Are there several stratified layers due to the alternating deposition of organic matter and mineral soil material deposited by flowing water
- ✓ Do one or more of the stratified layers satisfy either **Option A, B, and/or C**
  - **A.** Layer(s) is composed of organic soil material (peat, mucky peat, and/or muck soil texture)
  - **B.** Layer(s) is composed of mucky mineral soil texture
  - **C.** Layer(s) is composed of sandy or fine soil texture
    AND
    Has value of 3 or less and chroma of 1 or less
    AND
    If layer(s) texture is sandy at least 70% of the visible sand particles are masked with organic material when viewed through a 10x or 15x hand lens
- ✓ Other than the layer(s) meeting Option A, B, and/or C, do all of the remaining stratified layers have chroma of 2 or less
- ✓ Do the stratified layers start ≤ 6 inches from the soil surface

A6. Organic Bodies

- ✓ Is there a layer(s) with organic bodies composed of muck or mucky mineral soil texture
- ✓ Are there 2% or more organic bodies within the layer(s)
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

A7. 5 cm Mucky Mineral

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of mucky mineral soil texture
- ✓ Is the layer(s) 2 inches or more thick
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

A8. Muck Presence

Note: This is a stand alone D-Test indicator

- ✓ Is the soil profile located within Land Resource Region U
- ✓ Is there a layer(s) of muck soil texture
- ✓ Does the layer(s) have value of 3 or less and chroma of 1 or less

✓ Does the layer(s) start ≤ 6 inches from the soil surface

A9. 1 cm Muck

Note: This is a stand alone D-Test indicator

✓ Is the soil profile located within Land Resource Region P or T
✓ Is there a layer(s) of muck soil texture
✓ Does the layer(s) have value of 3 or less and chroma of 1 or less
✓ Is the layer(s) 0.5 inch or more thick
✓ Does the layer(s) start ≤ 6 inches from the soil surface

A11. Depleted Below Dark Surface

✓ Is there a dark layer(s) that satisfies either **Option A and/or B**

A. Layer(s) is composed of muck, fine mucky mineral, and/or fine soil texture
AND
Has value of 3 or less and chroma of 2 or less

B. Layer(s) is composed of sandy and/or sandy mucky mineral soil texture
AND
Has value of 3 or less and chroma of 1 or less
AND
Has at least 70% of the visible sand particles masked with organic material when viewed through a 10x or 15x hand lens

✓ Does the dark layer(s) start ≤ 6 inches from the soil surface
✓ Does the layer(s) immediately below the dark layer(s) satisfy either **Option A and/or B**

A. The layer(s) has a gleyed matrix (value of 4 or more on the Gley 1 or Gley 2 page in the Munsell Soil Color Book, 2009)

B. The layer(s) has a depleted matrix (value of 4 or more and chroma of 2 or less, along with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or a reduced matrix)

✓ Does the underlying layer(s) with the gleyed or depleted matrix have 60% or more chroma of 2 or less
✓ Does the underlying layer(s) satisfy either **Option A or B**

A. Layer(s) is 6 inches or more thick

B. Layer(s) is 2 inches or more thick
AND
Is composed of fragmental soil material

✓ Does the underlying layer(s) with the gleyed or depleted matrix start ≤ 12 inches from the soil surface

A12. Thick Dark Surface

✓ Is there a dark layer(s) that has value of 2.5 or less and chroma of 1 or less
✓ Does the dark layer(s) satisfy either **Option A and/or B**

A. Layer(s) is composed of muck, fine mucky mineral, and/or fine soil texture

B. Layer(s) is composed of sandy and/or sandy mucky mineral soil texture
AND
Has at least 70% of the visible sand particles masked with organic material when viewed through a 10x or 15x hand lens

✓ Does the dark layer(s) start ≤ 6 inches from the soil surface and extend to a depth of at least 12 inches
✓ Is there a layer(s) below the dark layer(s) that satisfies either **Option A and/or B**

A. The layer(s) has a gleyed matrix (value of 4 or more on the Gley 1 or Gley 2 page in the Munsell Soil Color Book, 2009)

B. The layer(s) has a depleted matrix (value of 4 or more and chroma of 2 or less, along with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or a reduced matrix)

- ✓ Does the lower layer(s) with the gleyed or depleted matrix have 60% or more chroma of 2 or less
- ✓ Is the lower layer(s) with the gleyed or depleted matrix 6 inches or more thick
- ✓ Do all remaining layers between the aforementioned dark layer(s) and the layer(s) with the gleyed or depleted matrix have value of 3 or less and chroma of 1 or less

----------***For use in Sandy texture soils***----------

S4. Sandy Gleyed Matrix

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of sandy soil texture in which 60% or more of the layer is a gleyed matrix (value of 4 or more on the Gley 1 or Gley 2 page in the Munsell Soil Color Book, 2009)
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

S5. Sandy Redox

- ✓ Is there a layer(s) of sandy and/or sandy mucky mineral soil texture with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings
- ✓ Does the matrix of the layer(s) have 60% or more chroma of 2 or less
- ✓ Is the layer(s) 4 inches or more thick
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

S6. Stripped Matrix

- ✓ Is there a layer(s) of sandy and/or sandy mucky mineral soil texture with two or more **faintly**[1] **contrasting** colors (Contrast is due to organic matter and/or iron-manganese oxides having been stripped away from the matrix and the primary base color of the soil material has been exposed)
- ✓ Are there rounded, diffuse[2] boundaries between the faintly contrasting colors
- ✓ Do the stripped (lighter colored) areas of the faintly contrasting colors compose 10% or more of the layer(s)'s volume
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

[1] See Table 1 (p 32) to determine if contrast is faint

[2] See Figure 1 (p 32) to determine if boundaries are diffuse

S7. Dark Surface

- ✓ Is there a dark layer(s) of sandy, sandy mucky mineral, and/or muck soil texture with matrix value of 3 or less and chroma of 1 or less
- ✓ Does the dark layer(s)'s matrix have at least 70% of the visible sand particles masked with organic material when viewed through a 10x or 15x hand lens
- ✓ Does the dark layer(s) satisfy either **Option A or B**
  - **A.** The dark layer(s) is more than 4 inches thick
  - **B.** The dark layer(s) is exactly 4 inches thick
    AND
    The layer directly below has chroma of 2 or less
- ✓ Does the dark layer(s) start ≤ 6 inches from the soil surface

S8. Polyvalue Below Surface

- ✓ Is the soil profile located within Land Resource Region T or U
- ✓ Is there a dark layer(s) of sandy, sandy mucky mineral, and/or muck soil texture with value of 3 or less and chroma of 1 or less
- ✓ Does the dark layer(s) have at least 70% of the visible sand particles masked with organic material when viewed through a 10x or 15x hand lens
- ✓ Does the dark layer(s) start ≤ 6 inches from the soil surface
- ✓ Does the soil volume directly below this dark layer(s) to a depth of 12 inches from the soil surface or to the spodic horizon, whichever is less, meet both **Criteria 1 and 2**
  1. 5% or more of the soil volume has value of 3 or less and chroma of 1 or less

AND

2. The remainder of the soil volume has value of 4 or more and chroma of 1 or less

S9. Thin Dark Surface

- ✓ Is the soil profile located within Land Resource Region T or U
- ✓ Is there a dark layer(s) of sandy, sandy mucky mineral, and/or muck soil texture with value of 3 or less and chroma of 1 or less
- ✓ Does the dark layer(s) have at least 70% of the visible sand particles masked with organic material when viewed through a 10x or 15x hand lens
- ✓ Is the dark layer(s) 2 inches or more thick
- ✓ Does the dark layer(s) start ≤ 6 inches from the soil surface
- ✓ Directly below this dark layer(s) is there a layer(s) with value of 4 or less and chroma of 1 or less
- ✓ Does the underlying layer(s) extend to a depth of 12 inches from the soil surface or to the spodic horizon, whichever is less

S12. Barrier Islands 1 cm Muck

- ✓ Is the soil profile located within the swale portion of dune-and-swale complexes of barrier islands in Major Land Resource Area 153B (See p 42)
- ✓ Is there a layer(s) of muck soil texture
- ✓ Does the layer(s) have value of 3 or less and chroma of 2 or less
- ✓ Is the layer(s) 0.5 inch or more thick
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

----------***For use in Fine texture soils***----------

F2. Loamy Gleyed Matrix

Note: This is a stand alone D-Test indicator

- ✓ Is there a layer(s) of fine soil texture in which 60% or more of the layer is a gleyed matrix (value of 4 or more on the Gley 1 or Gley 2 page in the Munsell Soil Color Book, 2009)
- ✓ Does the layer(s) start ≤ 12 inches from the soil surface
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:
  - **A.** There are no mineral soil layers above this indicator
  - **B.** All mineral soil above this indicator has a dominant chroma of 2 or less
  - **C.** There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

F3. Depleted Matrix

- ✓ Is there a layer(s) of fine soil texture with a depleted matrix (value of 4 or more and chroma of 2 or less, along with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or a reduced matrix)
- ✓ Does the layer(s)'s matrix have 60% or more chroma of 2 or less
- ✓ Does the layer(s) satisfy either **Option A or B**
  - **A.** Layer(s) is 2 inches or more thick
    AND
    Starts ≤ 4 inches from the soil surface
  - **B.** Layer(s) is 6 inches or more thick
    AND
    Starts ≤ 10 inches from the soil surface
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:
  - **A.** There are no mineral soil layers above this indicator

B. All mineral soil above this indicator has a dominant chroma of 2 or less

C. There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

F6. Redox Dark Surface

- ✓ Is there a layer(s) of fine and/or fine mucky mineral soil texture with distinct or prominent redox concentrations occurring as soft masses and/or pore linings
- ✓ Does the layer(s) with redox concentrations satisfy either **Option A or B**
  - **A.** Layer(s)'s matrix has value of 3 or less and chroma of 1 or less
    AND
    Has 2% or more redox concentrations
  - **B.** Layer(s)'s matrix has value of 3 or less and chroma of 2 or less
    AND
    Has 5% or more redox concentrations
- ✓ Is the layer(s) 4 inches or more thick
- ✓ Does the layer(s) start ≤ 8 inches from the soil surface
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:
  - **A.** There are no mineral soil layers above this indicator
  - **B.** All mineral soil above this indicator has a dominant chroma of 2 or less
  - **C.** There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

F7. Depleted Dark Surface

- ✓ Is there a layer(s) of fine and/or fine mucky mineral soil texture with redox depletions (lighter areas with associated redox concentrations)
- ✓ Do the redox depletions have value of 5 or more and chroma of 2 or less
- ✓ Does the layer(s) with redox depletions satisfy either **Option A and/or B**
  - **A.** Layer(s)'s matrix has value of 3 or less and chroma of 1 or less
    AND
    Has 10% or more distinct or prominent redox depletions
  - **B.** Layer(s)'s matrix has value of 3 or less and chroma of 2 or less
    AND
    Has 20% or more distinct or prominent redox depletions
- ✓ Is the layer(s) 4 inches or more thick
- ✓ Does the layer(s) start ≤ 8 inches from the soil surface
- ✓ Above the starting depth of this indicator, is either **Option A, B, or C** satisfied:
  - **A.** There are no mineral soil layers above this indicator
  - **B.** All mineral soil above this indicator has a dominant chroma of 2 or less
  - **C.** There are less than 6 inches of mineral soil material with a dominant chroma of more than 2 above this indicator

F8. Redox Depressions

- ✓ Is the soil profile located within a closed depression subject to ponding
- ✓ Is there a layer(s) of fine and/or fine mucky mineral soil texture with 5% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings
- ✓ Is the layer(s) 2 inches or more thick
- ✓ Does the layer(s) start ≤ 4 inches from the soil surface

F10. Marl

- ✓ Is the soil profile located within Land Resource Region U
- ✓ Is there a layer(s) of marl material

- ✓ Does the layer(s) have value of 5 or more and chroma of 2 or less
- ✓ Does the layer(s) start ≤ 4 inches from the soil surface

F12. Iron/Manganese Masses

- ✓ Is the soil profile located within Land Resource Region P or T
- ✓ Is the soil profile located within a flood plain
- ✓ Is there a layer(s) of fine and/or fine mucky mineral soil texture with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings
- ✓ Do the redox concentrations occur as soft iron-manganese masses
- ✓ Do the iron-manganese masses have value and chroma of 3 or less
- ✓ Do the iron-manganese masses have diffuse[3] boundaries
- ✓ Does 40% or more of the layer(s) have chroma of 2 or less
- ✓ Does the layer(s) with iron-manganese masses satisfy either **Option A or B**

  A. Layer(s) starts at the soil surface

  B. Layer(s) is 4 inches or more thick
  AND
  Starts ≤ 8 inches from the soil surface

[3] See Figure 1 (p 32) to determine if boundaries are diffuse

F13. Umbric Surface

- ✓ Is the soil profile located within a depression or other concave landform
- ✓ Is there a layer(s) of fine, fine mucky mineral, and/or muck soil texture
- ✓ Is the layer(s) 10 inches or more thick
- ✓ Does the layer(s) satisfy both **Criteria 1 and 2**
  1. The upper 6 inches of the layer(s) has value of 3 or less and chroma of 1 or less
     AND
  2. The lower 4 inches of the layer(s) has chroma of 2 or less
- ✓ Does the layer(s) start ≤ 6 inches from the soil surface

F22. Very Shallow Dark Surface

- ✓ Is the soil profile located within Major Land Resource Area 138, 152A, or 154 (See p 42)
- ✓ Is the soil profile located within a depression or flood plain subject to frequent ponding and/or flooding
- ✓ Is there a dark layer(s) of fine, fine mucky mineral, and/or muck soil texture with value of 2.5 or less and chroma of 1 or less
- ✓ Does bedrock occur ≤ 10 inches from the soil surface
- ✓ Does the soil profile satisfy either **Option A or B**

  A. The bedrock occurs between 6 and 10 inches from the soil surface
  AND
  The dark layer(s) is 6 inches or more thick
  AND
  Starts ≤ 4 inches from the soil surface

  B. The bedrock occurs ≤ 6 inches from the soil surface
  AND
  The dark layer(s) constitutes more than half of the soil thickness
- ✓ Does all remaining soil between the dark layer(s) and the bedrock have chroma of 2 or less

Glossary from NRCS Field Indicators of Hydric Soils in the United States Version 8.1, 2017

As defined in this Glossary, terms marked with an asterisk (*) have definitions that are slightly different from the definitions in the referenced materials. The definitions in the Glossary are intended to assist users of this document and are not intended to add to or replace definitions in the referenced materials.
Data Form Guide Note: Definitions expressed in Chapter 62-340, F.A.C. supersede all other definitions contained within this guide when applying the rule.

A horizon. A mineral soil horizon that formed at the surface or below an O horizon where organic material is accumulating. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Accreting areas. Landscape positions in which soil material accumulates through deposition from higher elevations or upstream positions more rapidly than the rate at which soil material is being lost through erosion.

Anaerobic. A condition in which molecular oxygen is virtually absent from the soil.

Anaerobiosis. Microbiological activity under anaerobic conditions.

Aquic conditions. Conditions in the soil represented by depth of saturation, occurrence of reduction, and redoximorphic features. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

***Artificial drainage.** The use of human efforts and devices to remove free water from the soil surface or from the soil profile. The hydrology may also be modified by levees and dams, which keep water from entering a site.

CaCO3 equivalent. The acid neutralizing capacity of a soil expressed as a weight percentage of CaCO3 (molecular weight of CaCO3 equals 100).

Calcic horizon. An illuvial horizon in which carbonates have accumulated to a significant extent. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Calcium carbonate. Calcium carbonate has the chemical formula CaCO3. It effervesces when treated with cold hydrochloric acid.

Closed depressions. Low-lying areas that are surrounded by higher ground and have no natural outlet for surface drainage.

COE. U.S. Army Corps of Engineers.

Common. When referring to redox concentrations, redox depletions, or both, "common" represents 2 to 20 percent of the observed surface.

Concave landscapes. Landscapes in which the surface curves downward.

***Depleted matrix.** For loamy and clayey material (and sandy material in areas of indicators A11 and A12), a depleted matrix refers to the volume of a soil horizon or subhorizon in which the processes of reduction and translocation have removed or transformed iron, creating colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix; however, they are excluded from the concept of depleted matrix unless the soil has common or many distinct or prominent redox concentrations occurring as soft masses or pore linings. In some areas the depleted matrix may change color upon exposure to air (see Reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

1. Matrix value of 5 or more and chroma of 1 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
2. Matrix value of 6 or more and chroma of 2 or less with or without redox concentrations occurring as soft masses and/or pore linings; or
3. Matrix value of 4 or 5 and chroma of 2 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings; or
4. Matrix value of 4 and chroma of 1 and 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

Diffuse boundary. (Figure 1 *p.32*) Used to describe redoximorphic features that grade gradually from one color to another. The color grade is commonly more than 2 mm wide. "**Clear**" is used to describe boundary color gradations intermediate between sharp and diffuse.

Distinct.[1] (Table 1 *p.32*) Readily seen but contrasting only moderately with the color to which compared. The contrast is distinct if:

1. Delta hue[2] = 0, then a) Delta value ≤2 and delta chroma >1 to <4, or
   b) Delta value >2 to <4 and delta chroma <4.
2. Delta hue = 1, then a) Delta value ≤1 and delta chroma >1 to <3, or
   b) Delta value >1 to <3 and delta chroma <3.
3. Delta hue = 2, then a) Delta value = 0 and delta chroma >0 to <2, or
   b) Delta value >0 to <2 and delta chroma <2.

[1] Regardless of the magnitude of hue difference, where both colors have value ≤3 and chroma ≤2, the contrast is faint.

[2] Data Form Guide Note: A delta hue of 1 is equal to 2.5 units (Figure 2 *p.32*), as defined in the *Soil Survey Manual* (Soil Survey Staff, 1993)

E horizon. A mineral horizon in which the dominant process is loss of silicate clay, iron, and/or aluminum, leaving a concentration of sand and silt particles. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

EPA. U.S. Environmental Protection Agency.

Epipedon. A horizon that has developed at the soil surface. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Faint. (Table 1 *p.32*) Evident only on close examination. The contrast is faint if:

1. Delta hue = 0, then delta value ≤2 and delta chroma ≤1, or
2. Delta hue = 1, then delta value ≤1 and delta chroma ≤1, or
3. Delta hue = 2, then delta value = 0 and delta chroma = 0, or

Any delta hue if both colors have value ≤3 and chroma ≤2.

Fe-Mn concretions. Firm to extremely firm, irregularly shaped bodies with sharp to diffuse boundaries. When broken in half, concretions have concentric layers. See Vepraskas (1994) for a complete discussion.

Fe-Mn nodules. Firm to extremely firm, irregularly shaped bodies with sharp to diffuse boundaries. When broken in half, nodules do not have visibly organized internal structure. See Vepraskas (1994) for a complete discussion.

Few. When referring to redox concentrations, depletions, or both, "few" represents less than 2 percent of the observed surface.

Fibric. See Peat.

Flood plain. The nearly level plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is usually a constructional landform built of sediment deposited during overflow and lateral migration of the stream.

Fragmental soil material. Soil material that consists of 90 percent or more rock fragments. Less than 10 percent of the soil consists of particles 2 mm or smaller.

Frequently flooded or ponded. A frequency class in which flooding or ponding is likely to occur often under usual weather conditions (a chance of more than 50 percent in any year, or more than 50 times in 100 years).

FWS. U.S. Department of the Interior, Fish and Wildlife Service.

***g.** A horizon suffix indicating that the horizon is gray because of wetness but not necessarily that it is gleyed. All gleyed matrices (defined below) should have the suffix "g"; however, not all horizons with the "g" suffix are gleyed. For example, a horizon with the color 10YR 6/2 that is at least seasonally wet, with or without other redoximorphic features, should have the "g" suffix.

Glauconitic. Refers to a mineral aggregate that contains a micaceous mineral resulting in a characteristic green color, e.g., glauconitic shale or clay.

***Gleyed matrix.** Soils with a gleyed matrix have the following combinations of hue, value, and chroma (the soils are not glauconitic):

1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or

2. 5G with value of 4 or more and chroma of 1 or 2; or
3. N with value of 4 or more

In some places the gleyed matrix may change color upon exposure to air. (See Reduced matrix). This phenomenon is included in the concept of gleyed matrix.

***Hemic.** See Mucky peat.

Histels. Organic soils that overlie permafrost and show evidence of cryoturbation. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Histic epipedon. A thick (20- to 60-cm, or 8- to 24- inch) organic soil horizon that is saturated with water at some period of the year (unless the soil is artificially drained) and that is at or near the surface of a mineral soil.

Histosols. Organic soils that have organic soil materials in more than half of the upper 80 cm (32 inches) or that have organic materials of any thickness if they overlie rock or fragmental materials that have interstices filled with organic soil materials. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Horizon. A layer, approximately parallel to the surface of the soil, distinguishable from adjacent layers by a distinctive set of properties produced by soil-forming processes. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Hydric soil definition (1994). *(See also Ch 62-340, F.A.C. definition)* A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrogen sulfide odor. The odor of H2S. It is similar to the smell of rotten eggs.

Hydromorphic features. Features in the soil caused or formed by water.

Layer(s). A horizon, subhorizon, or combination of contiguous horizons or subhorizons sharing at least one property referred to in the indicators.

Lithologic discontinuity. Occurs in a soil that has developed in more than one type of parent material. Commonly determined by a significant change in particle-size distribution, mineralogy, etc. that indicates a difference in material from which the horizons formed.

LRR. Land resource region. LRRs are geographic areas characterized by a particular pattern of soils, climate, water resources, and land use. Each LRR is assigned a different letter of the alphabet (A-Z). LRRs are defined in U.S. Department of Agriculture Handbook 296 (USDA, NRCS, 2006b).

Many. When referring to redox concentrations, depletions, or both, "many" represents more than 20 percent of the observed surface.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions; formed primarily under freshwater lacustrine conditions. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

***Masked.** Through redoximorphic processes, the color of soil particles is hidden by organic material, silicate clay, iron, aluminum, or some combination of these.

Matrix. The dominant soil volume that is continuous in appearance. When three colors occur, such as when a matrix, depletions, and concentrations are present, the matrix may represent less than 50 percent of the total soil volume.

MLRA. Major land resource areas. MLRAs are geographically associated divisions of land resource regions. MLRAs are defined in U.S. Department of Agriculture Handbook 296 (USDA, NRCS, 2006b).

Mollic epipedon. A mineral surface horizon that is relatively thick, dark colored, and humus rich and has high base saturation. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Mollisols. Mineral soils that have a mollic epipedon. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

***Muck.** Sapric organic soil material in which virtually all of the organic material is so decomposed that identification of plant forms is not possible. Bulk density is normally 0.2 or more. Muck has less than one-sixth fibers after rubbing, and its sodium pyrophosphate solution extract color has lower value and chroma than 5/1, 6/2, and 7/3.

***Mucky modified mineral soil material.** (Figure 7) A USDA soil texture modifier, e.g., mucky sand. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material) or mucky peat (hemic material), mucky mineral soil material does not occur.

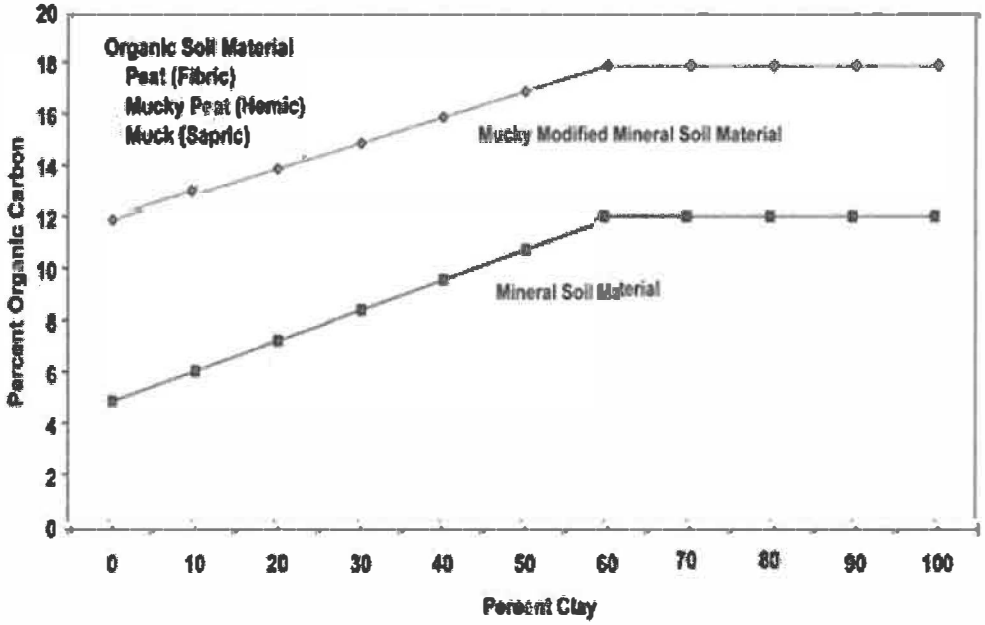


Figure 7: Percent organic carbon required for organic soil material, mucky modified mineral soil material, and mineral soil material as it is related to content of clay.

***Mucky peat.** Hemic organic material, which is characterized by decomposition that is intermediate between that of peat (fibric material) and that of muck (sapric material). Bulk density is normally between 0.1 and 0.2 g/cm3. Mucky peat does not meet the fiber content (after rubbing) or sodium pyrophosphate solution extract color requirements for either peat (fibric) or muck (sapric) soil material.

Nodules. See Fe-Mn nodules.

NRCS. USDA, Natural Resources Conservation Service (formerly Soil Conservation Service).

NTCHS. National Technical Committee for Hydric Soils.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic soil material. (Figure 7) Soil material that is saturated with water for long periods or artificially drained and, excluding live roots, has 18 percent or more organic carbon with 60 percent or more clay or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon. If the soil is never saturated for more than a few days, it contains 20 percent or more organic carbon. Organic soil material includes muck, mucky peat, and peat.

Data Form Guide Note: Generally, organic soil material is 2 cm or smaller and decomposing.

***Peat.** Fibric organic soil material. The plant forms can be identified in virtually all of the organic material. Bulk density is normally <0.1. Peat has three-fourths or more fibers after rubbing, or it has two-fifths or more fibers after rubbing and has sodium pyrophosphate solution extract color of 7/1, 7/2, 8/2, or 8/3.

Ped. A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete discussion.

Ponding. Standing water in a closed depression that is removed only by percolation, evaporation, or transpiration. The ponding lasts for more than 7 days.

Pore linings. Zones of accumulation that may be either coatings on a ped or pore surface or impregnations of the matrix adjacent to the pore or ped. See Vepraskas (1994) for a complete discussion.

Prominent. (Table 1 *p.32*) Contrasts strongly in color. Color contrasts more contrasting than faint and distinct are prominent.

Red parent material. The parent material with a natural inherent reddish color attributable to the presence of iron oxides, typically hematite (Elless and Rabenhorst, 1994; Elless et al., 1996), occurring as coatings on and occluded within mineral grains. Soils that formed in red parent material have conditions that greatly retard the development and extent of the redoximorphic features that normally occur under prolonged aquic conditions. They typically have a Color Change Propensity Index (CCPI) of <30 (Rabenhorst and Parikh, 2000). Most commonly, the material consists of dark red, consolidated Mesozoic or Paleozoic sedimentary rocks, such as shale, siltstone, and sandstone, or alluvial materials derived from such rocks. Assistance from a local soil scientist may be needed to determine where red parent material occurs.

Redox concentrations. Bodies of apparent accumulation of Fe-Mn oxides. Redox concentrations include soft masses, pore linings, nodules, and concretions. For the purposes of the indicators, nodules and concretions are excluded from the concept of redox concentrations unless otherwise specified by specific indicators. See Vepraskas (1994) for a complete discussion.

Redox depletions. Bodies of low chroma (2 or less) having value of 4 or more where Fe- Mn oxides have been stripped or where both Fe-Mn oxides and clay have been stripped. Redox depletions contrast distinctly or prominently with the matrix. See Vepraskas (1994) for a complete discussion.

Redoximorphic features. Features formed by the processes of reduction, translocation, and/or oxidation of Fe and Mn oxides; formerly called mottles and low-chroma colors. See Vepraskas (1994) for a complete discussion.

Reduced matrix. A soil matrix that has low chroma and high value, but in which the color changes in hue or chroma when the soil is exposed to air. See Vepraskas (1994) for a complete discussion.

***Reduction.** For the purpose of the indicators, reduction occurs when the redox potential (Eh) is below the ferric-ferrous iron threshold as adjusted for pH. In hydric soils, this is the point when the transformation of ferric iron (Fe3+) to ferrous iron (Fe2+) occurs.

Relict features. Soil morphological features that reflect past hydrologic conditions of saturation and anaerobiosis. See Vepraskas (1994) for a complete discussion.

***Sapric.** See Muck.

Saturation. *(See also Ch 62-340, F.A.C. definition)* Wetness characterized by zero or positive pressure of the soil water. Almost all of the soil pores are filled with water.

Sharp boundary. Used to describe redoximorphic features that grade sharply from one color to another. The color grade is commonly less than 0.1 mm wide.

Soft masses. Noncemented redox concentrations, frequently within the soil matrix, that are of various shapes and cannot be removed as discrete units.

Soil texture. The relative proportions, by weight, of sand, silt, and clay particles in the soil material less than 2 mm in size.

Spodic horizon. A mineral soil horizon that is characterized by the illuvial accumulation of amorphous materials consisting of aluminum and organic carbon with or without iron. The spodic horizon has a minimum thickness, a minimum quantity of oxalate extractable carbon plus aluminum, and/or specific color requirements.

Stream Terrace. Flat-topped landforms in a stream valley that flank and are parallel to the stream channel, originally formed by a previous stream level, and representing the abandoned flood plain, stream bed, or valley floor produced during a past state of fluvial erosion or deposition (i.e., currently very rarely or never flooded; inactive cut and fill and/or scour and fill processes). Stream terraces may occur singularly or as a series. Erosional surfaces cut into bedrock and thinly mantled with stream deposits (alluvium) are called "strath terraces." Remnants of constructional valley floors thickly mantled with alluvium are called alluvial terraces.

Umbric epipedon. A thick, dark mineral surface horizon with base saturation of less than 50 percent. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

Vertisol. A mineral soil with 30 percent or more clay in all layers. These soils expand and shrink, depending on moisture content, and have slickensides or wedge-shaped peds. See *Soil Taxonomy* (Soil Survey Staff, 1999) for a complete definition.

***Wetland.** *(See also Ch 62-340, F.A.C. definition)* An area that has hydrophytic vegetation, hydric soils, and wetland hydrology, as per the "National Food Security Act Manual" and the 1987 *Corps of Engineers Wetlands Delineation Manual* (United States Army Corps of Engineers, 1987).

Data Form Guide Notes:

Surface Water Definitions

Definition from §373.019(19) Florida Statutes
"**Surface water**" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

Definition from §373.019(14) Florida Statutes
"**Other watercourse**" means any canal, ditch, or other artificial watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted.

Definition from §62.340.200(15) Florida Administrative Code
"**Seasonal High Water**" means the elevation to which the ground and surface water can be expected to rise due to a normal wet season.

From The Florida Wetlands Delineation Manual pg. 37
Ordinary high water is that point on the slope or bank where the surface water from the water body ceases to exert a dominant influence on the character of the surrounding vegetation and soils. The OHWL frequently encompasses areas dominated by non-listed vegetation and non-hydric soils. When the OHWL is not at a wetland edge, the general view of the area may present an "upland" appearance.

Definition from §403.803(14) Florida Statutes
"**Swale**" means a manmade trench which:
(a) Has a top width-to-depth ratio of the cross-section equal to or greater than 6:1, or side slopes equal to or greater than 3 feet horizontal to 1 foot vertical;
(b) Contains contiguous areas of standing or flowing water only following a rainfall event;
(c) Is planted with or has stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake; and
(d) Is designed to take into account the soil erodibility, soil percolation, slope, slope length, and drainage area so as to prevent erosion and reduce pollutant concentration of any discharge.

Appendix B: Histosol and Histic Epipedon Definition

From *Keys to Soil Taxonomy* (Soil Survey Staff, 2014)

Histosols

1. Do not have andic soil properties in 60 percent or more of the thickness between the soil surface and either a depth of 60 cm or a densic, lithic, or paralithic contact or duripan if shallower; *and*

2. Have organic soil materials that meet *one or more* of the following:
   a. Overlie cindery, fragmental, or pumiceous materials and/or fill their interstices *and* directly below these materials, have a densic, lithic, or paralithic contact; *or*
   b. When added with the underlying cindery, fragmental, or pumiceous materials, total 40 cm or more between the soil surface and a depth of 50 cm; *or*
   c. Constitute two-thirds or more of the total thickness of the soil to a densic, lithic, or paralithic contact *and* have no mineral horizons or have mineral horizons with a total thickness of 10 cm or less; *or*
   d. Are saturated with water for 30 days or more per year in normal years (or are artificially drained), have an upper boundary within 40 cm of the soil surface, and have a total thickness of *either*:
      1) 60 cm or more if three-fourths or more of their volume consists of moss fibers or if their bulk density, moist, is less than 0.1 g/cm^3; *or*
      2) 40 cm or more if they consist either of Sapric or hemic materials, or of fibric materials with lessthan three-fourths (by volume) moss fibers and a bulk density, moist, of 0.1 g/cm^3 or more.

Folists (excluded from meeting indicator A1): Histosols that are saturated with water for less than 30 cumulative days during normal years (and are not artificially drained).

Histic Epipedon

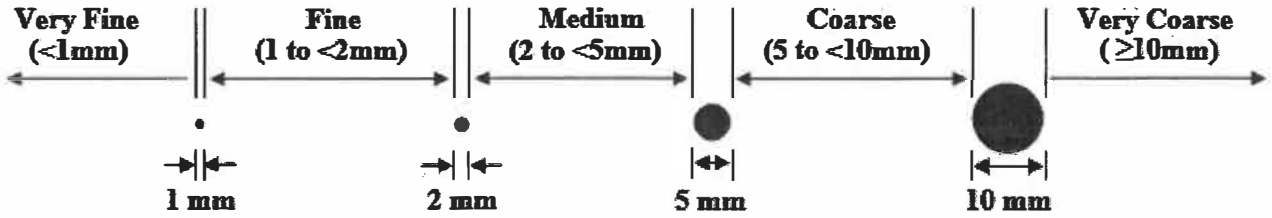
The histic epipedon is a layer (one or more horizons) that is characterized by saturation (for 30 days or more, cumulative) and reduction for some time during normal years (or is artificially drained) and *either*:

1. Consists of organic soil material that:
   a. Is 20 to 60 cm thick and either contains 75 percent or more (by volume) *Sphagnum* fibers or has a bulk density, moist, of less than 0.1; *or*
   b. Is 20 to 40 cm thick; *or*
2. Is an Ap horizon that, when mixed to a depth of 25 cm, has an organic-carbon content (by weight) of:
   a. 16 percent or more if the mineral fraction contains 60 percent or more clay; *or*
   b. 8 percent or more if the mineral fraction contains no clay; *or*
   c. 8 + (clay percentage divided by 7.5) percent or more if the mineral fraction contains less than 60 percent clay.

Most histic epipedons consist of organic soil material. Item 2 provides for a histic epipedon that is an Ap horizon consisting of mineral soil material. A Histic epipedon consisting of mineral soil material can also be part of a mollic or umbric epipedon.

Root Size Estimation Chart

Adapted from *Field Book for Describing Sampling Soils* version 3.0 (NRCS 2012)



Quantity Classes for Redox Features or Roots

Quantity Class	Few	Common	Many
Redox: % of Observed Surface	Less than 2%	2% to 20%	Greater than 20%
Roots: Average Count per Area*	< 1 per area*	1 to < 5 per area*	≥ 5 per area*

*Root assessment area = 1x1cm for <2mm roots, 10x10cm for 2 to <10mm, 100x100cm for ≥10mm

NRCS National Technical Committee for Hydric Soils

Hydric Soils Technical Notes contain National Technical Committee for Hydric Soils (NTCHS) updates, insights, and clarifications of the publication "Field Indicators of Hydric Soils in the United States" (USDA, NRCS, 1996 and 1998).

Hydric Soils Technical Note 4: Indicator Insights for Hydric Soil Identification

Question: I have a soil with layers that meet the color and redoximorphic requirements of several indicators; however, they do not meet any of the thickness requirements. What guidance is there regarding combining layers to meet a hydric soil indicator?

Answer: If layers/indicators are combined, the combination needs to meet the most stringent depth/thickness requirements of the combined indicators.

Example (The following table and guidance were adapted by FDEP staff to summarize Technical Note 4 and do not contain the exact text from this Note):

Layer	Depth	Matrix Color	Matrix Texture	Notes (RC = redox concentrations)
1	0-6	10YR 2/1	fine	None
2	6-8	10YR 3/1	fine	RC: 10YR 6/8, 5%, diffuse boundaries
3	8-12	10YR 5/2	fine	RC: 10YR 6/8, 10%, diffuse boundaries
4	12-20+	10YR 6/3	fine	RC: 10YR 6/8, 15%, diffuse boundaries

In this example, Layer 2 meets the requirements (except thickness) of indicator F6 – Redox Dark Surface. Layer 3 meets the requirements (except thickness) of indicator F3 – Depleted Matrix. Examining the indicator language, F6 requires a layer 4 inches thick starting within 8 inches; F3 requires a layer 6 inches thick starting within 10 inches. In this case, the soil has F6 starting within 8 inches (at 6) and has F3 starting within 10 inches (at 8); the combined thickness is 6 inches. Therefore, this soil meets the combined color, depth, and thickness requirements and should be documented as meeting hydric soil indicator(s) F6 and F3 (combined).

Hydric Soils Technical Note 13: Altered Hydric Soils

The following tables were created by FDEP staff to summarize Technical Note 13 and do not contain the exact text from this Note:

Altered Hydric Soil Type	What was modified?	Modified by what?	Modified how?	Soil status*	Example
Artificial	Hydrology or Soil	Human activities	Wetter or lower surface elevation	Hydric	Excavation/irrigation/ water impoundment
Drained/ protected	Hydrology	Human activities	Drier or barriers against flooding	Hydric	Ditches/roads/dams/ pumps/levees
Historic/ buried	Soil	Human activities	Soil placed on ground surface	Not hydric	Fill/erosional depositions
Relict	Hydrology	Geologic activities	Hydrology gone by natural means	Not hydric	Stream downcutting/ seismic activity

*See Appendix B for NRCS Hydric Soil Criteria

Soils that are no longer hydric may still exhibit redoximorphic features (called relict features), but these can be differentiated from those in contemporary (currently) hydric soils by the following characteristics:

Feature	Boundary	Nodule and Concretion Surfaces	Macropore Associated Depletions	Pore Linings	Value and Chroma
Contemporary	Diffuse	Irregular, or Smooth with red to yellow corona	Not overlain by iron rich coating	Continuous around live roots	Value ≥ 4 Chroma ≥ 4
Relict	Sharp	Smooth	Overlain by iron rich coating	Broken and unrelated to live roots	Value <4 Chroma <4

Appendix C: Hydric Soils Criteria and Technical Standard

Note: Hydric soil criteria, standards, and definitions used by the NRCS may differ from and do not supersede the criteria, standards, and definitions outlined in Chapter 62-340, F.A.C. to identify and delineate wetlands in Florida.

Soils are considered hydric by the NRCS if they:

1. Have a hydric soil indicator, or
2. Meet hydric soils list criteria 3 or 4, or
3. By data meet the Hydric Soil Technical Standard (HSTS).

Hydric Soils List Criteria (Updated by NTCHS February 2012)

1. All Histels except Folistels and Histosols except Folists; or
2. Map unit components in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, or Andic, Cumulic, Pachic, or Vitrandic subgroups that:
    a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
    b. Show evidence that the soil meets the definition of a hydric soil;
3. Map unit components that are frequently ponded for long duration or very long duration during the growing season that:
    a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
    b. Show evidence that the soil meets the definition of a hydric soil; or
4. Map unit components that are frequently flooded for long duration or very long duration during the growing season that:
    a. Based on the range of characteristics for the soil series, will at least in part meet one or more Field Indicators of Hydric Soils in the United States, or
    b. Show evidence that the soils meet the definition of a hydric soil.

Glossary of Terms Used in Hydric Soils List Criteria

Flooded means a condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from the high tides, or any combination of sources.

Frequently flooded, ponded, saturated: a frequency class in which flooding, ponding, or saturation is likely to occur often under usual weather conditions (more than 50 percent chance in any year, or more than 50 times in 100 years).

Ponded means a condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration.

Long duration means a duration class in which inundation for a single event ranges from 7 days to 1 month.

Map unit components means the collection of soils and miscellaneous areas found within a map unit.

Very long duration means a duration class in which inundation for a single event is greater than 1 month.

Hydric Soil Technical Standard (HSTS) (Updated by NTCHS December 2015)

For a soil to be considered hydric by the Natural Resources Conservation Service (NRCS), Anaerobic Conditions and Saturated Conditions must exist for at least 14 consecutive days.

1. Anaerobic Conditions (as documented by a, b, or c below)
    a. Indicator of Reduction in Soils (IRIS) tubes
    b. Oxidation-reduction potential (Eh) measurements using platinum electrodes
    c. Alpha-alpha-dipyridyl dye
2. Saturated Conditions
    - Confirmed by piezometer data.
    - NTCHS recommends that the piezometer data be verified by open well data.

(Onsite precipitation data are needed to confirm normal rainfall conditions)

Data Form Guide Note:

SUPPLEMENTAL SOIL DATA

HORIZON CRITERIA – MASTER HORIZON DESIGNATIONS

O Organic soil materials (not limnic)

A Mineral; organic matter (humus) accumulation, loss of Fe, Al, clay

E Mineral; loss of Fe, Al, clay, or organic matter
B Subsurface accumulation of clay, Fe, Al, Si, humus, $CaCO_3$, $CaSO_4$; or loss of $CaCO_3$; or accumulation of sesquioxides; or subsurface soil structure
C Little or no pedogenic alteration, unconsolidated earthy material, soft bedrock
L Limnic soil materials
R Bedrock, Strongly Cemented to Indurated

HORIZON CRITERIA – SUFFIX DESIGNATIONS

a Highly decomposed organic matter
b Buried genetic horizon (not used with C horizons)
c Concretions or nodules
e Moderately decomposed organic matter
g Strong gley
h Illuvial organic matter accumulation
i Slightly decomposed organic matter
k Pedogenic carbonate accumulation
m Strong cementation (pedogenic, massive)
ma Marl (Used only with L)
n Pedogenic, exchangeable sodium accumulation
o Residual sesquioxide accumulation (pedogenic)
p Plow layer or other artificial disturbance
r Weathered or soft bedrock
s Illuvial sesquioxide accumulation
t Illuvial accumulation of silicate clay
v Plinthite
w Weak color or structure within B (used only with B)
z Pedogenic accumulation of salt more soluble than gypsum

FNAI NATURAL COMMUNITIES OF FLORIDA

HARDWOOD FORESTED UPLANDS
Slope Forest
Upland Hardwood Forest
Mesic Hammock
Rockland Hammock
Xeric Hammock

HIGH PINE AND SCRUB
Upland Mixed Woodland
Upland Pine
Sandhill
Scrub

PINE FLATWOODS AND DRY PRAIRIE
Wet Flatwoods
Mesic Flatwoods
Scrubby Flatwoods
Pine Rockland
Dry Prairie

COASTAL UPLANDS
Beach Dune
Coastal Berm
Coastal Grassland
Coastal Strand
Maritime Hammock
Shell Mound

SINKHOLES AND OUTCROP COMMUNITIES
Upland Glade
Sinkhole
Limestone Outcrop
Keys Cactus Barren

FRESHWATER NON-FORESTED WETLANDS
PRAIRIES AND BOGS
Seepage Slope
Wet Prairie
Marl Prairie
Shrub Bog
MARSHES
Depression Marsh
Basin Marsh
Coastal Interdunal Swale
Floodplain Marsh
Slough Marsh
Glades Marsh
Slough

FRESHWATER FORESTED WETLANDS
CYPRESS/TUPELO
Dome Swamp
Basin Swamp
Strand Swamp
Floodplain Swamp
HARDWOOD
Baygall
Hydric Hammock
Bottomland Forest
Alluvial Forest

MARINE AND ESTUARINE VEGETATED WETLANDS
Salt Marsh
Mangrove Swamp
Keys Tidal Rock Barren

LACUSTRINE
Clastic Upland Lake
Coastal Dune Lake
Coastal Rockland Lake
Flatwoods/Prairie Lake and Marsh Lake
River Floodplain Lake and Swamp Lake
Sandhill Upland Lake
Sinkhole Lake

RIVERINE
Alluvial Stream
Blackwater Stream
Seepage Stream
Spring-run Stream

Appendix A2: subsection 62-340.450(1), (2), (3), F.A.C. Vegetative Index Plant List by Common Name

Common Name / Botanical Name / Wetland Status

acacia, ear-leaved *Acacia auriculiformis* FAC
alder, hazel *Alnus serrulata* OBL
algal bulrush *Websteria confervoides* OBL
allamanda, wild *Urechites lutea* FACW
alligator flag *Thalia geniculata* OBL
alligator-weed *Alternanthera philoxeroides* OBL
alligator-weed, sessile *Alternanthera sessilis* OBL
amaranth, Florida *Amaranthus floridanus* OBL
amaranth, southern *Amaranthus australis* OBL
amaranth, tidemarsh *Amaranthus cannabinus* OBL
anise, Florida *Illicium floridanum* OBL
anise, star *Illicium parviflorum* FACW
arrowhead *Sagittaria* spp. OBL
arrow-wood *Viburnum dentatum* FACW
arum *Peltandra* spp. OBL
ash *Fraxinus* spp. OBL
ash, white *Fraxinus americana* U
aster, bog *Aster spinulosus* FACW
aster, bushy *Aster dumosus* FAC
aster, calico *Aster lateriflorus* FACW
aster, climbing *Aster carolinianus* OBL
aster, coyote-thistle *Aster eryngiifolius* FACW
aster, Elliott's *Aster elliottii* OBL
aster, flat-top white *Aster umbellatus* FAC
aster, saltmarsh *Aster subulatus* OBL
aster, saltmarsh *Aster tenuifolius* OBL
aster, savannah *Aster chapmanii* FACW
aster, small white *Aster vimineus* FACW
Australian pine *Casuarina* spp. FAC
axilflower *Mecardonia* spp. FACW
azalea, swamp *Rhododendron viscosum* FACW
baby tears *Micranthemum* spp. OBL
baby-blue-eyes, small-flower *Nemophila aphylla* FACW
balsam-scale, Pan-American *Elionurus tripsacoides* FACW
bantam-buttons *Syngonanthus flavidulus* FACW
barbara's-buttons, grass-leaf *Marshallia graminifolia* FACW
barbara's-buttons, slim-leaf *Marshallia tenuifolia* FACW
basswood, American *Tilia americana* FACW
bay, swamp *Persea palustris* OBL
bayberry, evergreen *Myrica heterophylla* FACW
bayberry, odorless *Myrica inodora* FACW
bayberry, southern *Myrica cerifera* FAC
bay-cedar *Suriana maritima* FAC
beach alternanthera *Alternanthera maritima* FACW
beach creeper *Ernodea littoralis* FAC
bedstraw, stiff marsh *Galium tinctorium* FACW
beefwood *Guapira discolor* FAC
beggar-ticks *Bidens* spp. OBL

This index is for reference purposes only. Scientific names shall be used in all applications of Ch. 62-340, F.A.C. This index contains all plant species in subsection 62-340.450(1), (2), (3), F.A.C., listed alphabetically by their most widely used common names. In this index, plant species within a genus that has a consistent common name are listed by the common name of their genus, followed by the descriptor. For example, *Quercus nigra* is listed as oak, water. For families or larger taxonomic divisions in which all members are collectively referred to by a consistent common name, such as grasses, sedges, palms, orchids, and ferns, all members are listed under that group name, with the last member alphabetically being underlined to denote the end of the group. Plant species may appear multiple times within this list, as many have multiple common names. However, this list is not exhaustive.

beggar-ticks, white *Bidens pilosa (B. alba)* FAC
bellflower, American *Campanula americana* FAC
bellflower, Florida *Campanula floridana* OBL
bellwort, Florida *Uvularia floridana* FACW
bindweed, dwarf *Evolvulus convolvuloides* FACW
bindweed, silky *Evolvulus sericeus* FACW
birch, river *Betula nigra* OBL
birds-in-a-nest *Macbridea* spp. FACW
bitter-cress *Cardamine bulbosa* OBL
black senna *Seymeria cassioides* FAC
blackbead *Pithecellobium keyensis* FAC
blackbead, catclaw *Pithecellobium unguis-cati* FAC
blackberry *Rubus* spp. FAC
blackgum *Nyssa sylvatica var. biflora* OBL
bladdernut, American *Staphylea trifolia* FACW
bladderpod *Sesbania* spp. FAC
bladderwort *Utricularia* spp. OBL
blazing star *Liatris gracilis* FAC
blolly *Guapira discolor* FAC
blueberry, Elliott *Vaccinium elliottii* FAC
blueberry, highbush *Vaccinium corymbosum* FACW
blue-eye-grass *Sisyrinchium capillare* FACW
blue-eye-grass, eastern *Sisyrinchium atlanticum* FACW
blue-eye-grass, Michaux's *Sisyrinchium mucronatum* FACW
bluestar, eastern *Amsonia tabernaemontana* FACW
bluethread *Burmannia* spp. OBL
bluets, water *Oldenlandia* spp. FACW
bog hemp *Boehmeria cylindrica* OBL
bogbutton, Engler's *Lachnocaulon engleri* OBL
bogbutton, pineland *Lachnocaulon digynum* OBL
bogbutton, Small's *Lachnocaulon minus* OBL
bogbutton, southern *Lachnocaulon beyrichianum* FACW
bogbutton, white-head *Lachnocaulon anceps* FACW
boneset *Eupatorium perfoliatum* FACW
box briar *Randia aculeata* FAC
box-elder *Acer negundo* FACW
bractspike, yellow *Yeatesia viridiflora* FACW
Brazilian pepper-tree *Schinus terebinthifolius* FAC
broomspurge, spreading *Euphorbia humistrata* FACW
buckwheat-tree *Cliftonia monophylla* FACW
bugleweed *Lycopus* spp. OBL
bully, buckthorn *Bumelia lycioides* FAC
bully, Florida *Bumelia reclinata* FAC
bumelia, buckthorn *Bumelia lycioides* FAC
bumelia, coastal *Bumelia celastrina* FAC
bumelia, smooth *Bumelia reclinata* FAC
bunchflower, Virginia *Melanthium virginicum* OBL
burhead *Echinodorus* spp. OBL
burnweed, American *Erechtites hieraciifolia* FAC
burreed *Sparganium americanum* OBL
bushy goldenrod *Euthamia* spp. FAC

butter-cup *Ranunculus* spp. FACW
butterweed *Senecio glabellus* OBL
butterwort *Pinguicula* spp. OBL
buttonbush *Cephalanthus occidentalis* OBL
button-plant, smooth *Spermacoce glabra* FACW
button-weed *Diodia virginiana* FACW
buttonwood *Conocarpus erectus* FACW
cajeput *Melaleuca quinquenervia* FAC
camphor-weed *Pluchea* spp. FACW
canker-berry *Solanum bahamense* FACW
canna *Canna* spp. OBL
canna, common *Canna x generalis* FAC
caperonia *Caperonia* spp. FACW
caper-tree *Capparis flexuosa* FACW
cardinal flower *Lobelia cardinalis* OBL
carrotwood *Cupaniopsis anacardioides* FAC
catsclaw *Pithecellobium unguis-cati* FAC
cattail *Typha* spp. OBL
cayaponia, five-lobe *Cayaponia quinqueloba* FAC
celestial lily *Nemastylis floridana* FACW
chaff-flower, beach *Alternanthera maritima* FACW
chaffhead, bristle-leaf *Carphephorus pseudoliatris* FACW
chaffhead, hairy *Carphephorus paniculatus* FAC
chaffhead, pineland *Carphephorus carnosus* FACW
chamber-bitter *Phyllanthus urinaria* FAC
chicken-spike *Sphenoclea zeylandica* FACW
chickweed, West Indian *Drymaria cordata* FAC
chocolate-weed *Melochia corchorifolia* FAC
chokeberry, red *Aronia arbutifolia* FACW
Christmas berry *Lycium carolinianum* OBL
clearweed *Pilea* spp. FACW
climbing-dogbane *Trachelospermum difforme* FACW
clubmoss *Lycopodium* spp. FACW
cocoplum *Chrysobalanus icaco* FACW
coinwort *Centella asiatica* FACW
colic-root *Aletris spp* FAC
colicwood *Myrsine guianensis* FAC
coneflower, cut-leaf *Rudbeckia laciniata* FACW
coneflower, grass-leaf *Rudbeckia graminifolia* FACW
coneflower, Mohr's *Rudbeckia mohrii* OBL
coneflower, orange *Rudbeckia fulgida* FACW
coneflower, Shiny *Rudbeckia nitida* FACW
coralberry *Ardisia* spp. FAC
corkwood *Leitneria floridana* OBL
corkwood *Stillingia aquatica* OBL
cottonwood, eastern *Populus deltoides* FACW
cottonwood, swamp *Populus heterophylla* OBL
coughbush *Ernodea littoralis* FAC
cowbane *Oxypolis* spp. OBL
cow-lily, yellow *Nuphar luteum* OBL
coyote-thistle, Baldwin's *Eryngium baldwinii* FAC
coyote-thistle, blue-flower *Eryngium integrifolium* FACW

coyote-thistle, creeping *Eryngium prostratum* FACW
creeping ox-eye *Wedelia trilobata* FAC
croton, Elliott's *Croton elliottii* FACW
crow poison *Zigadenus densus* FACW
crownbeard, Chapman's *Verbesina chapmanii* FACW
crownbeard, diverse-leaf *Verbesina heterophylla* FACW
crownbeard, white *Verbesina virginica* FAC
culver's-root *Veronicastrum virginicum* FACW
cupseed *Calycocarpum lyonii* FACW
cypress, bald *Taxodium distichum* OBL
cypress, pond *Taxodium ascendens* OBL
dangleberry *Gaylussacia frondosa* FAC
danglepod *Sesbania* spp. FAC
darling-plum *Reynosia septentrionalis* FAC
dasheen *Colocasia esculenta* OBL
dayflower *Commelina* spp. FACW
dayflower, sandhill *Commelina erecta* U
deathcamas, Atlantic *Zigadenus glaberrimus* FACW
deer-tongue *Carphephorus paniculatus* FAC
desert-thorn, Carolina *Lycium carolinianum* OBL
devil's claws *Pisonia rotundata* FAC
dewberry *Rubus* spp. FAC
dewflower *Murdannia* spp. FAC
ditch stonecrop *Penthorum sedoides* OBL
dock *Rumex* spp. FACW
dog-fennel *Eupatorium capillifolium* FAC
dog-hobble *Leucothoe* spp. FACW
dogwood, silky *Cornus amomum* OBL
dogwood, swamp *Cornus foemina* FACW
dollarweed *Hydrocotyle* spp. FACW
doll's daisy *Boltonia* spp. FACW
dragon-head, false *Physostegia virginiana* FACW
dragon-head, Godfrey's *Physostegia godfreyi* OBL
dragon-head, purple *Physostegia purpurea* FACW
dragon-head, slender-leaf *Physostegia leptophylla* OBL
drymary *Drymaria cordata* FAC
duck potato *Sagittaria* spp. OBL
dwarf morning-glory, bindweed *Evolvulus convolvuloides* FACW
dwarf morning-glory, silver *Evolvulus sericeus* FACW
elder, American *Sambucus canadensis* FAC
elderberry *Sambucus canadensis* FAC
elephant's ear *Colocasia esculenta* OBL
elephant's ear *Xanthosoma sagittifolium* FACW
elm *Ulmus* spp. FACW
elm, slippery *Ulmus rubra* U
false buttonweed, smooth *Spermacoce glabra* FACW
false daisy *Eclipta alba* FACW
false indigo, bastard *Amorpha fruticosa* FACW
false-asphodel, coastal *Tofieldia racemosa* OBL
false-croton *Caperonia* spp. FACW
falsefennel *Eupatorium leptophyllum* OBL
false-fiddle-leaf *Hydrolea* spp. OBL

false-foxglove *Agalinis pinetorum* FACW
false-foxglove, flax-leaf *Agalinis linifolia* OBL
false-foxglove, large purple *Agalinis purpurea* FACW
false-foxglove, saltmarsh *Agalinis maritima* OBL
false-foxglove, scale-leaf *Agalinis aphylla* FACW
false-nettle *Boehmeria cylindrica* OBL
false-pimpernel *Lindernia* spp. FACW
false-pimpernel, Malayan *Lindernia crustacea* FAC
false-willow, broom-bush *Baccharis dioica* FAC
false-willow, eastern *Baccharis halimifolia* FAC
false-willow, saltwater *Baccharis angustifolia* OBL
feather-bells, eastern *Stenanthium gramineum* FACW
FERNS
bead fern *Hypolepis repens* FACW
Boston fern *Nephrolepis exaltata* FAC
brake, giant *Pteris tripartita* FACW
bramble fern, creeping *Hypolepis repens* FACW
chainfern, netted *Woodwardia aereolata* OBL
chainfern, Virginia *Woodwardia virginica* FACW
cinnamon fern *Osmunda cinnamomea* FACW
comb fern, brown-hair *Ctenitis submarginalis* FACW
lady fern, subarctic *Athyrium filix-femina* FACW
leather fern *Acrostichum* spp. OBL
maiden fern *Thelypteris* spp. FACW
marsh fern *Thelypteris* spp. FACW
royal fern *Osmunda regalis* OBL
sensitive fern *Onoclea sensibilis* FACW
shield fern *Thelypteris* spp. FACW
swamp fern *Blechnum serrulatum* FACW
sword fern *Nephrolepis* spp. FAC
wood fern, southern *Dryopteris ludoviciana* FACW
fetter-bush *Lyonia lucida* FACW
fetter-bush, climbing *Pieris phillyreifolia* FACW
fever-tree *Pinckneya bracteata* OBL
fig, Florida strangler *Ficus aurea* FAC
fire flag *Thalia geniculata* OBL
fireweed *Erechtites hieraciifolia* FAC
flameflower *Macranthera flammea* OBL
flattop goldenrod *Euthamia* spp. FAC
flax, Carter's *Linum carteri* FACW
flax, Florida yellow *Linum floridanum* FAC
flax, ridged yellow *Linum striatum* FACW
flax, stiff yellow *Linum medium* FAC
flax, West's *Linum westii* OBL
fleabane, early whitetop *Erigeron vernus* FACW
fleabane, oakleaf *Erigeron quercifolius* FAC
floating hearts *Nymphoides* spp. OBL
frogbit *Limnobium spongia* OBL
frog-fruit *Phyla* spp. FAC
frostweed *Verbesina virginica* FAC
gayfeather, garber's *Liatris garberi* FACW
gayfeather, slender *Liatris gracilis* FAC

gayfeather, spiked *Liatris spicata* FAC
gentian *Gentiana* spp. FACW
germander, American *Teucrium canadense* FACW
ginger *Hedychium coronarium* FACW
gingerlily, white *Hedychium coronarium* FACW
glasswort *Salicornia* spp. OBL
goat-weed *Scoparia dulcis* FAC
golden club *Orontium aquaticum* OBL
golden creeper *Ernodea littoralis* FAC
golden-crest *Lophiola americana* FACW
golden-rod, Elliott's *Solidago elliottii* OBL
golden-rod, leavenworth's *Solidago leavenworthii* FACW
golden-rod, marsh *Solidago fistulosa* FACW
golden-rod, rough-leaf *Solidago patula* OBL
golden-rod, seaside *Solidago sempervirens* FACW
golden-rod, willow-leaf *Solidago stricta* FACW
golden-rod, wrinkled *Solidago rugosa* FAC
grass-of-parnassus *Parnassia* spp. OBL
grasswort *Lilaeopsis* spp. OBL

GRASSES

arrowfeather grass *Aristida purpurascens* FACW
arrow-grass *Triglochin striatam* OBL
barnyardgrass *Echinochloa* spp. FACW
basketgrass *Oplismenus setarius* FAC
blue maidencane *Amphicarpum muhlenbergianum* FACW
bluestem *Schizachyrium* spp. FAC
bluestem, big *Andropogon gerardii* FAC
bluestem, broom-sedge *Andropogon virginicus* FAC
bluestem, bushy *Andropogon glomeratus* FACW
bluestem, Mohr's *Andropogon liebmanii var. pungensis (A. mohrii)* FACW
bluestem, savannah *Andropogon arctatus* FAC
bluestem, short-spike *Andropogon brachystachys* FAC
bluestem, slim *Andropogon perangustatus* FAC
bristlegrass *Setaria geniculata* FAC
broom-sedge *Andropogon virginicus* FAC
Burma reed *Neyraudia reynaudiana* FAC
carpet grass *Axonopus* spp. FAC
cockspur grass *Echinochloa* spp. FACW
common reed *Phragmites australis* OBL
cordgrass, big *Spartina cynosuroides* OBL
cordgrass, gulf *Spartina spartinae* OBL
cordgrass, saltmarsh *Spartina alterniflora* OBL
cordgrass, saltmeadow *Spartina patens* FACW
cordgrass, sand *Spartina bakeri* FACW
crabgrass, dwarf *Digitaria serotina* FAC
crabgrass, twospike *Digitaria pauciflora* FACW
cupgrass *Eriochloa* spp. FACW
cupscale, American *Sacciolepis striata* OBL
cupscale, Indian *Sacciolepis indica* FAC
cutgrass *Leersia* spp. OBL
cut-throat grass *Panicum abscissum* FACW
dallisgrass *Paspalum dilatatum* FAC

dropseed, Florida *Sporobolus floridanus* FACW
dropseed, seashore *Sporobolus virginicus* OBL
elephantgrass *Pennisetum purpureum* FAC
everglades grass *Digitaria pauciflora* FACW
fingergrass, pinewoods *Eustachys petraea* FAC
fingergrass, saltmarsh *Eustachys glauca* FACW
fluffgrass, pineland *Tridens ambiguus* FACW
foxtail, giant *Setaria magna* OBL
foxtail, knotroot *Setaria geniculata* FAC
foxtail, tufted *Alopecurus carolinianus* FAC
gamagrass, eastern *Tripsacum dactyloides* FAC
giant cane *Arundinaria gigantea* FACW
giant cutgrass *Zizaniopsis miliacea* OBL
giant reed *Arundo donax* FAC
hilograss *Paspalum conjugatum* FAC
indian rice *Zizania aquatica* OBL
jointgrass; jointtailgrass *Manisuris* spp. FACW
jointgrass, pitted *Manisuris cylindrica* FAC
jungle-rice *Echinochloa* spp. FACW
keygrass *Monanthochloe littoralis* OBL
kissimmeegrass *Paspalidium geminatum* OBL
knotgrass *Paspalum distichum* OBL
lovegrass *Eragrostis* spp. FAC
maidencane *Panicum hemitomon* OBL
mannagrass, fowl *Glyceria striata* OBL
muhly grass, hairawn *Muhlenbergia capillaris* OBL
muhly grass, nimblewill *Muhlenbergia schreberi* FACW
muhly, cutover *Muhlenbergia expansa* FAC
napiergrass *Pennisetum purpureum* FAC
needlegrass, Florida *Stipa avenacioides* FACW
panic grass, cypress *Panicum ensifolium* OBL
panicum, beaked *Panicum anceps* FAC
panicum, bluejoint *Panicum tenerum* OBL
panicum, Eaton's *Panicum spretum* FACW
panicum, fall *Panicum dichotomiflorum* FACW
panicum, fringed *Panicum strigosum* FAC
panicum, Ft Myers *Panicum pinetorum* FACW
panicum, gaping *Panicum hians* FAC
panicum, red-top *Panicum rigidulum* FACW
panicum, savannah *Panicum gymnocarpon* OBL
panicum, shining *Panicum dichotomum* FACW
panicum, tall thin *Panicum longifolium* OBL
panicum, variable *Panicum commutatum* FAC
panicum, velvet *Panicum scoparium* FACW
panicum, warty *Panicum verrucosum* FACW
panicum, white-edge *Panicum tenue* FAC
panicum, woolly *Panicum scabriusculum* OBL
paragrass *Brachiaria purpurascens* FACW
paspalum, brook *Paspalum acuminatum* FACW
paspalum, brown-seed *Paspalum plicatulum* FAC
paspalum, bull *Paspalum boscianum* FACW
paspalum, early *Paspalum praecox* OBL

paspalum, field *Paspalum laeve* FACW
paspalum, Florida *Paspalum floridanum* FACW
paspalum, gulf *Paspalum monostachyum* OBL
paspalum, hairy-seed *Paspalum pubiflorum* FACW
paspalum, joint *Paspalum distichum* OBL
paspalum, mudbank *Paspalum dissectum* OBL
paspalum, Panama *Paspalum fimbriatum* FAC
paspalum, sour *Paspalum conjugatum* FAC
paspalum, thin *Paspalum setaceum* FAC
paspalum, water *Paspalum repens* OBL
plumegrass, narrow *Erianthus strictus* OBL
plumegrass, short-beard *Erianthus brevibarbus* FACW
plumegrass, sugarcane *Erianthus giganteus* OBL
rabbit-foot grass *Polypogon* spp. FAC
redtop *Agrostis stolonifera* FACW
reed grass, Curtiss' *Calamovilfa curtissii* FACW
reimargrass, Florida *Reimarochloa oligostachya* FACW
rice, cultivated *Oryza sativa* FAC
saltgrass, seashore *Distichlis spicata* OBL
sandgrass, Curtiss' *Calamovilfa curtissii* FACW
silk reed *Neyraudia reynaudiana* FAC
silky-scale, purple *Anthaenantia rufa* FACW
spanglegrass *Chasmanthium* spp. FACW
spanglegrass, indian *Chasmanthium latifolium* FAC
spanglegrass, long-leaf *Chasmanthium sessiliflorum* FAC
switchcane *Arundinaria gigantea* FACW
switchgrass *Panicum virgatum* FACW
three-awn grass, bottlebrush *Aristida spiciformis* FAC
three-awn grass, long-leaf *Aristida affinis* OBL
three-awn grass, pineland *Aristida stricta* FAC
three-awn grass, rhizomatous *Aristida rhizomophora* FAC
three-awn grass, wand-like *Aristida purpurascens* FACW
toothache grass *Ctenium* spp. FACW
torpedograss *Panicum repens* FACW
tridens, long-spike *Tridens strictus*. FACW
tridens, savannah *Tridens ambiguus* FACW
trompetilla *Hymenachne amplexicaulis* OBL
vaseygrass *Paspalum urvillei* FAC
watergrass *Hydrochloa caroliniensis* OBL
West Indian marsh grass *Hymenachne amplexicaulis* OBL
wildrice, annual *Zizania aquatica* OBL
wildrice, southern *Zizaniopsis miliacea* OBL
wiregrass *Aristida stricta* FAC
witchgrass, cypress *Panicum ensifolium* OBL
witchgrass, erect-leaf *Panicum erectifolium* OBL
witchgrass, roughhair *Panicum strigosum* FAC
witchgrass, shining *Panicum dichotomum* FACW
witchgrass, variable *Panicum commutatum* FAC
witchgrass, velvet *Panicum scoparium* FACW
witchgrass, woolly *Panicum scabriusculum* OBL
woodoats *Chasmanthium* spp. FACW
woodoats, indian *Chasmanthium latifolium* FAC

woodoats, long-leaf *Chasmanthium sessiliflorum* FAC
woodsgrass *Oplismenus setarius* FAC
green-dragon *Arisaema* spp. FACW
green-haw *Crataegus viridis* FACW
gregory wood *Bucida buceras* FAC
groundsel tree *Baccharis glomeruliflora* FAC
guava, strawberry *Psidium cattleianum* FAC
hackberry *Celtis laevigata* FACW
hardscale, one flower *Sclerolepis uniflora* FACW
Harper's beauty *Harperocallis flava* FACW
hartwrightia, Florida *Hartwrightia floridana* FACW
hatpin *Eriocaulon* spp. OBL
hatpins, yellow *Syngonanthus flavidulus* FACW
haw, green *Crataegus viridis* FACW
haw, may *Crataegus aestivalis* OBL
haw, parsley *Crataegus marshallii* FACW
hazel-alder *Alnus serrulata* OBL
hedgehyssop *Gratiola* spp. FACW
hedgehyssop, rough *Gratiola hispida* FAC
hedgenettle *Stachys lythroides* OBL
heliotrope, four-spike *Heliotropium procumbens* FACW
heliotrope, pineland *Heliotropium polyphyllum* FAC
heliotrope, seaside *Heliotropium curassavicum* FAC
hickory, water *Carya aquatica* OBL
hobble-bush *Agarista populifolia* FACW
holly, American *Ilex opaca var. opaca* FAC
holly, bay-gall *Ilex coriacea* FACW
holly, dahoon *Ilex cassine* OBL
holly, deciduous *Ilex decidua* FACW
holly, myrtle *Ilex myrtifolia* OBL
holly, sarvis *Ilex amelanchier* OBL
holly, yaupon *Ilex vomitoria* FAC
honeycomb-head, one-flower *Balduina uniflora* FACW
honeycomb-head, purple *Balduina atropurpurea* FACW
honey-locust *Gleditsia triacanthos* FACW
hornbeam, American *Carpinus caroliniana* FACW
hornpod *Mitreola* spp. FACW
horse-purslane *Trianthema portulacastrum* FACW
horsetail *Equisetum hyemale* FACW
huckleberry, dwarf *Gaylussacia dumosa* FAC
hummingbird-flower *Macranthera flammea* OBL
hygrophila *Hygrophila* spp. OBL
hyssop, hispid *Gratiola hispida* FAC
indian-plantain, egg-leaf *Arnoglossum ovatum* FACW
indian-plantain, Georgia *Arnoglossum sulcatum* OBL
indian-plantain, sweet-scent *Cacalia suaveolens* FACW
indian-plantain, variable-leaf *Arnoglossum diversifolium* FACW
indigoberry, white *Randia aculeata* FAC
indigo-bush *Amorpha fruticosa* FACW
iris *Iris* spp. OBL
iris, dwarf *Iris verna* U
ironweed *Vernonia* spp. FACW

ironweed, narrow-leaf *Vernonia angustifolia* U
ironwood *Carpinus caroliniana* FACW
ixia, Bartram's *Sphenostigma coelestinum* FACW
ixia, fall-flowering *Nemastylis floridana* FACW
jack-in-the-pulpit *Arisaema* spp. FACW
Java plum *Syzygium* spp. FAC
jessamine, day *Cestrum diurnum* FAC
jewel weed *Impatiens capensis* OBL
joe-pye-weed *Eupatoriadelphus fistulosus* FACW
Joewood *Jacquinia keyensis* FAC
joint-vetch, India *Aeschynomene indica* FACW
joint-vetch, meadow *Aeschynomene pratensis* OBL
joyweed, seaside *Alternanthera maritima* FACW
joyweed, sessile *Alternanthera sessilis* OBL
joyweed, smooth *Alternanthera paronychioides* FAC
jumpseed *Polygonum virginianum* FACW
juniperleaf *Polypremum procumbens* FAC
justiceweed *Eupatorium leucolepis* FACW
keygrass *Monanthochloe littoralis* OBL
lakecress *Armoracia aquatica* OBL
large gallberry *Ilex coriacea* FACW
latherleaf *Colubrina asiatica* FAC
leaf-flower, Carolina *Phyllanthus caroliniensis* FACW
leaf-flower, Florida *Phyllanthus liebmannianus* FACW
leaf-flower, water *Phyllanthus urinaria* FAC
lily, atamasco *Zephyranthes atamasco* FACW
lily, panhandle *Lilium iridollae* OBL
lily, southern red *Lilium catesbaei* FAC
lizard's tail *Saururus cernuus* OBL
lobelia *Lobelia* spp. FACW
lobelia, Florida *Lobelia floridana* OBL
loblolly-bay *Gordonia lasianthus* FACW
locust-berry *Byrsonima lucida* FAC
loosestrife *Lysimachia* spp. OBL
loosestrife, marsh *Lythrum* spp. OBL
lotus, American *Nelumbo* spp. OBL
magnolia, sweetbay *Magnolia virginiana var. australis* OBL
Malabar plum *Syzygium* spp. FAC
maleberry *Lyonia ligustrina* FAC
mallow, coastal *Kosteletzkya pentasperma* FAC
mallow, mangrove *Pavonia spicata* FACW
mallow, seashore *Kosteletzkya virginica* OBL
mangrove, black *Avicennia germinans* OBL
mangrove, red *Rhizophora mangle* OBL
mangrove, white *Laguncularia racemosa* OBL
maple, red *Acer rubrum* FACW
maple, silver *Acer saccharinum* OBL
marlberry *Ardisia* spp. FAC
marsh elder *Iva frutescens* OBL
marsh elder, little *Iva microcephala* FACW
marsh loosestrife *Lythrum* spp. OBL
marsh St. John's-wort *Triadenum* spp. OBL

marsh-gentian *Eustoma exaltatum* FACW
marshpennywort *Hydrocotyle* spp. FACW
marshweed *Limnophila* spp. OBL
mayhaw *Crataegus aestivalis* OBL
mayten, Florida *Maytenus phyllanthoides* FAC
meadow-beauty *Rhexia* spp. FACW
meadow-beauty, panhandle *Rhexia salicifolia* OBL
meadow-beauty, white *Rhexia parviflora* OBL
meadow-rue *Thalictrum* spp. FACW
melonleaf, five-lobe *Cayaponia quinqueloba* FAC
mermaid-weed *Proserpinaca* spp. OBL
milkweed, aquatic *Asclepias perennis* OBL
milkweed, fen-flower *Asclepias lanceolata* OBL
milkweed, large-flower *Asclepias connivens* FACW
milkweed, long-leaf *Asclepias longifolia* FACW
milkweed, red *Asclepias rubra* OBL
milkweed, savannah *Asclepias pedicellata* FACW
milkweed, southern *Asclepias viridula* FACW
milkweed, swamp *Asclepias incarnata* OBL
milkwort *Polygala* spp. FACW
milkwort, racemed *Polygala polygama* U
milkwort, sandhill *Polygala leptostachys* U
milkwort, scrub *Polygala lewtonii* U
milkwort, tall *Polygala cymosa* OBL
milkwort, whorled *Polygala verticillata* U
mille graines *Oldenlandia* spp. FACW
mimosa, black *Mimosa pigra* FAC
mistflower *Conoclinium coelestinum* FAC
miterwort *Mitreola* spp. FACW
mock bishop-weed *Ptilimnium capillaceum* FACW
monkey-flower *Mimulus alatus* OBL
mountain-laurel *Kalmia latifolia* FACW
mountain-mint, coastal-plain *Pycnanthemum nudum* FACW
mouse-tail, tiny *Myosurus minimus* FAC
mudflower *Micranthemum* spp. OBL
mud-plantain, kidney-leaf *Heteranthera reniformis* OBL
mudwort, wild *Dicliptera brachiata* FACW
mulberry, red *Morus rubra* FAC
musclewood *Carpinus caroliniana* FACW
musky mint *Hyptis alata* FACW
myrsine, guiana *Myrsine guianensis* FAC
nakedwood, Asian *Colubrina asiatica* FAC
necklacepod, yellow *Sophora tomentosa* FACW
nettletree *Trema* spp. FAC
neverwet *Orontium aquaticum* OBL
nightshade, Bahama *Solanum bahamense* FACW
nightshade, shrub *Solanum erianthum* FACW
nodding nixie *Apteria aphylla* FACW
oak, cherry-bark *Quercus pagoda* FACW
oak, laurel *Quercus laurifolia* FACW
oak, overcup *Quercus lyrata* OBL
oak, swamp chestnut *Quercus michauxii* FACW

oak, water *Quercus nigra* FACW
oak, willow *Quercus phellos* FACW
obedient plant *Physostegia virginiana* FACW
ORCHIDS
adder's-mouth, Florida *Malaxis spicata* OBL
fringed orchid *Platanthera* spp. OBL
grass-pinks *Calopogon* spp. FACW
hidden orchid *Maxillaria crassifolia* OBL
jug orchid *Erythrodes querceticola* FACW
ladies'-tresses *Spiranthes* spp. FACW
liparis, tall *Liparis elata* OBL
noddingcaps *Triphora* spp. FACW
pogonia, rose *Pogonia ophioglossoides* OBL
pogonias, nodding *Triphora* spp. FACW
rein orchid *Habenaria* spp. FACW
rosebud orchid *Cleistes divaricata* OBL
shadow-witch *Ponthieva racemosa* FACW
snakemouth orchid *Pogonia ophioglossoides* OBL
twayblade *Listera* spp. FACW
widelip orchid *Liparis elata* OBL
wild coco *Eulophia alta* FACW
ox-eye, creeping *Wedelia trilobata* FAC
oxeye, seaside *Borrichia* spp. OBL
PALMS
palm, bluestem *Sabal minor* FACW
palm, cabbage *Sabal palmetto* FAC
palm, Florida thatch *Thrinax radiata* FAC
palm, needle *Rhapidophyllum hystrix* FACW
palm, paurotis *Acoelorraphe wrightii* OBL
palm, royal *Roystonea* spp. FACW
palmetto, dwarf *Sabal minor* FACW
panal *Cypselea humifusa* FAC
paperbark tree *Melaleuca quinquenervia* FAC
parsley-haw *Crataegus marshallii* FACW
peatmoss *Sphagnum* spp. OBL
pellitory *Parietaria* spp. FAC
pennywort *Hydrocotyle* spp. FACW
penny-wort, floating *Hydrocotyle ranunculoides* OBL
pentodon, Hall's *Pentodon pentandrus* OBL
persimmon, common *Diospyros virginiana* FAC
pickerelweed *Pontederia cordata* OBL
picklewort *Salicornia* spp. OBL
pimpernel, Florida *Anagallis pumila* FAC
pimpernel, water *Samolus* spp. OBL
pine, pond *Pinus serotina* FACW
pine, spruce *Pinus glabra* FACW
pineland daisy *Chaptalia tomentosa* FACW
pineweed *Hypericum gentianoides* U
pink-root *Spigelia loganioides* FACW
pipestem *Agarista populifolia* FACW
pipewort *Eriocaulon* spp. OBL
pitcher-plant *Sarracenia* spp. OBL

pitcher-plant, hooded *Sarracenia minor* FACW
planer tree *Planera aquatica* OBL
planetree, American *Platanus occidentalis* FACW
pleatleaf, fall-flowering *Nemastylis floridana* FACW
poison sumac *Toxicodendron vernix* FACW
poisonwood *Metopium toxiferum* FAC
pond apple *Annona glabra* OBL
pondberry *Lindera melissaefolia* OBL
pondlily, yellow *Nuphar luteum* OBL
pondspice *Litsea aestivalis* OBL
pony-foot *Dichondra caroliniensis* FAC
popcorn tree *Sapium sebiferum* FAC
portia tree *Thespesia populnea* FAC
possum-haw *Viburnum nudum* FACW
potatotree *Solanum erianthum* FACW
prairie-gentian *Eustoma exaltatum* FACW
pride-of-Big-Pine *Strumpfia maritima* FACW
primrosewillow *Ludwigia* spp. OBL
privet, swamp *Forestiera acuminata* FACW
punk tree *Melaleuca quinquenervia* FAC
queen's-delight, marsh *Stillingia sylvatica var. tenuis* FAC
quillwort *Isoetes* spp. OBL
ragwort, golden *Senecio aureus* OBL
rainlily *Zephyranthes atamasco* FACW
raspberry *Rubus* spp. FAC
rattlebox; rattle-bush *Sesbania* spp. FAC
rattlesnake master *Eryngium yuccifolium* FACW
rayless golden-rod *Bigelowia nudata* FACW
redgal *Morinda royoc* FACW
redroot *Lachnanthes caroliniana* FAC
redstem *Ammannia* spp. OBL
rose myrtle, downy *Rhodomyrtus tomentosus* FAC
rose, swamp *Rosa palustris* OBL
rose-apple *Syzygium* spp. FAC
rose-gentian *Sabatia* spp. FACW
rose-gentian, Bartram's *Sabatia bartramii* OBL
rose-gentian, coast *Sabatia calycina* OBL
rose-gentian, large *Sabatia dodecandra* OBL
rosemallow *Hibiscus aculeatus* FACW
rosemallow, crimson-eyed *Hibiscus moscheutos* OBL
rosemallow, halberd-leaf *Hibiscus laevis* OBL
rosemallow, scarlet *Hibiscus coccineus* OBL
rosemallow, sea *Hibiscus tiliaceus* FAC
rosemallow, swamp *Hibiscus grandiflorus* OBL
rush *Juncus* spp. OBL
rush, grassleaf *Juncus marginatus* FACW
rush, path *Juncus tenuis* FAC
rush, shore *Juncus marginatus* FACW
rush-featherling *Pleea tenuifolia* OBL
rustweed *Polypremum procumbens* FAC
sachsia *Sachsia polycephala* FACW
saffron plum *Bumelia celastrina* FAC

saltbush *Baccharis halimifolia* FAC
saltbush, halberd-leaf *Atriplex patula* FACW
saltwort *Batis maritima* OBL
sandmat, spreading *Euphorbia humistrata* FACW
sandspurry, saltmarsh *Spergularia marina* OBL
sandwort, Godfrey's *Arenaria godfreyi* FACW
savory, Brown's *Micromeria brownei* OBL
sawgrass *Cladium* spp. OBL
scaly-stem, Carolina *Elytraria caroliniensis* FAC
scouring-rush *Equisetum hyemale* FACW
screwstem *Bartonia* spp. FACW
sea myrtle *Baccharis halimifolia* FAC
sea oxeye *Borrichia* spp. OBL
sea-blite *Suaeda* spp. OBL
sea-lavender *Limonium carolinianum* OBL
sea-purslane *Sesuvium* spp. FACW
seaside mahoe *Thespesia populnea* FAC
sebastian-bush, gulf *Sebastiana fruticosa* FAC

SEDGES

baldrush *Psilocarya* spp. OBL
beakrush *Rhynchospora* spp. FACW
beakrush, Chapman's *Rhynchospora chapmanii* OBL
beakrush, clustered *Rhynchospora cephalantha* OBL
beakrush, few-flower *Rhynchospora oligantha* OBL
beakrush, giant-fruited *Rhynchospora megalocarpa* U
beakrush, Gray's *Rhynchospora grayi* U
beakrush, Harper's *Rhynchospora harperi* OBL
beakrush, horned *Rhynchospora inundata* OBL
beakrush, large *Rhynchospora macra* OBL
beakrush, millet *Rhynchospora miliacea* OBL
beakrush, mingled *Rhynchospora mixta* OBL
beakrush, narrow *Rhynchospora stenophylla* OBL
beakrush, pinebarren *Rhynchospora intermedia* U
beakrush, short-bristle *Rhynchospora corniculata* OBL
beakrush, southern *Rhynchospora microcarpa* OBL
beakrush, spreading *Rhynchospora divergens* OBL
beakrush, swamp-forest *Rhynchospora decurrens* OBL
beakrush, Tracy's *Rhynchospora tracyi* OBL
black-sedge *Schoenus nigricans* FACW
bogrush, black *Schoenus nigricans* FACW
bulrush *Scirpus* spp. OBL
dwarf-bulrush *Hemicarpha* spp. FACW
fimbry *Fimbristylis* spp. OBL
fimbry, annual *Fimbristylis annua* FACW
fimbry, hairy *Fimbristylis puberula* FACW
flatsedge *Cyperus* spp. FACW
flatsedge, alternate-leaf *Cyperus alternifolius* OBL
flatsedge, Asian *Cyperus metzii* FAC
flatsedge, baldwin *Cyperus globulosus* FAC
flatsedge, bentawn *Cyperus reflexus* U
flatsedge, black *Cyperus huarmensis* FAC
flatsedge, coastal-plain *Cyperus cuspidatus* FAC

flatsedge, Drummond's *Cyperus drummondii* OBL
flatsedge, epiphytic *Cyperus lanceolatus* OBL
flatsedge, giant *Cyperus giganteus* FAC
flatsedge, globe *Cyperus ovularis* U
flatsedge, hammock *Cyperus tetragonus* U
flatsedge, jointed *Cyperus articulatus* OBL
flatsedge, marshland *Cyperus distinctus* OBL
flatsedge, papyrus *Cyperus papyrus* OBL
flatsedge, pinebarrenf *Cyperus retrorsus* FAC
flatsedge, purple *Cyperus rotundus* FAC
flatsedge, red-root *Cyperus erythrorhizos* OBL
flatsedge, rough *Cyperus retrofractus* U
flatsedge, sandhill *Cyperus filiculmis* U
flatsedge, sheathed *Cyperus haspan* OBL
flatsedge, variable *Cyperus difformis* OBL
flatsedge, woodrush *Cyperus entrerianus* OBL
flatsedge, yellow *Cyperus esculentus* FAC
flatspike rush *Abildgaardia ovata* FACW
fringe-rush *Fimbristylis* spp. OBL
fringe-rush, annual *Fimbristylis annua* FACW
fringe-rush, Vahl's *Fimbristylis puberula* FACW
halfchaff sedge *Lipocarpha* spp. FACW
hurricane-grass *Fimbristylis spathacea* FAC
nut-grass, purple *Cyperus rotundus* FAC
nut-grass, yellow *Cyperus esculentus* FAC
nutrush *Scleria* spp. FACW
sedge *Carex* spp. FACW
sedge, bearded *Carex comosa* OBL
sedge, bristly-stalk *Carex leptalea* OBL
sedge, cypress-knee *Carex decomposita* OBL
sedge, Elliott's *Carex elliottii* OBL
sedge, fringed *Carex crinita* OBL
sedge, hop *Carex lupulina* OBL
sedge, Howe's *Carex howei* OBL
sedge, large *Carex gigantea* OBL
sedge, long *Carex folliculata* OBL
sedge, Louisiana *Carex louisianica* OBL
sedge, prickly bog *Carex atlantica* OBL
sedge, raven-foot *Carex crus-corvi* OBL
sedge, shallow *Carex lurida* OBL
sedge, shoreline *Carex hyalinolepis* OBL
sedge, stalk-grain *Carex stipata* OBL
sedge, Walter's *Carex walteriana* OBL
spikerush *Eleocharis* spp. OBL
three-way sedge *Dulichium arundinaceum* OBL
umbrella-sedge *Fuirena* spp. OBL
white-top sedge, Everglades *Dichromena floridensis* FACW
white-top sedge, giant *Dichromena latifolia* OBL
white-top sedge, starbrush *Dichromena colorata* FACW
seedbox *Ludwigia* spp. OBL
seedbox, hairy *Ludwigia hirtella* FACW
seedbox, headed *Ludwigia suffruticosa* FACW

seedbox, savanna *Ludwigia virgata* FACW
seedbox, seaside *Ludwigia maritima* FACW
seepweed *Suaeda* spp. OBL
seven-sisters *Crinum americanum* OBL
shaggytuft *Stenandrium floridanum* FACW
she-oak *Casuarina* spp. FAC
shrimp plant *Justicia brandegeana* U
silver-bell *Halesia diptera* FACW
silverhead *Philoxerus vermicularis* FACW
silverling *Baccharis glomeruliflora* FAC
skullcap, blue *Scutellaria lateriflora* OBL
skullcap, Florida *Scutellaria floridana* FAC
skullcap, rough *Scutellaria integrifolia* FAC
skullcap, South American *Scutellaria racemosa* OBL
skyflower *Hydrolea* spp. OBL
slimpod, eastern *Amsonia tabernaemontana* FACW
slimpod, stiff *Amsonia rigida* FACW
smartweed *Polygonum* spp. OBL
smartweed, silversheath *Polygonum argyrocoleon* U
smooth chaff-flower *Alternanthera paronychioides* FAC
snakeherb, swamp *Dyschoriste humistrata* FACW
snakeroot, corn *Eryngium aquaticum* OBL
snakewood, Asian *Colubrina asiatica* FAC
sneezeweed *Helenium* spp. FACW
sneezeweed, pasture *Helenium amarum* FAC
snowbell *Styrax americana* OBL
snowberry *Chiococca* spp. FAC
spadeleaf *Centella asiatica* FACW
Spanish needles *Bidens bipinnata* U
spatterdock *Nuphar luteum* OBL
speedwell, water *Veronica anagallis-aquatica* OBL
sphagnum moss *Sphagnum* spp. OBL
spicebush, northern *Lindera benzoin* FACW
spicebush, southern *Lindera melissaefolia* OBL
spider-lily *Hymenocallis* spp. OBL
spiderwort, trailing *Tradescantia fluminensis* FAC
spike-moss, meadow *Selaginella apoda* FACW
spindle-root *Ludwigia hirtella* FACW
spoon flower *Peltandra* spp. OBL
spotflower, creeping *Spilanthes americana* FACW
sprangle-top *Leptochloa* spp. FACW
sprangle-top, tropic *Leptochloa virgata* FAC
spring-cress *Cardamine pensylvanica* OBL
spurge, Florida *Euphorbia inundata* FACW
spurge, many-leaved *Euphorbia polyphylla* FACW
squarestem *Melanthera nivea* FACW
St. Andrew's cross *Hypericum hypericoides* FAC
St. John's-wort *Hypericum* spp. FACW
St. John's-wort, Atlantic *Hypericum reductum* U
St. John's-wort, Carolina *Hypericum nitidum* OBL
St. John's-wort, Chapman's *Hypericum chapmanii* OBL
St. John's-wort, dotted *Hypericum punctatum* U

St. John's-wort, Drummond's *Hypericum drummondii* U
St. John's-wort, Edison's *Hypericum edisonianum* OBL
St. John's-wort, four-petal *Hypericum tetrapetalum* FAC
St. John's-wort, marsh *Triadenum* spp. OBL
St. John's-wort, peelbark *Hypericum fasciculatum* OBL
St. John's-wort, scrub *Hypericum cumulicola* U
St. John's-wort, shrubby *Hypericum prolificum* U
St. John's-wort, small-sepal *Hypericum microsepalum* U
St. John's-wort, smooth-bark *Hypericum lissophloeus* OBL
St. John's Susan *Rudbeckia nitida* FACW
staggerbush, piedmont *Lyonia mariana* FACW
stargrasses, yellow *Hypoxis* spp. FACW
stitchwort, Godfrey's *Arenaria godfreyi* FACW
Stoke's aster *Stokesia laevis* FACW
storax *Styrax americana* OBL
string-lily *Crinum americanum* OBL
stripeseed *Piriqueta caroliniana* FAC
sugar-berry *Celtis laevigata* FACW
sumpweed, bigleaf *Iva frutescens* OBL
sunbonnet *Chaptalia tomentosa* FACW
sundew, dwarf *Drosera brevifolia* FACW
sundew, Gulf coast *Drosera tracyi* OBL
sundew, pink *Drosera capillaris* FACW
sundew, spoon-leaf *Drosera intermedia* OBL
sundew, thread-leaf *Drosera filiformis* OBL
sunflower, Florida *Helianthus floridanus* FAC
sunflower, lakeside *Helianthus carnosus* FACW
sunflower, muck *Helianthus simulans* FACW
sunflower, southeastern *Helianthus agrestis* FACW
sunflower, swamp *Helianthus angustifolius* FACW
sunflower, wetland *Helianthus heterophyllus* FACW
sunny bells, white *Schoenolirion elliottii* FACW
sunny bells, yellow *Schoenolirion croceum* FACW
swamp-lily, southern *Crinum americanum* OBL
swamp-loosestrife *Decodon verticillatus* OBL
swampprivet, eastern *Forestiera acuminata* FACW
swampprivet, Florida *Forestiera segregata* FAC
swampweed *Hygrophila* spp. OBL
sweet broom *Scoparia dulcis* FAC
sweet pepper bush *Clethra alnifolia* FACW
sweetbay *Magnolia virginiana var. australis* OBL
sweetgum *Liquidambar styraciflua* FACW
sycamore, American *Platanus occidentalis* FACW
tallow-tree, Chinese *Sapium sebiferum* FAC
thistle, Leconte's *Cirsium lecontei* FACW
thistle, Nuttall's *Cirsium nuttallii* FACW
thistle, swamp *Cirsium muticum* OBL
thoroughwort, marsh *Eupatorium leptophyllum* OBL
thoroughwort, semaphore *Eupatorium mikanioides* FACW
thoroughwort, white-bract *Eupatorium leucolepis* FACW
thoroughworts *Eupatorium* spp. FAC
tickseed, ciliate-leaf *Coreopsis integrifolia* FACW

tickseed, Florida *Coreopsis floridana* FACW
tickseed, Georgia *Coreopsis nudata* OBL
tickseed, Leavenworth's *Coreopsis leavenworthii* FACW
tickseed, sickle *Coreopsis falcata* FACW
tickseed, southeastern *Coreopsis gladiata* FACW
tickseed, tall *Coreopsis tripteris* FAC
tickseed, Texas *Coreopsis linifolia* FACW
titi, black *Cliftonia monophylla* FACW
titi, swamp *Cyrilla racemiflora* FAC
toothcup *Ammannia* spp. OBL
toothcup *Rotala ramosior* OBL
torchwood, black *Erithalis fruticosa* FAC
touch-me-not, spotted *Impatiens capensis* OBL
trema *Trema* spp. FAC
tulip tree *Liriodendron tulipifera* FACW
tupelo, ogeechee *Nyssa ogeche* OBL
tupelo, swamp *Nyssa sylvatica var. biflora* OBL
tupelo, water *Nyssa aquatica* OBL
turtleweed *Batis maritima* OBL
twinflower, swamp *Dyschoriste humistrata* FACW
vanillaleaf; vanilla plant *Carphephorus odoratissimus* FAC
Venus' flytrap *Dionaea muscipula* FACW
vervain, sandpaper *Verbena scabra* FACW
vetch, Florida *Vicia floridana* FACW
vetch, four-leaf *Vicia acutifolia* FACW
vetch, Ocala *Vicia ocalensis* OBL
viburnum, possum-haw *Viburnum nudum* FACW
viburnum, walter *Viburnum obovatum* FACW
violet, edible *Viola esculenta* FACW
violet, lance-leaf *Viola lanceolata* OBL
violet, Leconte's *Viola affinis* FACW
violet, primrose-leaf *Viola primulifolia* FACW
Virginia willow *Itea virginica* OBL
water drop-wort *Oxypolis* spp. OBL
water snowflake *Nymphoides* spp. OBL
water-cress *Nasturtium* spp. OBL
water-elm *Planera aquatica* OBL
water-hemlock *Cicuta* spp. OBL
water-hoarhound *Lycopus* spp. OBL
water-hyssop *Bacopa* spp. OBL
water-lily *Nymphaea* spp. OBL
water-locust *Gleditsia aquatica* OBL
water-lotus *Nelumbo* spp. OBL
water-meal *Websteria confervoides* OBL
water-parsnip *Sium suave* OBL
water-plantain, subcordate *Alisma subcordatum* OBL
waterpod *Hydrolea* spp. OBL
water-poppy *Hydrocleis nymphoides* OBL
water-primrose *Ludwigia* spp. OBL
water-starwort *Callitriche* spp. OBL
water-willow *Justicia* spp. OBL
wax myrtle *Myrica cerifera* FAC

waxweed, Columbia *Cuphea carthagenensis* FAC
waxweed, common *Cuphea aspera* FACW
wedgescale, swamp *Sphenopholis pensylvanica* OBL
white-cedar, Atlantic *Chamaecyparis thyoides* OBL
whitenymph *Trepocarpus aethusae* FACW
wild coffee *Psychotria* spp. FAC
wild corndog *Typha* spp. OBL
wild dilly *Manilkara bahamensis* FAC
wild petunia *Ruellia caroliniensis* FAC
wild taro *Colocasia esculenta* OBL
wild-petunia, Britton's *Ruellia brittoniana* FAC
wild-petunia, night-flowering *Ruellia noctiflora* FACW
willow *Salix* spp. OBL
winterberry *Ilex verticillata* OBL
witch-alder, dwarf *Fothergilla gardenii* FACW
wood-nettle, Canada *Laportea canadensis* FACW
wood-sage *Teucrium canadense* FACW
woolly-berry *Gaylussacia mosieri* FACW
yellow stargrasses *Hypoxis* spp. FACW
yellow-cress *Rorippa* spp. OBL
yellow-eyed grass *Xyris* spp. OBL
yellow-eyed-grass, Carolina *Xyris caroliniana* FACW
yellow-eyed-grass, Richard's *Xyris jupicai* FACW
yellow-poplar *Liriodendron tulipifera* FACW
yellow-root, shrubby *Xanthorhiza simplicissima* FACW
yellowtop, clustered *Flaveria trinervia* FAC
yellowtop, coastalplain *Flaveria bidentis* FAC
yellowtop, Florida *Flaveria floridana* FACW
yellowtop, narrowleaf *Flaveria linearis* FACW
yerba de Tajo *Eclipta alba* FACW

Recommended 5-Step Field Wetland Delineation Procedure

1. Identify the indisputable wetland area and the indisputable upland area.
2. In the area between the indisputable wetlands and uplands, identify the most landward boundary of where the vegetation meets A or B test criteria.
3. In the area between the indisputable wetlands and uplands, identify the most landward boundary of where hydrologic indicators are present.
4. Between the vegetation test boundary and the hydrologic indicator boundary, identify the most landward hydric soil boundary.
5. Applying the wetland definition and reasonable scientific judgment, evaluate and modify if necessary the most landward boundary of the wetland based on the A, B, C, or D tests delineated by the previous steps.

Required Equipment for the Implementation of Chapter 62-340, F.A.C.

Sharpshooter Shovel (minimum soil examination of 20 inch+)
Munsell Soil Color Charts
Hand Lens (10x-15x)
Soil survey map for inspection area
Soil knife
Spray bottle (misting)
Tape measure

Suggested Equipment for the Implementation of Chapter 62-340, F.A.C.

FDEP Data Form Guide
FDEP Chapter 62-340, F.A.C. Data Form
Appropriate plant identification manuals
Appropriate soil information documents
A copy of Chapter 62-340, F.A.C.
Florida Wetlands Delineation Manual
Compass
Camera with extra batteries
Towel
Pens and pencils
Permanent Markers – two colors preferably
GPS Units
Flagging tape
Pin flags
4-foot level
First Aid
Sunscreen
Insect Repellent
Plant presses
Auger
Waterproof equipment case

Chapter 62-340, F.A.C. Data Form Instructions

Introduction

The purpose of the Chapter 62-340, F.A.C. Data Form (hereafter Form) is to record relevant information at a specific point to demonstrate whether the point is a wetland, a non-wetland surface water, or an upland according to the methodology set forth in Ch. 62-340, F.A.C. The Form is intended to be filled out after the field evaluator has made a determination.

Any time a regulatory agency concludes that an area is a non-wetland surface water, wetland, or upland at least one data point should be documented, i.e., once a conclusion informally or formally has been made by the regulatory agency at least one complete data form supporting that conclusion is required.

The number of data forms required will depend on the size and variability of the site inspection area. There is no size threshold or maximum number of data forms required for an inspection site. Reasonable scientific judgement should be used to determine the number of required data forms on a case by case basis.

(a) For the delineation of the landward extent of wetlands and other surface waters, at least one delineation data point along the boundary shall be verified and documented by the regulatory agency during the visual site inspection pursuant to Chapter 62-340.100(1) F.A.C. Documentation of a delineation data point shall include two data forms; one representative of the waterward area adjacent to the data point, the other representative of the landward or upland area adjacent to the data point. The two complete data forms at a delineation data point will document failure or satisfaction of all methodology criteria pursuant to Chapter 62-340 F.A.C. and changes in evidence used to determine the boundary delineation at that point.

A delineation data point will be documented for each homogeneous boundary within the site inspection area. If all delineation boundaries on site are homogenous in character, one data point is sufficient for documentation. One delineation data point representative of homogeneous boundaries found in other locations throughout the site is sufficient for documentation.

For purposes of the delineation data point, "homogeneous boundary" means all or part of a site delineation that is sufficiently similar in current condition to be delineated determine the landward extent of wetlands and other surface waters with a particular "test(s)" or interpretation of evidence as contemplated in Chapter 62-340 F.A.C. Characteristics that distinguish homogeneous boundaries may include, but are not limited to:

1. plant community type,
2. surface water type,
3. hydrologic indicators,
4. soils,
5. alterations to plants, hydrology, or soils,
6. hydrologic isolation or connection to waters of the State, or
7. other current condition expression which separate it from other boundaries on site.

(b) For identification or conclusions regarding the absence or presence of a non-wetland surface water, wetland, or upland classification by the regulatory agency within the site inspection area, at least one data form within homogeneous areas of classification shall be verified and documented by the regulatory agency during the visual site inspection pursuant to Chapter 62-340.100(1) F.A.C.

Documentation of an identification data point shall include one data form representative of the area of classification. The data form at an identification data point will document failure or satisfaction of all methodology criteria pursuant to Chapter 62-340 F.A.C. and evidence used to determine the upland, wetland, or non-wetland surface water classification.

An identification data point will be documented for each homogeneous area within the site inspection area. If all areas on site are homogenous in character, one data point is sufficient for documentation. One data point representative of homogeneous areas found in other locations throughout the site is sufficient for documentation.

For purposes of the identification data point, "homogeneous area" means all or part of a site inspection area that is sufficiently similar in current condition to classify with a particular "test(s)" or interpretation of evidence as contemplated in Chapter 62-340 F.A.C. Characteristics that distinguish a homogeneous area may include, but are not limited to:

1. upland classification,
2. wetland classification,
3. non-wetland surface water classification,
4. hydrologic isolation or connection to waters of the State,
5. plant community type,
6. surface water type,
7. hydrologic indicators,
8. soils,
9. alterations to plants, hydrology, or soils, or
10. other current condition expression which separate it from other areas on site.

This instructional document provides explanations of each question in the Form and guidance on how to answer them. Numbered (and lettered) bullet points, as well as anything denoted by "#" in this document refer directly to the corresponding question with that number in the Form. Citations from Chapter 62-340, F.A.C. (hereafter 62-340) and associated references are given to show where questions are drawn from and provide further clarity. For any question on the Form that requires an open-ended explanation that will not fit in the space provided, write "See note [#]" and continue the explanation with its identifying number in the "Notes" section at the end.

Site Information

1. The date on which the field data were collected on site. If the data were collected over multiple days, select the earliest date and note the other collection dates in the Notes section.
2. The staff that were present on site at the time of data collection, denoted at minimum by first initial and last name.

3. The initials of the staff member(s) that recorded data on this Form. A space for initials is provided in later sections to document the "plant recorder" and "soil describer" if completed by multiple parties.
4. The county in which the point being described lies.
5. The name of the larger site within which a point is being described (*e.g.*, a project name or parcel owner's name). If a tracking number exists (*e.g.*, from PA) include this as well.
6. A unique name to identify the specific point being described (*e.g.,* the delineation flag number closest to the point or a unique combination of letters and numbers). It is also recommended to take a GPS reading if possible and record the coordinates here. Write this identifier at the top of each of the other sheets in the Form in the box labeled "Point ID/Location". This will identify the sheets in case they get separated.
7. If the location of the described point is not going to be surveyed, attempt to locate at least 2, but preferably 3 or more stationary objects nearby that are easily identifiable and expected to remain in their fixed location indefinitely, such as utility poles, survey markers, road intersections, corners of buildings, etc. Standing at each object, record the compass bearing and the distance to the described point. This will allow triangulation to the point's location in the future.
8. The legal condition of the site.
    - If the point is unaltered or if all alterations at the point are exempt, authorized, permitted, or grandfathered select "Authorized or legal condition".
    - If any unauthorized alterations have occurred at the point, select "Unauthorized or illegal condition".
9. The type of evaluation being performed on site.
    - If only the presence or absence of a wetland or other surface water is being determined, select "Identification."
    - If a boundary between a wetland or other surface water and an upland is being marked, select "Delineation".

    Then select whether the point being described is in a wetland, a non-wetland surface water, or an upland. If the point lies within both a wetland and another type of surface water, select "Wetland".
    - ***For identifications, the data form should characterize the entire homogenous area being identified, whereas for delineations, the data forms should characterize the change on either side of the boundary at a specific point.***

Vegetation

10. Appropriate vegetative stratum: 62-340.400
    - The Rule defines 3 plant strata (Canopy, Subcanopy, and Groundcover) in 62-340.200
    - If vegetation is absent from the area, select "Vegetation Absent at Point" and skip to #14. Otherwise, select one stratum using the guidelines in 62-340.400, F.A.C.
    - The top stratum shall be used unless either:
        - The top stratum constitutes less than 10% areal extent, in which case the next lower stratum shall be used, as long as that stratum constitutes 10% areal extent or is the groundcover stratum. OR
        - The top stratum is not indicative of hydrologic conditions on site, in which case the stratum most indicative of hydrologic conditions shall be used. Either

subcanopy or ground cover may be selected depending on which is most indicative of hydrologic conditions.

- ***Facultative plants shall not be considered in the determination of areal extent or appropriateness of strata.***
- ***All evidence shall be considered when shifting to a lower stratum (e.g. number or wetland species compared to upland species, landform, plant community type, regional specificity); the statuses of plant(s) in a lower stratum are not by themselves sufficient evidence to shift strata.***

- Explain why the stratum was selected. "Normal expression" may be sufficient when the top stratum is used. Additional explanations may include: selective clearing of only wetland or upland tree species; planting of only upland or wetland species; recruitment of invasive exotic species.

11. Plant List 62-340.200(2),(6),(16), 62-340.400, 62-340.450
    - Select an evaluation area for the plant community.
        - The area should be just large enough to capture the species diversity and abundance of the plant community at the described point.
        - The area should not extend into different hydrologic conditions or adjacent plant communities – this may dictate the shape of the area.
    - Record the scientific name of each plant species in the evaluation area in the "Binomial of Observed Species" column.
        - Nomenclature from 62-340.450 must be used, regardless of taxonomic changes.
        - Record all plants in all three strata. Use one line per species.
        - Recorded plants must have their main stem rooted within the evaluation area.
    - Record the 62-340.450 status (Upland, Facultative, Facultative Wet, or Obligate) in the "Status" column.
        - Select one of the following status abbreviations: U, F, FW, or O.
        - ***Exotic species that naturalized on or after July 1, 1994 are considered Facultative. Otherwise, all species were given a status, so those naturalized prior to July 1, 1994 but not listed in 62-340.450 are Upland.***
        - ***If desired for land management or mitigation assessment purposes, names and percentages of vines and aquatic plants may be included within the notes section but not in section 11.***
    - For each listed species, record its percent areal extent in the Canopy, Subcanopy, and Groundcover strata (defined in 62-340.200) in the appropriately named columns.
        - See "Tips for Determining Areal Extent of Plants" In the "Chapter 62-340, F.A.C. Data Form Guide" (hereafter "Guide") for guidance.
        - For species not fully leafed out, evaluate areal extent as it would be when fully leafed out. Do not evaluate dead plants nor attempt to predict plants that would be present under different circumstances. This plant list reflects the conditions on the day of the evaluation, as is. If needed, past or predicted (e.g. when no vegetation is present) plant lists should be documented in the notes section.
    - Refer to the stratum selected in #10. Use the numbers only from the column of the selected stratum. For each species in the selected stratum, transfer the areal

extent from the selected stratum column to the status column (Upland, Facultative, Fac. Wet, or Obligate) that corresponds to that species.
- Use the boxes at the bottom right of the table to total the areal extents in the Upland, Facultative, Fac. Wet, and Obligate columns.

12. A Test vegetation: 62-340.300(2)(a)
    - For percent Obligate and percent Upland transfer the percent areal extent total from the Obligate and Upland columns in #11.
    - Evaluate whether the total areal extent of Obligate plants is greater than that of Upland plants. If they are equal, select "No".
13. B Test vegetation: 62-340.300(2)(b)
    - Add the totals from the Obligate and Fac. Wet columns in #11 to determine their combined value.
    - Add the total from the Upland column in #11 to the Obligate and Fac. Wet total to determine their combined value.
    - Divide the first result by the second result and multiply by 100 to obtain the percent of Obligate and Fac. Wet plants in relation to all plants, excluding Facultative.

📷 Vegetative Photo Tips:
- Document unknown plants by photographing features used in identification.
- Take plant community shots in each of the four cardinal directions (North, South, East, and West) at the described point. Plant community shots should include enough detail to identify species in the canopy, subcanopy, and ground cover. Additional shots may include canopy, subcanopy, or groundcover areal extents.

Soils

14. Indicate the Land Resource Region or, if necessary, the Major Land Resource Area where the described point is located.
    - The Land Resource Regions can be determined in two NRCS publications "Field Indicators of Hydric Soils in the United States" (hereafter "NRCS FIHSUS") or "Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin".
    - There are two hydric soil field indicators (S12 & F22) which require a specific Major Land Resource Area. The Major Land Resource Areas can be determined in the NRCS publication "Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin".
15. Determine if it is possible to examine and describe a soil profile.
    - If it is possible to examine and describe any depth of soil, whether the soil is naturally or artificially occurring in that environment, select "Yes".
    - If it is not possible to examine the soil due to it being in an inaccessible area, under water, composed of rock or a cemented layer, no soil present, etc.; select "No", explain why, and skip to #18.
16. Describe the soil profile.
    - Determine the different horizons (i.e. layers) of the soil profile. Horizon is defined in the glossary of NRCS FIHSUS. NRCS horizon designations (*e.g.*, O, A, E) are not necessary nor recommended for Chapter 62-340, F.A.C. soil profile descriptions.

- ***Soil material is defined in "Keys to Soil Taxonomy" as both mineral material less than 2 mm in diameter and decomposing organic material that is less than 20 mm in its smallest dimension. All material not meeting these requirements is considered nonsoil. Fragmental soil material (defined in the glossary of NRCS FIHSUS) should be treated as soil in the profile description and noted as fragmental in the notes column.***

- Determine the beginning and ending depth in inches for each horizon.
  - The 0-inch depth is the soil surface, which is the muck or mineral surface (whether natural or fill) according to "Soil and Water Relationships of Florida's Ecological Communities".
  - If peat, mucky peat, or a nonsoil with an accessible soil underneath exists on top of the muck or mineral surface, the beginning depth will begin with a '+' and the number of inches above the muck (e.g.+3 -0) or mineral surface the horizon starts.
- Determine the Matrix hue, value, and chroma for each horizon.
  - Matrix is defined in the glossary of NRCS FIHSUS.
  - ***The Matrix color should be determined in moist condition using a "Munsell Soil Color" book without sunglasses and ideally with normal sunlight (e.g. not early in the morning, late in the day, or under smoky conditions). With practice, compensation can be made for the differences unless the light is so subdued that the distinctions between colors chips are not apparent.***
  - For nonsoil horizons, write N/A.
- Determine the Matrix texture for each horizon.
  - Recommended Matrix textures are peat, mucky peat, muck, mucky mineral, marl (as defined in glossary and described in the Introduction of NRCS FIHSUS), sand, and fine (defined below). See the Guide for "Field Determination of Soil Indicator Texture" and "Tips for Determining Texture of Soil materials with High Organic Content".
  - Sand refers to USDA textures of loamy fine sand and coarser.
  - Fine refers to USDA textures of loamy very fine sand and finer.
  - "Mucky" as in mucky peat or mucky mineral is a texture modifier and does not constitute the presence of muck. See "NRCS FIHSUS" for definition of muck, mucky modified mineral soil material, and mucky peat.
  - For nonsoil horizons, write N/A.
- Determine the percentage of sand in the Matrix masked with organic material.
  - ***Determinations are conducted with a 10x or 15x hand lens. See "Estimating Percent Organic Carbon" in the Guide. A hand lens is strongly recommended for consistency and legal challenges, in lieu of the naked eye, due to:***
    - ***No NRCS guidance for distance of the observer from the soil being assessed (i.e. 6 inches or 6 feet),***
    - ***No NRCS guidance for the lighting conditions under which the soil is being assessed (i.e. shade or full sun),***
    - ***No NRCS percentage definition for "particles appear to be close to 100% masked" (i.e. 99% or 85%)***

    - ***No NRCS guidance regarding vision requirements of the observer estimating organic coating percentages (i.e. 20/20 or 20/15 vision).***
  - For Matrix values ≤ 3 in only sandy matrix soil layers, estimate percent organic coatings of the sand.
  - While sand may be visible within the horizon, the sand is not the matrix for textures of peat, mucky peat, muck, or mucky mineral layers, therefore, percent organic coating is not required to determine hydric soil status. Likewise, mucky mineral sand will not contain less than 70% organic coating and therefore, also does not require organic coating estimates to determine hydric soil status.
  - If the Matrix has a value higher than 3, write N/A, as these colors are unlikely to approach 70% or more organic coating in sandy matrix soils.
- Describe any soil features contained within the horizon and record any other relevant notes. There may be more than one of each type of feature within a horizon. If no features are present in the horizon, write "None".
  - DAs are areas darker than the Matrix's color. LAs are areas lighter than the Matrix's color. These are larger characteristics of the horizon and not micro-characteristics such as: sparsely dispersed value differences between single grains of sand, finely dispersed value differences between single grains of sand giving a salt and pepper appearance, or inclusions of shell fragments. For DA and LA areas record in moist condition the hue, value, and chroma; percent volume in the layer; the boundary (sharp, clear, diffuse; defined in the glossary of NRCS FIHSUS); and the shape (rounded, linear, angular; see "Tips for Determining Shapes of Features in Soil" in the Guide). Percent organic coating of sand is not required for DAs and LAs.
  - RCs are redox concentrations, which are defined in the glossary of NRCS FIHSUS. For these areas record in moist condition the hue, value, and chroma; percent volume in the layer; the boundary (sharp, clear, diffuse); and the shape (rounded, linear, angular).
  - OBs are organic bodies. Organic bodies must have a muck or mucky mineral texture. There are no size requirements for OBs, but generally 1- 3 cm in diameter. For OBs record the texture and the percent volume in the horizon. Percent organic coating of sand is not required for OBs.
  - Features generally must have a percent volume less than the Matrix's percent volume for each horizon, and the sum of the Matrix's and all features' volumes in a horizon must equal 100%. One exception may be a high percentage of redox concentrations making the matrix of the layer appear to be a high chroma matrix when in fact these are hydric soil features occurring in a lower chroma matrix. Another exception may be a horizon with abundant organic bodies of muck or mucky mineral texture within a sandy matrix. The matrix is not muck or mucky mineral, the matrix is sandy with many and numerous hydric soil indicators in the form of organic bodies.
  - Note if the horizon has been nonhydrologically physically mixed (PM) to the extent that the disturbance is a dominant characteristic of the horizon or is precluding reliable identification of hydric soil field indicators.
  - Note if the horizon is nonsoil and describe the type of material.

- Note if the horizon is fill, as defined in 62-330, F.A.C.
- Note if the fill material has blended in with natural soil material or developed contemporary hydric soil features (i.e. not imported within the fill material).
- Describe any significant features (DAs, LAs, RCs, OBs), inclusions (features that are not the same soil texture as the Matrix), or nonsoil materials within the fill horizon.

17. Check off which Hydric Soil Field Indicators are present, if any, and specify their beginning and ending depths.
    - Hydric soil field indicator requirements may be found in NRCS FIHSUS. See the Guide for a "Hydric Soil Field Indicators Simplified Checklist".
    - A hydric soil field indicator is only met and should only be selected if all the required characteristics, including depth, are documented within the soil profile description.
    - If hydric soil field indicators are combined, both indicators must be checked and documented (see example below).
    - ***NRCS periodically updates FIHSUS so check for additional hydric soil field indicators within the appropriate LRR or MLRA. If an indicator is met which is not included within the list in #17, identify the indicator and its beginning and ending depths.***
    - ***National Technical Committee for Hydric Soils Technical Note 4 explains how to combine certain indicators to satisfy their unmet thickness requirements.***

Documentation Example:

	Indicator Present	Begin Depth	End Depth
1.	S5/F3	5	14+

18. Determine if there is any nonsoil at or within 12 inches of the ground surface.
    - Is there an impenetrable layer at the soil surface or within 12 inches of the soil surface, if so, select "yes."
    - If the entire upper 12 inches is composed of soil material, select "no".
    - If it is impossible to examine the soil profile due to it being in an inaccessible area, underwater, physically mixed, hydrologically mixed, or otherwise disturbed, such that hydric soil field indicators cannot express or be reliably identified, select "Indeterminable".
19. Determine the hydric status of the soil.
    - If one or more of the hydric soil field indicators in #17 are checked, select "Hydric".
    - Select "Hydric" if the soil is in a reliable condition and meets the definition of hydric soil in 62-340.200(8). This definition may be met without a hydric soil field indicator being present. See Notes above "Field Identification of Hydric Soils," as well as the "Hydric Soil Technical Standard (HSTS)" in the Guide.
    - Select "Non-hydric" if the soil is in a reliable condition and no hydric soil field indicators are checked in #17 or if the definition of hydric soil in 62-340.200(8) is not met.

- Select "Inconclusive" if the soil profile is in an unreliable condition (i.e. disturbed/mixed soil, insufficient evaluation depth due to presence of nonsoil or standing water, lack of site access, etc.) and hydric status cannot be evaluated.
- Explain the reason for the hydric status selected. "See #17" may be sufficient if the soil was hydric due to one or more hydric soil field indicators being checked.

20. Note whether the depth of the soil profile is 20 inches or greater from the soil surface according to Soil and Water Relationships of Florida's Ecological Communities. If the profile is less than 20 inches from the soil surface explain why. Explanation options are not limited to the examples provided in the Data Form.
    - ➢ **Length of shovel is not an appropriate limitation of profile depth**.
21. Determine the height or depth of the observed standing water from the soil surface.
    - Select whether the water level is above the soil surface or below (in the soil pit). If the water table is below, ideally, wait enough time for the water table to stabilize before taking a measurement. Alternatively, estimate depth to water table from observed lateral side wall intrusion of water.
    - If no standing water is observed or no lateral water intrusion is observed in the soil pit, select "Not Observed" and leave the space provided for the measurement blank.

📷 Soil Profile Photo Tips:

- Each soil photo should be taken in either full sun or full shade, in a moist condition, cleaned (with all smearing removed and no shovel slices within the profile), preferably as a flat trench-cut 16-20 inch profile instead of a conical spoil plug. Ensure the soil profile has not been crushed, compacted, contains shovel cuts through the profile, or otherwise altered during the process of removing the profile.
- Soil Profile ID photograph-
  - Demarcate each horizon (i.e. layer) by scoring the soil profile surface so the depths of each layer are easily identifiable within the photo.
  - Take a photo of the entire soil profile with scale (i.e. measuring tape at soil surface). Angle of photo should be 90° to the profile face. Include the 62-340 Data Form sheet with box 1-9 visible within the photo to document point ID location information.
  - Ensure the background does not visually interfere with the edges of the soil profile being photographed. Interferences such as side cast material from cleaning, backgrounds of similar color and texture, etc. make distinction of colors and patterns difficult.
  - ➢ **If a peat or mucky peat layers are present two profile ID photographs will be necessary. The first photo shall document the entire length of the profile with the measuring tape or scale device beginning at the top including any peat or mucky peat layer(s). The second photo will show the tape measure or scale device beginning at the muck or mineral surface (i.e. 0 inches) and shall be used for purposes of describing the profile.**
- Soil Profile
  - Follow the same procedures in the Soil profile ID above, but remove the Data form, and frame the photo as close to the soil profile as possible while including all layers.
- Soil horizon

- Take photos of each horizon pointing out any distinguishing features (DAs, LAs, OBs, RCs) with scale. Take close-ups of

- Cross sections (soil horizon/critical depth)
  - Cross section the middle of each individual soil horizon, horizontally, taking photos of any distinguishing features or characteristics (DAs, LAs, OBs, RCs) with scale.
  - When needed, cross section photos at the 6 inch depth (for sandy soils) or other critical depth for meeting a hydric soil field indicator should be taken. If hydric soil field indicator(s) begin(s) at the soil surface photograph the surface of the soil profile close-up.
- Other Hydric Soil Characteristics or Features
  - Photograph characteristics used in determining hydric condition of soils (e.g. muck smeared fingers, results of fiber rub test, color of decant test water, etc.)
  - Photograph any inclusions of shell, charcoal, fill material, texture, or other lithologic discontinuities, etc.
- Photograph the water table
  - Photograph if the water level is above the soil surface or below (in the soil pit). If the water table is below, ideally, wait enough time for the water table to stabilize before taking a measurement and photographing. Alternatively, estimate depth to water table from observed lateral sidewall intrusion of water and photograph the evidence of intrusion, pointing out the lateral sidewall seepage.

Hydrology

22. Hydrologic indicators 62-340.500
    - Investigate the area immediately around the described point (no further than the area used to evaluate the plant community) for each of the 13 listed Hydrologic Indicators.
      - For any indicator present and representative of normal wet season or high water hydrology, check the corresponding box in the "Present at or near…" column
      - For any indicator present that is not representative of normal wet season or high water hydrology, e.g. resulting from rare or aberrant events, check the corresponding box in the "Present but not reflective…" column.
      - ***For identifications, the data form should characterize the entire homogenous area being identified and all hydrologic indicators, whereas for delineations, the data forms should characterize the change on either side of the boundary at a specific point.***
    - If the site investigation is being performed during the dry season or a drought, or if it is believed that a Hydrologic Indicator that is currently absent would be present during normal wet season or high water conditions, check the corresponding box in the "Predicted…" column.
    - If the described point is the waterward area adjacent to the data point side of the delineation boundary, investigate the area within 100 feet waterward of the point for each of the 13 listed Hydrologic Indicators.
      - For any indicator present within the 100 ft area, check the corresponding box in the "Within 100 ft…" column.

- These indicators are **not** considered for purposes of meeting the A, B, or D Tests at the data point, but offer details of the larger landscape context of the point.

➢ For any checked indicators, provide all relevant supporting information in the corresponding box in the last column.
- For any indicator that expresses in different forms (aquatic moss, aquatic plants, rafted debris, aquatic fauna, hydrologic data, morphological plant adaptations, tussocks or hummocks) describe the indicator type and the species on which it expresses (e.g., *Lemna sp.,* crayfish chimneys, A8 Muck Presence, adventitious roots on *Hypericum spp.*, tussocked *Andropogon*).
- For any indicator within 100 ft of the point (checked in the "Within 100 ft..." column), record its approximate distance and compass direction from the point along with the name of the species on which it expresses.
- For any indicator that reflects a water elevation (algal mats, aquatic mosses, aquatic plants, or rafted debris deposited on surfaces; elevated lichen lines, hydrologic data, adventitious roots as morphological plant adaptations, tussocks or hummocks, water marks) measure its height from the ground and record the measurement and the species name of the species on which it expresses.
- If the "Present but not reflective..." box is checked for any indicator, explain why it is not reflective of normal hydrology.

➢ To determine the estimated Seasonal High Water at the point, review the recorded indicators present at the point for any that reflected a water elevation, including any indicators of inundation at or above the soil surface.
- If the described point is within an Upland select "N/A".
- If there are no indicators that reflect a water elevation, select "No water level indicators".
- If any indicators reflect an inundation water elevation, determine the highest elevation from either the ground surface (begins at the peat, mucky peat, muck, or mineral surface) or soil surface (begins at the muck or mineral surface).
  - If the ground and soil surface are the same at the described point, record the highest water elevation as is and select "Above soil surface".
  - If there is a difference between ground and soil surface or if the soil surface elevation is unknown, record the highest water elevation as is and select "Above ground surface".
  - If indicators reflect inundation without reflecting a specific elevation (e.g. algal mats on the ground), record the Seasonal High Water as 0 and select "Above ground surface" or "Above soil surface" using the above guidelines.

23. If any of the 13 listed Hydrologic Indicators were checked in the "Present at or very near..." or "Predicted..." columns, select "Yes", otherwise, select "No".

📷 Hydrologic Indicator Photo Tips:
- Take photos documenting the observed hydrologic indicators.
  - Include a visible scale such as a measuring tape or ruler. Use a level pointer (e.g. soil knife, stick, finger) to help visually identify height of feature.

- Hold the camera level to the height of the indicator so the photo accurately depicts the height of the measured indicator.
- Photos depicting water level indicators consistently on several specimens are also recommended, if available.

Criteria Tests

24. Delineation by Wetland Definition §62-340.300(1),
    a) Determine if a wetland delineation resulting in a wetland boundary has been performed.
       - If the "Work Type" selected in #9 is "Delineation" and the Data Form is describing a point on either side of a wetland boundary, select "Yes".
       - If the "Work Type" selected in #9 is "Identification" or if the delineated line is a non-wetland surface water boundary, select "No" and skip to #25.
    b) Determine if the wetland boundary could be easily delineated using the definition of wetlands.
       - If the boundary could be easily delineated by the individual evaluator by following a clear break in the vegetative community, topographic elevations, landform type, regional or site specific hydrologic indicators or soil changes, etc., indicative of a frequency and duration of inundation or saturation sufficient to support the wetland definition, select "Yes".
       - If the boundary could not be easily located in this manner and more in-depth inspection was necessary, select "No".

25. A & B Test Wetland Criteria §62-340.300(2)(a),(b),
    a) A Test vegetation: 62-340.300(2)(a)
    Consult #10 and #12 to select answer. If "Vegetation Absent at Point" skip to #25f.
    b) B Test vegetation: 62-340.300(2)(b)
    Consult #13 to select answer.
    c) A & B Test hydric soils: 62-340.300(2)(a)1 and (b)1
    Consult #19 to select answer, unless #19 was "Inconclusive" due to nonhydrological mixing of the profile. In this case, use any available evidence or data to determine whether a hydric soil would be present if not for the mixing of the profile. If a hydric soil would be present, select "Yes", otherwise select "Indeterminable".
    d) A & B Test other soils or substrates: 62-340.300(2)(a)1,2 and (b)1,2 and 62-340.200(13)
    If the substrate is composed of Riverwash (defined in 62-340.200(13)), nonsoil (see #18), rock outcrop-soil complex, or located in an artificially created wetland area, select Yes, otherwise select No.
       - Rock Outcrop-Soil Complex refers to areas where the underlying rock substrate has been exposed in multiple locations. While some of these areas have been labeled in Map Units as a soil type with the words Rock Outcrop Complex, any area with exposed bare rock mixed in with the surrounding soil would meet this requirement. See the NRCS publication Soil Survey Manual for more details.

- Artificially created wetland areas could consist of ditches, borrow pits, mitigation creation sites, etc.

e) A & B Test hydrologic indicators: 62-340.300(2)(a)3 and (b)3
Consult #23 to select answer.

f) A Test criteria summary: 62-340.300(2)(a)
Consult note under #25f to select answer.

g) B Test criteria summary: 62-340.300(2)(b)
Consult note under #25g to select answer.

h) A & B Test reliability: 62-340.300(3)
If evaluation of any of the answers in #25a-e was affected by conditions or alterations on the site, natural or man-made, such that any answers were incomplete, indeterminable, or unreliable, select "Yes".

26. C Test Criteria

a) C Test conditional requirements: 62-340.300(2)(c)4
If the point meets any of the C-test definitions of pine flatwoods, improved pasture, or drained soils, select "Yes", select which of the three definitions are met, and skip to #26d and select "No".
   - ***If any facultative wet or obligate species are present in the ground cover, the point is <u>NOT</u> pine flatwoods or improved pasture.***
   - ***If any contemporary hydric soil field indicators are present, the point does <u>NOT</u> have drained soils.***

b) C Test saline sands and soil taxonomy: 62-340.300(2)(c)1,2
   - If the described point is within a salt flat or tidal flat select "Yes".
   - If the soil at the point has been field verified as an Umbraqualf, Sulfaquent, Hydraquent, Humaquept, Histosols (except Folists), Argiaquoll, or Umbraquult by a soil scientist according to *Keys to Soil Taxonomy* (USDA, 4th ed. 1990), select "Yes". If field verification by a soil scientist was not attempted, select "No".
   - ***If hydric soil field indicator A1 – Histosol has been checked in #17, then a Histosol has been field verified, select "Yes."***

c) C Test map unit designations: 62-340.300(2)(c)3
   - If the described point lies within a USDA-NRCS Soil Survey Map Unit that is designated as frequently flooded, depressional, or water <u>and</u> if a hydric soil field indicator has been met (see #16), select "Yes".
     - ***Map Units may be designated by name (e.g., "Felda fine sand, depressional") and/or by the information in the "Water Features" table within the Soil Survey. Those with a Flooding Frequency of "frequent" are frequently flooded, and those with a Ponding Frequency of "frequent" or a High Water Table above the soil surface are depressional.***
   - If the map unit is not frequently flooded, depressional, or water, select "No".
   - If the soil was determined to be non-hydric, select "No".
   - If the map unit is frequently flooded, depressional, or water but the soil was determined to be inconclusive, select "Inconclusive".
   - Record the map unit name regardless of the answer selected.

d) C Test criteria summary: 62-340.300(2)(c)

Consult under #26d to select answer.

e) C Test reliability: 62-340.300(3)
If evaluation of any of the answers in #26a-c was affected by conditions or alterations on the site, natural or man-made, such that any answers were incomplete, indeterminable, or unreliable, select "Yes".

27. D Test Criteria

a) D Test hydric soils: 62-340.300(2)(d)
- If a hydric soil field indicator was checked in #17, select "Yes".
- If a hydric soil field indicator was not checked in #17, select "No", even if the definition of hydric soil was met. Then skip to #27d and select "No".
- If the soil was deemed "Inconclusive" in #19, select "Inconclusive" and do not attempt to predict if a hydric soil would be present but for any disturbance. Then skip to #27d and select "No".

b) D Test hydric soils that are hydrologic indicators: 62-340.300(2)(d), 62-340.500(8),(11)
If any hydric soil field indicator in #17 began at the soil surface (0-inch depth), or if any of the "stand-alone D-Test" indicators listed in this question were checked in #17, select "Yes".
- If indicator A5 was checked, make sure that Sediment Deposition is marked as "Present at or very near..." in #22
- If A1, A2, A3, A4, A7, A8, A9, S4, or F2 were checked or if any other indicator began at the soil surface, make sure that Hydrologic Data is marked as "Present at or very near..." in #22.

c) D Test hydrologic indicator: 62-340.300(2)(d)
This answer should match the answer given in #23.

d) D Test criteria summary: 62-340.300(2)(d)
The D Test is met if #27a was answered "Yes" and at least one of #27b or #27c was answered "Yes". If these criteria are met, select "Yes".

e) D Test reliability: 62-340.300(3)
If evaluation of any of the answers in #27a-c was affected by conditions or alterations on the site, natural or man-made, such that any answers were incomplete, indeterminable, or unreliable, select "Yes".

Altered Sites Tests

28. Determine if any conditions or alterations on the site, natural or man-made, have masked or eliminated expression of any wetland indicators (*e.g.*, plants, soils, hydrologic indicators) such that the wetland cannot be completely or reliably identified or delineated.
- If #25h, 26e, or 27e were answered "Yes", select "Yes".
- If the criteria tests could be evaluated reliably but more abundant, diverse, or persuasive evidence would be present but for the alterations, select "Yes".
- If there are no alterations, select "No" and skip to #32.
- If alterations have occurred on a site, but all wetland indicators are expressing normally and reliably and on-site evidence is deemed sufficient, select "No" and skip to #32.

- **Selecting "No" may possibly limit utilization of other reliable information in the documentation.**

29. Authorized or Legally Altered Vegetation and Soils: 62-340.300(3)(a)
    a) Determine if the vegetation on site has been altered by authorized or legal activities (*e.g.*, by mowing, planting, tree harvesting, fire, landscaping, herbicide, site preparation, etc.) such that its expression is incomplete or unreliable.
        - If so, select "Yes" and describe the alterations and their effects on vegetation.
        - If vegetation was not affected by alterations or if any alterations were unauthorized, select "No".
    b) Determine if the soils on site have been altered by authorized or legal activities (*e.g.*, by animals such as hogs or livestock, or by authorized plowing, disking, scalping, filling, shallow rutting, etc.) such that they cannot be evaluated completely or reliably.
        - If so, select "Yes" and describe the alterations and their effects on the soils.
        - If soils were not affected by alterations or if any alterations were unauthorized, select "No".
        - If "No" was selected for both 29a and 29b, indicating the vegetation and soils were not affected by any legal or authorized alterations, skip to #30.
    c) Select which of the four criteria tests could not be completely or reliably evaluated due to the legal alterations to vegetation or soils on site. These answers will often reflect those in #25h, 26e, and 27e.
    d) Determine if the described point would be identified or delineated as a wetland using the methodology in 62-340.300 if the altering activities were stopped and the site given time to recover normal expression of vegetation and soils. Use reasonable scientific judgement and the most reliable available information to make this determination. A reference point in an unaltered or more reliable condition, described on a separate Data Form, is recommended if possible.
        - If the point would be a wetland given normal expression, select "Yes".
        - Otherwise, select "No", explain why this conclusion was reached, and skip to #30.
    e) If #29d was answered "Yes", indicate which components of 62-340.300 would express following the cessation of legal alterations.
        - Include evidence that is currently present as well as evidence that is predicted to be present.
        - "Plants" can refer to the vegetative community, A and B test plant ratios, or both.
    f) Select which tests are predicted to be passed following the cessation of alterations, including tests that are currently being passed.
        - ***If a wetland has been determined to be present using any of the 62-340.300 tests, "Wetland Definition" should be selected.***
        - Explain why it is believed that these tests would be passed. "See [reference point name]" is sufficient when a reference point has been described on a separate Form. Otherwise, list whatever evidence was used in the conclusion.

30. Authorized or Legally Altered Hydrology: 62-340.300(3)(b)
    a) Determine if authorized or permitted activities have altered wetland hydrology in a way that either lowers the water table or raises the soil surface, thereby reducing wetland hydrology.
        - If so, select "Yes", and explain the alteration and its effects.

- If hydrology has been unchanged or if frequency or duration of saturation or inundation has increased, select "No" and skip to #31.
- If the site is and has always been an upland, select "No" and skip to #31.
- If the decreased hydrology is a result of unauthorized activities (including water use permits that are out of compliance), select "No" and skip to #31.

b) Determine if the authorized activities have completely eliminated wetland hydrology at the described point (i.e. point has been converted to upland). If wetland hydrology was reduced but not fully eliminated, select "No" and skip to #31. Otherwise, select "Yes".

c) Determine if elimination of wetland hydrology was accomplished solely by dredging or filling activities authorized by Part IV of Chapter 373, F.S. and if the elimination is therefore permanent.
- If so, select "Yes". This means that the point is now legally converted to an upland. Skip to #31.
- If wetland hydrology was eliminated by activities in Part II of Chapter 373, F.S., such as water use permits, select "No". These areas are still considered wetlands even if they lack wetland hydrology and may temporarily not be expressing wetland characteristics.
- If wetland hydrology was eliminated by temporary alterations such as surface water pumps, or by temporary conditions such as droughts, select "No". These areas are still considered wetlands even if they lack wetland hydrology and may temporarily not be expressing wetland characteristics.

d) If the elimination of wetland hydrology is temporary or not authorized by Part IV of Chapter 373, F.S., indicate which components of 62-340.300 would express following the cessation of hydrologic alterations and return of normal wetland hydrology.
- Include evidence that is currently present as well as evidence that is predicted to be present with the return of wetland hydrology.
- "Plants" can refer to the vegetative community, A and B test plant ratios, or both.

e) Select which tests are predicted to be passed following the cessation of alterations, including tests that are currently being passed.
- ➢ ***If a wetland has been determined to be present using any of the 62-340.300 tests, "Wetland Definition" should be selected.***
- Explain why it is believed that these tests would be passed. "See [reference point name]" is sufficient when a reference point in an unaltered or more reliable condition has been described on a separate Form. Otherwise, list whatever evidence was used in the conclusion.

31. Illegal or Unauthorized Altered Sites: 62-340.300(3)(c)

a) Determine if any alterations that are in violation of regulatory requirements have occurred at the described point and have affected normal expression of any wetland characteristics.
- If so, select "Yes" and describe the alterations and how they have affected the normal wetland condition.
- Otherwise, select "No" and skip to #32.

b) Select which of the four criteria tests could not be completely or reliably evaluated due to the unauthorized alterations on site. These answers will often reflect those in #25h, 26e, and 27e.

c) Determine if the described point would have been identified or delineated as a wetland immediately prior to the unauthorized alterations. Use reasonable scientific judgement and all available information to make this determination in a forensic manner. A reference point in an unaltered or more reliable condition, described on a separate Data Form, is recommended if possible.
   - If the point would have been a wetland immediately prior to the unauthorized alterations, or if it is still currently a wetland despite the alterations, select "Yes".
   - Otherwise, select "No", explain why this area was an upland immediately prior to the unauthorized alteration and how the conclusion was reached, then skip to #32.

d) If #31c was answered "Yes", predict which components of 62-340.300 would have been present immediately prior to the unauthorized alterations.
   - Include evidence that is currently present as well as evidence that is predicted to have been present.
   - "Plants" can refer to the vegetative community, A and B test plant ratios, or both.

e) Select which tests would have been passed immediately prior to the alterations, including tests that are currently being passed.
   - ➢ ***If a wetland has been determined to be present using any of the 62-340.300 tests, "Wetland Definition" should be selected.***
   - Explain why it is believed that these tests would have been passed. "See [reference point name]" is sufficient when a reference point has been described on a separate Form. Otherwise, list whatever evidence was used in the conclusion.

Summaries

32. Wetland and Other Surface Water Summary

a) Wetland Summary
   - If the described point is in a **normal condition** with no alterations, use reasonable scientific judgement to determine if the conclusions made in #25f, 25g, 26d, and 27d are reliable and if the described point meets the wetland definition in 62-340.200(19).
     - o If any of the criteria tests were reliably passed or if the definition of wetlands was met, select "Yes" and indicate which tests were reliably passed.
       - ➢ ***If a wetland has been determined to be present using any of the 62-340.300 tests, "Wetland Definition" should be selected.***
     - o If any answers in #25f, 25g, 26d, and 27d are different from the answers to #32 (*i.e.,* a criteria test was deemed unreliable), explain how this conclusion was reached with reasonable scientific judgement.
   - If **authorized or legal alterations to plants or soils** have occurred at the described point, this answer should reflect those in #29d, e, and f.
   - If **authorized or legal alterations to hydrology** have occurred at the described point, this answer should reflect those in #30c, d, and e. If dredge or fill alterations authorized by Part IV of Chapter 373, F.S. have permanently and completely eliminated wetland hydrology at the point, the point has legally been converted to an upland.
   - If **unauthorized or illegal alterations** affected any aspect of normal wetland expression, this answer should reflect those in #31c, d, and e.

- If any of the **altered sites tests** were used, summary answers 31e are likely to differ from those in #25f, 25g, 26d, and 27d; if they do, explain why. "See #[29, 30, or 31]" may be a sufficient explanation if all relevant details have been documented in that section.

b) Mean High Water: 62-340.600(2)(b)
- If there are no tidal water bodies nearby, select "No".
- If a licensed Professional Land Surveyor has located the Mean High Water Line of a tidal water body and the point is located at or waterward of that line, select "Yes".
- If a survey is not currently available, select "MHWL unknown".
- ***Determination of Mean High Water for 62-340 is not for purposes of title.***

c) Ordinary High Water: 62-340.600(2)(c)
- If there are no bodies of open water within a distance close enough to exert a dominant influence on the hydrology of the point, select "No".
- If an open water body exists nearby that is natural (not man-made) and non-tidal, determine its Ordinary High Water Line by direct field observation.
  - If the described point is at or waterward of this line, select "Yes".
  - ***Ordinary High Water is defined on page 37 of The "Florida Wetlands Delineation Manual", which is available for download on the Department's website, and on page 6 of the Form.***
  - ***Water bodies must have little to no emergent vegetation and have standing or flowing water during normal wet season or high water that exerts an influence on the landscape. They may be ephemeral.***
  - ***For non-tidal natural water systems only, the 2.33 return frequency interval (i.e. Mean Annual Flood) may be an acceptable approximation for Ordinary High Water***
  - ***Determination of Ordinary High Water for 62-340 is not for purposes of title.***

d) Top of Bank: 62-340.600(2)(d)
- If the point is not in or near an artificially created water body or watercourse with side slopes of 1 foot vertical to 4 feet horizontal or steeper, select "No".
- If the point is in or near an artificially created water body or watercourse with side slopes of 1 foot vertical to 4 feet horizontal or steeper, determine where the top of the bank is.
  - If the point is at or waterward of the top of the bank, select "Yes".
  - Do not include spoil banks from excavation when determining top of bank.

e) Seasonal High Water: 62-340.600(2)(e)
- If there are no artificially created water bodies or watercourses with side slopes flatter than 1 foot vertical to 4 feet horizontal within a distance close enough to exert an influence on the hydrology of the point, select "No".
- If an artificially created water body or watercourse with side slopes flatter than 1 foot vertical to 4 feet horizontal exists nearby, determine its Seasonal High Water Line.
  - If the described point is at or waterward of this line, select "Yes".
  - ***Seasonal High Water is defined in 62-340.200(15)***

2. Photographs
   a) Take photographs of the evidence used to draw conclusions about wetland or other surface waters at the described point. Photo documentation tips may be found in the relevant sections above. Recommended photos include, but are not limited to:

- Vegetation: landscape photos in the four cardinal directions, plant species important to the identification or delineation of the surface water, unusual plant morphology, etc.
- Soil: soil profile with ID, soil profile close-up, soil horizon(s) close-up, hydric soil indicator(s) close-up, unusual soil characteristics, landscape location of soil pit, observed water in soil pit, etc.
- Hydrology: hydrologic indicators, hydrologic indicator height from ground with tape measure, non-wetland surface water indicators (*e.g.*, basal scarring, stained leaves, drainage patterns), nearby water bodies or water control structures that may influence area hydrology, etc.

b) For each photo, record the number from the memory card that identifies the photo. This will allow easy identification of the photo when downloaded to a computer. If multiple photos are taken of the same subject, these can be listed within the same metadata box.
c) Specify what is in the photo. Include a compass direction for landscape photos.
d) Write the initials of who took each photo. This should match a name listed in #2. Photos cannot be used as evidence in litigation without a known photographer.

Optional Video Documentation Suggestions

- Video documentation of the same features and characteristics in the photo tips above may be taken in video format as well.
- Videos should include a statement of who is shooting the video, any other person in the video, the date recorded, the location of the site and location of the video on the site with minimal narration, explanation, or background noise.

Notes

Record any relevant information that was not captured in another part of the form

- General description and conditions of the site and its surrounding landscape
- Current or recent weather conditions
- Information relied upon for determination of non-wetland surface water boundaries
- Features that are not specified in 62-340.500 as indicators of wetland hydrology, but that were used in conjunction with reasonable scientific judgment to guide conclusions (*e.g.*, indicators used by the Army Corps)
- Text that would not fit in the space provided in another part of the form
  - Write "See note [#]" in the space provided
  - Begin text with matching [#] in Notes section
- Species of vines and aquatic plants with areal extents
- Indicate results of a fiber rub test or decant test if instrumental to a hydric soil determination. Document with photos as applicable.

References

Florida Department of Environmental Protection, Wetlands Evaluation and Delineation Section. 1995. *The Florida Wetlands Delineation Manual.* K.M. Gilbert, J.D. Tobe, R. W. Cantrell, M.E. Sweeley, and J.R. Cooper (eds.).

Florida Department of Environmental Protection, Submerged Lands and Environmental Resources Coordination program. April 2017. *Chapter 62-340, F.A.C. Data Form Guide*. C.J. Beasley, S.L. Hinrichs, and E.D. Hickman (eds.).

Gretag-Macbeth. 2000. Munsell Color. New Windsor, NY.

Soil Science Division Staff. 2017. *Soil Survey Soil.* C. Ditzler, K. Scheffe, and H.C. Monger (eds.). USDA Handbook 18. Government Printing Office, Washington D.C.

United States Department of Agriculture, Natural Resources Conservation Service. 2016. *Field Indicators of Hydric Soils in the United States*, Version 8.0. L.M. Vasilas, G.W. Hurt, and C.V. Noble (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin.* U.S. Department of Agriculture Handbook 296.

United States Department of Agriculture, National Technical Committee for Hydric Soils. *Hydric Soils Technical Note 4: Indicator Insights for Hydric Soil Identification.* Retrieved from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053979

Appendix L

Additional Criteria for Dam Systems

1. Applicability

This appendix contains the four criteria referenced in this Volume, subsection 8.4.5, *Dam Systems*. These criteria apply to proposed construction of new dams and alteration of existing dams, as defined in paragraph 2.0(a)27. in this Volume and meets the dam thresholds specified in the applicable Volume II. These criteria do not apply to a levee or levee system, as defined in paragraphs 2.0(a)66. and 67., respectively, in this Volume. The four criteria require: 1) providing dam system information, 2) establishing a Downstream Hazard Potential, 3) developing an Emergency Action Plan for a High Hazard Potential or Significant Hazard Potential dam, and 4) submitting a Condition Assessment Report for a High Hazard Potential or Significant Hazard Potential dam. These criteria and their requirements are described in detail below.

Applicants with such dam projects shall provide the required information to the permitting agency in the application submittal, and electronically submit this information to the Department at DamSafety@FloridaDEP.gov or mail it to the State Dam Safety Officer, Florida Department of Environmental Protection, 2600 Blair Stone Road, Mail Station 3595, Tallahassee, Florida 32399. Applicants are encouraged to contact the permitting agency to request a pre-application meeting to discuss the applicability of these criteria and best approaches to meet the requirements for their specific dam project.

2. Dam System Information

Form 62-330.301(25), "Dam System Information", incorporated by reference in subsection 62-330.301(2) shall be completed in accordance with the instructions on the form. This information will be maintained by the Department to provide a repository for these systems, and for dissemination where needed in the event of an emergency situation.

3. Downstream Hazard Potential

A Downstream Hazard Potential shall be determined for each dam based on probable loss of human life or adverse impacts on economic, environmental, and lifeline interests, and other concerns, such as water quality degradation, should the dam or appurtenant structures fail (e.g., breach) or are mis-operated (e.g., unscheduled release). Importantly, the Downstream Hazard Potential does not reflect the current safety, structural integrity, or flood routing capacity of a dam and its appurtenant structures. Also, the Downstream Hazard Potential may change over time (typically, it will increase as the downstream area is developed). Lastly, for dams in series, each upstream dam shall have a Downstream Hazard Potential equal to or greater than the next downstream dam.

(1) Classification

The Downstream Hazard Potential shall be classified as one of the three categories described below.

a) High Hazard Potential (HHP) – Failure or mis-operation of the dam will probably cause the loss of human life. Economic, environmental, and lifeline losses may also occur, but are not necessary for this classification.

b) Significant Hazard Potential (SHP) – Failure or mis-operation would result in no probable loss of human life, but may cause economic loss, environmental damage, disruption of lifeline interests, or impact other concerns, such as water quality degradation.

c) Low Hazard Potential (LHP) – Failure or mis-operation is not expected to result in loss of human life and may result in low economic and/or environmental losses, that are largely limited to the owner's property.

The table below shows the expected consequences for each Downstream Hazard Potential.

Downstream Hazard Potential	**Loss of Human Life**	**Economic, Environmental, & Lifeline Losses**
High	Probable	Yes, but not necessary
Significant	None expected	Yes
Low	None expected	Low and generally limited to owner's property

(2) Evaluation

For each dam, the applicant shall provide the Downstream Hazard Potential and supporting information for its determination that is developed in a manner consistent with the following methodologies:

a) Obvious LHP dams – The Photo-Based Mapping method may be used to provide inundation maps without an engineering analysis for dams less than or equal to 10 feet in dam height and less than or equal to 1,000 acre-feet maximum storage, with no downstream structures and roads at or below the elevation of the dam crest within the expected inundation area. The dam height and maximum storage definitions to use are provided in form 62-330.301(25), *Dam System Information*. Refer to the *Emergency Action Plan Template For Florida Dams Instruction Manual* (DEP January 2023) on how to use Photo-Based Mapping to estimate conservative flood areas. The *Emergency Action Plan Template For Florida Dams Instruction Manual* is available on the [DEP website]. Submit an aerial map(s), elevation contour or digital elevation map(s), field survey (if available), dam geometry, reservoir capacity, locations and types of downstream structures, a depiction of the anticipated flood extent and a discussion of the expected consequences and Downstream Hazard Potential. The maps must be at legible scales to see structures and details. This method of classification, including the supporting information, does not need to be certified by a registered professional.

b) Probable LHP dams – A Simplified Engineering Analysis may be used where there are few structures or roads below the dam crest and the downstream terrain is relatively flat and constant. The methodology to perform a Simplified Engineering Analysis is described in the *Emergency Action Plan Template For Florida Dams Instruction Manual* (DEP January 2023). Submit a report, including aerial map(s), elevation contour or digital elevation map(s), field survey (if available), dam and downstream geometry, reservoir capacity, locations and types of downstream structures, engineering calculations, and inundation maps, and evacuation maps, including peak flood wave depth, peak flood wave stage, and peak flood wave arrival times at the locations of interest downstream of the dam, a discussion of the study input and output parameters and expected consequences, and the Downstream Hazard Potential. If the Downstream Hazard Potential is not LHP, refer to paragraph 3.2.c below to perform an inundation study using hydrologic-hydrodynamic modeling. A registered professional must certify the Simplified Engineering Analysis and Downstream Hazard Potential designation.

c) SHP and HHP dams. For dams that do not fit the descriptions above, the Downstream Hazard Potential shall be determined through an inundation study performed using hydrologic-hydrodynamic modeling software with two-dimensional unsteady state flow capability, preferably HEC-RAS 2D, version 6, or equivalent. The inundation report, including inundation and evacuation

maps for an Emergency Action Plan, shall meet the *Federal Guidelines for Inundation Mapping of Flood Risks Associated with Dam Incidents and Failures* (FEMA P-946, July 2013), which is incorporated by reference in subsection 62-330.010(4). The Downstream Hazard Potential shall be stated in the inundation report and certified by a registered professional qualified in the evaluation of dam systems.

4. Emergency Action Plan

An emergency action plan (EAP), as defined in paragraph 2.0(a)44 in this Volume, shall be developed for each SHP and HHP dam. The EAP may include multiple dams that are owned by the same owner(s), if they are in close proximity with one another or in succession. An EAP provides the dam owner, the dam owner's engineer, emergency management officials, and other personnel and responders with clear instructions to take should an anomalous or emergency condition develop at a dam. The EAP format is not mandatory, but the EAP shall address six basic elements: 1) detection and classification, 2) roles and responsibilities, 3) notification flow charts and contact information, 4) response procedures, 5) inundation and evacuation maps, and 6) appendixes for training, exercises, and updates. The completed EAP shall be signed and dated by the applicant or an authorized representative.

The *Emergency Action Plan Template for Florida Dams* (DEP January 2023; EAP Template) and accompanying instruction manual, *Emergency Action Plan Template For Florida Dams Instruction Manual* (DEP January 2023), are available for use to facilitate EAP development, provide consistency, and reduce costs; however, use of the EAP Template is not required. The *Emergency Action Plan Template for Florida Dams* is available on the [DEP website]. The EAP Template characterizes abnormal occurrences in three types of events: Unusual (a slowly developing event), Watch (a rapidly developing event), and Warning (an imminent or ongoing dam failure). The template may be modified to provide additional information, such as an alert system activation plan, cascading dam inundation maps, monitoring and operating plans, and multiple owners' information.

5. Condition Assessment

A Condition Assessment Report (CAR) shall be provided for each existing SHP and HHP dam. The CAR shall include completed Form 62-330.311(4), *Condition Assessment Report for Florida Dams,* incorporated by reference in subsection 62-330.311(7), F.A.C., and required supporting information, if applicable, as described below. The information in this form may be completed through a combination of new and historical inspections performed within the past five years, as long as the data are still representative of the dam condition. Copies of the original inspection reports are to be included in the CAR. The current overall condition assessment of Satisfactory, Fair, Poor, or Unsatisfactory, as defined in the form, shall be designated for each dam and certified by a registered professional qualified in the evaluation of dam systems.

Appendix M

Rainfall Criteria

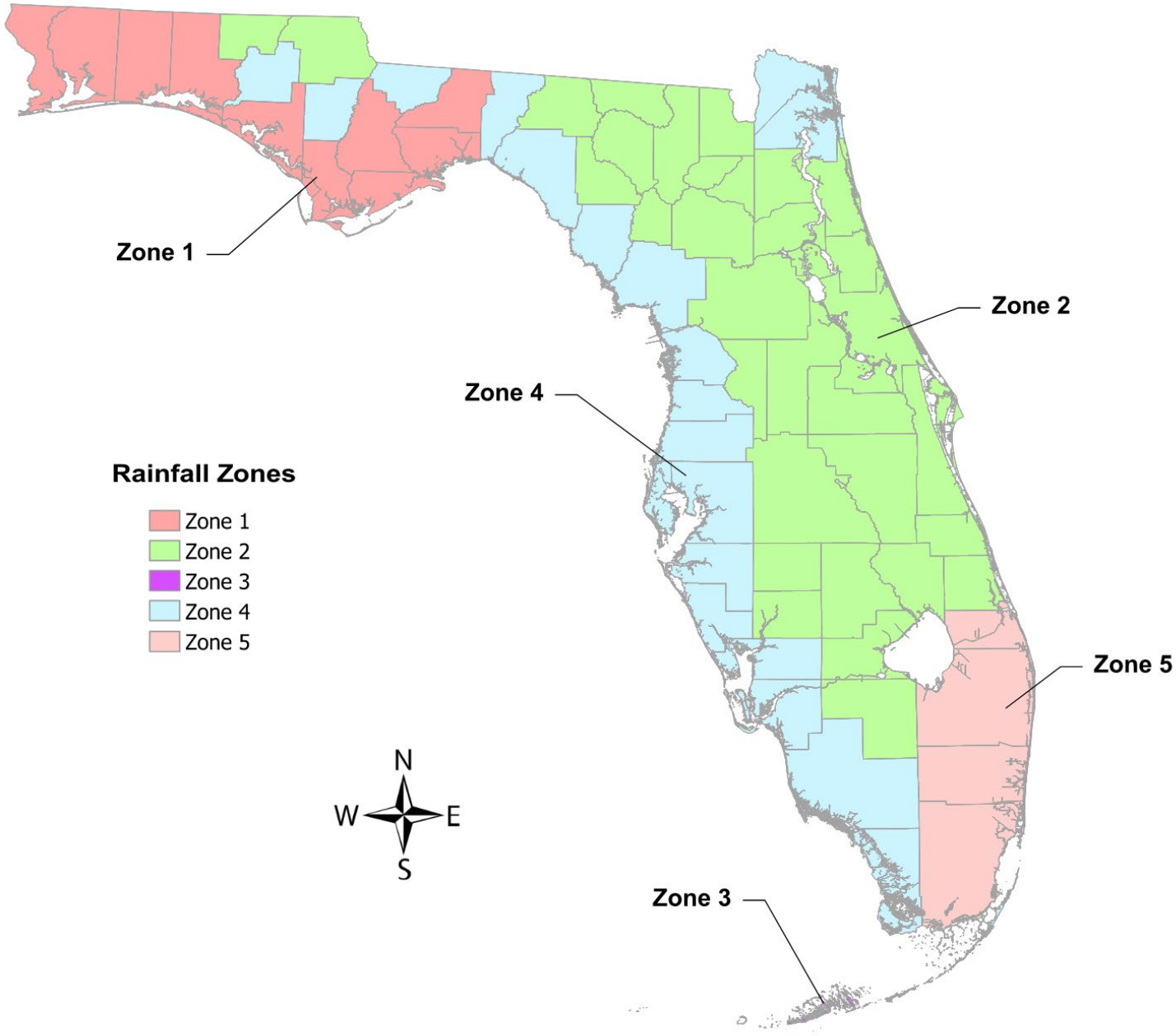
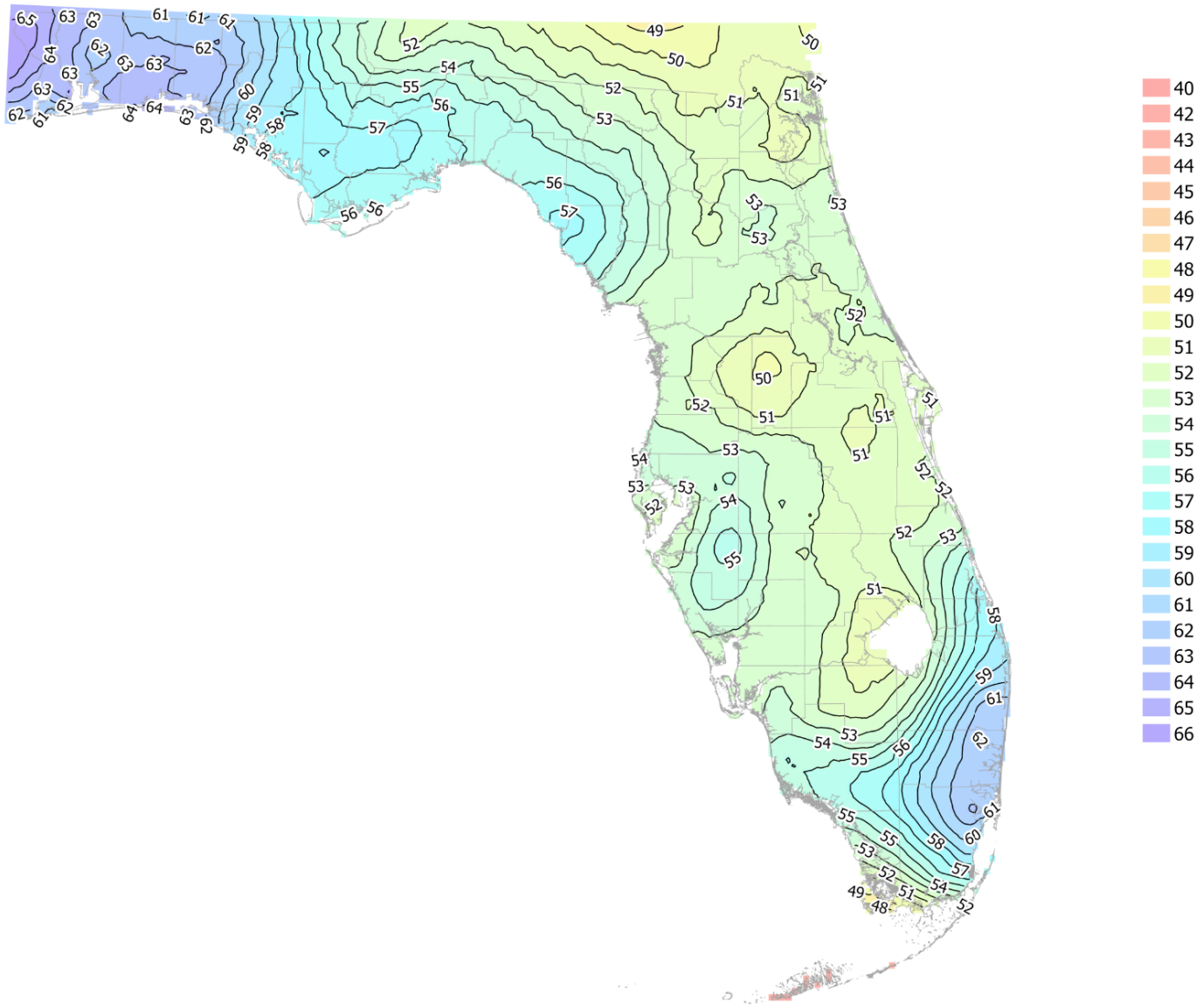


Figure 1: Designated Meteorological Regions (Zones) in Florida

Table 1: Counties Included in the Designated Meteorological Zones

ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
Bay	Alachua	Monroe County - Florida Keys from Key Largo to Key West	Charlotte	Broward
Escambia	Baker		Citrus	Miami-Dade
Franklin	Bradford		Collier	Martin
Gulf	Brevard		Dixie	Palm Beach
Leon	Calhoun		Duval	
Liberty	Clay		Hernando	
Okaloosa	Columbia		Hillsborough	
Santa Rosa	Desoto		Jefferson	
Wakulla	Flagler		Lee	
Walton	Gadsden		Levy	
	Gilchrist		Manatee	
	Glades		Mainland	
	Hamilton		Monroe	
	Hardee		Nassau	
	Hendry		Pasco	
	Highlands		Pinellas	
	Holmes		Sarasota	
	Indian River		Taylor	
	Jackson		Washington	
	Lafayette			
	Lake			
	Madison			
	Marion			
	Okeechobee			
	Orange			
	Osceola			
	Polk			
	Putnam			
	Seminole			
	St. Johns			
	St. Lucie			
	Sumter			
	Suwannee			
	Union			
	Volusia			

Figure 2: Average Annual Rainfall Isopleth Map for Florida



Appendix N
Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

ZONE 1
Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

NDCIA CN	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	0.006	0.048	0.090	0.132	0.175	0.217	0.259	0.301	0.343	0.386	0.428	0.470	0.512	0.554	0.596	0.639	0.681	0.723	0.765	0.807	0.849
35	0.009	0.051	0.093	0.135	0.177	0.219	0.261	0.303	0.345	0.387	0.429	0.471	0.513	0.555	0.597	0.639	0.681	0.723	0.765	0.807	0.849
40	0.014	0.056	0.098	0.139	0.181	0.223	0.265	0.307	0.348	0.390	0.432	0.474	0.515	0.557	0.599	0.641	0.682	0.724	0.766	0.808	0.849
45	0.020	0.062	0.103	0.145	0.186	0.228	0.269	0.311	0.352	0.394	0.435	0.476	0.518	0.559	0.601	0.642	0.684	0.725	0.767	0.808	0.849
50	0.029	0.070	0.111	0.152	0.193	0.234	0.275	0.316	0.357	0.398	0.439	0.480	0.521	0.562	0.603	0.644	0.685	0.726	0.767	0.808	0.849
55	0.039	0.079	0.120	0.161	0.201	0.242	0.282	0.323	0.363	0.404	0.444	0.485	0.525	0.566	0.606	0.647	0.687	0.728	0.768	0.809	0.849
60	0.052	0.092	0.132	0.172	0.212	0.252	0.291	0.331	0.371	0.411	0.451	0.491	0.531	0.570	0.610	0.650	0.690	0.730	0.770	0.810	0.849
65	0.069	0.108	0.147	0.186	0.225	0.264	0.303	0.342	0.381	0.420	0.459	0.498	0.537	0.576	0.615	0.654	0.693	0.732	0.771	0.810	0.849
70	0.092	0.130	0.167	0.205	0.243	0.281	0.319	0.357	0.395	0.433	0.471	0.508	0.546	0.584	0.622	0.660	0.698	0.736	0.774	0.812	0.849
75	0.121	0.158	0.194	0.230	0.267	0.303	0.340	0.376	0.412	0.449	0.485	0.522	0.558	0.595	0.631	0.667	0.704	0.740	0.777	0.813	0.849
80	0.162	0.196	0.230	0.265	0.299	0.334	0.368	0.402	0.437	0.471	0.506	0.540	0.574	0.609	0.643	0.678	0.712	0.746	0.781	0.815	0.849
85	0.220	0.252	0.283	0.315	0.346	0.378	0.409	0.441	0.472	0.503	0.535	0.566	0.598	0.629	0.661	0.692	0.724	0.755	0.787	0.818	0.849
90	0.312	0.339	0.366	0.393	0.419	0.446	0.473	0.500	0.527	0.554	0.581	0.608	0.634	0.661	0.688	0.715	0.742	0.769	0.796	0.823	0.849
95	0.478	0.496	0.515	0.533	0.552	0.571	0.589	0.608	0.626	0.645	0.664	0.682	0.701	0.719	0.738	0.757	0.775	0.794	0.812	0.831	0.849
98	0.656	0.666	0.676	0.685	0.695	0.705	0.714	0.724	0.734	0.743	0.753	0.763	0.772	0.782	0.792	0.801	0.811	0.821	0.830	0.840	0.849

ZONE 2

Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

NDCIA CN	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	0.002	0.043	0.083	0.123	0.164	0.204	0.244	0.285	0.325	0.366	0.406	0.446	0.487	0.527	0.567	0.608	0.648	0.688	0.729	0.769	0.809
35	0.004	0.044	0.085	0.125	0.165	0.205	0.246	0.286	0.326	0.366	0.407	0.447	0.487	0.528	0.568	0.608	0.648	0.689	0.729	0.769	0.809
40	0.007	0.047	0.087	0.127	0.167	0.207	0.248	0.288	0.328	0.368	0.408	0.448	0.488	0.528	0.569	0.609	0.649	0.689	0.729	0.769	0.809
45	0.010	0.050	0.090	0.130	0.170	0.210	0.250	0.290	0.330	0.370	0.410	0.450	0.490	0.530	0.570	0.610	0.650	0.690	0.729	0.769	0.809
50	0.015	0.055	0.095	0.134	0.174	0.214	0.254	0.293	0.333	0.373	0.412	0.452	0.492	0.531	0.571	0.611	0.651	0.690	0.730	0.770	0.809
55	0.022	0.061	0.101	0.140	0.179	0.219	0.258	0.298	0.337	0.376	0.416	0.455	0.494	0.534	0.573	0.613	0.652	0.691	0.731	0.770	0.809
60	0.030	0.069	0.108	0.147	0.186	0.225	0.264	0.303	0.342	0.381	0.420	0.459	0.498	0.537	0.576	0.615	0.654	0.693	0.731	0.770	0.809
65	0.042	0.080	0.119	0.157	0.195	0.234	0.272	0.311	0.349	0.387	0.426	0.464	0.502	0.541	0.579	0.618	0.656	0.694	0.733	0.771	0.809
70	0.057	0.095	0.133	0.170	0.208	0.245	0.283	0.321	0.358	0.396	0.433	0.471	0.509	0.546	0.584	0.621	0.659	0.697	0.734	0.772	0.809
75	0.079	0.116	0.152	0.189	0.225	0.262	0.298	0.335	0.371	0.408	0.444	0.481	0.517	0.554	0.590	0.627	0.663	0.700	0.736	0.773	0.809
80	0.111	0.146	0.181	0.216	0.251	0.285	0.320	0.355	0.390	0.425	0.460	0.495	0.530	0.565	0.600	0.635	0.670	0.705	0.740	0.774	0.809
85	0.160	0.192	0.225	0.257	0.290	0.322	0.355	0.387	0.420	0.452	0.485	0.517	0.550	0.582	0.614	0.647	0.679	0.712	0.744	0.777	0.809
90	0.242	0.270	0.299	0.327	0.355	0.384	0.412	0.440	0.469	0.497	0.526	0.554	0.582	0.611	0.639	0.667	0.696	0.724	0.753	0.781	0.809
95	0.404	0.424	0.444	0.464	0.485	0.505	0.525	0.546	0.566	0.586	0.606	0.627	0.647	0.667	0.688	0.708	0.728	0.749	0.769	0.789	0.809
98	0.595	0.605	0.616	0.627	0.638	0.648	0.659	0.670	0.680	0.691	0.702	0.713	0.723	0.734	0.745	0.756	0.766	0.777	0.788	0.799	0.809

ZONE 3
Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

NDCIA CN	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	0.008	0.047	0.087	0.126	0.165	0.205	0.244	0.283	0.323	0.362	0.401	0.441	0.480	0.519	0.559	0.598	0.637	0.677	0.716	0.756	0.795
35	0.012	0.051	0.090	0.129	0.168	0.207	0.247	0.286	0.325	0.364	0.403	0.442	0.482	0.521	0.560	0.599	0.638	0.677	0.717	0.756	0.795
40	0.016	0.055	0.094	0.133	0.172	0.211	0.250	0.289	0.328	0.367	0.406	0.445	0.483	0.522	0.561	0.600	0.639	0.678	0.717	0.756	0.795
45	0.022	0.061	0.099	0.138	0.177	0.215	0.254	0.292	0.331	0.370	0.408	0.447	0.486	0.524	0.563	0.602	0.640	0.679	0.718	0.756	0.795
50	0.029	0.067	0.105	0.144	0.182	0.220	0.259	0.297	0.335	0.374	0.412	0.450	0.488	0.527	0.565	0.603	0.642	0.680	0.718	0.757	0.795
55	0.037	0.075	0.113	0.151	0.189	0.227	0.265	0.302	0.340	0.378	0.416	0.454	0.492	0.530	0.568	0.605	0.643	0.681	0.719	0.757	0.795
60	0.048	0.085	0.123	0.160	0.197	0.235	0.272	0.309	0.347	0.384	0.421	0.459	0.496	0.533	0.571	0.608	0.645	0.683	0.720	0.758	0.795
65	0.061	0.098	0.134	0.171	0.208	0.244	0.281	0.318	0.355	0.391	0.428	0.465	0.501	0.538	0.575	0.611	0.648	0.685	0.721	0.758	0.795
70	0.078	0.114	0.149	0.185	0.221	0.257	0.293	0.329	0.365	0.400	0.436	0.472	0.508	0.544	0.580	0.616	0.651	0.687	0.723	0.759	0.795
75	0.100	0.135	0.170	0.204	0.239	0.274	0.308	0.343	0.378	0.413	0.447	0.482	0.517	0.552	0.586	0.621	0.656	0.691	0.725	0.760	0.795
80	0.131	0.164	0.197	0.231	0.264	0.297	0.330	0.363	0.397	0.430	0.463	0.496	0.529	0.562	0.596	0.629	0.662	0.695	0.728	0.762	0.795
85	0.177	0.208	0.239	0.269	0.300	0.331	0.362	0.393	0.424	0.455	0.486	0.517	0.548	0.579	0.609	0.640	0.671	0.702	0.733	0.764	0.795
90	0.252	0.279	0.306	0.333	0.360	0.388	0.415	0.442	0.469	0.496	0.523	0.550	0.578	0.605	0.632	0.659	0.686	0.713	0.741	0.768	0.795
95	0.399	0.419	0.439	0.458	0.478	0.498	0.518	0.538	0.557	0.577	0.597	0.617	0.637	0.656	0.676	0.696	0.716	0.735	0.755	0.775	0.795
98	0.578	0.589	0.600	0.611	0.622	0.633	0.643	0.654	0.665	0.676	0.687	0.697	0.708	0.719	0.730	0.741	0.752	0.762	0.773	0.784	0.795

ZONE 4
Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

NDCIA CN	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	0.004	0.045	0.086	0.127	0.168	0.209	0.250	0.291	0.332	0.373	0.414	0.455	0.496	0.536	0.577	0.618	0.659	0.700	0.741	0.782	0.823
35	0.007	0.048	0.089	0.129	0.170	0.211	0.252	0.293	0.333	0.374	0.415	0.456	0.497	0.537	0.578	0.619	0.660	0.701	0.741	0.782	0.823
40	0.011	0.051	0.092	0.133	0.173	0.214	0.254	0.295	0.336	0.376	0.417	0.458	0.498	0.539	0.579	0.620	0.661	0.701	0.742	0.782	0.823
45	0.016	0.056	0.096	0.137	0.177	0.217	0.258	0.298	0.339	0.379	0.419	0.460	0.500	0.540	0.581	0.621	0.662	0.702	0.742	0.783	0.823
50	0.022	0.062	0.102	0.142	0.182	0.222	0.262	0.302	0.342	0.382	0.423	0.463	0.503	0.543	0.583	0.623	0.663	0.703	0.743	0.783	0.823
55	0.030	0.070	0.109	0.149	0.189	0.228	0.268	0.308	0.347	0.387	0.427	0.466	0.506	0.546	0.585	0.625	0.664	0.704	0.744	0.783	0.823
60	0.040	0.080	0.119	0.158	0.197	0.236	0.275	0.314	0.353	0.393	0.432	0.471	0.510	0.549	0.588	0.627	0.667	0.706	0.745	0.784	0.823
65	0.054	0.092	0.131	0.169	0.208	0.246	0.285	0.323	0.362	0.400	0.438	0.477	0.515	0.554	0.592	0.631	0.669	0.708	0.746	0.785	0.823
70	0.071	0.109	0.147	0.184	0.222	0.259	0.297	0.335	0.372	0.410	0.447	0.485	0.522	0.560	0.598	0.635	0.673	0.710	0.748	0.785	0.823
75	0.096	0.132	0.168	0.205	0.241	0.277	0.314	0.350	0.387	0.423	0.459	0.496	0.532	0.568	0.605	0.641	0.678	0.714	0.750	0.787	0.823
80	0.130	0.165	0.199	0.234	0.268	0.303	0.338	0.372	0.407	0.442	0.476	0.511	0.546	0.580	0.615	0.650	0.684	0.719	0.754	0.788	0.823
85	0.182	0.214	0.246	0.278	0.310	0.342	0.374	0.406	0.438	0.470	0.502	0.534	0.566	0.599	0.631	0.663	0.695	0.727	0.759	0.791	0.823
90	0.266	0.294	0.322	0.350	0.378	0.406	0.433	0.461	0.489	0.517	0.545	0.573	0.600	0.628	0.656	0.684	0.712	0.740	0.767	0.795	0.823
95	0.429	0.449	0.469	0.488	0.508	0.528	0.547	0.567	0.587	0.606	0.626	0.646	0.665	0.685	0.705	0.725	0.744	0.764	0.784	0.803	0.823
98	0.616	0.626	0.636	0.647	0.657	0.667	0.678	0.688	0.699	0.709	0.719	0.730	0.740	0.750	0.761	0.771	0.782	0.792	0.802	0.813	0.823

ZONE 5
Mean Annual Runoff Coefficients (ROC Value) as a Function of DCIA Percentage and Non-DCIA Curve Number

NDCIA CN	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	0.008	0.048	0.088	0.128	0.168	0.208	0.248	0.288	0.328	0.368	0.408	0.448	0.488	0.528	0.568	0.608	0.648	0.688	0.728	0.768	0.808
35	0.012	0.052	0.092	0.132	0.171	0.211	0.251	0.291	0.331	0.370	0.410	0.450	0.490	0.529	0.569	0.609	0.649	0.689	0.728	0.768	0.808
40	0.018	0.057	0.097	0.136	0.176	0.215	0.255	0.294	0.334	0.373	0.413	0.452	0.492	0.531	0.571	0.611	0.650	0.690	0.729	0.769	0.808
45	0.025	0.064	0.103	0.142	0.182	0.221	0.260	0.299	0.338	0.377	0.417	0.456	0.495	0.534	0.573	0.612	0.651	0.691	0.730	0.769	0.808
50	0.034	0.072	0.111	0.150	0.189	0.227	0.266	0.305	0.343	0.382	0.421	0.460	0.498	0.537	0.576	0.614	0.653	0.692	0.731	0.769	0.808
55	0.044	0.082	0.121	0.159	0.197	0.235	0.273	0.312	0.350	0.388	0.426	0.464	0.502	0.541	0.579	0.617	0.655	0.693	0.732	0.770	0.808
60	0.057	0.095	0.132	0.170	0.207	0.245	0.282	0.320	0.357	0.395	0.433	0.470	0.508	0.545	0.583	0.620	0.658	0.695	0.733	0.770	0.808
65	0.073	0.110	0.147	0.183	0.220	0.257	0.294	0.330	0.367	0.404	0.441	0.477	0.514	0.551	0.588	0.624	0.661	0.698	0.735	0.771	0.808
70	0.093	0.129	0.165	0.201	0.236	0.272	0.308	0.344	0.379	0.415	0.451	0.486	0.522	0.558	0.594	0.629	0.665	0.701	0.737	0.772	0.808
75	0.120	0.155	0.189	0.223	0.258	0.292	0.327	0.361	0.395	0.430	0.464	0.498	0.533	0.567	0.602	0.636	0.670	0.705	0.739	0.774	0.808
80	0.157	0.189	0.222	0.254	0.287	0.319	0.352	0.385	0.417	0.450	0.482	0.515	0.547	0.580	0.613	0.645	0.678	0.710	0.743	0.775	0.808
85	0.209	0.239	0.269	0.299	0.329	0.359	0.389	0.419	0.449	0.479	0.509	0.538	0.568	0.598	0.628	0.658	0.688	0.718	0.748	0.778	0.808
90	0.292	0.318	0.343	0.369	0.395	0.421	0.447	0.472	0.498	0.524	0.550	0.576	0.602	0.627	0.653	0.679	0.705	0.731	0.756	0.782	0.808
95	0.445	0.464	0.482	0.500	0.518	0.536	0.554	0.572	0.590	0.609	0.627	0.645	0.663	0.681	0.699	0.717	0.736	0.754	0.772	0.790	0.808
98	0.614	0.624	0.633	0.643	0.653	0.662	0.672	0.682	0.692	0.701	0.711	0.721	0.730	0.740	0.750	0.760	0.769	0.779	0.789	0.798	0.808

Appendix O

Traditional BMP Treatment Efficiencies

Directions for use

This listing of BMPs defines the treatment efficiencies for total phosphorous (TP) and total nitrogen (TN) for traditional BMPs. Applicants will determine the predicted pollutant loading from their post development site the treatment efficiency required as described in applicant's Handbook Volume I. Treatment efficiencies for traditional BMPs alone are listed in the table. Some BMPs do not have a static efficiency and the applicant will have to refer to the formulas or tables provided to calculate the BMP's efficiency. Applicants will design their system so that their BMP's Efficiency, either by itself or in series with others, matches the required efficiency set forth in AH Vol I. BMPs designed in series will have their treatment efficiencies calculated by the formula listed in the BMP Treatment Train section.

All BMPs are required to meet all the design requirements outlined in the applicable Applicant's Handbook Volume II.

Table 1: of BMP Efficiencies

BMP	TP Reduction	TN Reduction	Data Source
Retention Pond and Retention Systems	Based on percent reduction using project's percent directly connected impervious area (DCIA), non-DCIA curve number (CN), and rainfall zone	Based on percent reduction using project's percent directly connected impervious area (DCIA), non-DCIA curve number (CN), and rainfall zone	Evaluation of current stormwater design criteria within the state of Florida, Harper and Baker 2007
Wet detention ponds	Formula based on Average Annual Residence Time for Removal Efficiency of Total Phosphorus	Formula based on Average Annual Residence Time Removal Efficiency of Total Nitrogen	Evaluation of current stormwater design criteria within the state of Florida, Harper and Baker 2007
Baffle boxes (gravity-based separators)—First generation	2.30%	0.50%	Final report, Contract S0236, Effectiveness of baffle boxes plus media filter, by GPI Southeast 2010; Demonstration bio media for ultra-urban stormwater treatment, by University of Central Florida (UCF) for Florida Department of Transportation (FDOT); and Final report, Contract S0497, Baffle box with media filtration installation and effectiveness evaluation by City of Casselberry,
Baffle boxes (gravity-based separators)—Second generation	15.50%	19.05%	
Baffle boxes (gravity-based separators)—Second generation plus media filter	Media Mix Efficiency	Media Mix Efficiency	

BMP	TP Reduction	TN Reduction	Data Source
Hydrodynamic separators (including vortex and continuous deflector separators [CDS] units)	10%	N/A	Final Report, Contract S0095, Sanford Stormceptor Project, 2008; Final Report, Contract WM793, Broadway Outfall Project, 2006
Catch basin inserts/inlet filter cleanout (drainage features and units with no specific water quality treatment mechanism), including the following: • Curb inlets. • Area catch basins. • Pavement catch basins. • Projects serving drainage and conveyance functions.	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP Toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TP reduction	Determine annual average dry weight/volume of material collected over a period of 3 years (or representative period of current effort) and enter values into the Florida Stormwater Association (FSA) University of Florida (UF) Municipal Separate Storm Sewer (MS4) BMP Toolkit (FINAL MS4 Load Reduction Tool 2019 or newer version) for estimated TN reduction	2019 Final Report (or newer version), FSA UF MS4 BMP Project
Green Stormwater Infrastructure Efforts Including: Green Roofs, Rain gardens, Swales with blocks, Bioswales, Tree boxes, Tree wells, Vegetated Natural Buffers, Vegetated filter strip, Pervious Pavement Systems	Use appropriate retention or detention calculation for volume captured then add an additional removal based on plant, soil and media selections in a treatment train configuration.	Use appropriate retention or detention calculation for volume captured then add an additional removal based on plant, soil and media selections in a treatment train configuration.	Evaluation of current stormwater design criteria within the state of Florida, Harper and Baker 2007
Floating islands/managed aquatic plant systems (MAPS)	12% removal with 5 % pond coverage based on harvesting at least every 12 months.	12% removal with 5 % pond coverage based on harvesting at least every 12 months.	Floating Wetland Systems for Nutrient Removal in Stormwater Ponds Wanielista and Chang 2012

BMP	TP Reduction	TN Reduction	Data Source
Littoral Zone	Maximum 10% removal with a minimum littoral zone area as described in AH Volume II.	Maximum 10% removal with a minimum littoral zone area as described in AH Volume II.	Nutrient Removal From Urban Strom Urban Stormwater Using Floating Stormwater Using Floating Treatment Wetland System Kamrul Islam 2011 Quantifying the Effect of a Vegetated Littoral Zone on Wet Detention Pond Pollutant Load Reduction DB Environmental, Inc. (2005)
Stormwater harvesting	Estimate annual load of stormwater (and percentage of total if not 100 %) not discharged because used for irrigation	Estimate annual load of stormwater (and percentage of total if not 100 %) not discharged because used for irrigation	Evaluated on case-by-case basis (to estimate volume of stormwater reuse, use the rate-efficiency-volume [REV] curve methodology used by DEP. Based on 1991 Wanielista, M., Y. Yousef, G. Harper, and L. Dansereau, Design Curves for the Reuse of Stormwater and 1992 Wanielista, M. and J. Bradner, Maintaining the Balance)
Stormwater alum injection systems	Based on dosage determined in jar testing	Based on dosage determined in jar testing	Harper, H., and J. Herr 1998 study for DEP – Alum treatment of stormwater: The first ten years

Treatment Train

BMPs can be implemented in combination or in conjunction with one another in a series called a best management practice treatment train. Where BMPs are used in series, the calculated overall efficiency of the treatment train must account for the reduced loading or concentrations that are available for removal by the subsequent downstream treatment device. This relationship is shown in Equation 9-5. This equation assumes each BMP acts independently of upstream BMPs, and that upstream BMPs do not impact performance of downstream BMPs. As stormwater pollutant concentrations are reduced in each BMP in the treatment train, the ability of a downstream BMP in the treatment train should not be arbitrarily reduced when used in Equation 9-5. The overall design removal calculations for a BMP treatment train should reflect any objective information where there is an identifiable causal relationship where a downstream unit treatment efficiency would be diminished in some manner by the operation of a specific upstream treatment unit. If such a causal relationship exists where the BMP acts in combination with the upstream BMP, the designer should consider the use of another methodology to accurately determine the resultant efficiency of the overall BMP treatment train.

Equation 9-5: Overall Treatment Train Efficiency for systems in series

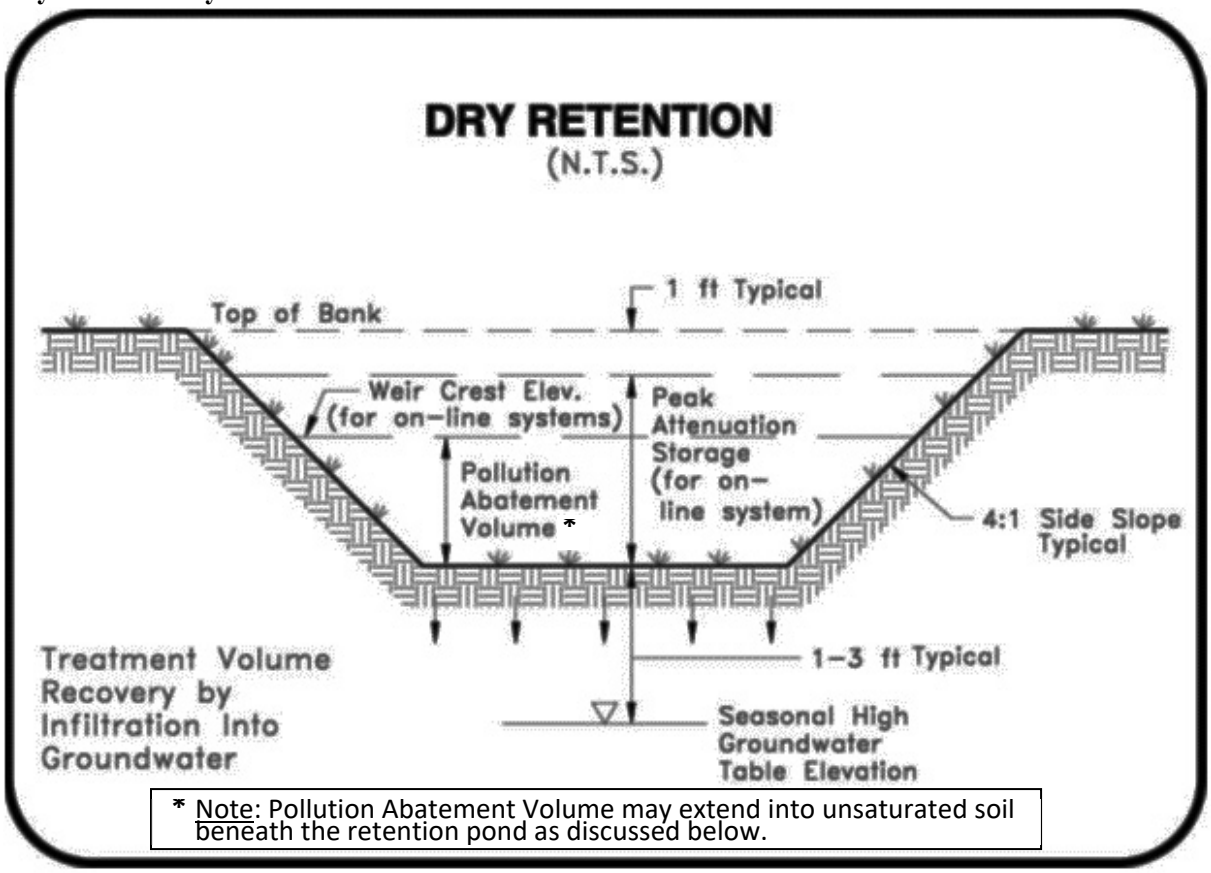
$$Overall\ Treatment\ Train\ Efficiency = Eff1 + [(1 - Eff1)x\ Eff2] + [\{(1 - Eff1) - ((1 - Eff1)xEff2)\}\ x\ Eff3\ ]$$

$$or\ (in\ simplified\ form)$$

$$= 1 - [(1 - Eff1) \times (1 - Eff2) \times (1 - Eff3) \times \ldots \times (1 - Effn)]$$

where:
Eff1 = efficiency (as a decimal) of initial or first treatment system
Eff2 = efficiency (as a decimal) of second treatment system
Eff3 = efficiency (as a decimal) of third treatment system
Effn = efficiency (as a decimal) of the n^{th} treatment system

Dry Retention Systems



The average annual effectiveness is calculated using an event maximum runoff volume that can be captured in the retention system. This maximum volume is expressed as inches over the catchment area and is called the design volume. It is adjusted for the Curve Number (CN) applied to the non-directly connected impervious area (NDCIA) and the directly connected impervious area (DCIA).

Recovery of the required treatment volume (Pollution Abatement Volume, or PAV) must be achieved within 72 hours or less, equivalent to the volume recovery period utilized for generation of the performance efficiency summarized in the tables. Ability of the pond to achieve this recovery rate must be certified by a registered professional engineer. The required PAV may include the effective unsaturated soil volume beneath the retention pond, to the elevation of the seasonal high groundwater level; however, the PAV inside and above the pond bottom shall at least equal 0.5 inches over the project drainage are for the pond. All side slopes and bottom areas of the pond must be seeded or sodded with water-tolerant grass species grown on sandy soils. If sod is used as the vegetative cover on the bottom of the pond, changes in permeability of the basin resulting from the sod must be included in evaluation of the recovery period for the pond. Inlets and outlets must be located as far apart as possible to prevent short-circuiting. Oil and grease skimmers must be provided at all outfall structures. Other requirements related to side slopes, fencing, maintenance berms, and access will adhere to applicable local agency criteria.

There are 80 tables reflecting design retention depths for five rainfall regions. Each region has a table for 17 different design retention depths. For DCIA and CN other than increments of 5, linear interpolation between the values is performed.

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	86.2	81.3	73.3	65.5	58.7	53.0	48.3	44.2	40.8	37.9	35.3	33.1	31.1	29.4	27.8	26.4	25.1	24.0	22.9	21.9
35	81.6	78.7	71.7	64.5	58.0	52.5	47.9	44.0	40.6	37.7	35.2	33.0	31.0	29.3	27.8	26.4	25.1	23.9	22.9	21.9
40	76.4	75.5	69.6	63.1	57.1	51.9	47.4	43.6	40.3	37.5	35.0	32.9	30.9	29.2	27.7	26.3	25.1	23.9	22.9	21.9
45	70.7	71.7	67.2	61.4	55.9	51.0	46.8	43.1	40.0	37.2	34.8	32.7	30.8	29.1	27.6	26.3	25.0	23.9	22.9	21.9
50	64.7	67.5	64.2	59.4	54.5	50.0	46.0	42.6	39.5	36.9	34.6	32.5	30.7	29.0	27.5	26.2	25.0	23.9	22.9	21.9
55	58.6	62.8	60.9	57.0	52.7	48.7	45.1	41.8	39.0	36.5	34.2	32.3	30.5	28.9	27.4	26.1	24.9	23.9	22.9	21.9
60	52.8	57.8	57.1	54.2	50.7	47.1	43.9	40.9	38.3	35.9	33.8	31.9	30.2	28.7	27.3	26.0	24.9	23.8	22.8	21.9
65	47.3	52.6	53.0	51.1	48.3	45.3	42.5	39.8	37.4	35.3	33.3	31.5	29.9	28.4	27.1	25.9	24.8	23.8	22.8	21.9
70	42.2	47.3	48.6	47.6	45.6	43.2	40.8	38.5	36.4	34.4	32.6	31.0	29.5	28.1	26.9	25.7	24.7	23.7	22.8	21.9
75	37.8	42.2	43.9	43.7	42.4	40.7	38.8	36.9	35.1	33.4	31.8	30.4	29.0	27.8	26.6	25.5	24.5	23.6	22.7	21.9
80	34.0	37.5	39.1	39.4	38.8	37.7	36.4	34.9	33.5	32.1	30.8	29.5	28.3	27.2	26.2	25.2	24.3	23.5	22.7	21.9
85	30.8	33.1	34.3	34.8	34.7	34.2	33.4	32.5	31.4	30.4	29.4	28.4	27.4	26.5	25.7	24.8	24.1	23.3	22.6	21.9
90	27.9	29.2	29.9	30.3	30.3	30.2	29.8	29.3	28.8	28.2	27.5	26.8	26.2	25.5	24.9	24.2	23.6	23.0	22.5	21.9
95	25.3	25.6	25.8	25.9	26.0	25.9	25.8	25.6	25.4	25.2	24.9	24.6	24.3	24.0	23.6	23.3	23.0	22.6	22.3	21.9
98	23.8	23.8	23.8	23.7	23.7	23.6	23.5	23.4	23.3	23.2	23.1	23.0	22.9	22.8	22.6	22.5	22.4	22.2	22.1	21.9

Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	91.8	91.5	88.3	84.0	79.5	75.0	70.7	66.6	62.9	59.6	56.5	53.6	51.1	48.7	46.6	44.6	42.8	41.1	39.6	38.1
35	88.2	89.1	86.6	82.8	78.6	74.3	70.1	66.2	62.6	59.3	56.3	53.5	51.0	48.7	46.5	44.6	42.8	41.1	39.6	38.1
40	84.0	86.3	84.4	81.2	77.4	73.4	69.4	65.7	62.2	59.0	56.0	53.3	50.8	48.5	46.4	44.5	42.7	41.1	39.6	38.1
45	79.6	82.9	81.9	79.3	75.9	72.2	68.5	65.0	61.7	58.6	55.7	53.0	50.6	48.4	46.3	44.4	42.7	41.0	39.5	38.1
50	74.8	79.1	79.0	77.0	74.1	70.8	67.4	64.1	61.0	58.0	55.3	52.7	50.4	48.2	46.2	44.3	42.6	41.0	39.5	38.1
55	70.1	74.9	75.6	74.2	71.9	69.1	66.1	63.0	60.1	57.3	54.7	52.3	50.0	47.9	46.0	44.2	42.5	40.9	39.5	38.1
60	65.5	70.4	71.7	71.1	69.4	67.0	64.4	61.7	59.1	56.5	54.1	51.8	49.6	47.6	45.8	44.0	42.4	40.9	39.5	38.1
65	61.0	65.8	67.5	67.6	66.4	64.7	62.5	60.2	57.8	55.5	53.3	51.1	49.1	47.2	45.5	43.8	42.3	40.8	39.4	38.1
70	56.7	61.1	63.1	63.6	63.1	61.9	60.2	58.3	56.3	54.3	52.3	50.3	48.5	46.8	45.1	43.5	42.1	40.7	39.4	38.1
75	52.7	56.6	58.6	59.3	59.3	58.6	57.5	56.0	54.4	52.7	51.0	49.3	47.7	46.1	44.6	43.2	41.8	40.5	39.3	38.1
80	49.1	52.2	54.1	55.0	55.2	54.9	54.2	53.2	52.1	50.8	49.4	48.0	46.6	45.3	44.0	42.7	41.5	40.3	39.2	38.1
85	46.1	48.3	49.7	50.5	50.8	50.8	50.5	49.9	49.2	48.3	47.3	46.3	45.2	44.2	43.1	42.1	41.0	40.0	39.1	38.1
90	43.5	44.8	45.6	46.1	46.4	46.5	46.4	46.1	45.7	45.2	44.6	44.0	43.3	42.6	41.9	41.1	40.4	39.6	38.9	38.1
95	41.1	41.5	41.8	41.9	42.0	42.1	42.0	41.9	41.8	41.6	41.3	41.1	40.8	40.4	40.1	39.7	39.3	38.9	38.5	38.1
98	39.8	39.8	39.8	39.8	39.8	39.7	39.7	39.6	39.5	39.4	39.3	39.2	39.1	39.0	38.9	38.7	38.6	38.4	38.3	38.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.0	94.9	93.4	91.0	88.1	85.0	81.8	78.7	75.5	72.6	69.7	67.0	64.5	62.1	59.8	57.7	55.7	53.8	52.1	50.5
35	91.2	93.0	91.9	89.8	87.2	84.2	81.2	78.2	75.2	72.3	69.5	66.8	64.3	62.0	59.7	57.6	55.7	53.8	52.1	50.5
40	88.1	90.5	90.1	88.3	86.0	83.3	80.5	77.6	74.7	71.9	69.2	66.6	64.1	61.8	59.6	57.6	55.6	53.8	52.1	50.5
45	84.5	87.7	87.9	86.5	84.5	82.1	79.5	76.8	74.0	71.4	68.8	66.3	63.9	61.6	59.5	57.5	55.5	53.7	52.0	50.5
50	80.8	84.6	85.2	84.4	82.8	80.7	78.3	75.8	73.3	70.7	68.3	65.9	63.6	61.4	59.3	57.3	55.5	53.7	52.0	50.5
55	77.1	81.1	82.2	81.9	80.7	79.0	76.9	74.6	72.3	70.0	67.6	65.4	63.2	61.1	59.1	57.2	55.3	53.6	52.0	50.5
60	73.2	77.5	79.0	79.1	78.3	76.9	75.2	73.2	71.1	69.0	66.9	64.7	62.7	60.7	58.8	56.9	55.2	53.5	51.9	50.5
65	69.6	73.8	75.4	75.8	75.5	74.5	73.2	71.5	69.7	67.8	65.9	63.9	62.0	60.2	58.4	56.7	55.0	53.4	51.9	50.5
70	66.1	69.9	71.7	72.3	72.3	71.7	70.8	69.5	68.0	66.4	64.7	63.0	61.3	59.6	57.9	56.3	54.8	53.3	51.8	50.5
75	62.7	66.0	67.8	68.6	68.8	68.5	67.9	67.1	65.9	64.7	63.3	61.8	60.3	58.8	57.3	55.9	54.5	53.1	51.7	50.5
80	59.6	62.2	63.8	64.7	65.1	65.1	64.8	64.2	63.4	62.5	61.4	60.3	59.1	57.8	56.6	55.3	54.0	52.8	51.6	50.5
85	56.8	58.7	60.0	60.8	61.2	61.4	61.3	61.0	60.5	59.9	59.1	58.3	57.4	56.5	55.5	54.5	53.5	52.5	51.4	50.5
90	54.5	55.6	56.4	57.0	57.3	57.5	57.5	57.4	57.2	56.8	56.4	55.9	55.4	54.7	54.1	53.4	52.7	51.9	51.2	50.5
95	52.5	52.9	53.2	53.3	53.5	53.6	53.6	53.6	53.5	53.4	53.2	53.0	52.8	52.5	52.2	51.9	51.6	51.2	50.8	50.5
98	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.6	51.6	51.5	51.4	51.3	51.3	51.2	51.1	51.0	50.8	50.7	50.6	50.5

Mean Annual Mass Removal Efficiencies for 1.00-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.3	96.5	95.9	94.4	92.5	90.3	87.9	85.5	83.1	80.6	78.2	75.8	73.6	71.4	69.2	67.2	65.3	63.4	61.6	60.0
35	93.1	94.9	94.6	93.3	91.6	89.5	87.3	85.0	82.7	80.3	77.9	75.6	73.4	71.2	69.1	67.1	65.2	63.4	61.6	60.0
40	90.7	93.0	93.0	92.0	90.5	88.6	86.6	84.4	82.1	79.9	77.6	75.4	73.2	71.1	69.0	67.0	65.2	63.3	61.6	60.0
45	88.0	90.7	91.0	90.5	89.2	87.5	85.6	83.6	81.5	79.3	77.2	75.0	72.9	70.9	68.8	66.9	65.1	63.3	61.6	60.0
50	85.0	88.0	88.8	88.6	87.6	86.2	84.5	82.7	80.7	78.7	76.6	74.6	72.6	70.6	68.6	66.8	65.0	63.2	61.6	60.0
55	81.8	85.3	86.4	86.3	85.7	84.6	83.2	81.5	79.8	77.9	75.9	74.0	72.1	70.2	68.4	66.6	64.8	63.1	61.5	60.0
60	78.7	82.3	83.6	83.9	83.5	82.7	81.5	80.1	78.6	76.9	75.1	73.4	71.6	69.8	68.0	66.3	64.7	63.0	61.5	60.0
65	75.6	79.1	80.6	81.2	81.0	80.5	79.6	78.5	77.2	75.7	74.1	72.5	70.9	69.3	67.6	66.0	64.4	62.9	61.4	60.0
70	72.7	75.9	77.5	78.2	78.3	78.0	77.4	76.5	75.5	74.2	72.9	71.5	70.1	68.6	67.1	65.6	64.2	62.7	61.3	60.0
75	69.9	72.7	74.2	75.0	75.3	75.2	74.8	74.2	73.4	72.5	71.4	70.3	69.1	67.8	66.5	65.1	63.8	62.5	61.2	60.0
80	67.2	69.5	70.8	71.7	72.1	72.1	72.0	71.6	71.1	70.4	69.6	68.7	67.8	66.7	65.6	64.5	63.4	62.2	61.1	60.0
85	64.8	66.5	67.6	68.3	68.7	68.9	68.9	68.7	68.4	68.0	67.5	66.8	66.1	65.4	64.5	63.7	62.8	61.8	60.9	60.0
90	62.7	63.7	64.4	65.0	65.3	65.5	65.6	65.6	65.5	65.2	65.0	64.6	64.2	63.7	63.1	62.6	61.9	61.3	60.6	60.0
95	61.1	61.5	61.8	62.0	62.1	62.2	62.3	62.3	62.3	62.2	62.1	62.0	61.8	61.6	61.4	61.2	60.9	60.6	60.3	60.0
98	60.7	60.7	60.7	60.8	60.8	60.8	60.8	60.8	60.7	60.7	60.7	60.6	60.6	60.5	60.4	60.3	60.3	60.2	60.1	60.0

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	96.1	97.3	97.2	96.3	94.9	93.4	91.6	89.7	87.8	85.8	83.8	81.8	79.9	77.9	76.0	74.2	72.4	70.6	68.9	67.3
35	94.5	96.1	96.2	95.4	94.1	92.7	91.0	89.2	87.4	85.5	83.5	81.6	79.7	77.8	75.9	74.1	72.3	70.6	68.9	67.3
40	92.5	94.5	94.8	94.2	93.2	91.9	90.3	88.6	86.9	85.0	83.2	81.3	79.5	77.6	75.8	74.0	72.3	70.6	68.9	67.3
45	90.4	92.7	93.2	92.8	92.0	90.9	89.4	87.9	86.3	84.5	82.8	81.0	79.2	77.4	75.6	73.9	72.2	70.5	68.9	67.3
50	88.0	90.6	91.3	91.2	90.6	89.7	88.4	87.0	85.5	83.9	82.2	80.5	78.8	77.1	75.4	73.7	72.1	70.4	68.9	67.3
55	85.4	88.2	89.2	89.3	88.9	88.2	87.2	86.0	84.6	83.1	81.6	80.0	78.4	76.7	75.1	73.5	71.9	70.3	68.8	67.3
60	82.7	85.7	86.9	87.2	87.0	86.5	85.7	84.7	83.5	82.2	80.8	79.3	77.8	76.3	74.8	73.2	71.7	70.2	68.8	67.3
65	80.1	83.1	84.4	84.9	84.9	84.5	83.9	83.1	82.1	81.0	79.8	78.5	77.1	75.7	74.3	72.9	71.5	70.1	68.7	67.3
70	77.6	80.3	81.7	82.4	82.5	82.4	81.9	81.3	80.6	79.7	78.6	77.5	76.3	75.1	73.8	72.5	71.2	69.9	68.6	67.3
75	75.2	77.6	79.0	79.7	80.0	79.9	79.7	79.3	78.7	78.0	77.2	76.3	75.3	74.2	73.1	72.0	70.9	69.7	68.5	67.3
80	73.0	74.9	76.1	76.8	77.2	77.3	77.3	77.0	76.6	76.1	75.5	74.8	74.0	73.2	72.3	71.4	70.4	69.4	68.4	67.3
85	70.9	72.3	73.3	73.9	74.3	74.5	74.6	74.5	74.3	73.9	73.5	73.1	72.5	71.9	71.2	70.5	69.8	69.0	68.2	67.3
90	69.2	70.0	70.6	71.1	71.4	71.6	71.7	71.7	71.7	71.5	71.3	71.1	70.7	70.4	70.0	69.5	69.0	68.5	67.9	67.3
95	67.8	68.1	68.4	68.6	68.7	68.9	68.9	69.0	69.0	69.0	68.9	68.9	68.7	68.6	68.5	68.3	68.1	67.8	67.6	67.3
98	67.7	67.7	67.7	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.7	67.7	67.6	67.6	67.5	67.5	67.4	67.3

Mean Annual Mass Removal Efficiencies for 1.50-inches of Retention for Zone 1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	96.8	97.8	98.0	97.5	96.5	95.3	94.0	92.5	90.9	89.3	87.7	86.0	84.3	82.7	81.0	79.3	77.7	76.1	74.6	73.1
35	95.5	96.9	97.1	96.7	95.8	94.7	93.5	92.1	90.6	89.0	87.4	85.8	84.1	82.5	80.9	79.3	77.7	76.1	74.6	73.1
40	93.9	95.6	96.0	95.7	95.0	94.0	92.8	91.5	90.1	88.6	87.1	85.5	83.9	82.3	80.7	79.2	77.6	76.1	74.6	73.1
45	92.1	94.2	94.7	94.5	93.9	93.1	92.0	90.8	89.5	88.1	86.6	85.1	83.6	82.1	80.6	79.0	77.5	76.0	74.5	73.1
50	90.3	92.5	93.1	93.1	92.7	92.0	91.1	90.0	88.8	87.5	86.1	84.7	83.3	81.8	80.3	78.9	77.4	75.9	74.5	73.1
55	88.2	90.5	91.3	91.4	91.2	90.7	89.9	89.0	87.9	86.8	85.5	84.2	82.8	81.5	80.1	78.6	77.2	75.8	74.4	73.1
60	85.9	88.3	89.3	89.6	89.6	89.2	88.6	87.8	86.9	85.9	84.7	83.5	82.3	81.0	79.7	78.4	77.0	75.7	74.4	73.1
65	83.5	86.0	87.2	87.7	87.7	87.5	87.0	86.4	85.7	84.8	83.8	82.8	81.7	80.5	79.3	78.1	76.8	75.6	74.3	73.1
70	81.4	83.7	85.0	85.5	85.7	85.6	85.3	84.8	84.2	83.5	82.7	81.8	80.9	79.9	78.8	77.7	76.5	75.4	74.2	73.1
75	79.4	81.4	82.5	83.2	83.5	83.5	83.3	83.0	82.6	82.1	81.4	80.7	79.9	79.1	78.1	77.2	76.2	75.2	74.1	73.1
80	77.4	79.1	80.1	80.8	81.1	81.2	81.2	81.0	80.8	80.4	79.9	79.4	78.8	78.1	77.3	76.5	75.7	74.9	74.0	73.1
85	75.7	76.9	77.7	78.3	78.6	78.8	78.9	78.9	78.7	78.5	78.2	77.8	77.4	76.9	76.3	75.8	75.1	74.5	73.8	73.1
90	74.2	74.9	75.4	75.9	76.2	76.4	76.5	76.5	76.5	76.4	76.3	76.1	75.8	75.5	75.2	74.8	74.4	74.0	73.6	73.1
95	73.1	73.3	73.6	73.8	73.9	74.0	74.1	74.2	74.2	74.2	74.2	74.2	74.1	74.0	73.9	73.8	73.6	73.5	73.3	73.1
98	73.1	73.1	73.2	73.2	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.3	73.2	73.2	73.2	73.1	73.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.3	98.1	98.4	98.2	97.6	96.6	95.6	94.4	93.2	91.8	90.4	89.0	87.6	86.1	84.7	83.3	81.8	80.4	79.0	77.6
35	96.1	97.4	97.7	97.6	97.0	96.1	95.1	94.0	92.8	91.5	90.2	88.8	87.4	86.0	84.6	83.2	81.8	80.4	79.0	77.6
40	94.9	96.4	96.8	96.7	96.2	95.5	94.5	93.5	92.4	91.1	89.9	88.5	87.2	85.8	84.4	83.1	81.7	80.3	78.9	77.6
45	93.5	95.3	95.8	95.7	95.3	94.6	93.8	92.9	91.8	90.6	89.5	88.2	86.9	85.6	84.2	82.9	81.6	80.2	78.9	77.6
50	92.0	93.9	94.5	94.5	94.2	93.7	93.0	92.1	91.2	90.1	89.0	87.8	86.6	85.3	84.0	82.8	81.5	80.2	78.9	77.6
55	90.3	92.3	93.0	93.1	92.9	92.5	92.0	91.2	90.4	89.4	88.4	87.3	86.1	85.0	83.8	82.6	81.3	80.1	78.8	77.6
60	88.4	90.5	91.3	91.5	91.5	91.2	90.8	90.1	89.4	88.6	87.7	86.7	85.6	84.5	83.4	82.3	81.1	80.0	78.8	77.6
65	86.4	88.4	89.4	89.8	89.9	89.7	89.4	88.9	88.3	87.6	86.8	86.0	85.0	84.0	83.0	82.0	80.9	79.8	78.7	77.6
70	84.4	86.4	87.4	88.0	88.1	88.1	87.9	87.5	87.0	86.4	85.8	85.1	84.3	83.4	82.5	81.6	80.6	79.6	78.6	77.6
75	82.6	84.4	85.4	86.0	86.2	86.3	86.2	85.9	85.6	85.1	84.6	84.0	83.4	82.7	81.9	81.1	80.3	79.4	78.5	77.6
80	81.0	82.4	83.3	83.9	84.2	84.3	84.3	84.2	84.0	83.7	83.3	82.8	82.4	81.8	81.2	80.6	79.9	79.1	78.4	77.6
85	79.4	80.5	81.2	81.7	82.0	82.2	82.3	82.3	82.2	82.0	81.8	81.5	81.2	80.8	80.4	79.9	79.3	78.8	78.2	77.6
90	78.1	78.8	79.3	79.6	79.9	80.1	80.2	80.3	80.3	80.2	80.1	80.0	79.8	79.6	79.3	79.0	78.7	78.4	78.0	77.6
95	77.3	77.5	77.8	77.9	78.1	78.2	78.3	78.3	78.4	78.4	78.4	78.4	78.4	78.3	78.2	78.1	78.0	77.9	77.7	77.6
98	77.4	77.5	77.5	77.6	77.6	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.7	77.6	77.6	77.6

Mean Annual Mass Removal Efficiencies for 2.00-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.9	98.5	98.6	98.6	98.3	97.6	96.7	95.8	94.8	93.7	92.5	91.3	90.0	88.8	87.5	86.2	85.0	83.7	82.4	81.2
35	96.7	97.8	98.1	98.1	97.8	97.1	96.3	95.4	94.4	93.4	92.2	91.1	89.9	88.7	87.4	86.2	84.9	83.7	82.4	81.2
40	95.6	97.0	97.5	97.4	97.1	96.6	95.8	94.9	94.0	93.0	91.9	90.8	89.7	88.5	87.3	86.0	84.8	83.6	82.4	81.2
45	94.5	96.1	96.6	96.6	96.3	95.8	95.2	94.4	93.5	92.6	91.6	90.5	89.4	88.3	87.1	85.9	84.7	83.6	82.4	81.2
50	93.3	95.0	95.5	95.6	95.4	94.9	94.4	93.7	93.0	92.1	91.1	90.1	89.1	88.0	86.9	85.8	84.6	83.5	82.3	81.2
55	91.9	93.7	94.3	94.4	94.2	93.9	93.5	92.9	92.2	91.4	90.6	89.6	88.7	87.7	86.6	85.6	84.5	83.4	82.3	81.2
60	90.4	92.1	92.8	93.0	93.0	92.8	92.4	91.9	91.3	90.6	89.9	89.1	88.2	87.3	86.3	85.3	84.3	83.3	82.2	81.2
65	88.7	90.4	91.2	91.5	91.6	91.5	91.2	90.8	90.3	89.8	89.1	88.4	87.6	86.8	85.9	85.0	84.1	83.1	82.2	81.2
70	87.0	88.6	89.4	89.9	90.1	90.1	89.9	89.6	89.2	88.7	88.2	87.6	86.9	86.2	85.4	84.6	83.8	83.0	82.1	81.2
75	85.3	86.8	87.7	88.2	88.4	88.5	88.4	88.2	87.9	87.6	87.1	86.7	86.1	85.5	84.9	84.2	83.5	82.8	82.0	81.2
80	83.8	85.1	85.8	86.3	86.7	86.8	86.8	86.7	86.5	86.3	86.0	85.6	85.2	84.7	84.2	83.7	83.1	82.5	81.9	81.2
85	82.5	83.4	84.0	84.5	84.8	85.0	85.0	85.0	84.9	84.8	84.6	84.4	84.1	83.8	83.4	83.1	82.6	82.2	81.7	81.2
90	81.4	81.9	82.4	82.7	82.9	83.1	83.2	83.3	83.3	83.3	83.2	83.1	82.9	82.8	82.6	82.3	82.1	81.8	81.5	81.2
95	80.7	80.9	81.1	81.2	81.4	81.5	81.6	81.6	81.7	81.7	81.7	81.7	81.7	81.7	81.6	81.6	81.5	81.4	81.3	81.2
98	80.9	80.9	81.0	81.0	81.1	81.1	81.1	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2	81.2

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.4	98.8	98.9	98.9	98.7	98.2	97.6	96.8	95.9	95.0	94.0	93.0	91.9	90.8	89.7	88.6	87.5	86.3	85.2	84.1
35	97.2	98.1	98.4	98.5	98.3	97.9	97.2	96.5	95.6	94.7	93.8	92.8	91.8	90.7	89.6	88.5	87.4	86.3	85.2	84.1
40	96.2	97.4	97.8	97.9	97.8	97.3	96.8	96.1	95.3	94.4	93.5	92.6	91.6	90.5	89.5	88.4	87.3	86.2	85.1	84.1
45	95.3	96.7	97.2	97.3	97.1	96.7	96.2	95.5	94.8	94.0	93.2	92.3	91.3	90.3	89.3	88.3	87.2	86.2	85.1	84.1
50	94.3	95.8	96.3	96.5	96.3	95.9	95.5	94.9	94.3	93.6	92.8	91.9	91.0	90.1	89.1	88.1	87.1	86.1	85.1	84.1
55	93.2	94.8	95.3	95.4	95.3	95.0	94.6	94.2	93.6	93.0	92.3	91.5	90.6	89.8	88.9	87.9	87.0	86.0	85.0	84.1
60	92.0	93.5	94.1	94.3	94.2	94.0	93.7	93.3	92.8	92.3	91.6	90.9	90.2	89.4	88.6	87.7	86.8	85.9	85.0	84.1
65	90.6	92.0	92.7	92.9	93.0	92.9	92.7	92.4	92.0	91.5	90.9	90.3	89.7	89.0	88.2	87.4	86.6	85.8	84.9	84.1
70	89.1	90.4	91.1	91.5	91.6	91.6	91.5	91.3	91.0	90.5	90.1	89.6	89.0	88.4	87.8	87.1	86.4	85.6	84.8	84.1
75	87.6	88.8	89.5	90.0	90.2	90.3	90.2	90.1	89.8	89.5	89.2	88.8	88.3	87.8	87.3	86.7	86.1	85.4	84.7	84.1
80	86.2	87.2	87.9	88.4	88.6	88.8	88.8	88.7	88.6	88.4	88.1	87.8	87.5	87.1	86.7	86.2	85.7	85.2	84.6	84.1
85	85.0	85.8	86.4	86.8	87.0	87.2	87.3	87.3	87.2	87.1	86.9	86.8	86.5	86.3	86.0	85.6	85.3	84.9	84.5	84.1
90	84.0	84.5	84.9	85.2	85.4	85.6	85.7	85.7	85.7	85.7	85.7	85.6	85.5	85.4	85.2	85.0	84.8	84.6	84.3	84.1
95	83.4	83.6	83.8	84.0	84.1	84.2	84.3	84.3	84.4	84.4	84.4	84.4	84.4	84.4	84.4	84.3	84.3	84.2	84.1	84.1
98	83.7	83.7	83.8	83.8	83.9	83.9	83.9	84.0	84.0	84.0	84.0	84.0	84.0	84.1	84.1	84.1	84.1	84.1	84.1	84.1

Mean Annual Mass Removal Efficiencies for 2.50-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.7	99.1	99.1	99.1	99.0	98.7	98.2	97.6	96.8	96.1	95.2	94.3	93.4	92.5	91.5	90.5	89.5	88.5	87.4	86.4
35	97.7	98.4	98.6	98.7	98.6	98.4	97.9	97.3	96.6	95.8	95.0	94.2	93.3	92.3	91.4	90.4	89.4	88.4	87.4	86.4
40	96.7	97.8	98.2	98.3	98.2	98.0	97.5	96.9	96.3	95.5	94.8	93.9	93.1	92.2	91.3	90.3	89.3	88.4	87.4	86.4
45	95.9	97.2	97.6	97.8	97.7	97.4	97.0	96.4	95.8	95.2	94.4	93.7	92.8	92.0	91.1	90.2	89.3	88.3	87.4	86.4
50	95.1	96.5	97.0	97.1	97.0	96.7	96.3	95.9	95.3	94.7	94.1	93.3	92.6	91.7	90.9	90.0	89.2	88.2	87.3	86.4
55	94.3	95.6	96.1	96.3	96.2	95.9	95.6	95.2	94.7	94.2	93.6	92.9	92.2	91.5	90.7	89.9	89.0	88.2	87.3	86.4
60	93.3	94.6	95.1	95.3	95.2	95.0	94.8	94.4	94.0	93.6	93.0	92.4	91.8	91.1	90.4	89.6	88.9	88.1	87.2	86.4
65	92.2	93.4	93.9	94.1	94.1	94.0	93.8	93.6	93.2	92.9	92.4	91.9	91.3	90.7	90.0	89.4	88.7	87.9	87.2	86.4
70	90.8	91.9	92.5	92.8	92.9	92.9	92.8	92.6	92.4	92.0	91.6	91.2	90.7	90.2	89.6	89.1	88.4	87.8	87.1	86.4
75	89.5	90.5	91.1	91.5	91.6	91.7	91.7	91.6	91.4	91.1	90.8	90.4	90.1	89.6	89.2	88.7	88.1	87.6	87.0	86.4
80	88.2	89.1	89.7	90.1	90.3	90.4	90.4	90.4	90.3	90.1	89.9	89.6	89.3	89.0	88.6	88.2	87.8	87.4	86.9	86.4
85	87.1	87.8	88.3	88.6	88.9	89.0	89.1	89.1	89.0	89.0	88.8	88.7	88.5	88.3	88.0	87.7	87.4	87.1	86.8	86.4
90	86.3	86.7	87.0	87.3	87.5	87.6	87.7	87.8	87.8	87.8	87.7	87.7	87.6	87.5	87.3	87.2	87.0	86.8	86.6	86.4
95	85.8	85.9	86.1	86.2	86.3	86.4	86.5	86.6	86.6	86.6	86.7	86.7	86.7	86.7	86.6	86.6	86.6	86.5	86.5	86.4
98	86.0	86.1	86.1	86.2	86.2	86.2	86.3	86.3	86.3	86.3	86.3	86.3	86.4	86.4	86.4	86.4	86.4	86.4	86.4	86.4

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.9	99.3	99.3	99.3	99.2	99.0	98.6	98.2	97.5	96.9	96.2	95.4	94.6	93.8	92.9	92.0	91.1	90.2	89.3	88.3
35	98.2	98.7	98.8	98.9	98.9	98.7	98.4	97.9	97.3	96.7	96.0	95.2	94.5	93.6	92.8	91.9	91.1	90.2	89.2	88.3
40	97.2	98.1	98.4	98.5	98.5	98.4	98.0	97.6	97.0	96.4	95.7	95.0	94.3	93.5	92.7	91.8	91.0	90.1	89.2	88.3
45	96.4	97.5	97.9	98.1	98.1	97.9	97.6	97.1	96.6	96.1	95.4	94.8	94.1	93.3	92.5	91.7	90.9	90.1	89.2	88.3
50	95.8	97.0	97.4	97.6	97.6	97.4	97.0	96.6	96.2	95.6	95.1	94.5	93.8	93.1	92.4	91.6	90.8	90.0	89.2	88.3
55	95.1	96.3	96.8	96.9	96.9	96.7	96.4	96.0	95.6	95.1	94.6	94.1	93.5	92.8	92.1	91.4	90.7	89.9	89.1	88.3
60	94.4	95.5	95.9	96.1	96.0	95.9	95.7	95.3	95.0	94.6	94.1	93.6	93.1	92.5	91.9	91.2	90.5	89.8	89.1	88.3
65	93.4	94.5	94.9	95.1	95.1	95.0	94.8	94.6	94.3	93.9	93.6	93.1	92.6	92.1	91.5	90.9	90.3	89.7	89.0	88.3
70	92.3	93.2	93.7	93.9	94.0	94.0	93.9	93.7	93.5	93.2	92.9	92.5	92.1	91.7	91.2	90.7	90.1	89.5	88.9	88.3
75	91.0	91.9	92.4	92.7	92.9	92.9	92.9	92.8	92.6	92.4	92.2	91.9	91.5	91.1	90.7	90.3	89.9	89.4	88.9	88.3
80	89.9	90.6	91.1	91.5	91.7	91.8	91.8	91.8	91.7	91.5	91.3	91.1	90.9	90.6	90.3	89.9	89.6	89.2	88.8	88.3
85	88.9	89.5	89.9	90.2	90.4	90.5	90.6	90.6	90.6	90.5	90.4	90.3	90.1	89.9	89.7	89.5	89.2	89.0	88.7	88.3
90	88.1	88.5	88.8	89.0	89.2	89.3	89.4	89.4	89.5	89.5	89.4	89.4	89.3	89.2	89.1	89.0	88.9	88.7	88.5	88.3
95	87.7	87.8	88.0	88.1	88.2	88.3	88.4	88.4	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.5	88.4	88.4	88.3
98	87.9	88.0	88.0	88.1	88.1	88.1	88.2	88.2	88.2	88.2	88.3	88.3	88.3	88.3	88.3	88.3	88.3	88.3	88.3	88.3

Mean Annual Mass Removal Efficiencies for 3.00-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.1	99.4	99.5	99.4	99.3	99.2	99.0	98.6	98.1	97.5	96.9	96.2	95.5	94.8	94.1	93.3	92.4	91.6	90.8	89.9
35	98.6	99.0	99.1	99.1	99.1	99.0	98.7	98.4	97.9	97.3	96.7	96.1	95.4	94.7	94.0	93.2	92.4	91.6	90.8	89.9
40	97.7	98.4	98.6	98.7	98.7	98.7	98.5	98.1	97.6	97.1	96.5	95.9	95.2	94.6	93.8	93.1	92.3	91.5	90.8	89.9
45	96.9	97.8	98.2	98.4	98.4	98.3	98.1	97.7	97.3	96.8	96.2	95.7	95.0	94.4	93.7	93.0	92.2	91.5	90.7	89.9
50	96.3	97.3	97.8	98.0	98.0	97.9	97.6	97.2	96.9	96.4	95.9	95.4	94.8	94.2	93.5	92.9	92.2	91.4	90.7	89.9
55	95.7	96.8	97.3	97.4	97.4	97.3	97.0	96.7	96.4	96.0	95.5	95.0	94.5	93.9	93.3	92.7	92.0	91.4	90.7	89.9
60	95.2	96.2	96.6	96.8	96.7	96.6	96.4	96.1	95.8	95.4	95.0	94.6	94.1	93.6	93.1	92.5	91.9	91.3	90.6	89.9
65	94.5	95.3	95.8	95.9	95.9	95.8	95.7	95.4	95.2	94.9	94.5	94.1	93.7	93.3	92.8	92.3	91.7	91.1	90.6	89.9
70	93.5	94.3	94.7	94.9	95.0	94.9	94.8	94.7	94.5	94.2	93.9	93.6	93.3	92.9	92.4	92.0	91.5	91.0	90.5	89.9
75	92.4	93.2	93.6	93.8	93.9	93.9	93.9	93.8	93.7	93.5	93.3	93.0	92.7	92.4	92.1	91.7	91.3	90.9	90.4	89.9
80	91.3	92.0	92.4	92.6	92.8	92.9	92.9	92.9	92.8	92.7	92.6	92.4	92.1	91.9	91.6	91.3	91.0	90.7	90.3	89.9
85	90.4	90.9	91.3	91.5	91.7	91.8	91.9	91.9	91.9	91.8	91.7	91.6	91.5	91.3	91.1	90.9	90.7	90.5	90.2	89.9
90	89.7	90.0	90.3	90.5	90.6	90.8	90.8	90.9	90.9	90.9	90.9	90.8	90.8	90.7	90.6	90.5	90.4	90.2	90.1	89.9
95	89.3	89.4	89.6	89.7	89.8	89.8	89.9	90.0	90.0	90.0	90.1	90.1	90.1	90.1	90.1	90.1	90.0	90.0	90.0	89.9
98	89.6	89.6	89.6	89.7	89.7	89.7	89.8	89.8	89.8	89.8	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9	89.9

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.3	99.5	99.6	99.5	99.5	99.4	99.2	98.9	98.5	98.1	97.5	96.9	96.3	95.7	95.0	94.3	93.6	92.8	92.1	91.3
35	98.8	99.2	99.3	99.2	99.2	99.1	99.0	98.7	98.3	97.9	97.3	96.8	96.2	95.6	94.9	94.2	93.5	92.8	92.0	91.3
40	98.2	98.7	98.8	98.9	98.9	98.9	98.7	98.5	98.1	97.7	97.2	96.6	96.0	95.4	94.8	94.1	93.5	92.7	92.0	91.3
45	97.4	98.1	98.5	98.6	98.6	98.6	98.4	98.2	97.8	97.4	96.9	96.4	95.8	95.3	94.7	94.0	93.4	92.7	92.0	91.3
50	96.7	97.7	98.1	98.2	98.3	98.2	98.1	97.8	97.4	97.0	96.6	96.1	95.6	95.1	94.5	93.9	93.3	92.6	92.0	91.3
55	96.2	97.2	97.6	97.8	97.9	97.8	97.6	97.3	97.0	96.6	96.2	95.8	95.3	94.8	94.3	93.8	93.2	92.6	91.9	91.3
60	95.8	96.7	97.1	97.3	97.3	97.2	97.0	96.8	96.5	96.2	95.8	95.4	95.0	94.6	94.1	93.6	93.0	92.5	91.9	91.3
65	95.3	96.1	96.5	96.6	96.6	96.5	96.3	96.2	95.9	95.6	95.3	95.0	94.6	94.2	93.8	93.4	92.9	92.4	91.8	91.3
70	94.5	95.3	95.6	95.7	95.7	95.7	95.6	95.5	95.3	95.1	94.8	94.5	94.2	93.9	93.5	93.1	92.7	92.2	91.8	91.3
75	93.6	94.2	94.5	94.7	94.8	94.8	94.8	94.7	94.6	94.4	94.2	94.0	93.8	93.5	93.2	92.8	92.5	92.1	91.7	91.3
80	92.6	93.1	93.5	93.7	93.8	93.9	93.9	93.9	93.8	93.7	93.6	93.4	93.2	93.0	92.8	92.5	92.2	91.9	91.6	91.3
85	91.7	92.1	92.4	92.6	92.8	92.9	93.0	93.0	93.0	92.9	92.9	92.8	92.6	92.5	92.3	92.2	92.0	91.8	91.5	91.3
90	91.0	91.3	91.6	91.7	91.9	92.0	92.0	92.1	92.1	92.1	92.1	92.1	92.0	91.9	91.9	91.8	91.7	91.6	91.4	91.3
95	90.7	90.8	91.0	91.0	91.1	91.2	91.2	91.3	91.3	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.4	91.3	91.3
98	90.9	91.0	91.0	91.0	91.1	91.1	91.1	91.1	91.2	91.2	91.2	91.2	91.2	91.2	91.3	91.3	91.3	91.3	91.3	91.3

Mean Annual Mass Removal Efficiencies for 3.50-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.4	99.6	99.6	99.6	99.6	99.5	99.4	99.2	98.8	98.4	98.0	97.5	97.0	96.4	95.8	95.2	94.5	93.8	93.1	92.4
35	99.0	99.3	99.4	99.4	99.4	99.3	99.2	99.0	98.7	98.3	97.9	97.4	96.8	96.3	95.7	95.1	94.5	93.8	93.1	92.4
40	98.5	98.9	99.1	99.1	99.1	99.1	98.9	98.8	98.5	98.1	97.7	97.2	96.7	96.2	95.6	95.0	94.4	93.8	93.1	92.4
45	97.8	98.4	98.7	98.8	98.8	98.8	98.7	98.5	98.2	97.9	97.4	97.0	96.5	96.0	95.5	94.9	94.3	93.7	93.1	92.4
50	97.2	98.0	98.3	98.5	98.5	98.5	98.4	98.2	97.9	97.5	97.2	96.8	96.3	95.8	95.3	94.8	94.2	93.7	93.1	92.4
55	96.7	97.5	97.9	98.1	98.2	98.1	98.0	97.8	97.5	97.2	96.8	96.5	96.0	95.6	95.1	94.7	94.1	93.6	93.0	92.4
60	96.3	97.1	97.5	97.7	97.7	97.7	97.5	97.3	97.1	96.8	96.5	96.1	95.7	95.3	94.9	94.5	94.0	93.5	93.0	92.4
65	95.9	96.6	97.0	97.2	97.2	97.1	96.9	96.8	96.6	96.3	96.0	95.7	95.4	95.1	94.7	94.3	93.9	93.4	92.9	92.4
70	95.4	96.0	96.3	96.4	96.4	96.4	96.3	96.1	96.0	95.8	95.5	95.3	95.0	94.7	94.4	94.1	93.7	93.3	92.9	92.4
75	94.6	95.1	95.4	95.5	95.6	95.6	95.5	95.4	95.3	95.2	95.0	94.8	94.6	94.4	94.1	93.8	93.5	93.2	92.8	92.4
80	93.7	94.1	94.4	94.6	94.7	94.7	94.7	94.7	94.6	94.5	94.4	94.3	94.1	93.9	93.7	93.5	93.3	93.0	92.7	92.4
85	92.9	93.2	93.5	93.6	93.8	93.8	93.9	93.9	93.9	93.8	93.8	93.7	93.6	93.5	93.4	93.2	93.0	92.8	92.6	92.4
90	92.2	92.4	92.6	92.8	92.9	93.0	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.0	92.9	92.8	92.8	92.7	92.5	92.4
95	91.9	92.0	92.1	92.2	92.3	92.3	92.4	92.4	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.5	92.4
98	92.1	92.1	92.2	92.2	92.2	92.2	92.3	92.3	92.3	92.3	92.3	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.6	99.7	99.7	99.7	99.7	99.6	99.5	99.4	99.1	98.8	98.4	98.0	97.5	97.0	96.4	95.9	95.3	94.7	94.1	93.4
35	99.2	99.4	99.5	99.5	99.5	99.4	99.3	99.2	99.0	98.6	98.3	97.8	97.4	96.9	96.4	95.8	95.2	94.6	94.0	93.4
40	98.8	99.1	99.2	99.3	99.2	99.2	99.1	99.0	98.8	98.5	98.1	97.7	97.2	96.8	96.3	95.7	95.2	94.6	94.0	93.4
45	98.2	98.7	98.9	99.0	99.0	99.0	98.9	98.8	98.6	98.3	97.9	97.5	97.1	96.6	96.1	95.6	95.1	94.6	94.0	93.4
50	97.6	98.2	98.5	98.7	98.7	98.7	98.6	98.5	98.3	98.0	97.7	97.3	96.9	96.5	96.0	95.5	95.0	94.5	94.0	93.4
55	97.1	97.9	98.2	98.4	98.4	98.4	98.3	98.2	97.9	97.7	97.4	97.0	96.6	96.3	95.8	95.4	94.9	94.5	93.9	93.4
60	96.7	97.5	97.8	98.0	98.1	98.1	98.0	97.8	97.5	97.3	97.0	96.7	96.4	96.0	95.6	95.2	94.8	94.4	93.9	93.4
65	96.4	97.1	97.4	97.6	97.6	97.6	97.4	97.3	97.1	96.9	96.6	96.4	96.1	95.7	95.4	95.1	94.7	94.3	93.9	93.4
70	96.0	96.6	96.9	97.0	97.0	97.0	96.9	96.7	96.6	96.4	96.2	96.0	95.7	95.4	95.2	94.9	94.5	94.2	93.8	93.4
75	95.5	95.9	96.1	96.2	96.3	96.3	96.2	96.1	96.0	95.9	95.7	95.5	95.3	95.1	94.9	94.6	94.4	94.1	93.7	93.4
80	94.7	95.0	95.2	95.4	95.5	95.5	95.5	95.4	95.4	95.3	95.2	95.0	94.9	94.7	94.6	94.4	94.2	93.9	93.7	93.4
85	93.8	94.1	94.4	94.5	94.6	94.7	94.7	94.7	94.7	94.7	94.6	94.5	94.4	94.3	94.2	94.1	93.9	93.8	93.6	93.4
90	93.2	93.4	93.6	93.7	93.8	93.9	93.9	94.0	94.0	94.0	94.0	94.0	93.9	93.9	93.8	93.8	93.7	93.6	93.5	93.4
95	92.9	93.0	93.1	93.2	93.2	93.3	93.3	93.4	93.4	93.4	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.4	93.4
98	93.1	93.1	93.2	93.2	93.2	93.2	93.3	93.3	93.3	93.3	93.3	93.3	93.4	93.4	93.4	93.4	93.4	93.4	93.4	93.4

Mean Annual Mass Removal Efficiencies for 4.00-inches of Retention for Zone 1 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.6	99.7	99.8	99.8	99.7	99.7	99.6	99.5	99.3	99.0	98.7	98.3	97.9	97.5	97.0	96.5	95.9	95.4	94.8	94.3
35	99.3	99.5	99.6	99.6	99.6	99.5	99.5	99.3	99.2	98.9	98.6	98.2	97.8	97.4	96.9	96.4	95.9	95.4	94.8	94.3
40	99.0	99.3	99.4	99.4	99.4	99.3	99.3	99.2	99.0	98.8	98.5	98.1	97.7	97.3	96.8	96.3	95.8	95.3	94.8	94.3
45	98.5	98.9	99.1	99.1	99.1	99.1	99.1	99.0	98.8	98.6	98.3	97.9	97.6	97.2	96.7	96.3	95.8	95.3	94.8	94.3
50	98.0	98.5	98.7	98.9	98.9	98.9	98.8	98.7	98.6	98.3	98.1	97.7	97.4	97.0	96.6	96.2	95.7	95.2	94.8	94.3
55	97.5	98.1	98.4	98.6	98.6	98.6	98.6	98.5	98.3	98.1	97.8	97.5	97.1	96.8	96.4	96.0	95.6	95.2	94.7	94.3
60	97.1	97.8	98.1	98.3	98.3	98.3	98.3	98.1	98.0	97.7	97.5	97.2	96.9	96.6	96.3	95.9	95.5	95.1	94.7	94.3
65	96.8	97.4	97.8	97.9	98.0	98.0	97.9	97.7	97.5	97.3	97.1	96.9	96.6	96.3	96.0	95.7	95.4	95.0	94.7	94.3
70	96.5	97.1	97.3	97.5	97.5	97.5	97.4	97.2	97.1	96.9	96.7	96.5	96.3	96.1	95.8	95.5	95.2	94.9	94.6	94.3
75	96.1	96.5	96.7	96.8	96.8	96.8	96.8	96.7	96.6	96.4	96.3	96.1	96.0	95.8	95.5	95.3	95.1	94.8	94.5	94.3
80	95.5	95.8	95.9	96.1	96.1	96.1	96.1	96.1	96.0	95.9	95.8	95.7	95.6	95.4	95.3	95.1	94.9	94.7	94.5	94.3
85	94.7	95.0	95.1	95.3	95.3	95.4	95.4	95.4	95.4	95.4	95.3	95.2	95.1	95.0	94.9	94.8	94.7	94.6	94.4	94.3
90	94.1	94.3	94.4	94.5	94.6	94.7	94.7	94.8	94.8	94.8	94.8	94.7	94.7	94.7	94.6	94.6	94.5	94.4	94.3	94.3
95	93.8	93.9	94.0	94.0	94.1	94.1	94.2	94.2	94.2	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3	94.3
98	94.0	94.0	94.0	94.0	94.1	94.1	94.1	94.1	94.1	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.2	94.3

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.4	90.4	83.0	75.1	68.0	61.9	56.6	52.1	48.3	44.9	42.0	39.4	37.2	35.1	33.3	31.7	30.2	28.8	27.6	26.4
35	91.8	88.8	82.0	74.5	67.6	61.5	56.4	51.9	48.1	44.8	41.9	39.4	37.1	35.1	33.3	31.7	30.2	28.8	27.6	26.4
40	88.2	86.6	80.6	73.5	66.9	61.1	56.0	51.7	47.9	44.7	41.8	39.3	37.1	35.0	33.2	31.6	30.2	28.8	27.6	26.4
45	83.9	83.8	78.7	72.3	66.1	60.4	55.6	51.4	47.7	44.5	41.7	39.2	37.0	35.0	33.2	31.6	30.1	28.8	27.6	26.4
50	78.8	80.4	76.4	70.7	64.9	59.6	55.0	50.9	47.3	44.2	41.5	39.0	36.8	34.9	33.1	31.5	30.1	28.8	27.6	26.4
55	73.2	76.4	73.6	68.7	63.5	58.6	54.2	50.3	46.9	43.9	41.2	38.8	36.7	34.8	33.0	31.5	30.1	28.7	27.5	26.4
60	67.4	71.8	70.2	66.3	61.7	57.3	53.2	49.6	46.3	43.4	40.8	38.6	36.5	34.6	32.9	31.4	30.0	28.7	27.5	26.4
65	61.4	66.7	66.3	63.4	59.5	55.6	51.9	48.6	45.5	42.9	40.4	38.2	36.2	34.4	32.8	31.3	29.9	28.7	27.5	26.4
70	55.7	61.1	61.8	59.8	56.8	53.5	50.4	47.3	44.6	42.1	39.8	37.7	35.9	34.1	32.6	31.1	29.8	28.6	27.5	26.4
75	50.1	55.2	56.5	55.6	53.5	50.9	48.3	45.7	43.3	41.1	39.0	37.1	35.4	33.8	32.3	30.9	29.7	28.5	27.4	26.4
80	45.0	49.1	50.7	50.6	49.4	47.6	45.6	43.6	41.6	39.7	37.9	36.2	34.7	33.2	31.9	30.7	29.5	28.4	27.4	26.4
85	40.3	43.2	44.5	44.8	44.3	43.4	42.1	40.7	39.2	37.8	36.3	35.0	33.7	32.5	31.3	30.2	29.2	28.2	27.3	26.4
90	36.0	37.5	38.3	38.6	38.5	38.1	37.5	36.7	35.9	35.0	34.0	33.1	32.2	31.3	30.4	29.5	28.7	27.9	27.2	26.4
95	31.7	32.1	32.3	32.4	32.3	32.2	32.0	31.7	31.4	31.0	30.6	30.2	29.7	29.3	28.8	28.3	27.9	27.4	26.9	26.4
98	29.3	29.3	29.2	29.1	29.0	28.9	28.8	28.6	28.5	28.3	28.2	28.0	27.8	27.7	27.5	27.3	27.1	26.9	26.6	26.4

Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.0	96.7	94.8	91.7	87.9	83.8	79.7	75.7	71.9	68.4	65.2	62.1	59.4	56.9	54.5	52.3	50.3	48.4	46.7	45.1
35	95.2	95.5	93.8	90.9	87.3	83.4	79.3	75.4	71.7	68.3	65.0	62.1	59.3	56.8	54.4	52.3	50.3	48.4	46.7	45.1
40	92.9	94.0	92.5	89.9	86.5	82.7	78.9	75.1	71.4	68.0	64.9	61.9	59.2	56.7	54.4	52.2	50.2	48.4	46.7	45.1
45	90.2	91.9	90.9	88.6	85.5	81.9	78.2	74.6	71.1	67.7	64.6	61.7	59.1	56.6	54.3	52.2	50.2	48.4	46.7	45.1
50	86.7	89.2	88.9	87.0	84.2	80.9	77.4	73.9	70.5	67.3	64.3	61.5	58.9	56.5	54.2	52.1	50.2	48.3	46.6	45.1
55	82.7	86.1	86.4	84.9	82.6	79.6	76.4	73.1	69.9	66.8	63.9	61.2	58.6	56.3	54.1	52.0	50.1	48.3	46.6	45.1
60	78.5	82.6	83.4	82.5	80.6	78.0	75.1	72.1	69.1	66.1	63.4	60.8	58.3	56.0	53.9	51.9	50.0	48.2	46.6	45.1
65	74.2	78.6	79.8	79.5	78.1	76.0	73.5	70.7	68.0	65.3	62.7	60.2	57.9	55.7	53.6	51.7	49.9	48.2	46.6	45.1
70	69.8	74.2	75.8	76.0	75.2	73.5	71.4	69.1	66.6	64.2	61.8	59.5	57.3	55.3	53.3	51.4	49.7	48.1	46.5	45.1
75	65.4	69.6	71.4	71.9	71.5	70.4	68.8	66.9	64.9	62.7	60.6	58.6	56.6	54.7	52.8	51.1	49.5	47.9	46.5	45.1
80	61.4	64.9	66.6	67.3	67.2	66.5	65.5	64.1	62.5	60.8	59.0	57.3	55.5	53.9	52.2	50.7	49.2	47.7	46.4	45.1
85	57.6	60.1	61.6	62.2	62.3	62.0	61.3	60.4	59.3	58.1	56.8	55.4	54.0	52.7	51.3	50.0	48.7	47.4	46.2	45.1
90	54.1	55.4	56.2	56.7	56.8	56.7	56.4	55.9	55.2	54.5	53.6	52.8	51.8	50.9	49.9	48.9	47.9	46.9	46.0	45.1
95	50.1	50.5	50.7	50.8	50.8	50.8	50.6	50.4	50.2	49.9	49.5	49.1	48.7	48.2	47.7	47.2	46.7	46.1	45.6	45.1
98	47.8	47.7	47.7	47.6	47.6	47.5	47.4	47.2	47.1	46.9	46.8	46.6	46.5	46.3	46.1	45.9	45.7	45.5	45.3	45.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.9	98.2	97.5	96.2	94.4	92.1	89.6	86.9	84.1	81.3	78.5	75.9	73.3	70.9	68.5	66.3	64.2	62.2	60.4	58.6
35	96.7	97.3	96.8	95.6	93.8	91.7	89.2	86.6	83.8	81.1	78.4	75.7	73.2	70.8	68.5	66.3	64.2	62.2	60.4	58.6
40	95.0	96.1	95.9	94.8	93.1	91.1	88.7	86.2	83.5	80.8	78.2	75.6	73.1	70.7	68.4	66.2	64.2	62.2	60.4	58.6
45	93.0	94.7	94.6	93.7	92.2	90.3	88.1	85.6	83.1	80.5	77.9	75.4	72.9	70.6	68.3	66.2	64.1	62.2	60.4	58.6
50	90.7	92.8	93.1	92.4	91.1	89.3	87.3	85.0	82.5	80.0	77.5	75.1	72.7	70.4	68.2	66.1	64.0	62.1	60.3	58.6
55	88.0	90.6	91.1	90.7	89.7	88.1	86.3	84.1	81.8	79.4	77.0	74.7	72.4	70.1	68.0	65.9	64.0	62.1	60.3	58.6
60	84.8	87.9	88.8	88.7	88.0	86.7	85.0	83.0	80.9	78.7	76.5	74.2	72.0	69.8	67.8	65.8	63.8	62.0	60.3	58.6
65	81.5	84.9	86.2	86.3	85.8	84.8	83.4	81.7	79.8	77.8	75.7	73.6	71.5	69.5	67.5	65.5	63.7	61.9	60.2	58.6
70	78.1	81.7	83.1	83.5	83.2	82.5	81.4	80.0	78.4	76.6	74.7	72.8	70.9	68.9	67.1	65.2	63.5	61.8	60.2	58.6
75	74.9	78.1	79.6	80.2	80.2	79.8	79.0	77.9	76.5	75.0	73.4	71.7	70.0	68.3	66.5	64.8	63.2	61.6	60.1	58.6
80	71.6	74.3	75.8	76.5	76.7	76.5	76.0	75.2	74.1	73.0	71.7	70.3	68.8	67.3	65.8	64.3	62.8	61.4	60.0	58.6
85	68.6	70.6	71.8	72.5	72.8	72.7	72.4	71.9	71.2	70.3	69.3	68.3	67.1	65.9	64.7	63.5	62.2	61.0	59.8	58.6
90	65.7	66.9	67.7	68.1	68.3	68.3	68.2	67.9	67.5	66.9	66.3	65.6	64.9	64.0	63.2	62.3	61.4	60.5	59.5	58.6
95	62.7	63.0	63.2	63.3	63.4	63.4	63.3	63.2	63.0	62.8	62.5	62.2	61.8	61.4	61.0	60.5	60.1	59.6	59.1	58.6
98	60.8	60.8	60.8	60.7	60.7	60.6	60.5	60.4	60.3	60.2	60.1	59.9	59.8	59.6	59.5	59.3	59.2	59.0	58.8	58.6

Mean Annual Mass Removal Efficiencies for 1.00-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.5	98.8	98.5	97.9	96.9	95.6	94.1	92.3	90.4	88.4	86.3	84.2	82.1	80.0	77.9	75.9	74.0	72.2	70.3	68.6
35	97.5	98.2	98.0	97.4	96.5	95.3	93.7	92.0	90.2	88.2	86.2	84.1	82.0	79.9	77.9	75.9	74.0	72.1	70.3	68.6
40	96.4	97.3	97.2	96.8	95.9	94.8	93.3	91.7	89.9	87.9	85.9	83.9	81.8	79.8	77.8	75.8	73.9	72.1	70.3	68.6
45	94.8	96.1	96.3	96.0	95.2	94.1	92.7	91.2	89.4	87.6	85.6	83.6	81.6	79.6	77.7	75.8	73.9	72.1	70.3	68.6
50	93.0	94.8	95.2	94.9	94.3	93.3	92.0	90.5	88.9	87.1	85.3	83.3	81.4	79.5	77.5	75.6	73.8	72.0	70.3	68.6
55	91.0	93.2	93.7	93.6	93.1	92.3	91.1	89.8	88.2	86.6	84.8	82.9	81.1	79.2	77.3	75.5	73.7	72.0	70.2	68.6
60	88.8	91.2	92.0	92.0	91.7	91.0	90.0	88.8	87.4	85.9	84.2	82.4	80.7	78.9	77.1	75.3	73.6	71.9	70.2	68.6
65	86.2	88.9	89.9	90.2	90.0	89.5	88.7	87.6	86.4	85.0	83.4	81.8	80.2	78.5	76.8	75.1	73.4	71.8	70.2	68.6
70	83.6	86.4	87.5	88.0	88.0	87.6	86.9	86.1	85.1	83.8	82.5	81.0	79.5	77.9	76.4	74.8	73.2	71.6	70.1	68.6
75	81.0	83.6	84.9	85.5	85.6	85.3	84.9	84.2	83.4	82.4	81.2	80.0	78.6	77.2	75.8	74.3	72.9	71.5	70.0	68.6
80	78.6	80.8	82.0	82.5	82.8	82.7	82.4	81.9	81.3	80.5	79.6	78.5	77.4	76.3	75.0	73.8	72.5	71.2	69.9	68.6
85	76.1	77.7	78.7	79.3	79.6	79.7	79.5	79.2	78.8	78.2	77.5	76.7	75.9	74.9	74.0	72.9	71.9	70.8	69.7	68.6
90	73.9	74.8	75.5	75.9	76.1	76.2	76.2	76.0	75.7	75.3	74.9	74.4	73.8	73.2	72.5	71.8	71.0	70.3	69.4	68.6
95	71.5	71.8	72.0	72.1	72.2	72.2	72.2	72.1	72.0	71.9	71.7	71.4	71.2	70.9	70.6	70.2	69.9	69.5	69.0	68.6
98	70.2	70.2	70.2	70.2	70.1	70.1	70.1	70.0	69.9	69.8	69.7	69.7	69.6	69.4	69.3	69.2	69.0	68.9	68.8	68.6

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.9	99.1	99.0	98.7	98.1	97.3	96.4	95.2	93.9	92.4	90.9	89.3	87.7	86.0	84.3	82.6	80.9	79.2	77.6	76.0
35	98.1	98.6	98.6	98.3	97.7	97.0	96.1	94.9	93.7	92.3	90.8	89.2	87.6	85.9	84.2	82.5	80.9	79.2	77.6	76.0
40	97.2	98.0	98.0	97.8	97.3	96.6	95.7	94.6	93.4	92.0	90.5	89.0	87.4	85.8	84.1	82.5	80.8	79.2	77.6	76.0
45	96.1	97.1	97.3	97.1	96.7	96.1	95.2	94.2	93.0	91.7	90.3	88.8	87.2	85.6	84.0	82.4	80.7	79.1	77.6	76.0
50	94.7	96.0	96.4	96.3	96.0	95.4	94.6	93.6	92.5	91.3	89.9	88.5	87.0	85.4	83.8	82.2	80.7	79.1	77.5	76.0
55	93.0	94.8	95.3	95.3	95.1	94.6	93.9	93.0	91.9	90.8	89.5	88.1	86.7	85.2	83.6	82.1	80.6	79.0	77.5	76.0
60	91.3	93.3	94.0	94.1	94.0	93.6	92.9	92.2	91.2	90.1	88.9	87.7	86.3	84.9	83.4	81.9	80.4	78.9	77.5	76.0
65	89.4	91.6	92.4	92.7	92.6	92.3	91.8	91.1	90.3	89.3	88.3	87.1	85.8	84.5	83.1	81.7	80.3	78.8	77.4	76.0
70	87.5	89.6	90.6	91.0	91.0	90.8	90.4	89.8	89.1	88.3	87.4	86.3	85.2	83.9	82.7	81.4	80.0	78.7	77.3	76.0
75	85.4	87.4	88.5	89.0	89.1	89.0	88.7	88.3	87.7	87.0	86.2	85.3	84.3	83.3	82.1	80.9	79.7	78.5	77.3	76.0
80	83.4	85.2	86.2	86.7	86.9	86.9	86.7	86.4	86.0	85.5	84.8	84.1	83.3	82.3	81.4	80.4	79.3	78.2	77.1	76.0
85	81.6	82.9	83.7	84.2	84.4	84.5	84.4	84.2	84.0	83.6	83.1	82.5	81.9	81.2	80.4	79.6	78.8	77.9	76.9	76.0
90	79.7	80.5	81.0	81.4	81.6	81.7	81.7	81.7	81.5	81.3	80.9	80.6	80.1	79.7	79.1	78.6	78.0	77.4	76.7	76.0
95	77.9	78.2	78.4	78.5	78.6	78.7	78.7	78.6	78.6	78.4	78.3	78.2	78.0	77.8	77.5	77.3	77.0	76.7	76.3	76.0
98	77.1	77.1	77.1	77.1	77.1	77.1	77.0	77.0	76.9	76.9	76.8	76.8	76.7	76.6	76.5	76.4	76.3	76.2	76.1	76.0

Mean Annual Mass Removal Efficiencies for 1.50-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.2	99.4	99.3	99.1	98.7	98.2	97.6	96.8	95.9	94.9	93.7	92.5	91.3	89.9	88.6	87.2	85.7	84.3	82.9	81.5
35	98.6	99.0	99.0	98.8	98.5	98.0	97.4	96.6	95.7	94.7	93.6	92.4	91.2	89.8	88.5	87.1	85.7	84.3	82.9	81.5
40	97.8	98.4	98.5	98.4	98.1	97.6	97.1	96.3	95.5	94.5	93.4	92.2	91.0	89.7	88.4	87.1	85.7	84.3	82.9	81.5
45	96.9	97.8	98.0	97.9	97.6	97.2	96.7	96.0	95.1	94.2	93.1	92.0	90.8	89.6	88.3	87.0	85.6	84.2	82.9	81.5
50	95.9	96.9	97.2	97.2	97.0	96.7	96.2	95.5	94.7	93.8	92.8	91.8	90.6	89.4	88.2	86.9	85.5	84.2	82.8	81.5
55	94.6	95.9	96.3	96.4	96.3	96.0	95.6	95.0	94.2	93.4	92.4	91.4	90.3	89.2	88.0	86.7	85.4	84.1	82.8	81.5
60	93.1	94.7	95.3	95.5	95.4	95.2	94.8	94.3	93.6	92.8	92.0	91.0	90.0	88.9	87.7	86.5	85.3	84.0	82.8	81.5
65	91.7	93.4	94.1	94.4	94.4	94.2	93.9	93.4	92.8	92.1	91.3	90.5	89.5	88.5	87.4	86.3	85.1	83.9	82.7	81.5
70	90.1	91.9	92.7	93.0	93.1	93.0	92.7	92.3	91.9	91.2	90.6	89.8	88.9	88.0	87.0	86.0	84.9	83.8	82.6	81.5
75	88.5	90.2	91.0	91.5	91.6	91.6	91.4	91.1	90.7	90.2	89.6	88.9	88.2	87.4	86.5	85.6	84.6	83.6	82.6	81.5
80	86.9	88.4	89.2	89.6	89.9	89.9	89.8	89.6	89.3	88.9	88.4	87.9	87.3	86.6	85.9	85.1	84.2	83.3	82.4	81.5
85	85.4	86.5	87.2	87.6	87.9	88.0	87.9	87.8	87.6	87.3	87.0	86.6	86.1	85.6	85.0	84.4	83.7	83.0	82.3	81.5
90	84.1	84.7	85.1	85.4	85.6	85.7	85.8	85.7	85.6	85.5	85.3	85.0	84.7	84.4	84.0	83.5	83.1	82.6	82.0	81.5
95	82.7	82.9	83.1	83.2	83.3	83.3	83.4	83.4	83.4	83.3	83.2	83.1	83.0	82.8	82.6	82.4	82.2	82.0	81.8	81.5
98	82.2	82.2	82.2	82.2	82.2	82.2	82.2	82.2	82.1	82.1	82.1	82.0	82.0	81.9	81.9	81.8	81.7	81.7	81.6	81.5

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.4	99.5	99.5	99.4	99.1	98.8	98.3	97.8	97.2	96.4	95.6	94.6	93.6	92.6	91.5	90.4	89.2	88.0	86.8	85.6
35	98.9	99.2	99.2	99.1	98.9	98.6	98.1	97.6	97.0	96.3	95.4	94.5	93.5	92.5	91.4	90.3	89.2	88.0	86.8	85.6
40	98.3	98.8	98.9	98.8	98.6	98.3	97.9	97.4	96.8	96.1	95.3	94.4	93.4	92.4	91.4	90.3	89.1	88.0	86.8	85.6
45	97.5	98.3	98.4	98.4	98.2	97.9	97.5	97.1	96.5	95.8	95.0	94.2	93.2	92.3	91.2	90.2	89.1	87.9	86.8	85.6
50	96.7	97.6	97.8	97.8	97.7	97.5	97.1	96.7	96.2	95.5	94.8	93.9	93.0	92.1	91.1	90.1	89.0	87.9	86.7	85.6
55	95.7	96.8	97.1	97.2	97.1	96.9	96.6	96.2	95.7	95.1	94.4	93.6	92.8	91.9	90.9	89.9	88.9	87.8	86.7	85.6
60	94.5	95.8	96.3	96.4	96.4	96.3	96.0	95.7	95.2	94.6	94.0	93.3	92.5	91.6	90.7	89.8	88.8	87.7	86.7	85.6
65	93.3	94.7	95.3	95.5	95.6	95.5	95.3	95.0	94.5	94.0	93.4	92.8	92.1	91.3	90.4	89.5	88.6	87.6	86.6	85.6
70	92.0	93.5	94.2	94.5	94.6	94.5	94.4	94.1	93.7	93.3	92.8	92.2	91.5	90.8	90.1	89.3	88.4	87.5	86.6	85.6
75	90.8	92.1	92.9	93.2	93.4	93.4	93.3	93.1	92.8	92.4	92.0	91.5	90.9	90.3	89.6	88.9	88.2	87.3	86.5	85.6
80	89.6	90.7	91.4	91.8	92.0	92.0	92.0	91.9	91.6	91.3	91.0	90.6	90.1	89.6	89.1	88.5	87.8	87.1	86.4	85.6
85	88.4	89.2	89.8	90.2	90.4	90.5	90.5	90.4	90.3	90.1	89.8	89.5	89.2	88.8	88.4	87.9	87.4	86.8	86.2	85.6
90	87.3	87.8	88.2	88.4	88.6	88.7	88.8	88.7	88.7	88.6	88.4	88.2	88.0	87.8	87.5	87.2	86.8	86.4	86.0	85.6
95	86.2	86.4	86.6	86.7	86.8	86.8	86.9	86.9	86.9	86.8	86.8	86.7	86.7	86.6	86.4	86.3	86.1	86.0	85.8	85.6
98	86.0	86.0	86.0	86.0	86.1	86.1	86.1	86.0	86.0	86.0	86.0	86.0	85.9	85.9	85.9	85.8	85.8	85.7	85.6	85.6

Mean Annual Mass Removal Efficiencies for 2.00-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.5	99.7	99.6	99.6	99.4	99.1	98.8	98.4	97.9	97.4	96.8	96.1	95.3	94.4	93.6	92.6	91.7	90.7	89.7	88.7
35	99.2	99.4	99.4	99.4	99.2	99.0	98.6	98.2	97.8	97.3	96.6	95.9	95.2	94.4	93.5	92.6	91.6	90.7	89.7	88.7
40	98.6	99.0	99.1	99.1	98.9	98.7	98.4	98.0	97.6	97.1	96.5	95.8	95.1	94.3	93.4	92.5	91.6	90.6	89.7	88.7
45	98.0	98.6	98.8	98.7	98.6	98.4	98.1	97.8	97.4	96.9	96.3	95.6	94.9	94.1	93.3	92.5	91.5	90.6	89.6	88.7
50	97.3	98.1	98.3	98.3	98.2	98.0	97.8	97.5	97.1	96.6	96.1	95.4	94.7	94.0	93.2	92.4	91.5	90.6	89.6	88.7
55	96.6	97.4	97.7	97.8	97.7	97.6	97.4	97.1	96.7	96.3	95.8	95.2	94.5	93.8	93.0	92.2	91.4	90.5	89.6	88.7
60	95.6	96.6	97.0	97.1	97.1	97.0	96.9	96.6	96.3	95.9	95.4	94.9	94.2	93.6	92.8	92.1	91.3	90.4	89.6	88.7
65	94.5	95.7	96.2	96.4	96.5	96.4	96.3	96.0	95.7	95.4	94.9	94.4	93.9	93.3	92.6	91.9	91.1	90.3	89.5	88.7
70	93.5	94.7	95.3	95.5	95.7	95.6	95.5	95.3	95.1	94.8	94.4	93.9	93.4	92.9	92.3	91.6	90.9	90.2	89.5	88.7
75	92.5	93.6	94.2	94.5	94.7	94.7	94.7	94.5	94.3	94.0	93.7	93.3	92.9	92.4	91.9	91.3	90.7	90.1	89.4	88.7
80	91.5	92.5	93.1	93.4	93.6	93.7	93.6	93.5	93.4	93.2	92.9	92.6	92.2	91.8	91.4	90.9	90.4	89.9	89.3	88.7
85	90.6	91.3	91.8	92.1	92.3	92.4	92.4	92.4	92.3	92.1	91.9	91.7	91.4	91.1	90.8	90.4	90.0	89.6	89.2	88.7
90	89.7	90.1	90.5	90.7	90.9	91.0	91.0	91.0	91.0	90.9	90.8	90.6	90.5	90.3	90.1	89.9	89.6	89.3	89.0	88.7
95	88.9	89.1	89.2	89.3	89.4	89.5	89.5	89.5	89.5	89.5	89.5	89.4	89.4	89.3	89.2	89.2	89.0	88.9	88.8	88.7
98	88.8	88.8	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.8	88.8	88.8	88.8	88.7	88.7	88.7

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.7	99.7	99.7	99.7	99.6	99.4	99.1	98.8	98.5	98.1	97.6	97.0	96.4	95.8	95.0	94.3	93.5	92.7	91.8	91.0
35	99.3	99.5	99.6	99.5	99.4	99.2	99.0	98.7	98.3	97.9	97.5	96.9	96.3	95.7	95.0	94.3	93.5	92.7	91.8	91.0
40	99.0	99.2	99.3	99.3	99.2	99.0	98.8	98.5	98.2	97.8	97.3	96.8	96.2	95.6	94.9	94.2	93.4	92.6	91.8	91.0
45	98.4	98.9	99.0	99.0	98.9	98.8	98.6	98.3	98.0	97.6	97.2	96.7	96.1	95.5	94.8	94.1	93.4	92.6	91.8	91.0
50	97.8	98.5	98.6	98.7	98.6	98.5	98.3	98.0	97.7	97.4	97.0	96.5	95.9	95.4	94.7	94.0	93.3	92.5	91.8	91.0
55	97.2	97.9	98.2	98.2	98.2	98.1	97.9	97.7	97.4	97.1	96.7	96.3	95.8	95.2	94.6	93.9	93.2	92.5	91.7	91.0
60	96.5	97.3	97.6	97.7	97.7	97.6	97.5	97.3	97.0	96.8	96.4	96.0	95.5	95.0	94.4	93.8	93.1	92.4	91.7	91.0
65	95.6	96.5	96.9	97.1	97.1	97.1	97.0	96.8	96.6	96.3	96.0	95.6	95.2	94.7	94.2	93.6	93.0	92.3	91.7	91.0
70	94.6	95.6	96.1	96.3	96.4	96.4	96.4	96.3	96.1	95.8	95.5	95.2	94.8	94.4	93.9	93.4	92.8	92.2	91.6	91.0
75	93.8	94.7	95.2	95.5	95.7	95.7	95.7	95.6	95.4	95.2	95.0	94.7	94.4	94.0	93.6	93.1	92.6	92.1	91.5	91.0
80	93.0	93.8	94.3	94.6	94.8	94.9	94.9	94.8	94.7	94.5	94.3	94.1	93.8	93.5	93.1	92.8	92.4	91.9	91.4	91.0
85	92.3	92.9	93.3	93.6	93.7	93.8	93.9	93.8	93.8	93.7	93.5	93.4	93.1	92.9	92.6	92.4	92.0	91.7	91.3	91.0
90	91.6	92.0	92.3	92.5	92.6	92.7	92.7	92.7	92.7	92.7	92.6	92.5	92.4	92.2	92.1	91.9	91.7	91.5	91.2	91.0
95	91.0	91.2	91.3	91.4	91.4	91.5	91.5	91.5	91.6	91.5	91.5	91.5	91.5	91.4	91.4	91.3	91.2	91.1	91.1	91.0
98	91.0	91.0	91.0	91.0	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.1	91.0	91.0	91.0	91.0	91.0	91.0

Mean Annual Mass Removal Efficiencies for 2.50-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.7	99.8	99.8	99.8	99.7	99.6	99.4	99.1	98.8	98.5	98.1	97.7	97.2	96.7	96.1	95.5	94.9	94.2	93.5	92.7
35	99.5	99.6	99.7	99.6	99.6	99.4	99.3	99.0	98.7	98.4	98.0	97.6	97.2	96.6	96.1	95.5	94.8	94.2	93.4	92.7
40	99.2	99.4	99.5	99.5	99.4	99.3	99.1	98.9	98.6	98.3	97.9	97.5	97.1	96.6	96.0	95.4	94.8	94.1	93.4	92.7
45	98.7	99.1	99.2	99.2	99.2	99.0	98.9	98.7	98.4	98.1	97.8	97.4	97.0	96.5	95.9	95.4	94.7	94.1	93.4	92.7
50	98.2	98.8	98.9	98.9	98.9	98.8	98.6	98.4	98.2	97.9	97.6	97.2	96.8	96.4	95.8	95.3	94.7	94.1	93.4	92.7
55	97.7	98.3	98.5	98.6	98.5	98.5	98.3	98.1	97.9	97.7	97.4	97.0	96.6	96.2	95.7	95.2	94.6	94.0	93.4	92.7
60	97.1	97.8	98.0	98.1	98.1	98.1	97.9	97.8	97.6	97.4	97.1	96.8	96.4	96.0	95.6	95.1	94.5	93.9	93.3	92.7
65	96.4	97.1	97.5	97.6	97.6	97.6	97.5	97.4	97.2	97.0	96.8	96.5	96.2	95.8	95.4	94.9	94.4	93.9	93.3	92.7
70	95.6	96.4	96.8	97.0	97.1	97.1	97.0	96.9	96.8	96.6	96.4	96.1	95.8	95.5	95.1	94.7	94.2	93.8	93.3	92.7
75	94.8	95.6	96.0	96.3	96.4	96.5	96.4	96.4	96.3	96.1	95.9	95.7	95.5	95.2	94.8	94.5	94.1	93.6	93.2	92.7
80	94.1	94.8	95.3	95.5	95.7	95.8	95.8	95.7	95.7	95.5	95.4	95.2	95.0	94.8	94.5	94.2	93.8	93.5	93.1	92.7
85	93.6	94.1	94.4	94.7	94.8	94.9	95.0	95.0	94.9	94.9	94.7	94.6	94.5	94.3	94.1	93.8	93.6	93.3	93.0	92.7
90	93.1	93.4	93.6	93.8	93.9	94.0	94.1	94.1	94.1	94.0	94.0	93.9	93.8	93.7	93.6	93.4	93.3	93.1	92.9	92.7
95	92.7	92.8	92.9	93.0	93.0	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.0	93.0	92.9	92.9	92.8	92.7
98	92.7	92.7	92.7	92.7	92.7	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.7	92.7	92.7	92.7

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.8	99.9	99.9	99.8	99.8	99.7	99.5	99.4	99.1	98.8	98.5	98.2	97.8	97.4	96.9	96.4	95.9	95.3	94.7	94.1
35	99.6	99.7	99.7	99.7	99.7	99.6	99.4	99.3	99.0	98.8	98.5	98.1	97.8	97.4	96.9	96.4	95.9	95.3	94.7	94.1
40	99.4	99.5	99.6	99.6	99.5	99.4	99.3	99.1	98.9	98.6	98.4	98.0	97.7	97.3	96.8	96.4	95.8	95.3	94.7	94.1
45	99.0	99.3	99.4	99.4	99.3	99.2	99.1	98.9	98.7	98.5	98.2	97.9	97.6	97.2	96.8	96.3	95.8	95.2	94.7	94.1
50	98.6	99.0	99.1	99.2	99.1	99.0	98.9	98.7	98.6	98.3	98.1	97.8	97.5	97.1	96.7	96.2	95.7	95.2	94.7	94.1
55	98.1	98.6	98.8	98.8	98.8	98.7	98.6	98.5	98.3	98.1	97.9	97.6	97.3	97.0	96.6	96.1	95.7	95.2	94.6	94.1
60	97.6	98.2	98.4	98.5	98.5	98.4	98.3	98.2	98.0	97.9	97.6	97.4	97.1	96.8	96.4	96.0	95.6	95.1	94.6	94.1
65	97.0	97.6	97.9	98.0	98.1	98.0	98.0	97.9	97.7	97.6	97.4	97.2	96.9	96.6	96.2	95.9	95.5	95.0	94.6	94.1
70	96.4	97.0	97.3	97.5	97.6	97.6	97.5	97.5	97.4	97.2	97.1	96.9	96.6	96.3	96.0	95.7	95.3	94.9	94.5	94.1
75	95.7	96.4	96.7	96.9	97.0	97.1	97.0	97.0	96.9	96.8	96.7	96.5	96.3	96.1	95.8	95.5	95.2	94.8	94.5	94.1
80	95.1	95.6	96.0	96.3	96.4	96.5	96.5	96.5	96.4	96.3	96.2	96.1	95.9	95.7	95.5	95.3	95.0	94.7	94.4	94.1
85	94.6	95.0	95.3	95.6	95.7	95.8	95.8	95.8	95.8	95.8	95.7	95.6	95.5	95.3	95.2	95.0	94.8	94.6	94.3	94.1
90	94.2	94.5	94.7	94.9	95.0	95.0	95.1	95.1	95.1	95.1	95.1	95.0	94.9	94.9	94.8	94.6	94.5	94.4	94.2	94.1
95	93.9	94.0	94.1	94.2	94.3	94.3	94.3	94.4	94.4	94.4	94.4	94.4	94.4	94.3	94.3	94.3	94.2	94.2	94.1	94.1
98	94.0	94.0	94.0	94.0	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1	94.1

Mean Annual Mass Removal Efficiencies for 3.00-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.9	99.9	99.9	99.9	99.8	99.8	99.7	99.5	99.3	99.1	98.9	98.6	98.3	97.9	97.6	97.1	96.7	96.2	95.7	95.1
35	99.7	99.8	99.8	99.8	99.7	99.7	99.6	99.4	99.2	99.0	98.8	98.5	98.2	97.9	97.5	97.1	96.7	96.2	95.7	95.1
40	99.5	99.6	99.7	99.7	99.6	99.6	99.5	99.3	99.1	98.9	98.7	98.4	98.1	97.8	97.5	97.1	96.6	96.2	95.7	95.1
45	99.2	99.4	99.5	99.5	99.5	99.4	99.3	99.2	99.0	98.8	98.6	98.3	98.1	97.7	97.4	97.0	96.6	96.1	95.6	95.1
50	98.8	99.2	99.3	99.3	99.3	99.2	99.1	99.0	98.8	98.6	98.4	98.2	97.9	97.6	97.3	96.9	96.5	96.1	95.6	95.1
55	98.4	98.9	99.0	99.1	99.0	99.0	98.9	98.8	98.6	98.5	98.3	98.0	97.8	97.5	97.2	96.9	96.5	96.1	95.6	95.1
60	98.0	98.5	98.7	98.7	98.7	98.7	98.6	98.5	98.4	98.2	98.1	97.9	97.6	97.4	97.1	96.8	96.4	96.0	95.6	95.1
65	97.5	98.0	98.3	98.4	98.4	98.4	98.3	98.2	98.1	98.0	97.8	97.6	97.4	97.2	96.9	96.6	96.3	95.9	95.6	95.1
70	97.0	97.5	97.8	97.9	98.0	98.0	97.9	97.9	97.8	97.7	97.6	97.4	97.2	97.0	96.8	96.5	96.2	95.9	95.5	95.1
75	96.4	97.0	97.2	97.4	97.5	97.5	97.5	97.5	97.4	97.3	97.2	97.1	96.9	96.8	96.5	96.3	96.1	95.8	95.5	95.1
80	95.9	96.3	96.6	96.8	97.0	97.0	97.0	97.0	97.0	96.9	96.9	96.8	96.6	96.5	96.3	96.1	95.9	95.7	95.4	95.1
85	95.4	95.8	96.1	96.2	96.4	96.5	96.5	96.5	96.5	96.5	96.4	96.3	96.3	96.1	96.0	95.9	95.7	95.5	95.3	95.1
90	95.1	95.4	95.5	95.7	95.8	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.8	95.8	95.7	95.6	95.5	95.4	95.3	95.1
95	95.0	95.0	95.1	95.2	95.2	95.3	95.3	95.3	95.3	95.4	95.4	95.4	95.3	95.3	95.3	95.3	95.3	95.2	95.2	95.1
98	95.0	95.1	95.1	95.1	95.1	95.1	95.1	95.1	95.1	95.1	95.2	95.2	95.2	95.2	95.2	95.2	95.1	95.1	95.1	95.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.9	99.9	99.9	99.9	99.9	99.8	99.8	99.6	99.5	99.3	99.1	98.9	98.6	98.3	98.0	97.7	97.3	96.9	96.4	96.0
35	99.8	99.8	99.9	99.8	99.8	99.8	99.7	99.6	99.4	99.2	99.0	98.8	98.5	98.3	98.0	97.6	97.3	96.9	96.4	96.0
40	99.6	99.7	99.7	99.7	99.7	99.7	99.6	99.5	99.3	99.1	99.0	98.7	98.5	98.2	97.9	97.6	97.2	96.8	96.4	96.0
45	99.4	99.5	99.6	99.6	99.6	99.5	99.4	99.3	99.2	99.0	98.8	98.6	98.4	98.2	97.9	97.5	97.2	96.8	96.4	96.0
50	99.1	99.3	99.4	99.4	99.4	99.4	99.3	99.2	99.1	98.9	98.7	98.5	98.3	98.1	97.8	97.5	97.2	96.8	96.4	96.0
55	98.7	99.1	99.2	99.2	99.2	99.2	99.1	99.0	98.9	98.7	98.6	98.4	98.2	98.0	97.7	97.4	97.1	96.8	96.4	96.0
60	98.4	98.8	98.9	99.0	99.0	98.9	98.9	98.8	98.7	98.5	98.4	98.2	98.0	97.8	97.6	97.3	97.0	96.7	96.4	96.0
65	98.0	98.4	98.6	98.6	98.7	98.6	98.6	98.5	98.4	98.3	98.2	98.0	97.9	97.7	97.5	97.2	96.9	96.7	96.3	96.0
70	97.5	97.9	98.2	98.3	98.3	98.3	98.3	98.2	98.2	98.1	98.0	97.8	97.7	97.5	97.3	97.1	96.8	96.6	96.3	96.0
75	97.0	97.4	97.7	97.8	97.9	97.9	97.9	97.9	97.8	97.8	97.7	97.6	97.4	97.3	97.1	96.9	96.7	96.5	96.3	96.0
80	96.5	96.9	97.2	97.3	97.4	97.5	97.5	97.5	97.5	97.4	97.4	97.3	97.2	97.1	96.9	96.8	96.6	96.4	96.2	96.0
85	96.1	96.4	96.7	96.8	96.9	97.0	97.0	97.1	97.1	97.0	97.0	96.9	96.9	96.8	96.7	96.6	96.4	96.3	96.1	96.0
90	95.9	96.1	96.2	96.3	96.4	96.5	96.5	96.6	96.6	96.6	96.6	96.6	96.5	96.5	96.4	96.3	96.3	96.2	96.1	96.0
95	95.8	95.8	95.9	96.0	96.0	96.0	96.1	96.1	96.1	96.1	96.1	96.1	96.1	96.1	96.1	96.1	96.1	96.0	96.0	96.0
98	95.9	95.9	95.9	95.9	95.9	95.9	95.9	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0

Mean Annual Mass Removal Efficiencies for 3.50-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.9	99.9	99.9	99.9	99.9	99.9	99.8	99.7	99.6	99.5	99.3	99.1	98.9	98.6	98.4	98.1	97.8	97.4	97.0	96.7
35	99.8	99.9	99.9	99.9	99.8	99.8	99.8	99.7	99.5	99.4	99.2	99.0	98.8	98.6	98.3	98.0	97.7	97.4	97.0	96.7
40	99.7	99.8	99.8	99.8	99.8	99.7	99.7	99.6	99.5	99.3	99.2	99.0	98.8	98.5	98.3	98.0	97.7	97.4	97.0	96.7
45	99.5	99.7	99.7	99.7	99.7	99.6	99.6	99.5	99.4	99.2	99.1	98.9	98.7	98.5	98.2	98.0	97.7	97.4	97.0	96.7
50	99.3	99.5	99.5	99.5	99.5	99.5	99.4	99.3	99.2	99.1	98.9	98.8	98.6	98.4	98.2	97.9	97.6	97.3	97.0	96.7
55	98.9	99.2	99.3	99.4	99.4	99.3	99.3	99.2	99.1	99.0	98.8	98.7	98.5	98.3	98.1	97.9	97.6	97.3	97.0	96.7
60	98.6	99.0	99.1	99.2	99.2	99.1	99.1	99.0	98.9	98.8	98.7	98.5	98.4	98.2	98.0	97.8	97.5	97.3	97.0	96.7
65	98.3	98.7	98.8	98.9	98.9	98.9	98.8	98.8	98.7	98.6	98.5	98.4	98.2	98.1	97.9	97.7	97.5	97.2	96.9	96.7
70	97.9	98.3	98.5	98.5	98.6	98.6	98.6	98.5	98.4	98.4	98.3	98.2	98.0	97.9	97.7	97.6	97.4	97.2	96.9	96.7
75	97.5	97.8	98.1	98.2	98.2	98.3	98.2	98.2	98.2	98.1	98.0	97.9	97.8	97.7	97.6	97.4	97.3	97.1	96.9	96.7
80	97.1	97.4	97.6	97.7	97.8	97.9	97.9	97.9	97.9	97.8	97.8	97.7	97.6	97.5	97.4	97.3	97.2	97.0	96.8	96.7
85	96.7	97.0	97.1	97.3	97.4	97.4	97.5	97.5	97.5	97.5	97.5	97.4	97.4	97.3	97.2	97.1	97.0	96.9	96.8	96.7
90	96.5	96.6	96.8	96.9	97.0	97.0	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.0	97.0	96.9	96.9	96.8	96.7	96.7
95	96.4	96.5	96.5	96.6	96.6	96.7	96.7	96.7	96.7	96.7	96.8	96.8	96.8	96.8	96.7	96.7	96.7	96.7	96.7	96.7
98	96.5	96.5	96.5	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.6	96.7	96.7	96.7	96.7

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.9	99.9	100.0	100.0	99.9	99.9	99.9	99.8	99.7	99.6	99.4	99.3	99.1	98.9	98.6	98.4	98.1	97.8	97.5	97.2
35	99.9	99.9	99.9	99.9	99.9	99.9	99.8	99.7	99.6	99.5	99.4	99.2	99.0	98.8	98.6	98.4	98.1	97.8	97.5	97.2
40	99.8	99.8	99.9	99.8	99.8	99.8	99.7	99.7	99.6	99.5	99.3	99.2	99.0	98.8	98.6	98.3	98.1	97.8	97.5	97.2
45	99.6	99.7	99.8	99.7	99.7	99.7	99.7	99.6	99.5	99.4	99.2	99.1	98.9	98.7	98.5	98.3	98.1	97.8	97.5	97.2
50	99.4	99.6	99.6	99.6	99.6	99.6	99.5	99.5	99.4	99.3	99.1	99.0	98.8	98.7	98.5	98.3	98.0	97.8	97.5	97.2
55	99.1	99.4	99.5	99.5	99.5	99.5	99.4	99.3	99.2	99.1	99.0	98.9	98.7	98.6	98.4	98.2	98.0	97.7	97.5	97.2
60	98.9	99.2	99.3	99.3	99.3	99.3	99.2	99.2	99.1	99.0	98.9	98.8	98.6	98.5	98.3	98.1	97.9	97.7	97.5	97.2
65	98.6	98.9	99.0	99.1	99.1	99.1	99.0	99.0	98.9	98.8	98.7	98.6	98.5	98.4	98.2	98.0	97.9	97.7	97.4	97.2
70	98.3	98.6	98.7	98.8	98.8	98.8	98.8	98.8	98.7	98.6	98.5	98.5	98.3	98.2	98.1	98.0	97.8	97.6	97.4	97.2
75	97.9	98.2	98.4	98.5	98.5	98.5	98.5	98.5	98.4	98.4	98.3	98.3	98.2	98.1	98.0	97.8	97.7	97.6	97.4	97.2
80	97.5	97.8	98.0	98.1	98.2	98.2	98.2	98.2	98.2	98.1	98.1	98.0	98.0	97.9	97.8	97.7	97.6	97.5	97.3	97.2
85	97.2	97.4	97.6	97.7	97.8	97.8	97.9	97.9	97.9	97.9	97.8	97.8	97.8	97.7	97.6	97.6	97.5	97.4	97.3	97.2
90	97.0	97.1	97.2	97.3	97.4	97.4	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.4	97.4	97.3	97.3	97.2
95	96.9	97.0	97.0	97.1	97.1	97.2	97.2	97.2	97.2	97.2	97.2	97.3	97.3	97.3	97.3	97.3	97.2	97.2	97.2	97.2
98	97.0	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.2	97.2	97.2	97.2	97.2	97.2	97.2	97.2	97.2	97.2	97.2

Mean Annual Mass Removal Efficiencies for 4.00-inches of Retention in Zone 2 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.9	100.0	100.0	100.0	100.0	99.9	99.9	99.8	99.8	99.7	99.6	99.4	99.3	99.1	98.9	98.7	98.4	98.2	97.9	97.6
35	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.8	99.7	99.6	99.5	99.4	99.2	99.0	98.8	98.6	98.4	98.2	97.9	97.6
40	99.8	99.9	99.9	99.9	99.9	99.8	99.8	99.7	99.7	99.6	99.5	99.3	99.2	99.0	98.8	98.6	98.4	98.2	97.9	97.6
45	99.7	99.8	99.8	99.8	99.8	99.8	99.7	99.7	99.6	99.5	99.4	99.3	99.1	98.9	98.8	98.6	98.4	98.1	97.9	97.6
50	99.6	99.7	99.7	99.7	99.7	99.7	99.6	99.6	99.5	99.4	99.3	99.2	99.0	98.9	98.7	98.5	98.3	98.1	97.9	97.6
55	99.3	99.5	99.6	99.6	99.6	99.6	99.5	99.4	99.4	99.3	99.2	99.1	98.9	98.8	98.6	98.5	98.3	98.1	97.9	97.6
60	99.1	99.3	99.4	99.4	99.4	99.4	99.4	99.3	99.2	99.2	99.1	99.0	98.8	98.7	98.6	98.4	98.2	98.1	97.8	97.6
65	98.8	99.1	99.2	99.3	99.3	99.2	99.2	99.1	99.1	99.0	98.9	98.8	98.7	98.6	98.5	98.3	98.2	98.0	97.8	97.6
70	98.6	98.8	98.9	99.0	99.0	99.0	99.0	99.0	98.9	98.8	98.8	98.7	98.6	98.5	98.4	98.3	98.1	98.0	97.8	97.6
75	98.2	98.5	98.6	98.7	98.7	98.8	98.8	98.7	98.7	98.6	98.6	98.5	98.4	98.4	98.3	98.2	98.0	97.9	97.8	97.6
80	97.9	98.1	98.3	98.4	98.4	98.5	98.5	98.5	98.4	98.4	98.4	98.3	98.3	98.2	98.1	98.1	98.0	97.9	97.7	97.6
85	97.6	97.8	97.9	98.0	98.1	98.1	98.2	98.2	98.2	98.2	98.1	98.1	98.1	98.0	98.0	97.9	97.9	97.8	97.7	97.6
90	97.4	97.5	97.6	97.7	97.8	97.8	97.8	97.9	97.9	97.9	97.9	97.9	97.9	97.9	97.8	97.8	97.8	97.7	97.7	97.6
95	97.4	97.4	97.5	97.5	97.5	97.6	97.6	97.6	97.6	97.6	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.6	97.6	97.6
98	97.5	97.5	97.5	97.5	97.5	97.5	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6	97.6

Mean Annual Mass Removal Efficiencies for 0.25-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	82.7	81.2	75.5	69.3	63.6	58.6	54.2	50.4	47.0	44.1	41.4	39.1	37.1	35.2	33.5	32.0	30.6	29.3	28.1	27.0
35	77.8	78.2	73.6	68.0	62.7	58.0	53.7	50.0	46.8	43.9	41.3	39.0	37.0	35.1	33.4	31.9	30.5	29.2	28.1	27.0
40	72.7	74.9	71.5	66.6	61.7	57.2	53.2	49.6	46.4	43.6	41.1	38.9	36.8	35.0	33.4	31.9	30.5	29.2	28.1	27.0
45	67.3	71.3	69.0	64.9	60.5	56.3	52.5	49.1	46.0	43.3	40.9	38.7	36.7	34.9	33.3	31.8	30.5	29.2	28.1	27.0
50	61.8	67.4	66.3	62.9	59.1	55.3	51.7	48.5	45.6	42.9	40.6	38.5	36.5	34.8	33.2	31.7	30.4	29.2	28.0	27.0
55	56.5	63.2	63.2	60.7	57.4	54.0	50.8	47.8	45.0	42.5	40.2	38.2	36.3	34.6	33.1	31.7	30.4	29.1	28.0	27.0
60	51.5	58.8	59.9	58.2	55.5	52.6	49.7	46.9	44.3	42.0	39.8	37.9	36.1	34.4	32.9	31.6	30.3	29.1	28.0	27.0
65	46.7	54.3	56.2	55.4	53.4	50.9	48.3	45.9	43.5	41.3	39.3	37.5	35.8	34.2	32.8	31.4	30.2	29.0	28.0	27.0
70	42.4	49.7	52.3	52.2	50.8	48.9	46.8	44.6	42.5	40.5	38.7	37.0	35.4	33.9	32.5	31.3	30.1	29.0	28.0	27.0
75	38.8	45.1	48.0	48.6	47.9	46.5	44.8	43.1	41.3	39.5	37.9	36.3	34.9	33.5	32.2	31.1	29.9	28.9	27.9	27.0
80	35.5	40.7	43.4	44.5	44.4	43.7	42.5	41.1	39.7	38.3	36.9	35.5	34.2	33.0	31.9	30.8	29.7	28.8	27.9	27.0
85	32.7	36.5	38.7	39.9	40.3	40.1	39.5	38.6	37.6	36.5	35.4	34.4	33.3	32.3	31.3	30.4	29.5	28.6	27.8	27.0
90	30.6	32.8	34.3	35.2	35.7	35.8	35.6	35.2	34.7	34.1	33.4	32.7	31.9	31.2	30.4	29.7	29.0	28.3	27.6	27.0
95	29.1	29.8	30.3	30.7	30.9	31.0	31.0	31.0	30.8	30.6	30.3	30.0	29.7	29.4	29.0	28.6	28.2	27.8	27.4	27.0
98	28.5	28.5	28.6	28.6	28.6	28.6	28.6	28.5	28.5	28.4	28.3	28.2	28.0	27.9	27.8	27.6	27.5	27.3	27.2	27.0

Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	87.6	89.1	87.6	84.8	81.5	77.8	74.3	70.9	67.8	64.9	62.1	59.6	57.2	55.0	52.9	51.0	49.2	47.6	46.0	44.5
35	83.5	86.5	85.6	83.4	80.4	77.0	73.6	70.4	67.4	64.5	61.9	59.4	57.0	54.9	52.8	51.0	49.2	47.5	46.0	44.5
40	79.3	83.5	83.4	81.7	79.1	76.0	72.9	69.8	66.9	64.2	61.6	59.1	56.9	54.7	52.7	50.9	49.1	47.5	46.0	44.5
45	74.9	80.3	80.9	79.7	77.6	74.9	72.0	69.1	66.4	63.7	61.2	58.9	56.6	54.6	52.6	50.8	49.1	47.5	45.9	44.5
50	70.5	76.7	78.1	77.6	75.9	73.5	70.9	68.3	65.7	63.2	60.8	58.5	56.4	54.4	52.5	50.7	49.0	47.4	45.9	44.5
55	66.3	72.9	75.0	75.1	73.9	71.9	69.6	67.3	64.9	62.6	60.3	58.1	56.1	54.1	52.3	50.6	48.9	47.4	45.9	44.5
60	62.1	68.9	71.7	72.4	71.6	70.1	68.2	66.1	64.0	61.8	59.7	57.7	55.7	53.8	52.1	50.4	48.8	47.3	45.9	44.5
65	58.0	64.9	68.1	69.3	69.1	68.0	66.5	64.7	62.8	60.9	59.0	57.1	55.2	53.5	51.8	50.2	48.7	47.2	45.8	44.5
70	54.4	60.9	64.2	65.8	66.2	65.6	64.5	63.0	61.5	59.8	58.1	56.3	54.6	53.0	51.4	49.9	48.5	47.1	45.8	44.5
75	51.1	57.0	60.4	62.2	62.9	62.7	62.1	61.0	59.8	58.4	56.9	55.4	53.9	52.4	51.0	49.6	48.3	47.0	45.7	44.5
80	48.5	53.5	56.5	58.3	59.1	59.3	59.1	58.5	57.6	56.6	55.4	54.2	52.9	51.6	50.4	49.2	47.9	46.8	45.6	44.5
85	46.7	50.3	52.7	54.2	55.1	55.5	55.6	55.3	54.9	54.2	53.4	52.6	51.6	50.6	49.6	48.5	47.5	46.5	45.5	44.5
90	45.4	47.6	49.1	50.2	51.0	51.4	51.7	51.7	51.5	51.2	50.8	50.3	49.7	49.0	48.3	47.6	46.8	46.1	45.3	44.5
95	44.8	45.6	46.2	46.7	47.1	47.3	47.5	47.6	47.6	47.5	47.4	47.2	47.0	46.7	46.4	46.1	45.7	45.3	44.9	44.5
98	45.2	45.3	45.4	45.4	45.5	45.5	45.5	45.6	45.5	45.5	45.5	45.4	45.3	45.3	45.2	45.0	44.9	44.8	44.7	44.5

Mean Annual Mass Removal Efficiencies for 0.75-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	89.7	92.3	91.6	90.3	88.4	86.2	83.8	81.3	78.7	76.2	73.8	71.5	69.3	67.3	65.3	63.4	61.6	59.9	58.3	56.7
35	86.6	89.8	89.8	88.9	87.2	85.3	83.1	80.7	78.2	75.8	73.5	71.3	69.2	67.1	65.2	63.3	61.6	59.9	58.3	56.7
40	82.9	87.1	87.9	87.3	85.9	84.2	82.2	80.0	77.7	75.4	73.2	71.0	69.0	67.0	65.1	63.2	61.5	59.8	58.2	56.7
45	79.3	84.4	85.7	85.5	84.5	83.0	81.2	79.2	77.1	74.9	72.8	70.7	68.7	66.8	64.9	63.1	61.4	59.8	58.2	56.7
50	75.8	81.4	83.2	83.5	82.8	81.6	80.1	78.3	76.3	74.3	72.3	70.3	68.4	66.5	64.7	63.0	61.3	59.7	58.2	56.7
55	72.2	78.3	80.5	81.2	80.9	80.1	78.8	77.2	75.4	73.5	71.7	69.8	68.0	66.2	64.5	62.8	61.2	59.7	58.2	56.7
60	69.0	75.0	77.6	78.6	78.7	78.3	77.3	75.9	74.3	72.7	71.0	69.2	67.5	65.9	64.2	62.6	61.1	59.6	58.1	56.7
65	65.7	71.6	74.4	75.8	76.3	76.2	75.5	74.4	73.1	71.7	70.1	68.6	67.0	65.4	63.9	62.4	60.9	59.5	58.1	56.7
70	62.5	68.2	71.2	72.8	73.6	73.8	73.4	72.7	71.6	70.4	69.1	67.7	66.3	64.9	63.5	62.1	60.7	59.3	58.0	56.7
75	59.8	64.9	67.9	69.7	70.6	71.1	71.0	70.6	69.8	68.9	67.8	66.7	65.5	64.2	62.9	61.7	60.4	59.2	57.9	56.7
80	57.5	61.8	64.6	66.4	67.5	68.1	68.2	68.0	67.6	67.0	66.2	65.3	64.3	63.3	62.2	61.2	60.0	58.9	57.8	56.7
85	56.0	59.3	61.6	63.1	64.2	64.8	65.1	65.1	64.9	64.6	64.1	63.5	62.8	62.1	61.3	60.4	59.5	58.6	57.7	56.7
90	55.4	57.4	58.9	60.0	60.8	61.3	61.7	61.9	61.9	61.8	61.6	61.3	60.9	60.5	59.9	59.4	58.8	58.1	57.4	56.7
95	55.5	56.2	56.8	57.3	57.7	58.1	58.3	58.5	58.6	58.7	58.7	58.6	58.5	58.4	58.2	57.9	57.7	57.4	57.1	56.7
98	56.5	56.6	56.8	56.9	57.0	57.1	57.1	57.2	57.2	57.2	57.2	57.2	57.2	57.2	57.1	57.1	57.0	56.9	56.8	56.7

Mean Annual Mass Removal Efficiencies for 1.00-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	91.1	93.7	94.0	92.9	91.7	90.3	88.6	86.8	85.0	83.1	81.1	79.1	77.2	75.3	73.5	71.8	70.1	68.5	67.0	65.5
35	88.6	91.8	92.2	91.6	90.7	89.5	87.9	86.3	84.5	82.7	80.8	78.9	77.0	75.2	73.4	71.7	70.1	68.5	67.0	65.5
40	85.9	89.4	90.4	90.3	89.6	88.5	87.1	85.6	83.9	82.2	80.4	78.6	76.8	75.0	73.3	71.6	70.0	68.5	66.9	65.5
45	82.5	86.9	88.5	88.7	88.2	87.3	86.1	84.8	83.3	81.7	80.0	78.2	76.5	74.8	73.1	71.5	69.9	68.4	66.9	65.5
50	79.4	84.4	86.4	86.9	86.7	86.0	85.0	83.9	82.5	81.0	79.4	77.8	76.1	74.5	72.9	71.3	69.8	68.3	66.9	65.5
55	76.6	81.9	84.0	84.9	85.0	84.5	83.7	82.8	81.6	80.3	78.8	77.3	75.7	74.2	72.7	71.2	69.7	68.3	66.9	65.5
60	73.8	79.1	81.6	82.7	83.0	82.8	82.3	81.6	80.6	79.4	78.1	76.7	75.2	73.8	72.4	70.9	69.5	68.2	66.8	65.5
65	71.1	76.4	78.9	80.3	80.8	80.9	80.6	80.1	79.4	78.4	77.2	75.9	74.6	73.3	72.0	70.7	69.4	68.0	66.8	65.5
70	68.6	73.5	76.2	77.6	78.4	78.8	78.7	78.5	77.9	77.1	76.2	75.1	73.9	72.8	71.5	70.3	69.1	67.9	66.7	65.5
75	66.3	70.6	73.3	74.9	75.9	76.4	76.6	76.5	76.1	75.6	74.9	74.0	73.0	72.0	71.0	69.9	68.8	67.7	66.6	65.5
80	64.3	68.0	70.5	72.1	73.2	73.9	74.2	74.3	74.1	73.8	73.3	72.6	71.9	71.1	70.2	69.3	68.4	67.5	66.5	65.5
85	63.1	65.9	67.9	69.4	70.4	71.2	71.6	71.8	71.8	71.6	71.3	70.9	70.5	69.9	69.3	68.6	67.9	67.1	66.3	65.5
90	62.7	64.5	65.9	67.0	67.8	68.4	68.8	69.1	69.2	69.2	69.1	68.9	68.7	68.4	68.0	67.6	67.1	66.6	66.1	65.5
95	63.3	64.0	64.6	65.1	65.5	65.8	66.1	66.3	66.4	66.5	66.6	66.6	66.6	66.5	66.4	66.3	66.1	66.0	65.7	65.5
98	64.7	64.8	65.0	65.1	65.2	65.3	65.4	65.5	65.5	65.6	65.6	65.6	65.6	65.7	65.7	65.6	65.6	65.6	65.5	65.5

Mean Annual Mass Removal Efficiencies for 1.25-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	92.1	94.5	95.2	94.8	93.7	92.7	91.5	90.2	88.7	87.3	85.7	84.2	82.6	81.0	79.4	77.8	76.3	74.8	73.4	72.0
35	90.0	92.9	93.9	93.5	92.7	91.9	90.8	89.6	88.2	86.9	85.4	83.9	82.4	80.8	79.3	77.7	76.2	74.8	73.4	72.0
40	87.8	91.2	92.2	92.2	91.7	91.0	90.1	89.0	87.7	86.4	85.0	83.6	82.1	80.6	79.1	77.6	76.2	74.7	73.3	72.0
45	85.4	89.0	90.3	90.7	90.5	90.0	89.2	88.2	87.0	85.9	84.6	83.2	81.8	80.4	78.9	77.5	76.1	74.7	73.3	72.0
50	82.3	86.7	88.4	89.2	89.2	88.9	88.2	87.3	86.3	85.2	84.1	82.8	81.5	80.1	78.7	77.3	75.9	74.6	73.3	72.0
55	79.7	84.4	86.6	87.4	87.6	87.5	87.0	86.3	85.4	84.5	83.5	82.3	81.1	79.8	78.4	77.1	75.8	74.5	73.2	72.0
60	77.4	82.3	84.4	85.5	85.9	86.0	85.7	85.1	84.4	83.7	82.8	81.7	80.6	79.4	78.1	76.9	75.6	74.4	73.2	72.0
65	75.3	79.8	82.2	83.4	84.1	84.2	84.1	83.8	83.3	82.7	81.9	81.0	80.0	78.9	77.8	76.6	75.4	74.3	73.1	72.0
70	73.1	77.5	79.9	81.3	82.0	82.3	82.4	82.3	82.0	81.5	80.9	80.1	79.3	78.3	77.3	76.3	75.2	74.1	73.1	72.0
75	71.2	75.1	77.4	78.9	79.7	80.3	80.5	80.6	80.4	80.1	79.7	79.1	78.4	77.6	76.7	75.8	74.9	73.9	73.0	72.0
80	69.6	72.8	75.0	76.4	77.4	78.1	78.5	78.7	78.7	78.5	78.2	77.8	77.3	76.7	76.0	75.2	74.5	73.7	72.8	72.0
85	68.5	71.0	72.9	74.2	75.1	75.8	76.3	76.6	76.7	76.7	76.6	76.3	76.0	75.5	75.1	74.5	73.9	73.3	72.7	72.0
90	68.4	69.9	71.2	72.2	73.0	73.6	74.0	74.3	74.5	74.6	74.6	74.6	74.4	74.2	73.9	73.6	73.3	72.9	72.4	72.0
95	69.3	70.0	70.5	71.0	71.4	71.7	72.0	72.2	72.4	72.5	72.6	72.6	72.6	72.6	72.6	72.5	72.4	72.3	72.2	72.0
98	70.9	71.0	71.2	71.3	71.4	71.5	71.6	71.7	71.8	71.8	71.9	71.9	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0

Mean Annual Mass Removal Efficiencies for 1.50-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	92.8	95.2	95.9	95.9	95.3	94.3	93.3	92.3	91.2	90.1	88.8	87.6	86.3	84.9	83.6	82.3	80.9	79.6	78.2	77.0
35	91.0	93.8	94.7	94.9	94.3	93.5	92.7	91.8	90.8	89.7	88.5	87.3	86.0	84.8	83.5	82.2	80.8	79.5	78.2	77.0
40	89.1	92.3	93.5	93.6	93.3	92.7	92.0	91.2	90.3	89.2	88.1	87.0	85.8	84.6	83.3	82.0	80.8	79.5	78.2	77.0
45	87.2	90.7	91.9	92.2	92.1	91.8	91.2	90.5	89.7	88.7	87.7	86.6	85.5	84.3	83.1	81.9	80.7	79.4	78.2	77.0
50	85.1	88.6	90.1	90.7	90.9	90.7	90.4	89.7	89.0	88.1	87.1	86.2	85.1	84.0	82.9	81.7	80.5	79.3	78.1	77.0
55	82.4	86.5	88.3	89.2	89.6	89.6	89.3	88.8	88.2	87.4	86.6	85.7	84.7	83.7	82.7	81.5	80.4	79.2	78.1	77.0
60	80.2	84.5	86.6	87.7	88.1	88.2	88.1	87.7	87.2	86.6	85.9	85.1	84.3	83.3	82.4	81.3	80.2	79.1	78.0	77.0
65	78.4	82.6	84.7	85.9	86.5	86.7	86.7	86.5	86.1	85.6	85.1	84.4	83.7	82.9	82.0	81.0	80.0	79.0	78.0	77.0
70	76.7	80.6	82.7	84.0	84.7	85.1	85.2	85.1	84.9	84.6	84.1	83.6	83.0	82.3	81.5	80.7	79.8	78.8	77.9	77.0
75	75.1	78.5	80.7	82.0	82.8	83.3	83.5	83.6	83.5	83.3	83.1	82.7	82.2	81.6	81.0	80.3	79.5	78.6	77.8	77.0
80	73.8	76.7	78.6	79.9	80.7	81.3	81.7	81.9	82.0	82.0	81.8	81.6	81.2	80.8	80.3	79.7	79.1	78.4	77.7	77.0
85	72.9	75.1	76.7	77.9	78.8	79.4	79.9	80.2	80.3	80.4	80.4	80.3	80.1	79.8	79.5	79.0	78.6	78.1	77.5	77.0
90	72.9	74.3	75.4	76.3	77.0	77.6	78.0	78.4	78.6	78.7	78.8	78.8	78.8	78.6	78.5	78.2	78.0	77.7	77.3	77.0
95	74.0	74.6	75.1	75.5	75.9	76.2	76.5	76.8	77.0	77.1	77.2	77.3	77.3	77.3	77.3	77.3	77.2	77.2	77.1	77.0
98	75.8	75.9	76.0	76.2	76.3	76.4	76.4	76.5	76.6	76.7	76.7	76.8	76.8	76.9	76.9	76.9	76.9	76.9	77.0	77.0

Mean Annual Mass Removal Efficiencies for 1.75-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	93.3	95.6	96.4	96.6	96.3	95.6	94.7	93.8	92.9	92.0	91.0	89.9	88.8	87.8	86.6	85.5	84.3	83.2	82.0	80.8
35	91.8	94.4	95.4	95.7	95.5	94.8	94.1	93.3	92.5	91.6	90.7	89.7	88.6	87.6	86.5	85.4	84.3	83.1	82.0	80.8
40	90.2	93.1	94.3	94.7	94.5	94.0	93.4	92.7	92.0	91.2	90.4	89.4	88.4	87.4	86.3	85.3	84.2	83.1	82.0	80.8
45	88.6	91.8	93.1	93.5	93.4	93.1	92.6	92.1	91.5	90.8	89.9	89.0	88.1	87.1	86.2	85.1	84.1	83.0	81.9	80.8
50	86.9	90.3	91.6	92.1	92.2	92.1	91.8	91.4	90.9	90.2	89.5	88.6	87.7	86.9	85.9	85.0	84.0	82.9	81.9	80.8
55	84.9	88.3	89.9	90.6	91.0	91.1	90.9	90.6	90.2	89.6	88.9	88.1	87.4	86.6	85.7	84.8	83.8	82.9	81.9	80.8
60	82.7	86.4	88.2	89.2	89.7	89.9	89.9	89.7	89.3	88.8	88.2	87.6	86.9	86.2	85.4	84.6	83.7	82.8	81.8	80.8
65	80.9	84.6	86.7	87.7	88.4	88.6	88.7	88.6	88.3	87.9	87.5	86.9	86.4	85.7	85.0	84.3	83.5	82.6	81.8	80.8
70	79.6	83.0	85.0	86.2	86.8	87.2	87.4	87.4	87.2	87.0	86.6	86.2	85.7	85.2	84.6	84.0	83.2	82.5	81.7	80.8
75	78.3	81.4	83.2	84.4	85.2	85.7	85.9	86.0	86.0	85.8	85.6	85.3	85.0	84.6	84.1	83.5	82.9	82.3	81.6	80.8
80	77.2	79.8	81.5	82.7	83.5	84.0	84.3	84.5	84.6	84.6	84.5	84.4	84.1	83.8	83.5	83.1	82.6	82.0	81.5	80.8
85	76.6	78.5	79.9	80.9	81.7	82.2	82.7	83.0	83.2	83.3	83.3	83.3	83.2	83.0	82.8	82.5	82.1	81.7	81.3	80.8
90	76.4	77.7	78.7	79.5	80.2	80.7	81.1	81.4	81.7	81.9	82.0	82.1	82.1	82.0	81.9	81.8	81.6	81.4	81.1	80.8
95	77.6	78.1	78.6	79.0	79.4	79.7	80.0	80.3	80.5	80.6	80.8	80.9	80.9	81.0	81.0	81.0	81.0	81.0	80.9	80.8
98	79.5	79.7	79.8	79.9	80.0	80.1	80.2	80.3	80.4	80.5	80.5	80.6	80.6	80.7	80.7	80.8	80.8	80.8	80.8	80.8

Mean Annual Mass Removal Efficiencies for 2.00-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	93.8	95.9	96.7	97.0	97.0	96.6	95.8	95.0	94.2	93.4	92.6	91.7	90.8	89.8	88.9	87.9	86.9	85.9	84.9	83.9
35	92.4	94.9	95.8	96.2	96.3	95.9	95.2	94.5	93.8	93.1	92.3	91.5	90.6	89.7	88.7	87.8	86.8	85.9	84.9	83.9
40	91.0	93.8	94.9	95.4	95.4	95.1	94.5	93.9	93.3	92.7	92.0	91.2	90.4	89.5	88.6	87.7	86.8	85.8	84.8	83.9
45	89.7	92.7	93.9	94.5	94.4	94.2	93.8	93.3	92.8	92.3	91.6	90.9	90.1	89.2	88.4	87.6	86.7	85.8	84.8	83.9
50	88.2	91.4	92.8	93.3	93.3	93.3	93.0	92.7	92.3	91.8	91.2	90.5	89.8	89.0	88.2	87.4	86.6	85.7	84.8	83.9
55	86.9	90.0	91.3	91.9	92.2	92.2	92.2	91.9	91.6	91.2	90.7	90.1	89.4	88.7	87.9	87.2	86.4	85.6	84.7	83.9
60	85.0	88.2	89.7	90.6	91.0	91.2	91.2	91.1	90.9	90.5	90.1	89.6	88.9	88.3	87.7	87.0	86.3	85.5	84.7	83.9
65	83.2	86.4	88.2	89.2	89.8	90.1	90.2	90.2	90.0	89.7	89.4	88.9	88.4	87.9	87.3	86.7	86.1	85.4	84.6	83.9
70	81.7	85.0	86.7	87.8	88.5	88.9	89.1	89.1	89.1	88.8	88.6	88.2	87.8	87.4	86.9	86.4	85.8	85.2	84.6	83.9
75	80.8	83.5	85.3	86.4	87.1	87.6	87.9	88.0	87.9	87.9	87.7	87.4	87.1	86.8	86.4	86.0	85.6	85.0	84.5	83.9
80	80.0	82.3	83.8	84.9	85.6	86.2	86.5	86.6	86.7	86.8	86.7	86.6	86.4	86.2	85.9	85.6	85.2	84.8	84.4	83.9
85	79.5	81.2	82.5	83.4	84.1	84.6	85.0	85.3	85.5	85.6	85.6	85.6	85.5	85.4	85.3	85.1	84.9	84.6	84.2	83.9
90	79.5	80.6	81.5	82.2	82.8	83.3	83.6	83.9	84.2	84.3	84.5	84.6	84.6	84.6	84.6	84.5	84.4	84.3	84.1	83.9
95	80.6	81.1	81.5	81.9	82.2	82.5	82.8	83.0	83.2	83.4	83.5	83.6	83.7	83.8	83.9	83.9	83.9	83.9	83.9	83.9
98	82.4	82.6	82.7	82.8	82.9	83.1	83.2	83.2	83.3	83.4	83.5	83.5	83.6	83.7	83.7	83.7	83.8	83.8	83.9	83.9

Mean Annual Mass Removal Efficiencies for 2.25-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.1	96.2	97.0	97.3	97.4	97.2	96.7	96.0	95.2	94.5	93.8	93.0	92.3	91.5	90.6	89.8	88.9	88.0	87.1	86.2
35	92.9	95.3	96.2	96.6	96.8	96.6	96.1	95.5	94.8	94.2	93.5	92.8	92.1	91.3	90.5	89.7	88.8	88.0	87.1	86.2
40	91.7	94.3	95.4	95.9	96.1	95.9	95.5	95.0	94.4	93.8	93.2	92.5	91.9	91.1	90.4	89.5	88.7	87.9	87.1	86.2
45	90.6	93.3	94.6	95.1	95.3	95.1	94.8	94.4	93.9	93.4	92.8	92.2	91.6	90.9	90.2	89.4	88.6	87.9	87.1	86.2
50	89.4	92.3	93.6	94.2	94.3	94.2	94.0	93.7	93.3	92.9	92.5	91.9	91.3	90.7	90.0	89.3	88.5	87.8	87.0	86.2
55	88.2	91.2	92.5	93.1	93.3	93.3	93.2	93.0	92.7	92.4	92.0	91.5	91.0	90.4	89.7	89.1	88.4	87.7	87.0	86.2
60	87.0	89.7	91.1	91.8	92.1	92.3	92.3	92.2	92.0	91.8	91.5	91.0	90.6	90.1	89.5	88.9	88.2	87.6	86.9	86.2
65	85.3	88.1	89.6	90.5	91.0	91.3	91.4	91.4	91.3	91.1	90.9	90.5	90.1	89.7	89.1	88.6	88.1	87.5	86.9	86.2
70	83.8	86.6	88.2	89.2	89.8	90.2	90.4	90.5	90.5	90.4	90.2	89.9	89.6	89.2	88.8	88.3	87.9	87.4	86.8	86.2
75	82.9	85.3	86.9	87.9	88.6	89.1	89.3	89.5	89.6	89.5	89.4	89.2	89.0	88.7	88.3	88.0	87.6	87.2	86.7	86.2
80	82.2	84.3	85.7	86.7	87.4	87.9	88.2	88.4	88.5	88.5	88.5	88.4	88.3	88.1	87.8	87.6	87.3	87.0	86.6	86.2
85	81.9	83.4	84.6	85.5	86.1	86.6	86.9	87.2	87.4	87.5	87.5	87.5	87.5	87.4	87.3	87.1	87.0	86.8	86.5	86.2
90	82.1	83.0	83.8	84.5	85.0	85.4	85.7	86.0	86.2	86.4	86.5	86.6	86.7	86.7	86.7	86.7	86.6	86.5	86.4	86.2
95	83.0	83.5	83.9	84.2	84.5	84.8	85.0	85.2	85.4	85.6	85.7	85.8	85.9	86.0	86.1	86.2	86.2	86.2	86.3	86.2
98	84.8	84.9	85.0	85.1	85.3	85.4	85.5	85.6	85.6	85.7	85.8	85.9	85.9	86.0	86.0	86.1	86.1	86.2	86.2	86.2

Mean Annual Mass Removal Efficiencies for 2.50-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.3	96.4	97.2	97.5	97.6	97.6	97.3	96.8	96.1	95.4	94.7	94.1	93.4	92.7	92.0	91.3	90.5	89.7	88.9	88.1
35	93.3	95.6	96.5	96.9	97.1	97.1	96.8	96.3	95.7	95.1	94.5	93.9	93.2	92.6	91.9	91.2	90.4	89.7	88.9	88.1
40	92.3	94.7	95.8	96.3	96.5	96.5	96.3	95.8	95.3	94.7	94.2	93.6	93.0	92.4	91.7	91.1	90.3	89.6	88.9	88.1
45	91.2	93.9	95.0	95.6	95.9	95.9	95.6	95.2	94.8	94.3	93.8	93.3	92.8	92.2	91.6	90.9	90.2	89.5	88.8	88.1
50	90.3	93.0	94.2	94.9	95.1	95.1	94.9	94.6	94.3	93.8	93.4	93.0	92.5	92.0	91.4	90.8	90.1	89.5	88.8	88.1
55	89.3	92.1	93.4	94.0	94.2	94.2	94.1	93.9	93.7	93.3	93.0	92.6	92.2	91.7	91.2	90.6	90.0	89.4	88.8	88.1
60	88.4	91.0	92.2	92.9	93.1	93.3	93.3	93.2	93.0	92.8	92.5	92.2	91.8	91.4	90.9	90.4	89.9	89.3	88.7	88.1
65	87.2	89.6	90.9	91.6	92.1	92.3	92.4	92.4	92.3	92.2	92.0	91.7	91.4	91.0	90.7	90.2	89.7	89.2	88.7	88.1
70	85.8	88.2	89.5	90.5	91.0	91.3	91.5	91.6	91.6	91.5	91.4	91.2	90.9	90.6	90.3	89.9	89.5	89.0	88.6	88.1
75	84.7	87.0	88.3	89.2	89.9	90.3	90.6	90.7	90.8	90.8	90.7	90.6	90.4	90.2	89.9	89.6	89.2	88.9	88.5	88.1
80	84.0	85.9	87.2	88.1	88.8	89.2	89.6	89.8	89.9	90.0	90.0	89.9	89.8	89.7	89.5	89.2	89.0	88.7	88.4	88.1
85	83.8	85.3	86.3	87.1	87.7	88.2	88.5	88.8	89.0	89.1	89.1	89.1	89.1	89.1	89.0	88.8	88.7	88.5	88.3	88.1
90	84.1	85.0	85.8	86.4	86.8	87.2	87.5	87.8	88.0	88.1	88.3	88.3	88.4	88.4	88.4	88.4	88.3	88.3	88.2	88.1
95	85.1	85.5	85.9	86.2	86.5	86.7	86.9	87.1	87.3	87.4	87.5	87.7	87.8	87.8	87.9	88.0	88.0	88.1	88.1	88.1
98	86.7	86.8	86.9	87.0	87.1	87.2	87.3	87.4	87.5	87.6	87.6	87.7	87.8	87.8	87.9	87.9	88.0	88.0	88.1	88.1

Mean Annual Mass Removal Efficiencies for 2.75-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.6	96.5	97.3	97.7	97.8	97.9	97.7	97.4	96.8	96.2	95.6	94.9	94.4	93.7	93.1	92.4	91.8	91.1	90.4	89.6
35	93.6	95.9	96.7	97.1	97.3	97.4	97.3	97.0	96.5	95.9	95.3	94.7	94.2	93.6	93.0	92.4	91.7	91.0	90.3	89.6
40	92.8	95.1	96.1	96.6	96.8	97.0	96.8	96.5	96.0	95.5	95.0	94.5	94.0	93.4	92.8	92.2	91.6	91.0	90.3	89.6
45	91.8	94.3	95.4	96.0	96.3	96.4	96.3	96.0	95.6	95.1	94.7	94.2	93.7	93.2	92.7	92.1	91.6	90.9	90.3	89.6
50	91.0	93.6	94.8	95.4	95.7	95.8	95.6	95.4	95.0	94.7	94.3	93.9	93.5	93.0	92.5	92.0	91.5	90.9	90.3	89.6
55	90.2	92.8	94.0	94.7	95.0	95.0	94.9	94.7	94.5	94.2	93.9	93.5	93.2	92.8	92.3	91.8	91.3	90.8	90.2	89.6
60	89.4	92.0	93.2	93.8	94.0	94.1	94.2	94.0	93.9	93.7	93.4	93.1	92.9	92.5	92.1	91.7	91.2	90.7	90.2	89.6
65	88.7	90.9	92.0	92.7	93.1	93.3	93.3	93.3	93.2	93.1	92.9	92.7	92.5	92.2	91.8	91.4	91.1	90.6	90.1	89.6
70	87.5	89.6	90.8	91.6	92.1	92.3	92.5	92.5	92.5	92.5	92.4	92.2	92.0	91.8	91.5	91.2	90.9	90.5	90.1	89.6
75	86.4	88.4	89.7	90.4	91.0	91.3	91.6	91.7	91.8	91.8	91.8	91.7	91.6	91.4	91.2	90.9	90.7	90.3	90.0	89.6
80	85.8	87.4	88.6	89.4	90.0	90.4	90.7	90.9	91.0	91.1	91.1	91.1	91.0	90.9	90.8	90.6	90.4	90.2	89.9	89.6
85	85.5	86.8	87.7	88.5	89.0	89.4	89.8	90.0	90.2	90.3	90.4	90.4	90.4	90.4	90.4	90.3	90.1	90.0	89.8	89.6
90	85.8	86.6	87.3	87.9	88.3	88.7	89.0	89.2	89.4	89.6	89.7	89.8	89.8	89.9	89.9	89.9	89.8	89.8	89.7	89.6
95	86.9	87.2	87.6	87.8	88.1	88.3	88.5	88.7	88.9	89.0	89.1	89.2	89.3	89.4	89.5	89.5	89.5	89.6	89.6	89.6
98	88.4	88.5	88.6	88.7	88.8	88.9	88.9	89.0	89.1	89.1	89.2	89.3	89.3	89.4	89.4	89.5	89.5	89.6	89.6	89.6

Mean Annual Mass Removal Efficiencies for 3.00-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.9	96.7	97.4	97.8	98.0	98.0	98.0	97.8	97.4	96.9	96.3	95.7	95.1	94.6	94.0	93.4	92.8	92.2	91.6	90.9
35	93.9	96.0	96.9	97.3	97.5	97.6	97.7	97.4	97.1	96.6	96.0	95.5	94.9	94.4	93.9	93.3	92.7	92.2	91.6	90.9
40	93.1	95.4	96.3	96.8	97.1	97.2	97.2	97.1	96.7	96.2	95.7	95.2	94.7	94.3	93.7	93.2	92.7	92.1	91.5	90.9
45	92.4	94.7	95.7	96.3	96.6	96.8	96.8	96.6	96.2	95.8	95.4	95.0	94.5	94.1	93.6	93.1	92.6	92.1	91.5	90.9
50	91.6	94.0	95.2	95.8	96.1	96.3	96.2	96.0	95.8	95.4	95.1	94.7	94.3	93.9	93.4	93.0	92.5	92.0	91.5	90.9
55	91.0	93.4	94.6	95.2	95.6	95.7	95.6	95.4	95.2	94.9	94.6	94.3	94.0	93.6	93.3	92.8	92.4	91.9	91.4	90.9
60	90.4	92.7	93.9	94.6	94.8	94.9	94.9	94.8	94.6	94.4	94.2	93.9	93.7	93.4	93.0	92.7	92.3	91.9	91.4	90.9
65	89.8	92.0	93.0	93.6	93.9	94.1	94.2	94.1	94.0	93.9	93.7	93.5	93.3	93.1	92.8	92.5	92.1	91.8	91.4	90.9
70	89.0	90.9	91.9	92.6	93.0	93.2	93.3	93.4	93.4	93.3	93.2	93.1	92.9	92.8	92.5	92.2	92.0	91.6	91.3	90.9
75	88.0	89.7	90.8	91.6	92.0	92.3	92.5	92.6	92.7	92.7	92.7	92.6	92.5	92.4	92.2	92.0	91.8	91.5	91.2	90.9
80	87.3	88.8	89.8	90.5	91.0	91.4	91.7	91.8	92.0	92.0	92.1	92.1	92.1	92.0	91.8	91.7	91.6	91.4	91.2	90.9
85	87.0	88.1	89.0	89.7	90.1	90.5	90.8	91.1	91.3	91.4	91.5	91.5	91.5	91.5	91.5	91.4	91.3	91.2	91.1	90.9
90	87.2	88.0	88.6	89.1	89.5	89.9	90.2	90.4	90.6	90.7	90.8	90.9	91.0	91.0	91.1	91.1	91.1	91.0	91.0	90.9
95	88.3	88.7	88.9	89.2	89.4	89.6	89.8	90.0	90.1	90.2	90.4	90.5	90.6	90.7	90.7	90.8	90.8	90.9	90.9	90.9
98	89.7	89.8	89.9	90.0	90.1	90.2	90.3	90.3	90.4	90.5	90.5	90.6	90.6	90.7	90.7	90.8	90.8	90.9	90.9	90.9

Mean Annual Mass Removal Efficiencies for 3.25-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.2	96.9	97.5	97.9	98.1	98.2	98.2	98.1	97.8	97.5	96.9	96.4	95.8	95.3	94.7	94.2	93.7	93.1	92.6	92.0
35	94.1	96.2	97.0	97.5	97.7	97.8	97.9	97.8	97.5	97.2	96.7	96.2	95.6	95.1	94.6	94.1	93.6	93.1	92.5	92.0
40	93.4	95.6	96.6	97.0	97.3	97.5	97.5	97.4	97.2	96.8	96.4	95.9	95.4	95.0	94.5	94.0	93.5	93.0	92.5	92.0
45	92.8	95.0	96.0	96.6	96.9	97.1	97.1	97.1	96.8	96.5	96.1	95.7	95.2	94.8	94.4	93.9	93.5	93.0	92.5	92.0
50	92.1	94.4	95.5	96.1	96.5	96.7	96.7	96.6	96.3	96.1	95.7	95.4	95.0	94.6	94.2	93.8	93.4	92.9	92.5	92.0
55	91.5	93.8	95.0	95.6	96.0	96.2	96.2	96.0	95.9	95.6	95.3	95.0	94.7	94.4	94.0	93.7	93.3	92.9	92.4	92.0
60	91.1	93.3	94.4	95.1	95.5	95.6	95.5	95.5	95.3	95.1	94.9	94.7	94.4	94.1	93.8	93.5	93.2	92.8	92.4	92.0
65	90.7	92.7	93.8	94.4	94.7	94.8	94.9	94.9	94.8	94.6	94.5	94.3	94.0	93.8	93.6	93.3	93.0	92.7	92.4	92.0
70	90.3	92.0	92.9	93.4	93.8	94.0	94.2	94.2	94.1	94.1	94.0	93.8	93.7	93.5	93.4	93.1	92.9	92.6	92.3	92.0
75	89.4	90.9	91.8	92.5	93.0	93.2	93.4	93.5	93.5	93.5	93.4	93.4	93.3	93.2	93.1	92.9	92.7	92.5	92.2	92.0
80	88.7	90.1	91.0	91.6	92.0	92.3	92.6	92.7	92.8	92.9	92.9	92.9	92.9	92.9	92.8	92.6	92.5	92.3	92.2	92.0
85	88.4	89.4	90.2	90.7	91.2	91.5	91.8	92.0	92.1	92.3	92.4	92.4	92.5	92.5	92.4	92.4	92.3	92.2	92.1	92.0
90	88.5	89.2	89.7	90.2	90.6	90.9	91.2	91.4	91.6	91.7	91.9	91.9	92.0	92.0	92.0	92.1	92.1	92.1	92.0	92.0
95	89.6	89.9	90.1	90.4	90.6	90.8	90.9	91.1	91.2	91.3	91.4	91.5	91.6	91.7	91.8	91.8	91.9	91.9	92.0	92.0
98	90.8	90.9	91.0	91.1	91.2	91.2	91.3	91.4	91.4	91.5	91.6	91.6	91.7	91.7	91.8	91.8	91.9	91.9	92.0	92.0

Mean Annual Mass Removal Efficiencies for 3.50-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.5	97.0	97.6	98.0	98.2	98.3	98.3	98.3	98.1	97.9	97.5	96.9	96.4	95.9	95.4	94.9	94.4	93.9	93.4	92.9
35	94.4	96.3	97.2	97.6	97.9	98.0	98.0	98.0	97.9	97.6	97.2	96.7	96.3	95.8	95.3	94.8	94.4	93.9	93.4	92.9
40	93.6	95.8	96.8	97.2	97.5	97.6	97.7	97.7	97.6	97.3	96.9	96.5	96.1	95.6	95.2	94.7	94.3	93.8	93.4	92.9
45	93.2	95.3	96.3	96.8	97.1	97.3	97.4	97.4	97.3	97.0	96.6	96.3	95.9	95.4	95.0	94.6	94.2	93.8	93.3	92.9
50	92.6	94.7	95.8	96.4	96.7	97.0	97.1	97.0	96.9	96.6	96.3	96.0	95.6	95.2	94.9	94.5	94.1	93.7	93.3	92.9
55	92.1	94.2	95.3	96.0	96.4	96.6	96.7	96.6	96.4	96.2	95.9	95.6	95.3	95.0	94.7	94.4	94.0	93.7	93.3	92.9
60	91.7	93.8	94.9	95.5	95.9	96.1	96.1	96.0	95.9	95.8	95.5	95.3	95.0	94.8	94.5	94.2	93.9	93.6	93.2	92.9
65	91.4	93.3	94.4	95.0	95.4	95.5	95.5	95.5	95.4	95.3	95.1	94.9	94.7	94.5	94.3	94.0	93.8	93.5	93.2	92.9
70	91.2	92.9	93.8	94.3	94.5	94.7	94.8	94.9	94.8	94.8	94.7	94.5	94.4	94.2	94.0	93.9	93.7	93.4	93.1	92.9
75	90.7	92.0	92.8	93.3	93.7	94.0	94.1	94.2	94.2	94.2	94.2	94.1	94.0	93.9	93.8	93.7	93.5	93.3	93.1	92.9
80	89.9	91.1	91.9	92.5	92.9	93.2	93.4	93.5	93.6	93.6	93.7	93.6	93.6	93.6	93.5	93.4	93.3	93.2	93.0	92.9
85	89.7	90.5	91.2	91.7	92.1	92.4	92.7	92.8	93.0	93.0	93.1	93.2	93.2	93.2	93.2	93.2	93.1	93.1	93.0	92.9
90	89.7	90.3	90.8	91.2	91.5	91.8	92.0	92.2	92.4	92.5	92.7	92.8	92.8	92.9	92.9	92.9	92.9	92.9	92.9	92.9
95	90.6	90.9	91.1	91.3	91.5	91.7	91.9	92.0	92.2	92.3	92.4	92.4	92.5	92.6	92.7	92.7	92.8	92.8	92.8	92.9
98	91.8	91.9	92.0	92.0	92.1	92.2	92.2	92.3	92.4	92.4	92.5	92.5	92.6	92.6	92.7	92.7	92.8	92.8	92.8	92.9

Mean Annual Mass Removal Efficiencies for 3.75-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.8	97.2	97.8	98.1	98.2	98.4	98.4	98.4	98.3	98.2	97.9	97.5	97.0	96.5	96.0	95.5	95.0	94.6	94.1	93.6
35	94.7	96.5	97.3	97.7	98.0	98.1	98.2	98.2	98.1	97.9	97.7	97.3	96.8	96.3	95.9	95.4	95.0	94.5	94.1	93.6
40	93.9	95.9	96.9	97.4	97.7	97.8	97.9	97.9	97.9	97.7	97.4	97.0	96.6	96.2	95.8	95.3	94.9	94.5	94.1	93.6
45	93.4	95.5	96.5	97.0	97.3	97.5	97.6	97.7	97.6	97.4	97.1	96.8	96.4	96.0	95.6	95.2	94.8	94.5	94.1	93.6
50	93.1	95.1	96.0	96.6	97.0	97.2	97.3	97.4	97.3	97.1	96.8	96.5	96.2	95.8	95.5	95.1	94.8	94.4	94.0	93.6
55	92.5	94.6	95.6	96.2	96.6	96.9	97.0	97.0	96.9	96.7	96.5	96.2	95.9	95.6	95.3	95.0	94.7	94.3	94.0	93.6
60	92.2	94.1	95.2	95.9	96.3	96.5	96.6	96.6	96.4	96.3	96.1	95.9	95.6	95.4	95.1	94.8	94.6	94.3	94.0	93.6
65	92.0	93.8	94.8	95.5	95.9	96.1	96.1	96.0	96.0	95.9	95.7	95.5	95.3	95.1	94.9	94.7	94.4	94.2	93.9	93.6
70	91.9	93.5	94.4	95.0	95.3	95.4	95.4	95.5	95.5	95.4	95.3	95.2	95.0	94.8	94.7	94.5	94.3	94.1	93.9	93.6
75	91.8	93.0	93.7	94.1	94.4	94.7	94.8	94.9	94.9	94.9	94.8	94.7	94.7	94.5	94.4	94.3	94.2	94.0	93.8	93.6
80	91.1	92.1	92.8	93.3	93.7	94.0	94.1	94.2	94.3	94.3	94.3	94.3	94.3	94.2	94.2	94.1	94.0	93.9	93.8	93.6
85	90.7	91.6	92.2	92.6	93.0	93.2	93.4	93.6	93.7	93.8	93.8	93.9	93.9	93.9	93.9	93.9	93.8	93.8	93.7	93.6
90	90.8	91.3	91.8	92.1	92.4	92.7	92.9	93.0	93.2	93.3	93.4	93.5	93.5	93.6	93.6	93.7	93.7	93.7	93.7	93.6
95	91.5	91.7	92.0	92.2	92.3	92.5	92.7	92.8	92.9	93.0	93.1	93.2	93.3	93.4	93.4	93.5	93.5	93.6	93.6	93.6
98	92.6	92.7	92.8	92.9	92.9	93.0	93.1	93.1	93.2	93.2	93.3	93.3	93.4	93.4	93.4	93.5	93.5	93.6	93.6	93.6

Mean Annual Mass Removal Efficiencies for 4.00-inches of Retention for Zone 3 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	96.1	97.4	97.9	98.1	98.3	98.4	98.5	98.5	98.5	98.4	98.2	97.9	97.4	97.0	96.5	96.1	95.6	95.2	94.7	94.3
35	95.0	96.7	97.4	97.8	98.0	98.2	98.3	98.3	98.3	98.2	98.0	97.7	97.3	96.9	96.4	96.0	95.5	95.1	94.7	94.3
40	94.1	96.1	97.0	97.5	97.8	97.9	98.0	98.1	98.1	98.0	97.8	97.5	97.1	96.7	96.3	95.9	95.5	95.1	94.7	94.3
45	93.6	95.7	96.7	97.2	97.5	97.7	97.8	97.8	97.8	97.7	97.5	97.3	96.9	96.5	96.2	95.8	95.4	95.0	94.7	94.3
50	93.3	95.4	96.3	96.8	97.1	97.4	97.5	97.6	97.6	97.5	97.3	97.0	96.7	96.4	96.0	95.7	95.3	95.0	94.6	94.3
55	93.0	94.9	95.9	96.4	96.8	97.1	97.3	97.3	97.3	97.1	96.9	96.7	96.4	96.1	95.9	95.5	95.2	94.9	94.6	94.3
60	92.7	94.5	95.5	96.1	96.5	96.8	97.0	97.0	96.9	96.8	96.6	96.4	96.2	95.9	95.7	95.4	95.1	94.9	94.6	94.3
65	92.4	94.2	95.2	95.8	96.2	96.5	96.6	96.6	96.5	96.4	96.2	96.1	95.9	95.7	95.5	95.2	95.0	94.8	94.6	94.3
70	92.5	94.0	94.9	95.5	95.8	96.0	96.0	96.0	96.0	95.9	95.8	95.7	95.6	95.4	95.2	95.1	94.9	94.7	94.5	94.3
75	92.5	93.7	94.5	94.9	95.1	95.3	95.4	95.5	95.5	95.5	95.4	95.3	95.3	95.1	95.0	94.9	94.8	94.6	94.5	94.3
80	92.2	93.1	93.7	94.1	94.4	94.6	94.8	94.9	94.9	95.0	95.0	94.9	94.9	94.8	94.8	94.7	94.6	94.5	94.4	94.3
85	91.7	92.5	93.0	93.4	93.7	94.0	94.1	94.3	94.4	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.4	94.4	94.3
90	91.7	92.2	92.6	92.9	93.2	93.4	93.6	93.7	93.9	94.0	94.0	94.1	94.2	94.2	94.3	94.3	94.3	94.3	94.3	94.3
95	92.4	92.6	92.8	92.9	93.1	93.2	93.4	93.5	93.6	93.7	93.8	93.9	93.9	94.0	94.1	94.1	94.2	94.2	94.3	94.3
98	93.3	93.4	93.5	93.6	93.6	93.7	93.7	93.8	93.8	93.9	93.9	94.0	94.0	94.1	94.1	94.2	94.2	94.2	94.3	94.3

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	90.1	86.6	79.2	71.4	64.5	58.6	53.5	49.2	45.5	42.3	39.5	37.1	34.9	33.0	31.3	29.7	28.3	27.1	25.9	24.8
35	86.2	84.3	77.8	70.5	63.9	58.2	53.2	49.0	45.3	42.2	39.4	37.0	34.9	33.0	31.2	29.7	28.3	27.0	25.9	24.8
40	81.6	81.5	75.9	69.3	63.1	57.6	52.8	48.7	45.1	42.0	39.3	36.9	34.8	32.9	31.2	29.7	28.3	27.0	25.9	24.8
45	76.5	78.1	73.7	67.8	62.0	56.8	52.2	48.2	44.8	41.8	39.1	36.8	34.7	32.8	31.1	29.6	28.3	27.0	25.9	24.8
50	71.0	74.2	71.0	65.9	60.7	55.8	51.5	47.7	44.4	41.4	38.9	36.6	34.5	32.7	31.1	29.6	28.2	27.0	25.9	24.8
55	65.3	69.9	67.9	63.7	59.1	54.7	50.6	47.0	43.8	41.1	38.5	36.3	34.4	32.6	31.0	29.5	28.2	27.0	25.8	24.8
60	59.7	65.2	64.4	61.2	57.2	53.2	49.6	46.2	43.2	40.6	38.2	36.1	34.1	32.4	30.8	29.4	28.1	26.9	25.8	24.8
65	54.2	60.2	60.5	58.2	55.0	51.5	48.2	45.2	42.4	39.9	37.7	35.7	33.8	32.2	30.7	29.3	28.0	26.9	25.8	24.8
70	49.1	54.9	56.1	54.7	52.3	49.4	46.6	43.9	41.4	39.2	37.1	35.2	33.5	31.9	30.5	29.1	27.9	26.8	25.8	24.8
75	44.3	49.4	51.1	50.7	49.1	46.9	44.6	42.3	40.1	38.1	36.3	34.6	33.0	31.5	30.2	28.9	27.8	26.7	25.7	24.8
80	40.0	44.1	45.8	46.0	45.2	43.7	42.0	40.2	38.5	36.8	35.2	33.7	32.3	31.0	29.8	28.7	27.6	26.6	25.7	24.8
85	36.2	38.9	40.4	40.8	40.6	39.8	38.8	37.5	36.3	35.0	33.7	32.5	31.4	30.2	29.2	28.2	27.3	26.4	25.6	24.8
90	32.8	34.2	35.0	35.4	35.4	35.1	34.6	33.9	33.2	32.4	31.6	30.8	29.9	29.1	28.3	27.6	26.9	26.1	25.5	24.8
95	29.3	29.7	29.9	30.0	29.9	29.8	29.7	29.4	29.1	28.8	28.5	28.1	27.7	27.3	26.9	26.5	26.1	25.6	25.2	24.8
98	27.2	27.2	27.2	27.1	27.0	27.0	26.8	26.7	26.6	26.5	26.3	26.2	26.0	25.9	25.7	25.5	25.4	25.2	25.0	24.8

Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	94.0	94.2	92.1	88.8	84.8	80.5	76.3	72.4	68.6	65.2	62.0	59.1	56.4	53.9	51.7	49.5	47.6	45.8	44.1	42.6
35	91.1	92.3	90.7	87.7	84.0	79.9	75.9	72.0	68.4	65.0	61.9	59.0	56.3	53.9	51.6	49.5	47.6	45.8	44.1	42.6
40	87.8	90.0	88.9	86.4	82.9	79.1	75.3	71.5	68.0	64.7	61.6	58.8	56.2	53.8	51.5	49.4	47.5	45.7	44.1	42.6
45	84.0	87.2	86.8	84.7	81.6	78.1	74.5	70.9	67.5	64.3	61.3	58.6	56.0	53.6	51.4	49.4	47.5	45.7	44.1	42.6
50	79.9	84.0	84.3	82.7	80.1	76.9	73.5	70.2	66.9	63.9	61.0	58.3	55.8	53.5	51.3	49.3	47.4	45.7	44.1	42.6
55	75.6	80.4	81.4	80.4	78.2	75.4	72.3	69.2	66.2	63.3	60.5	57.9	55.5	53.2	51.1	49.2	47.3	45.6	44.0	42.6
60	71.3	76.5	78.1	77.6	75.9	73.6	70.9	68.0	65.2	62.5	59.9	57.4	55.1	53.0	50.9	49.0	47.2	45.6	44.0	42.6
65	67.1	72.4	74.4	74.5	73.3	71.4	69.1	66.6	64.1	61.6	59.2	56.9	54.7	52.6	50.6	48.8	47.1	45.5	44.0	42.6
70	63.0	68.1	70.3	70.8	70.2	68.9	67.0	64.9	62.7	60.5	58.3	56.1	54.1	52.1	50.3	48.6	46.9	45.4	43.9	42.6
75	59.2	63.7	65.9	66.7	66.6	65.7	64.4	62.7	60.9	59.0	57.1	55.2	53.3	51.5	49.8	48.2	46.7	45.2	43.8	42.6
80	55.8	59.4	61.4	62.3	62.4	61.9	61.1	59.9	58.6	57.1	55.5	53.9	52.3	50.7	49.2	47.8	46.4	45.0	43.8	42.6
85	52.7	55.2	56.7	57.5	57.7	57.6	57.1	56.4	55.5	54.5	53.3	52.1	50.8	49.6	48.3	47.1	45.9	44.7	43.6	42.6
90	49.7	51.1	52.0	52.5	52.8	52.8	52.6	52.2	51.7	51.1	50.3	49.6	48.7	47.9	47.0	46.1	45.2	44.3	43.4	42.6
95	46.7	47.1	47.4	47.5	47.6	47.6	47.5	47.3	47.1	46.8	46.5	46.2	45.8	45.4	44.9	44.5	44.0	43.5	43.0	42.6
98	44.9	44.9	44.8	44.8	44.7	44.7	44.6	44.5	44.3	44.2	44.1	44.0	43.8	43.6	43.5	43.3	43.1	42.9	42.7	42.6

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.6	96.4	95.6	94.1	92.1	89.6	86.8	83.9	81.0	78.1	75.3	72.7	70.1	67.7	65.4	63.3	61.2	59.3	57.4	55.7
35	93.5	94.9	94.5	93.2	91.3	89.0	86.3	83.5	80.7	77.9	75.1	72.5	70.0	67.6	65.4	63.2	61.2	59.3	57.4	55.7
40	91.0	93.1	93.0	92.0	90.3	88.1	85.7	83.0	80.2	77.5	74.9	72.3	69.8	67.5	65.3	63.1	61.1	59.2	57.4	55.7
45	88.1	90.9	91.3	90.5	89.1	87.1	84.8	82.3	79.7	77.1	74.5	72.0	69.6	67.3	65.1	63.0	61.1	59.2	57.4	55.7
50	85.0	88.4	89.2	88.8	87.6	85.9	83.8	81.5	79.0	76.5	74.1	71.7	69.3	67.1	65.0	62.9	61.0	59.1	57.4	55.7
55	81.7	85.7	86.8	86.8	85.9	84.5	82.6	80.5	78.2	75.9	73.5	71.2	69.0	66.8	64.8	62.8	60.9	59.1	57.4	55.7
60	78.4	82.6	84.1	84.4	83.9	82.7	81.1	79.2	77.2	75.0	72.8	70.7	68.6	66.5	64.5	62.6	60.8	59.0	57.3	55.7
65	75.0	79.3	81.1	81.7	81.5	80.7	79.4	77.8	76.0	74.0	72.0	70.0	68.0	66.1	64.2	62.3	60.6	58.9	57.3	55.7
70	71.7	75.9	77.9	78.7	78.7	78.2	77.3	76.0	74.4	72.7	71.0	69.1	67.3	65.5	63.8	62.0	60.4	58.8	57.2	55.7
75	68.7	72.5	74.4	75.4	75.6	75.3	74.7	73.7	72.5	71.1	69.6	68.0	66.4	64.8	63.2	61.6	60.1	58.6	57.1	55.7
80	65.9	69.0	70.8	71.7	72.1	72.1	71.7	71.0	70.1	69.0	67.8	66.6	65.2	63.9	62.5	61.1	59.7	58.3	57.0	55.7
85	63.5	65.7	67.1	67.9	68.3	68.3	68.1	67.7	67.1	66.4	65.5	64.6	63.6	62.5	61.4	60.3	59.1	58.0	56.8	55.7
90	61.2	62.4	63.2	63.8	64.1	64.2	64.1	63.9	63.6	63.2	62.7	62.1	61.4	60.7	59.9	59.1	58.3	57.4	56.6	55.7
95	58.7	59.1	59.4	59.6	59.7	59.7	59.7	59.7	59.5	59.4	59.1	58.9	58.6	58.2	57.9	57.5	57.1	56.6	56.2	55.7
98	57.5	57.5	57.5	57.5	57.5	57.4	57.4	57.3	57.2	57.1	57.0	56.9	56.8	56.6	56.5	56.4	56.2	56.0	55.9	55.7

Mean Annual Mass Removal Efficiencies for 1.00-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	96.6	97.5	97.2	96.4	95.2	93.7	91.9	90.0	87.9	85.7	83.5	81.2	79.0	76.9	74.8	72.8	70.9	69.1	67.3	65.6
35	95.0	96.3	96.2	95.6	94.5	93.1	91.4	89.6	87.5	85.4	83.2	81.1	78.9	76.8	74.8	72.8	70.9	69.0	67.2	65.6
40	93.0	94.9	95.1	94.6	93.6	92.4	90.8	89.0	87.1	85.1	82.9	80.8	78.7	76.7	74.7	72.7	70.8	69.0	67.2	65.6
45	90.8	93.1	93.6	93.4	92.6	91.5	90.0	88.4	86.5	84.6	82.6	80.5	78.5	76.5	74.5	72.6	70.7	68.9	67.2	65.6
50	88.3	91.1	92.0	91.9	91.4	90.4	89.1	87.6	85.9	84.0	82.1	80.1	78.2	76.2	74.3	72.5	70.6	68.9	67.2	65.6
55	85.7	89.0	90.1	90.2	89.9	89.1	88.0	86.6	85.1	83.4	81.5	79.7	77.8	75.9	74.1	72.3	70.5	68.8	67.1	65.6
60	83.1	86.6	87.9	88.3	88.1	87.6	86.7	85.5	84.1	82.5	80.8	79.1	77.3	75.6	73.8	72.1	70.4	68.7	67.1	65.6
65	80.4	83.9	85.5	86.1	86.1	85.8	85.1	84.1	82.9	81.5	80.0	78.4	76.8	75.1	73.5	71.8	70.2	68.6	67.1	65.6
70	77.7	81.2	82.8	83.6	83.9	83.7	83.2	82.4	81.4	80.3	78.9	77.5	76.0	74.5	73.0	71.5	70.0	68.5	67.0	65.6
75	75.2	78.4	80.1	81.0	81.3	81.3	81.0	80.4	79.6	78.7	77.6	76.4	75.1	73.8	72.4	71.0	69.6	68.3	66.9	65.6
80	73.0	75.6	77.2	78.1	78.5	78.6	78.4	78.1	77.5	76.8	75.9	74.9	73.9	72.8	71.6	70.4	69.2	68.0	66.8	65.6
85	71.1	73.0	74.2	75.0	75.4	75.6	75.5	75.3	74.9	74.4	73.8	73.1	72.3	71.4	70.5	69.6	68.6	67.6	66.6	65.6
90	69.4	70.5	71.2	71.7	72.0	72.2	72.2	72.1	71.9	71.6	71.2	70.8	70.3	69.7	69.1	68.5	67.8	67.1	66.3	65.6
95	67.6	67.9	68.1	68.3	68.4	68.5	68.5	68.5	68.4	68.3	68.2	68.0	67.8	67.6	67.3	67.0	66.7	66.3	65.9	65.6
98	66.7	66.8	66.8	66.8	66.8	66.7	66.7	66.7	66.6	66.6	66.5	66.4	66.3	66.3	66.1	66.0	65.9	65.8	65.7	65.6

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.3	98.0	98.0	97.5	96.8	95.8	94.6	93.3	91.8	90.2	88.5	86.8	85.0	83.2	81.4	79.6	77.9	76.2	74.5	72.9
35	95.9	97.2	97.3	96.9	96.2	95.3	94.2	92.9	91.5	89.9	88.3	86.6	84.8	83.0	81.3	79.5	77.8	76.2	74.5	72.9
40	94.5	96.0	96.3	96.1	95.5	94.6	93.6	92.4	91.1	89.6	88.0	86.3	84.6	82.9	81.2	79.5	77.8	76.1	74.5	72.9
45	92.7	94.6	95.1	95.0	94.6	93.9	93.0	91.8	90.6	89.1	87.6	86.0	84.4	82.7	81.0	79.3	77.7	76.1	74.5	72.9
50	90.7	93.1	93.8	93.8	93.6	93.0	92.1	91.1	89.9	88.6	87.2	85.7	84.1	82.4	80.8	79.2	77.6	76.0	74.5	72.9
55	88.6	91.3	92.2	92.5	92.3	91.9	91.2	90.3	89.2	88.0	86.6	85.2	83.7	82.1	80.6	79.0	77.5	75.9	74.4	72.9
60	86.4	89.3	90.5	90.9	90.9	90.6	90.0	89.2	88.3	87.2	86.0	84.6	83.2	81.8	80.3	78.8	77.3	75.8	74.4	72.9
65	84.3	87.2	88.5	89.1	89.2	89.0	88.6	88.0	87.2	86.3	85.2	84.0	82.7	81.3	79.9	78.5	77.1	75.7	74.3	72.9
70	82.1	85.0	86.4	87.1	87.4	87.3	87.0	86.6	85.9	85.1	84.2	83.1	82.0	80.7	79.5	78.2	76.9	75.6	74.3	72.9
75	80.1	82.7	84.1	84.9	85.3	85.4	85.2	84.9	84.4	83.7	82.9	82.0	81.1	80.0	78.9	77.7	76.6	75.4	74.2	72.9
80	78.2	80.4	81.7	82.5	83.0	83.2	83.1	82.9	82.5	82.0	81.4	80.7	79.9	79.1	78.1	77.1	76.1	75.1	74.0	72.9
85	76.7	78.3	79.3	80.1	80.5	80.7	80.7	80.6	80.4	80.1	79.6	79.1	78.5	77.8	77.1	76.4	75.5	74.7	73.8	72.9
90	75.4	76.3	77.0	77.5	77.8	78.0	78.1	78.0	77.9	77.7	77.5	77.1	76.8	76.3	75.9	75.3	74.8	74.2	73.6	72.9
95	74.2	74.5	74.7	74.9	75.0	75.1	75.1	75.1	75.1	75.0	74.9	74.8	74.6	74.5	74.3	74.0	73.8	73.5	73.3	72.9
98	73.7	73.7	73.7	73.7	73.7	73.7	73.7	73.7	73.7	73.6	73.6	73.6	73.5	73.4	73.4	73.3	73.2	73.1	73.0	72.9

Mean Annual Mass Removal Efficiencies for 1.50-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.8	98.4	98.5	98.2	97.7	97.1	96.2	95.3	94.2	93.0	91.7	90.4	89.0	87.5	86.0	84.5	83.0	81.5	80.0	78.5
35	96.7	97.7	97.9	97.7	97.3	96.6	95.8	94.9	93.9	92.8	91.5	90.2	88.8	87.4	85.9	84.4	82.9	81.4	80.0	78.5
40	95.5	96.8	97.1	97.0	96.6	96.1	95.4	94.5	93.5	92.4	91.2	89.9	88.6	87.2	85.8	84.3	82.9	81.4	80.0	78.5
45	94.1	95.7	96.2	96.2	95.9	95.4	94.8	94.0	93.1	92.0	90.9	89.7	88.4	87.0	85.6	84.2	82.8	81.3	79.9	78.5
50	92.5	94.4	95.1	95.2	95.0	94.6	94.1	93.3	92.5	91.5	90.5	89.3	88.1	86.8	85.4	84.1	82.7	81.3	79.9	78.5
55	90.8	93.0	93.8	94.0	94.0	93.7	93.2	92.6	91.8	91.0	90.0	88.9	87.7	86.5	85.2	83.9	82.5	81.2	79.9	78.5
60	88.9	91.3	92.3	92.7	92.8	92.6	92.2	91.7	91.0	90.3	89.4	88.4	87.3	86.1	84.9	83.7	82.4	81.1	79.8	78.5
65	87.1	89.6	90.7	91.3	91.4	91.3	91.1	90.6	90.1	89.4	88.6	87.7	86.8	85.7	84.6	83.4	82.2	81.0	79.8	78.5
70	85.4	87.8	89.0	89.6	89.9	89.9	89.7	89.4	89.0	88.4	87.7	87.0	86.1	85.1	84.1	83.1	82.0	80.8	79.7	78.5
75	83.8	85.9	87.1	87.8	88.2	88.3	88.2	88.0	87.7	87.2	86.7	86.0	85.3	84.4	83.6	82.6	81.6	80.6	79.6	78.5
80	82.2	84.0	85.2	85.9	86.3	86.4	86.5	86.4	86.2	85.8	85.4	84.9	84.3	83.6	82.9	82.1	81.2	80.4	79.5	78.5
85	81.0	82.3	83.2	83.8	84.2	84.4	84.5	84.5	84.4	84.2	83.9	83.5	83.0	82.5	82.0	81.4	80.7	80.0	79.3	78.5
90	80.0	80.7	81.3	81.8	82.1	82.3	82.4	82.4	82.4	82.2	82.1	81.8	81.6	81.2	80.9	80.5	80.0	79.6	79.1	78.5
95	79.1	79.4	79.6	79.8	79.9	80.0	80.1	80.1	80.1	80.1	80.0	79.9	79.8	79.7	79.6	79.4	79.2	79.0	78.8	78.5
98	79.0	79.0	79.0	79.1	79.1	79.1	79.1	79.1	79.0	79.0	79.0	79.0	78.9	78.9	78.8	78.8	78.7	78.7	78.6	78.5

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.2	98.7	98.8	98.7	98.4	97.9	97.3	96.5	95.7	94.8	93.8	92.8	91.7	90.5	89.3	88.0	86.7	85.4	84.1	82.8
35	97.3	98.1	98.3	98.2	97.9	97.5	96.9	96.2	95.5	94.6	93.6	92.6	91.5	90.4	89.2	87.9	86.7	85.4	84.1	82.8
40	96.2	97.4	97.7	97.7	97.4	97.0	96.5	95.9	95.1	94.3	93.4	92.4	91.3	90.2	89.0	87.8	86.6	85.4	84.1	82.8
45	95.1	96.5	96.9	97.0	96.8	96.5	96.0	95.4	94.7	93.9	93.1	92.1	91.1	90.0	88.9	87.7	86.5	85.3	84.1	82.8
50	93.9	95.5	96.0	96.1	96.0	95.8	95.4	94.8	94.2	93.5	92.7	91.8	90.8	89.8	88.7	87.6	86.4	85.2	84.0	82.8
55	92.4	94.3	95.0	95.2	95.2	95.0	94.6	94.2	93.6	93.0	92.2	91.4	90.5	89.5	88.5	87.4	86.3	85.2	84.0	82.8
60	90.9	92.9	93.7	94.1	94.2	94.0	93.8	93.4	92.9	92.4	91.7	90.9	90.1	89.2	88.2	87.2	86.2	85.1	83.9	82.8
65	89.4	91.4	92.4	92.9	93.0	93.0	92.8	92.5	92.1	91.6	91.0	90.4	89.6	88.8	87.9	87.0	86.0	84.9	83.9	82.8
70	87.9	89.9	90.9	91.5	91.7	91.8	91.7	91.5	91.2	90.7	90.3	89.7	89.0	88.3	87.5	86.6	85.7	84.8	83.8	82.8
75	86.5	88.4	89.4	90.0	90.3	90.5	90.4	90.3	90.1	89.7	89.3	88.9	88.3	87.7	87.0	86.2	85.4	84.6	83.7	82.8
80	85.3	86.8	87.8	88.4	88.8	88.9	89.0	88.9	88.8	88.6	88.3	87.9	87.4	86.9	86.4	85.7	85.1	84.4	83.6	82.8
85	84.3	85.4	86.2	86.7	87.1	87.3	87.4	87.4	87.3	87.2	87.0	86.7	86.4	86.0	85.6	85.1	84.6	84.0	83.4	82.8
90	83.5	84.1	84.7	85.0	85.3	85.5	85.7	85.7	85.7	85.6	85.5	85.4	85.2	84.9	84.7	84.4	84.0	83.7	83.3	82.8
95	82.9	83.2	83.4	83.6	83.7	83.8	83.9	83.9	83.9	83.9	83.9	83.8	83.8	83.7	83.6	83.5	83.3	83.2	83.0	82.8
98	83.0	83.1	83.1	83.1	83.1	83.1	83.2	83.2	83.2	83.1	83.1	83.1	83.1	83.1	83.0	83.0	83.0	82.9	82.9	82.8

Mean Annual Mass Removal Efficiencies for 2.00-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.5	99.0	99.1	99.0	98.7	98.4	98.0	97.4	96.8	96.1	95.3	94.5	93.6	92.6	91.6	90.6	89.5	88.4	87.3	86.1
35	97.8	98.5	98.6	98.6	98.4	98.1	97.7	97.1	96.5	95.9	95.1	94.3	93.4	92.5	91.5	90.5	89.4	88.4	87.3	86.1
40	96.9	97.8	98.1	98.1	98.0	97.7	97.3	96.8	96.2	95.6	94.9	94.1	93.3	92.4	91.4	90.4	89.4	88.3	87.2	86.1
45	95.9	97.1	97.5	97.6	97.5	97.2	96.8	96.4	95.9	95.3	94.6	93.8	93.0	92.2	91.3	90.3	89.3	88.3	87.2	86.1
50	94.9	96.3	96.7	96.9	96.8	96.6	96.3	95.9	95.4	94.9	94.2	93.6	92.8	92.0	91.1	90.2	89.2	88.2	87.2	86.1
55	93.7	95.3	95.9	96.1	96.1	95.9	95.7	95.3	94.9	94.4	93.8	93.2	92.5	91.7	90.9	90.0	89.1	88.1	87.1	86.1
60	92.5	94.1	94.9	95.1	95.2	95.1	95.0	94.7	94.3	93.9	93.4	92.8	92.1	91.4	90.6	89.8	88.9	88.0	87.1	86.1
65	91.2	92.9	93.7	94.1	94.3	94.3	94.1	93.9	93.6	93.2	92.8	92.3	91.7	91.0	90.3	89.6	88.8	87.9	87.1	86.1
70	89.9	91.6	92.5	92.9	93.2	93.2	93.2	93.0	92.8	92.5	92.1	91.7	91.2	90.6	90.0	89.3	88.6	87.8	87.0	86.1
75	88.7	90.2	91.2	91.7	92.0	92.1	92.1	92.0	91.9	91.6	91.3	91.0	90.5	90.1	89.5	88.9	88.3	87.6	86.9	86.1
80	87.7	89.0	89.8	90.3	90.7	90.9	90.9	90.9	90.8	90.6	90.4	90.1	89.8	89.4	89.0	88.5	88.0	87.4	86.8	86.1
85	86.9	87.8	88.5	89.0	89.3	89.5	89.6	89.6	89.6	89.5	89.4	89.2	88.9	88.7	88.3	88.0	87.6	87.1	86.6	86.1
90	86.3	86.8	87.3	87.6	87.9	88.0	88.2	88.2	88.3	88.2	88.2	88.1	87.9	87.8	87.6	87.3	87.1	86.8	86.5	86.1
95	85.9	86.1	86.3	86.5	86.6	86.7	86.8	86.8	86.8	86.9	86.9	86.8	86.8	86.8	86.7	86.6	86.5	86.4	86.3	86.1
98	86.1	86.2	86.2	86.2	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.3	86.2	86.2	86.2	86.2	86.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.8	99.2	99.2	99.2	99.0	98.8	98.4	98.0	97.5	97.0	96.3	95.7	94.9	94.2	93.3	92.5	91.6	90.6	89.7	88.7
35	98.1	98.7	98.9	98.8	98.7	98.5	98.2	97.8	97.3	96.8	96.2	95.5	94.8	94.0	93.2	92.4	91.5	90.6	89.7	88.7
40	97.4	98.2	98.4	98.5	98.4	98.2	97.9	97.5	97.0	96.5	96.0	95.3	94.6	93.9	93.1	92.3	91.5	90.6	89.6	88.7
45	96.5	97.6	97.9	98.0	97.9	97.8	97.5	97.1	96.7	96.2	95.7	95.1	94.4	93.7	93.0	92.2	91.4	90.5	89.6	88.7
50	95.7	96.9	97.3	97.4	97.4	97.3	97.0	96.7	96.3	95.9	95.4	94.8	94.2	93.6	92.8	92.1	91.3	90.5	89.6	88.7
55	94.8	96.1	96.6	96.8	96.8	96.7	96.5	96.2	95.9	95.5	95.0	94.5	94.0	93.3	92.7	91.9	91.2	90.4	89.6	88.7
60	93.7	95.1	95.7	96.0	96.0	96.0	95.9	95.6	95.4	95.0	94.6	94.1	93.6	93.1	92.4	91.8	91.1	90.3	89.5	88.7
65	92.6	94.1	94.8	95.1	95.2	95.2	95.2	95.0	94.7	94.4	94.1	93.7	93.2	92.7	92.2	91.6	90.9	90.2	89.5	88.7
70	91.5	92.9	93.7	94.1	94.3	94.4	94.3	94.2	94.0	93.8	93.5	93.2	92.8	92.3	91.8	91.3	90.7	90.1	89.4	88.7
75	90.5	91.8	92.6	93.0	93.3	93.4	93.4	93.4	93.3	93.1	92.8	92.6	92.2	91.9	91.4	91.0	90.5	89.9	89.3	88.7
80	89.6	90.7	91.4	91.9	92.2	92.3	92.4	92.4	92.4	92.3	92.1	91.9	91.6	91.3	91.0	90.6	90.2	89.7	89.2	88.7
85	88.9	89.7	90.3	90.7	91.0	91.2	91.3	91.4	91.4	91.3	91.2	91.1	90.9	90.7	90.4	90.1	89.8	89.5	89.1	88.7
90	88.4	89.0	89.3	89.6	89.9	90.0	90.1	90.2	90.2	90.2	90.2	90.1	90.1	89.9	89.8	89.6	89.4	89.2	89.0	88.7
95	88.2	88.4	88.6	88.7	88.9	89.0	89.0	89.1	89.1	89.2	89.2	89.2	89.1	89.1	89.1	89.0	89.0	88.9	88.8	88.7
98	88.6	88.6	88.6	88.7	88.7	88.7	88.7	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.8	88.7	88.7	88.7

Mean Annual Mass Removal Efficiencies for 2.50-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.0	99.3	99.4	99.3	99.2	99.0	98.8	98.5	98.1	97.6	97.1	96.6	95.9	95.3	94.6	93.9	93.1	92.4	91.5	90.7
35	98.4	98.9	99.1	99.1	99.0	98.8	98.6	98.3	97.9	97.4	96.9	96.4	95.8	95.2	94.5	93.8	93.1	92.3	91.5	90.7
40	97.8	98.5	98.7	98.7	98.7	98.5	98.3	98.0	97.6	97.2	96.8	96.2	95.7	95.1	94.4	93.8	93.0	92.3	91.5	90.7
45	97.1	98.0	98.2	98.3	98.3	98.2	98.0	97.7	97.4	97.0	96.5	96.0	95.5	94.9	94.3	93.7	93.0	92.2	91.5	90.7
50	96.3	97.4	97.8	97.9	97.9	97.8	97.6	97.3	97.0	96.7	96.3	95.8	95.3	94.7	94.2	93.5	92.9	92.2	91.4	90.7
55	95.6	96.7	97.2	97.3	97.3	97.3	97.1	96.9	96.6	96.3	95.9	95.5	95.0	94.5	94.0	93.4	92.8	92.1	91.4	90.7
60	94.7	95.9	96.4	96.7	96.7	96.7	96.6	96.4	96.2	95.9	95.5	95.2	94.8	94.3	93.8	93.2	92.7	92.0	91.4	90.7
65	93.8	95.0	95.6	95.9	96.0	96.0	95.9	95.8	95.6	95.4	95.1	94.8	94.4	94.0	93.5	93.0	92.5	91.9	91.3	90.7
70	92.8	94.0	94.7	95.0	95.2	95.3	95.3	95.2	95.0	94.8	94.6	94.3	94.0	93.7	93.3	92.8	92.3	91.8	91.3	90.7
75	91.9	93.1	93.7	94.1	94.3	94.5	94.5	94.4	94.3	94.2	94.0	93.8	93.5	93.2	92.9	92.5	92.1	91.7	91.2	90.7
80	91.2	92.1	92.7	93.1	93.4	93.5	93.6	93.6	93.6	93.5	93.4	93.2	93.0	92.8	92.5	92.2	91.9	91.5	91.1	90.7
85	90.6	91.3	91.8	92.2	92.4	92.6	92.7	92.7	92.7	92.7	92.6	92.5	92.4	92.2	92.0	91.8	91.6	91.3	91.0	90.7
90	90.2	90.6	91.0	91.2	91.4	91.6	91.7	91.8	91.8	91.8	91.8	91.8	91.7	91.6	91.5	91.4	91.2	91.1	90.9	90.7
95	90.1	90.3	90.4	90.6	90.7	90.7	90.8	90.9	90.9	91.0	91.0	91.0	91.0	91.0	90.9	90.9	90.9	90.8	90.8	90.7
98	90.5	90.5	90.5	90.6	90.6	90.6	90.6	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7	90.7

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.1	99.4	99.5	99.5	99.4	99.2	99.0	98.8	98.5	98.1	97.7	97.2	96.7	96.2	95.6	95.0	94.3	93.7	93.0	92.3
35	98.7	99.1	99.2	99.2	99.2	99.0	98.9	98.6	98.3	98.0	97.5	97.1	96.6	96.1	95.5	94.9	94.3	93.6	93.0	92.3
40	98.1	98.7	98.9	98.9	98.9	98.8	98.6	98.4	98.1	97.8	97.4	96.9	96.5	96.0	95.4	94.9	94.2	93.6	92.9	92.3
45	97.6	98.3	98.5	98.6	98.6	98.5	98.3	98.1	97.9	97.5	97.2	96.8	96.3	95.8	95.3	94.8	94.2	93.6	92.9	92.3
50	96.9	97.8	98.1	98.2	98.2	98.1	98.0	97.8	97.6	97.3	96.9	96.6	96.1	95.7	95.2	94.7	94.1	93.5	92.9	92.3
55	96.2	97.2	97.6	97.7	97.8	97.7	97.6	97.4	97.2	96.9	96.6	96.3	95.9	95.5	95.0	94.5	94.0	93.5	92.9	92.3
60	95.5	96.6	97.0	97.2	97.3	97.2	97.1	97.0	96.8	96.6	96.3	96.0	95.6	95.3	94.8	94.4	93.9	93.4	92.8	92.3
65	94.7	95.8	96.3	96.5	96.6	96.7	96.6	96.5	96.3	96.1	95.9	95.6	95.3	95.0	94.6	94.2	93.8	93.3	92.8	92.3
70	93.9	95.0	95.5	95.8	96.0	96.0	96.0	95.9	95.8	95.7	95.5	95.2	95.0	94.7	94.4	94.0	93.6	93.2	92.7	92.3
75	93.1	94.1	94.7	95.0	95.2	95.3	95.3	95.3	95.2	95.1	95.0	94.8	94.6	94.3	94.1	93.8	93.4	93.1	92.7	92.3
80	92.5	93.3	93.8	94.1	94.4	94.5	94.6	94.6	94.6	94.5	94.4	94.3	94.1	93.9	93.7	93.5	93.2	92.9	92.6	92.3
85	91.9	92.6	93.0	93.3	93.5	93.7	93.8	93.8	93.8	93.8	93.8	93.7	93.6	93.5	93.3	93.2	93.0	92.7	92.5	92.3
90	91.6	92.0	92.3	92.5	92.7	92.9	93.0	93.0	93.1	93.1	93.1	93.1	93.0	93.0	92.9	92.8	92.7	92.6	92.4	92.3
95	91.6	91.8	91.9	92.0	92.1	92.2	92.3	92.3	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.3	92.3	92.3
98	92.0	92.0	92.1	92.1	92.1	92.1	92.2	92.2	92.2	92.2	92.2	92.2	92.2	92.3	92.3	92.3	92.3	92.3	92.3	92.3

Mean Annual Mass Removal Efficiencies for 3.00-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.3	99.5	99.6	99.6	99.5	99.4	99.2	99.0	98.8	98.5	98.1	97.7	97.3	96.9	96.4	95.9	95.3	94.7	94.1	93.5
35	98.9	99.2	99.4	99.4	99.3	99.2	99.1	98.9	98.6	98.3	98.0	97.6	97.2	96.8	96.3	95.8	95.3	94.7	94.1	93.5
40	98.4	98.9	99.1	99.1	99.1	99.0	98.9	98.7	98.5	98.2	97.9	97.5	97.1	96.7	96.2	95.7	95.2	94.7	94.1	93.5
45	97.9	98.5	98.8	98.8	98.8	98.7	98.6	98.5	98.3	98.0	97.7	97.3	97.0	96.6	96.1	95.6	95.1	94.6	94.1	93.5
50	97.4	98.1	98.4	98.5	98.5	98.4	98.3	98.2	98.0	97.7	97.5	97.1	96.8	96.4	96.0	95.5	95.1	94.6	94.0	93.5
55	96.7	97.6	97.9	98.1	98.1	98.1	98.0	97.9	97.7	97.4	97.2	96.9	96.6	96.2	95.9	95.4	95.0	94.5	94.0	93.5
60	96.2	97.1	97.5	97.6	97.7	97.7	97.6	97.5	97.3	97.1	96.9	96.6	96.4	96.0	95.7	95.3	94.9	94.5	94.0	93.5
65	95.5	96.4	96.9	97.1	97.2	97.2	97.1	97.0	96.9	96.7	96.6	96.3	96.1	95.8	95.5	95.1	94.8	94.4	93.9	93.5
70	94.9	95.7	96.2	96.4	96.6	96.6	96.6	96.5	96.5	96.3	96.2	96.0	95.8	95.5	95.2	94.9	94.6	94.3	93.9	93.5
75	94.2	95.0	95.4	95.7	95.9	96.0	96.0	96.0	95.9	95.9	95.7	95.6	95.4	95.2	95.0	94.7	94.5	94.2	93.8	93.5
80	93.5	94.2	94.7	95.0	95.2	95.3	95.4	95.4	95.4	95.3	95.3	95.1	95.0	94.9	94.7	94.5	94.3	94.0	93.8	93.5
85	93.1	93.6	94.0	94.3	94.5	94.6	94.7	94.7	94.8	94.7	94.7	94.6	94.6	94.5	94.4	94.2	94.1	93.9	93.7	93.5
90	92.8	93.1	93.4	93.6	93.8	93.9	94.0	94.1	94.1	94.1	94.1	94.1	94.1	94.0	94.0	93.9	93.8	93.7	93.6	93.5
95	92.8	93.0	93.1	93.2	93.3	93.3	93.4	93.5	93.5	93.5	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.5	93.5
98	93.2	93.2	93.3	93.3	93.3	93.3	93.4	93.4	93.4	93.4	93.4	93.4	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.4	99.6	99.6	99.6	99.6	99.5	99.4	99.2	99.0	98.8	98.5	98.2	97.8	97.4	97.0	96.5	96.1	95.6	95.0	94.5
35	99.1	99.4	99.5	99.5	99.4	99.4	99.2	99.1	98.9	98.7	98.4	98.1	97.7	97.3	96.9	96.5	96.0	95.5	95.0	94.5
40	98.7	99.1	99.2	99.3	99.2	99.2	99.1	98.9	98.7	98.5	98.2	97.9	97.6	97.2	96.8	96.4	96.0	95.5	95.0	94.5
45	98.2	98.8	98.9	99.0	99.0	98.9	98.8	98.7	98.5	98.3	98.1	97.8	97.5	97.1	96.8	96.3	95.9	95.5	95.0	94.5
50	97.7	98.4	98.6	98.7	98.7	98.7	98.6	98.5	98.3	98.1	97.9	97.6	97.3	97.0	96.6	96.3	95.9	95.4	95.0	94.5
55	97.2	98.0	98.2	98.4	98.4	98.4	98.3	98.2	98.1	97.9	97.6	97.4	97.1	96.8	96.5	96.2	95.8	95.4	94.9	94.5
60	96.7	97.5	97.8	98.0	98.0	98.0	98.0	97.9	97.7	97.6	97.4	97.2	96.9	96.7	96.4	96.0	95.7	95.3	94.9	94.5
65	96.2	96.9	97.3	97.5	97.6	97.6	97.6	97.5	97.4	97.2	97.1	96.9	96.7	96.4	96.2	95.9	95.6	95.2	94.9	94.5
70	95.6	96.4	96.8	97.0	97.1	97.1	97.1	97.1	97.0	96.9	96.7	96.6	96.4	96.2	96.0	95.7	95.4	95.1	94.8	94.5
75	95.0	95.7	96.1	96.4	96.5	96.6	96.6	96.6	96.5	96.5	96.4	96.2	96.1	95.9	95.7	95.5	95.3	95.0	94.8	94.5
80	94.5	95.1	95.5	95.7	95.9	96.0	96.0	96.1	96.0	96.0	95.9	95.9	95.8	95.6	95.5	95.3	95.1	94.9	94.7	94.5
85	94.0	94.5	94.8	95.1	95.2	95.4	95.4	95.5	95.5	95.5	95.5	95.4	95.4	95.3	95.2	95.1	94.9	94.8	94.7	94.5
90	93.8	94.1	94.3	94.5	94.6	94.8	94.8	94.9	94.9	95.0	95.0	95.0	94.9	94.9	94.9	94.8	94.7	94.7	94.6	94.5
95	93.8	94.0	94.1	94.2	94.2	94.3	94.4	94.4	94.4	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5
98	94.2	94.2	94.2	94.3	94.3	94.3	94.3	94.4	94.4	94.4	94.4	94.4	94.4	94.5	94.5	94.5	94.5	94.5	94.5	94.5

Mean Annual Mass Removal Efficiencies for 3.50-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.5	99.7	99.7	99.7	99.7	99.6	99.5	99.4	99.2	99.0	98.8	98.5	98.2	97.8	97.5	97.1	96.7	96.2	95.8	95.3
35	99.2	99.5	99.5	99.6	99.5	99.5	99.4	99.2	99.1	98.9	98.7	98.4	98.1	97.8	97.4	97.0	96.6	96.2	95.8	95.3
40	98.9	99.2	99.4	99.4	99.4	99.3	99.2	99.1	98.9	98.8	98.5	98.3	98.0	97.7	97.3	97.0	96.6	96.2	95.7	95.3
45	98.5	98.9	99.1	99.2	99.2	99.1	99.0	98.9	98.8	98.6	98.4	98.2	97.9	97.6	97.3	96.9	96.5	96.2	95.7	95.3
50	98.0	98.6	98.8	98.9	98.9	98.9	98.8	98.7	98.6	98.4	98.2	98.0	97.7	97.5	97.2	96.8	96.5	96.1	95.7	95.3
55	97.6	98.3	98.5	98.6	98.6	98.6	98.6	98.5	98.4	98.2	98.0	97.8	97.6	97.3	97.0	96.7	96.4	96.1	95.7	95.3
60	97.2	97.8	98.1	98.3	98.3	98.3	98.3	98.2	98.1	98.0	97.8	97.6	97.4	97.2	96.9	96.6	96.3	96.0	95.7	95.3
65	96.7	97.4	97.7	97.9	97.9	98.0	97.9	97.9	97.8	97.7	97.5	97.4	97.2	97.0	96.7	96.5	96.2	95.9	95.6	95.3
70	96.2	96.9	97.2	97.4	97.5	97.6	97.5	97.5	97.4	97.3	97.2	97.1	96.9	96.8	96.6	96.3	96.1	95.9	95.6	95.3
75	95.7	96.3	96.7	96.9	97.0	97.1	97.1	97.1	97.0	97.0	96.9	96.8	96.7	96.5	96.4	96.2	96.0	95.8	95.5	95.3
80	95.3	95.8	96.1	96.3	96.5	96.5	96.6	96.6	96.6	96.6	96.5	96.4	96.4	96.3	96.1	96.0	95.8	95.7	95.5	95.3
85	94.8	95.2	95.5	95.7	95.9	96.0	96.1	96.1	96.1	96.1	96.1	96.1	96.0	96.0	95.9	95.8	95.7	95.6	95.4	95.3
90	94.6	94.9	95.1	95.2	95.4	95.5	95.5	95.6	95.6	95.7	95.7	95.7	95.7	95.6	95.6	95.6	95.5	95.4	95.4	95.3
95	94.7	94.8	94.9	95.0	95.0	95.1	95.2	95.2	95.2	95.3	95.3	95.3	95.3	95.3	95.3	95.3	95.3	95.3	95.3	95.3
98	95.0	95.0	95.1	95.1	95.1	95.1	95.2	95.2	95.2	95.2	95.2	95.2	95.2	95.3	95.3	95.3	95.3	95.3	95.3	95.3

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.7	99.7	99.7	99.7	99.7	99.7	99.6	99.5	99.3	99.2	99.0	98.7	98.5	98.2	97.9	97.5	97.2	96.8	96.4	96.0
35	99.3	99.5	99.6	99.6	99.6	99.6	99.5	99.4	99.2	99.1	98.9	98.7	98.4	98.1	97.8	97.5	97.1	96.8	96.4	96.0
40	99.0	99.3	99.4	99.5	99.5	99.4	99.3	99.2	99.1	99.0	98.8	98.6	98.3	98.1	97.8	97.4	97.1	96.7	96.4	96.0
45	98.7	99.1	99.2	99.3	99.3	99.3	99.2	99.1	99.0	98.8	98.7	98.4	98.2	98.0	97.7	97.4	97.1	96.7	96.4	96.0
50	98.3	98.8	99.0	99.1	99.1	99.0	99.0	98.9	98.8	98.7	98.5	98.3	98.1	97.8	97.6	97.3	97.0	96.7	96.3	96.0
55	98.0	98.5	98.7	98.8	98.8	98.8	98.8	98.7	98.6	98.5	98.3	98.1	97.9	97.7	97.5	97.2	96.9	96.6	96.3	96.0
60	97.6	98.1	98.4	98.5	98.5	98.5	98.5	98.5	98.4	98.3	98.1	98.0	97.8	97.6	97.4	97.1	96.9	96.6	96.3	96.0
65	97.1	97.7	98.0	98.2	98.2	98.2	98.2	98.2	98.1	98.0	97.9	97.7	97.6	97.4	97.2	97.0	96.8	96.5	96.3	96.0
70	96.7	97.3	97.6	97.8	97.9	97.9	97.9	97.9	97.8	97.7	97.6	97.5	97.4	97.2	97.1	96.9	96.7	96.5	96.2	96.0
75	96.3	96.8	97.1	97.3	97.4	97.5	97.5	97.5	97.5	97.4	97.3	97.2	97.1	97.0	96.9	96.7	96.6	96.4	96.2	96.0
80	95.9	96.4	96.6	96.8	97.0	97.0	97.1	97.1	97.1	97.0	97.0	96.9	96.9	96.8	96.7	96.6	96.4	96.3	96.1	96.0
85	95.6	95.9	96.1	96.3	96.4	96.5	96.6	96.6	96.7	96.7	96.6	96.6	96.6	96.5	96.5	96.4	96.3	96.2	96.1	96.0
90	95.3	95.6	95.7	95.9	96.0	96.1	96.1	96.2	96.2	96.3	96.3	96.3	96.3	96.2	96.2	96.2	96.1	96.1	96.0	96.0
95	95.4	95.5	95.6	95.6	95.7	95.8	95.8	95.8	95.9	95.9	95.9	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0	96.0
98	95.7	95.7	95.7	95.8	95.8	95.8	95.8	95.8	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	95.9	96.0	96.0	96.0

Mean Annual Mass Removal Efficiencies for 4.00-inches of Retention for Zone 4 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.7	99.8	99.8	99.8	99.8	99.8	99.7	99.6	99.5	99.3	99.1	99.0	98.7	98.5	98.2	97.9	97.6	97.3	96.9	96.5
35	99.5	99.6	99.7	99.7	99.7	99.7	99.6	99.5	99.4	99.2	99.1	98.9	98.7	98.4	98.2	97.9	97.6	97.2	96.9	96.5
40	99.2	99.4	99.5	99.6	99.6	99.5	99.5	99.4	99.3	99.1	99.0	98.8	98.6	98.4	98.1	97.8	97.5	97.2	96.9	96.5
45	98.9	99.2	99.4	99.4	99.4	99.4	99.3	99.2	99.1	99.0	98.9	98.7	98.5	98.3	98.0	97.8	97.5	97.2	96.9	96.5
50	98.6	99.0	99.1	99.2	99.2	99.2	99.1	99.1	99.0	98.9	98.7	98.6	98.4	98.2	97.9	97.7	97.4	97.1	96.8	96.5
55	98.2	98.7	98.9	99.0	99.0	99.0	98.9	98.9	98.8	98.7	98.6	98.4	98.2	98.1	97.8	97.6	97.4	97.1	96.8	96.5
60	97.9	98.4	98.6	98.7	98.8	98.8	98.7	98.7	98.6	98.5	98.4	98.3	98.1	97.9	97.7	97.5	97.3	97.1	96.8	96.5
65	97.6	98.0	98.3	98.4	98.5	98.5	98.5	98.4	98.4	98.3	98.2	98.1	97.9	97.8	97.6	97.4	97.2	97.0	96.8	96.5
70	97.1	97.6	97.9	98.1	98.1	98.2	98.2	98.2	98.1	98.1	98.0	97.9	97.7	97.6	97.5	97.3	97.1	96.9	96.7	96.5
75	96.8	97.2	97.5	97.7	97.8	97.8	97.9	97.8	97.8	97.8	97.7	97.6	97.5	97.4	97.3	97.2	97.0	96.9	96.7	96.5
80	96.4	96.8	97.1	97.3	97.4	97.4	97.5	97.5	97.5	97.4	97.4	97.3	97.3	97.2	97.1	97.0	96.9	96.8	96.7	96.5
85	96.2	96.5	96.7	96.8	96.9	97.0	97.0	97.1	97.1	97.1	97.1	97.1	97.0	97.0	96.9	96.9	96.8	96.7	96.6	96.5
90	95.9	96.1	96.3	96.4	96.5	96.6	96.6	96.7	96.7	96.7	96.8	96.8	96.8	96.7	96.7	96.7	96.7	96.6	96.6	96.5
95	96.0	96.1	96.1	96.2	96.3	96.3	96.4	96.4	96.4	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	83.0	80.8	74.1	67.0	60.7	55.3	50.7	46.8	43.4	40.4	37.8	35.5	33.5	31.7	30.1	28.6	27.3	26.1	25.0	24.0
35	77.3	77.4	72.0	65.6	59.8	54.7	50.2	46.4	43.1	40.2	37.6	35.4	33.4	31.6	30.0	28.6	27.3	26.1	25.0	24.0
40	71.3	73.5	69.4	63.9	58.6	53.8	49.6	45.9	42.7	39.9	37.4	35.2	33.3	31.5	30.0	28.5	27.3	26.1	25.0	24.0
45	65.3	69.3	66.5	61.9	57.2	52.8	48.8	45.3	42.3	39.6	37.1	35.0	33.1	31.4	29.9	28.5	27.2	26.0	25.0	24.0
50	59.6	64.8	63.4	59.6	55.5	51.6	47.9	44.7	41.7	39.2	36.8	34.8	32.9	31.3	29.8	28.4	27.2	26.0	25.0	24.0
55	54.0	60.2	59.9	57.1	53.7	50.2	46.9	43.9	41.1	38.7	36.5	34.5	32.7	31.1	29.6	28.3	27.1	26.0	24.9	24.0
60	49.0	55.7	56.3	54.4	51.6	48.6	45.6	42.9	40.4	38.1	36.0	34.1	32.4	30.9	29.5	28.2	27.0	25.9	24.9	24.0
65	44.5	51.0	52.5	51.4	49.3	46.8	44.2	41.8	39.5	37.4	35.5	33.7	32.1	30.6	29.3	28.1	26.9	25.9	24.9	24.0
70	40.5	46.5	48.5	48.1	46.6	44.7	42.6	40.5	38.4	36.6	34.8	33.2	31.7	30.3	29.1	27.9	26.8	25.8	24.9	24.0
75	37.0	42.0	44.2	44.5	43.7	42.2	40.6	38.9	37.2	35.5	34.0	32.5	31.2	29.9	28.8	27.7	26.7	25.7	24.8	24.0
80	33.9	37.8	39.8	40.5	40.2	39.4	38.2	36.9	35.6	34.2	32.9	31.7	30.5	29.4	28.4	27.4	26.5	25.6	24.8	24.0
85	31.1	33.8	35.4	36.1	36.3	35.9	35.3	34.5	33.5	32.5	31.5	30.5	29.6	28.7	27.8	27.0	26.2	25.4	24.7	24.0
90	28.7	30.2	31.2	31.8	32.0	32.0	31.7	31.3	30.8	30.2	29.6	29.0	28.3	27.6	27.0	26.4	25.7	25.1	24.6	24.0
95	26.6	27.0	27.4	27.6	27.7	27.7	27.7	27.6	27.4	27.2	26.9	26.6	26.3	26.0	25.7	25.4	25.0	24.7	24.3	24.0
98	25.7	25.7	25.7	25.7	25.7	25.6	25.6	25.5	25.4	25.3	25.2	25.1	25.0	24.8	24.7	24.6	24.4	24.3	24.1	24.0

Mean Annual Mass Removal Efficiencies for 0.50-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	88.6	89.9	87.9	84.5	80.5	76.4	72.3	68.5	65.1	61.9	58.9	56.2	53.7	51.4	49.3	47.3	45.5	43.8	42.2	40.8
35	84.1	86.8	85.6	82.8	79.3	75.4	71.6	68.0	64.6	61.5	58.7	56.0	53.6	51.3	49.2	47.3	45.5	43.8	42.2	40.8
40	79.3	83.3	82.9	80.8	77.8	74.3	70.7	67.3	64.1	61.1	58.3	55.8	53.4	51.1	49.1	47.2	45.4	43.8	42.2	40.8
45	74.4	79.5	80.0	78.5	76.0	72.9	69.6	66.5	63.4	60.6	57.9	55.4	53.1	51.0	48.9	47.1	45.3	43.7	42.2	40.8
50	69.7	75.5	76.8	76.0	73.9	71.3	68.4	65.5	62.6	60.0	57.4	55.0	52.8	50.7	48.8	47.0	45.3	43.7	42.2	40.8
55	65.2	71.4	73.4	73.1	71.7	69.5	66.9	64.3	61.7	59.2	56.9	54.6	52.5	50.4	48.6	46.8	45.2	43.6	42.1	40.8
60	61.0	67.2	69.7	70.1	69.2	67.4	65.3	63.0	60.6	58.4	56.2	54.0	52.0	50.1	48.3	46.6	45.0	43.5	42.1	40.8
65	57.1	63.1	65.9	66.8	66.4	65.1	63.3	61.4	59.4	57.3	55.3	53.4	51.5	49.7	48.0	46.4	44.9	43.4	42.1	40.8
70	53.6	59.2	62.0	63.2	63.3	62.5	61.2	59.6	57.9	56.1	54.3	52.6	50.9	49.2	47.6	46.1	44.7	43.3	42.0	40.8
75	50.7	55.5	58.1	59.5	59.8	59.4	58.6	57.4	56.1	54.6	53.1	51.6	50.1	48.6	47.1	45.8	44.4	43.2	41.9	40.8
80	48.3	52.0	54.3	55.5	56.0	56.0	55.6	54.8	53.9	52.8	51.6	50.3	49.0	47.8	46.5	45.3	44.1	43.0	41.8	40.8
85	46.2	48.7	50.5	51.5	52.0	52.2	52.1	51.7	51.1	50.4	49.6	48.6	47.6	46.7	45.6	44.6	43.7	42.7	41.7	40.8
90	44.2	45.6	46.7	47.4	47.9	48.1	48.2	48.1	47.8	47.4	46.9	46.4	45.7	45.1	44.4	43.7	43.0	42.2	41.5	40.8
95	42.5	43.0	43.4	43.7	43.9	44.0	44.1	44.1	44.0	43.9	43.7	43.5	43.2	43.0	42.7	42.3	42.0	41.6	41.2	40.8
98	42.1	42.2	42.2	42.2	42.2	42.2	42.2	42.1	42.1	42.0	41.9	41.8	41.7	41.6	41.5	41.4	41.2	41.1	40.9	40.8

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	91.4	93.0	92.4	90.8	88.5	85.9	83.0	80.1	77.2	74.4	71.6	69.1	66.7	64.4	62.3	60.2	58.3	56.5	54.8	53.2
35	87.7	90.5	90.4	89.2	87.2	84.8	82.2	79.5	76.7	73.9	71.3	68.8	66.5	64.2	62.1	60.2	58.3	56.5	54.8	53.2
40	83.8	87.6	88.1	87.2	85.7	83.6	81.2	78.7	76.0	73.4	70.9	68.5	66.2	64.1	62.0	60.0	58.2	56.4	54.8	53.2
45	80.0	84.4	85.6	85.1	83.9	82.2	80.0	77.7	75.3	72.8	70.4	68.1	65.9	63.8	61.8	59.9	58.1	56.4	54.7	53.2
50	76.0	81.1	82.7	82.8	82.0	80.5	78.7	76.6	74.4	72.1	69.8	67.7	65.6	63.5	61.6	59.8	58.0	56.3	54.7	53.2
55	72.3	77.7	79.7	80.2	79.8	78.7	77.2	75.3	73.3	71.2	69.2	67.1	65.1	63.2	61.3	59.6	57.9	56.2	54.7	53.2
60	68.9	74.2	76.5	77.4	77.4	76.6	75.4	73.9	72.1	70.2	68.3	66.4	64.6	62.8	61.0	59.3	57.7	56.1	54.6	53.2
65	65.5	70.7	73.3	74.5	74.7	74.4	73.5	72.2	70.7	69.1	67.4	65.7	64.0	62.3	60.7	59.1	57.5	56.0	54.6	53.2
70	62.6	67.4	70.0	71.3	71.9	71.8	71.2	70.3	69.1	67.7	66.3	64.7	63.2	61.7	60.2	58.7	57.3	55.9	54.5	53.2
75	60.1	64.2	66.7	68.1	68.8	68.9	68.7	68.0	67.1	66.1	64.9	63.6	62.3	60.9	59.6	58.3	57.0	55.7	54.4	53.2
80	58.0	61.3	63.5	64.8	65.5	65.9	65.8	65.4	64.8	64.0	63.1	62.1	61.1	60.0	58.9	57.7	56.6	55.4	54.3	53.2
85	56.4	58.8	60.4	61.5	62.2	62.5	62.6	62.4	62.0	61.6	61.0	60.3	59.5	58.7	57.9	57.0	56.0	55.1	54.1	53.2
90	55.1	56.4	57.4	58.1	58.6	58.9	59.0	59.0	58.9	58.7	58.4	58.0	57.6	57.1	56.5	55.9	55.3	54.6	53.9	53.2
95	53.7	54.2	54.6	54.9	55.2	55.4	55.5	55.6	55.6	55.5	55.5	55.3	55.2	55.0	54.7	54.5	54.2	53.9	53.5	53.2
98	53.9	54.0	54.0	54.1	54.1	54.1	54.1	54.1	54.1	54.0	54.0	53.9	53.9	53.8	53.7	53.6	53.5	53.4	53.3	53.2

Mean Annual Mass Removal Efficiencies for 1.00-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	93.5	94.8	94.6	93.7	92.3	90.6	88.7	86.5	84.3	82.1	79.8	77.6	75.4	73.3	71.3	69.4	67.5	65.8	64.1	62.5
35	90.2	92.6	92.9	92.3	91.1	89.6	87.8	85.9	83.8	81.6	79.5	77.3	75.2	73.1	71.2	69.3	67.5	65.7	64.0	62.5
40	87.0	90.2	91.0	90.7	89.7	88.4	86.8	85.0	83.1	81.1	79.0	77.0	74.9	72.9	71.0	69.1	67.4	65.7	64.0	62.5
45	83.7	87.6	88.8	88.8	88.1	87.1	85.7	84.1	82.3	80.4	78.5	76.5	74.6	72.7	70.8	69.0	67.3	65.6	64.0	62.5
50	80.5	84.8	86.4	86.8	86.4	85.5	84.4	83.0	81.4	79.7	77.9	76.0	74.2	72.3	70.5	68.8	67.1	65.5	64.0	62.5
55	77.3	82.0	83.9	84.5	84.4	83.9	83.0	81.8	80.3	78.8	77.1	75.4	73.7	72.0	70.3	68.6	67.0	65.4	63.9	62.5
60	74.4	79.1	81.1	82.0	82.2	82.0	81.3	80.3	79.2	77.8	76.3	74.7	73.1	71.5	69.9	68.3	66.8	65.3	63.9	62.5
65	71.8	76.1	78.3	79.5	79.9	79.9	79.5	78.7	77.8	76.6	75.3	73.9	72.4	71.0	69.5	68.0	66.6	65.2	63.8	62.5
70	69.2	73.2	75.5	76.8	77.4	77.6	77.4	76.9	76.2	75.3	74.2	72.9	71.6	70.3	69.0	67.7	66.3	65.0	63.7	62.5
75	67.0	70.6	72.8	74.1	74.8	75.1	75.1	74.8	74.3	73.6	72.7	71.7	70.7	69.5	68.4	67.2	66.0	64.8	63.6	62.5
80	65.3	68.1	70.0	71.3	72.1	72.5	72.6	72.5	72.2	71.7	71.0	70.3	69.4	68.5	67.6	66.6	65.6	64.5	63.5	62.5
85	63.9	66.0	67.5	68.6	69.3	69.7	69.9	69.9	69.8	69.5	69.0	68.5	67.9	67.2	66.5	65.8	65.0	64.2	63.3	62.5
90	63.0	64.3	65.2	65.9	66.4	66.8	67.0	67.1	67.0	66.9	66.7	66.4	66.1	65.7	65.2	64.7	64.2	63.6	63.1	62.5
95	62.3	62.8	63.1	63.4	63.6	63.8	63.9	64.0	64.1	64.1	64.1	64.0	63.9	63.8	63.6	63.4	63.2	63.0	62.7	62.5
98	62.6	62.7	62.8	62.8	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.9	62.8	62.8	62.7	62.7	62.6	62.5	62.5

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	95.1	96.1	96.0	95.4	94.5	93.3	91.9	90.4	88.7	86.9	85.1	83.3	81.5	79.7	77.8	76.1	74.4	72.7	71.1	69.5
35	92.3	94.2	94.5	94.2	93.4	92.4	91.1	89.7	88.2	86.5	84.8	83.0	81.2	79.5	77.7	76.0	74.3	72.6	71.1	69.5
40	89.3	92.0	92.8	92.8	92.2	91.3	90.2	88.9	87.5	85.9	84.3	82.6	80.9	79.2	77.5	75.8	74.2	72.6	71.0	69.5
45	86.5	89.8	90.9	91.2	90.9	90.1	89.2	88.0	86.7	85.3	83.8	82.2	80.6	78.9	77.3	75.7	74.1	72.5	71.0	69.5
50	83.8	87.5	88.9	89.5	89.3	88.8	88.0	87.0	85.8	84.5	83.1	81.7	80.2	78.6	77.0	75.5	73.9	72.4	71.0	69.5
55	81.2	85.1	86.8	87.5	87.5	87.2	86.6	85.8	84.8	83.7	82.4	81.1	79.7	78.2	76.7	75.3	73.8	72.3	70.9	69.5
60	78.6	82.7	84.6	85.4	85.6	85.5	85.1	84.5	83.7	82.7	81.6	80.4	79.1	77.8	76.4	75.0	73.6	72.2	70.9	69.5
65	76.4	80.3	82.2	83.1	83.6	83.7	83.5	83.1	82.4	81.6	80.7	79.6	78.5	77.2	76.0	74.7	73.4	72.1	70.8	69.5
70	74.3	77.7	79.7	80.8	81.5	81.7	81.7	81.4	80.9	80.3	79.5	78.7	77.7	76.6	75.4	74.3	73.1	71.9	70.7	69.5
75	72.4	75.4	77.3	78.5	79.2	79.6	79.7	79.6	79.3	78.8	78.2	77.5	76.7	75.8	74.8	73.8	72.7	71.7	70.6	69.5
80	70.8	73.3	75.1	76.2	76.9	77.4	77.6	77.6	77.4	77.1	76.7	76.2	75.5	74.8	74.0	73.2	72.3	71.4	70.5	69.5
85	69.8	71.6	72.9	73.9	74.6	75.0	75.3	75.4	75.4	75.2	75.0	74.6	74.1	73.6	73.0	72.4	71.7	71.0	70.3	69.5
90	69.2	70.3	71.1	71.8	72.3	72.6	72.9	73.0	73.1	73.1	72.9	72.7	72.5	72.2	71.8	71.4	71.0	70.5	70.0	69.5
95	68.9	69.3	69.7	70.0	70.2	70.4	70.5	70.6	70.7	70.7	70.7	70.7	70.6	70.5	70.4	70.3	70.1	69.9	69.7	69.5
98	69.4	69.5	69.6	69.6	69.7	69.7	69.8	69.8	69.8	69.8	69.8	69.8	69.8	69.8	69.7	69.7	69.7	69.6	69.6	69.5

Mean Annual Mass Removal Efficiencies for 1.50-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	96.3	97.1	97.0	96.5	95.9	95.0	93.9	92.8	91.5	90.2	88.7	87.2	85.7	84.1	82.6	81.1	79.5	78.0	76.5	75.1
35	93.9	95.4	95.6	95.4	95.0	94.2	93.2	92.2	91.0	89.7	88.3	86.9	85.4	83.9	82.4	81.0	79.5	78.0	76.5	75.1
40	91.3	93.5	94.1	94.2	93.9	93.3	92.4	91.5	90.4	89.2	87.9	86.5	85.1	83.7	82.3	80.8	79.4	77.9	76.5	75.1
45	88.8	91.5	92.5	92.8	92.7	92.2	91.5	90.6	89.6	88.6	87.4	86.1	84.8	83.4	82.0	80.6	79.2	77.8	76.4	75.1
50	86.4	89.6	90.8	91.3	91.4	91.0	90.4	89.7	88.8	87.9	86.8	85.6	84.4	83.1	81.8	80.4	79.1	77.7	76.4	75.1
55	84.2	87.5	89.0	89.7	89.8	89.6	89.2	88.6	87.9	87.1	86.1	85.0	83.9	82.7	81.5	80.2	78.9	77.6	76.3	75.1
60	81.9	85.4	87.1	87.9	88.2	88.1	87.9	87.4	86.9	86.2	85.3	84.4	83.3	82.2	81.1	79.9	78.7	77.5	76.3	75.1
65	80.0	83.4	85.1	86.0	86.4	86.5	86.4	86.1	85.7	85.1	84.4	83.6	82.7	81.7	80.7	79.6	78.5	77.4	76.2	75.1
70	78.3	81.3	83.0	84.0	84.5	84.8	84.8	84.7	84.4	83.9	83.4	82.7	81.9	81.1	80.2	79.3	78.2	77.2	76.1	75.1
75	76.6	79.3	80.9	81.9	82.6	83.0	83.1	83.1	82.9	82.6	82.2	81.6	81.0	80.4	79.6	78.8	77.9	77.0	76.0	75.1
80	75.3	77.4	78.9	79.9	80.6	81.1	81.3	81.4	81.3	81.1	80.8	80.4	80.0	79.5	78.9	78.2	77.5	76.7	75.9	75.1
85	74.4	76.0	77.2	78.0	78.7	79.1	79.4	79.5	79.5	79.5	79.3	79.1	78.8	78.4	78.0	77.5	76.9	76.3	75.7	75.1
90	73.9	74.9	75.7	76.3	76.8	77.1	77.4	77.6	77.7	77.7	77.7	77.6	77.4	77.2	76.9	76.6	76.3	75.9	75.5	75.1
95	74.0	74.4	74.7	75.0	75.2	75.4	75.6	75.7	75.8	75.9	75.9	75.9	75.9	75.8	75.7	75.6	75.5	75.4	75.2	75.1
98	74.8	74.9	75.0	75.0	75.1	75.1	75.1	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.2	75.1	75.1	75.1

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.2	97.7	97.7	97.4	96.8	96.2	95.4	94.4	93.5	92.4	91.2	90.0	88.7	87.4	86.1	84.8	83.4	82.1	80.8	79.4
35	95.1	96.3	96.6	96.4	96.0	95.5	94.7	93.9	93.0	91.9	90.8	89.7	88.5	87.2	85.9	84.6	83.3	82.0	80.7	79.4
40	92.9	94.7	95.2	95.2	95.0	94.6	94.0	93.2	92.4	91.4	90.4	89.3	88.2	87.0	85.7	84.5	83.2	82.0	80.7	79.4
45	90.7	93.0	93.7	94.0	94.0	93.7	93.2	92.5	91.7	90.9	89.9	88.9	87.8	86.7	85.5	84.3	83.1	81.9	80.7	79.4
50	88.5	91.2	92.2	92.7	92.8	92.6	92.2	91.7	91.0	90.2	89.4	88.4	87.4	86.4	85.3	84.1	83.0	81.8	80.6	79.4
55	86.5	89.4	90.7	91.3	91.5	91.5	91.2	90.7	90.2	89.5	88.7	87.9	87.0	86.0	85.0	83.9	82.8	81.7	80.6	79.4
60	84.6	87.5	89.0	89.8	90.2	90.2	90.0	89.6	89.2	88.6	88.0	87.3	86.4	85.6	84.6	83.6	82.6	81.6	80.5	79.4
65	82.9	85.8	87.4	88.3	88.6	88.7	88.7	88.5	88.1	87.7	87.2	86.6	85.8	85.1	84.2	83.3	82.4	81.4	80.5	79.4
70	81.4	84.1	85.6	86.5	87.0	87.2	87.2	87.2	87.0	86.6	86.2	85.7	85.1	84.5	83.7	83.0	82.1	81.3	80.4	79.4
75	80.2	82.4	83.8	84.7	85.2	85.6	85.8	85.8	85.7	85.5	85.2	84.8	84.3	83.8	83.2	82.5	81.8	81.1	80.3	79.4
80	78.9	80.8	82.0	82.9	83.5	84.0	84.2	84.3	84.3	84.2	84.0	83.7	83.4	83.0	82.5	82.0	81.4	80.8	80.1	79.4
85	78.1	79.5	80.5	81.3	81.9	82.3	82.6	82.8	82.8	82.8	82.7	82.5	82.3	82.1	81.7	81.4	81.0	80.5	80.0	79.4
90	77.8	78.6	79.3	79.9	80.4	80.7	80.9	81.1	81.2	81.3	81.3	81.2	81.1	81.0	80.9	80.6	80.4	80.1	79.8	79.4
95	78.0	78.4	78.7	78.9	79.1	79.3	79.5	79.6	79.7	79.8	79.9	79.9	79.9	79.9	79.9	79.8	79.8	79.7	79.6	79.4
98	79.0	79.0	79.1	79.2	79.2	79.3	79.3	79.4	79.4	79.4	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.4

Mean Annual Mass Removal Efficiencies for 2.00-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	97.8	98.3	98.3	98.0	97.5	97.0	96.4	95.6	94.8	93.9	93.0	92.0	91.0	89.9	88.7	87.6	86.4	85.2	84.0	82.9
35	96.2	97.1	97.3	97.1	96.8	96.3	95.8	95.1	94.4	93.6	92.7	91.7	90.7	89.7	88.6	87.4	86.3	85.2	84.0	82.9
40	94.3	95.7	96.1	96.1	95.9	95.6	95.2	94.5	93.8	93.1	92.3	91.4	90.4	89.4	88.4	87.3	86.2	85.1	84.0	82.9
45	92.3	94.2	94.8	95.0	94.9	94.8	94.4	93.9	93.3	92.6	91.8	91.0	90.1	89.2	88.2	87.1	86.1	85.0	83.9	82.9
50	90.3	92.5	93.4	93.8	93.9	93.8	93.6	93.1	92.6	92.0	91.3	90.5	89.7	88.8	87.9	87.0	86.0	84.9	83.9	82.9
55	88.4	90.9	92.0	92.6	92.8	92.8	92.6	92.3	91.8	91.3	90.7	90.0	89.3	88.5	87.6	86.7	85.8	84.8	83.9	82.9
60	86.8	89.3	90.6	91.3	91.6	91.7	91.6	91.3	91.0	90.6	90.0	89.4	88.8	88.1	87.3	86.5	85.6	84.7	83.8	82.9
65	85.3	87.7	89.1	90.0	90.4	90.5	90.5	90.3	90.0	89.7	89.3	88.8	88.2	87.6	86.9	86.2	85.4	84.6	83.7	82.9
70	83.9	86.3	87.7	88.5	88.9	89.2	89.2	89.1	89.0	88.8	88.4	88.0	87.6	87.1	86.5	85.8	85.1	84.4	83.7	82.9
75	82.9	84.9	86.2	87.0	87.4	87.7	87.9	87.9	87.9	87.7	87.5	87.2	86.9	86.4	86.0	85.4	84.8	84.2	83.6	82.9
80	81.9	83.5	84.6	85.4	85.9	86.3	86.5	86.7	86.7	86.6	86.5	86.3	86.1	85.7	85.4	84.9	84.5	84.0	83.4	82.9
85	81.1	82.3	83.3	84.0	84.5	84.9	85.1	85.3	85.4	85.4	85.4	85.3	85.1	84.9	84.7	84.4	84.1	83.7	83.3	82.9
90	80.9	81.7	82.3	82.8	83.2	83.5	83.8	84.0	84.1	84.2	84.2	84.2	84.1	84.0	83.9	83.8	83.6	83.4	83.1	82.9
95	81.3	81.6	81.9	82.1	82.3	82.5	82.6	82.8	82.9	83.0	83.0	83.1	83.1	83.1	83.1	83.1	83.1	83.0	82.9	82.9
98	82.3	82.3	82.4	82.5	82.5	82.6	82.6	82.7	82.7	82.7	82.8	82.8	82.8	82.8	82.9	82.9	82.9	82.9	82.9	82.9

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.2	98.7	98.6	98.5	98.1	97.6	97.1	96.5	95.9	95.1	94.3	93.5	92.6	91.7	90.7	89.7	88.7	87.7	86.6	85.6
35	97.0	97.7	97.8	97.7	97.5	97.0	96.6	96.1	95.4	94.7	94.0	93.2	92.4	91.5	90.6	89.6	88.6	87.6	86.6	85.6
40	95.3	96.5	96.9	96.8	96.6	96.3	96.0	95.5	95.0	94.3	93.6	92.9	92.1	91.3	90.4	89.5	88.5	87.6	86.6	85.6
45	93.6	95.2	95.7	95.8	95.7	95.6	95.3	94.9	94.4	93.9	93.2	92.6	91.8	91.0	90.2	89.3	88.4	87.5	86.5	85.6
50	91.9	93.7	94.5	94.7	94.8	94.8	94.6	94.3	93.8	93.3	92.8	92.1	91.5	90.7	90.0	89.1	88.3	87.4	86.5	85.6
55	90.1	92.2	93.2	93.6	93.8	93.9	93.8	93.5	93.2	92.7	92.2	91.7	91.1	90.4	89.7	88.9	88.1	87.3	86.5	85.6
60	88.6	90.8	91.9	92.5	92.8	92.9	92.9	92.7	92.4	92.0	91.6	91.1	90.6	90.0	89.4	88.7	88.0	87.2	86.4	85.6
65	87.2	89.4	90.6	91.3	91.7	91.9	91.9	91.8	91.6	91.3	90.9	90.6	90.1	89.6	89.0	88.4	87.8	87.1	86.3	85.6
70	86.0	88.1	89.3	90.1	90.6	90.8	90.8	90.8	90.6	90.4	90.2	89.9	89.5	89.1	88.6	88.1	87.5	86.9	86.3	85.6
75	85.1	87.0	88.1	88.8	89.3	89.5	89.6	89.7	89.6	89.6	89.4	89.1	88.9	88.5	88.2	87.7	87.2	86.7	86.2	85.6
80	84.5	85.8	86.8	87.5	87.9	88.2	88.4	88.6	88.6	88.6	88.5	88.3	88.1	87.9	87.6	87.3	86.9	86.5	86.1	85.6
85	83.8	84.8	85.6	86.1	86.6	87.0	87.2	87.4	87.5	87.5	87.5	87.5	87.4	87.2	87.0	86.8	86.5	86.3	85.9	85.6
90	83.5	84.2	84.7	85.2	85.6	85.8	86.1	86.2	86.4	86.5	86.5	86.5	86.5	86.5	86.4	86.3	86.1	86.0	85.8	85.6
95	83.9	84.2	84.5	84.7	84.9	85.1	85.2	85.3	85.4	85.5	85.6	85.6	85.7	85.7	85.7	85.7	85.7	85.7	85.6	85.6
98	84.9	85.0	85.1	85.1	85.2	85.2	85.3	85.3	85.4	85.4	85.4	85.5	85.5	85.5	85.5	85.5	85.6	85.6	85.6	85.6

Mean Annual Mass Removal Efficiencies for 2.50-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.6	98.9	98.9	98.8	98.6	98.2	97.7	97.2	96.7	96.0	95.3	94.6	93.9	93.1	92.3	91.4	90.6	89.6	88.7	87.8
35	97.6	98.1	98.3	98.2	98.0	97.6	97.2	96.8	96.3	95.7	95.0	94.4	93.7	92.9	92.1	91.3	90.5	89.6	88.7	87.8
40	96.2	97.1	97.4	97.4	97.3	97.0	96.7	96.3	95.9	95.3	94.7	94.1	93.4	92.7	92.0	91.2	90.4	89.5	88.7	87.8
45	94.7	96.0	96.5	96.5	96.5	96.3	96.0	95.8	95.4	94.9	94.3	93.8	93.2	92.5	91.8	91.0	90.3	89.5	88.6	87.8
50	93.2	94.8	95.3	95.6	95.6	95.5	95.4	95.2	94.8	94.4	93.9	93.4	92.8	92.2	91.6	90.9	90.1	89.4	88.6	87.8
55	91.6	93.4	94.2	94.5	94.7	94.7	94.7	94.5	94.2	93.9	93.4	93.0	92.5	91.9	91.3	90.7	90.0	89.3	88.5	87.8
60	90.1	92.0	93.0	93.5	93.8	93.9	93.9	93.8	93.5	93.2	92.9	92.5	92.0	91.6	91.0	90.4	89.8	89.2	88.5	87.8
65	88.9	90.8	91.8	92.4	92.8	93.0	93.1	93.0	92.8	92.6	92.3	92.0	91.6	91.2	90.7	90.2	89.6	89.1	88.4	87.8
70	87.8	89.6	90.7	91.4	91.8	92.1	92.1	92.1	92.0	91.8	91.6	91.4	91.1	90.7	90.3	89.9	89.4	88.9	88.4	87.8
75	86.9	88.6	89.6	90.3	90.8	91.0	91.1	91.1	91.1	91.0	90.9	90.7	90.5	90.2	89.9	89.5	89.2	88.7	88.3	87.8
80	86.4	87.7	88.6	89.2	89.6	89.9	90.0	90.1	90.2	90.2	90.1	90.0	89.8	89.7	89.4	89.2	88.9	88.5	88.2	87.8
85	85.9	86.9	87.5	88.0	88.4	88.7	88.9	89.1	89.2	89.3	89.3	89.2	89.2	89.1	88.9	88.8	88.6	88.3	88.1	87.8
90	85.6	86.2	86.7	87.1	87.5	87.8	88.0	88.1	88.3	88.4	88.4	88.4	88.4	88.4	88.4	88.3	88.2	88.1	87.9	87.8
95	86.1	86.4	86.6	86.8	87.0	87.1	87.3	87.4	87.5	87.6	87.7	87.7	87.8	87.8	87.8	87.8	87.8	87.8	87.8	87.8
98	87.1	87.2	87.2	87.3	87.3	87.4	87.4	87.5	87.5	87.6	87.6	87.6	87.7	87.7	87.7	87.7	87.7	87.8	87.8	87.8

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	98.9	99.1	99.1	99.1	98.9	98.6	98.2	97.8	97.3	96.7	96.2	95.5	94.9	94.2	93.5	92.8	92.0	91.2	90.4	89.6
35	98.1	98.5	98.6	98.6	98.4	98.1	97.7	97.4	96.9	96.4	95.9	95.3	94.7	94.1	93.4	92.7	91.9	91.2	90.4	89.6
40	97.0	97.7	97.9	97.9	97.8	97.5	97.2	96.9	96.5	96.1	95.6	95.0	94.5	93.9	93.2	92.5	91.8	91.1	90.3	89.6
45	95.6	96.7	97.1	97.1	97.1	96.9	96.6	96.4	96.1	95.7	95.2	94.7	94.2	93.6	93.0	92.4	91.7	91.0	90.3	89.6
50	94.3	95.6	96.1	96.3	96.3	96.2	96.0	95.8	95.6	95.3	94.9	94.4	93.9	93.4	92.8	92.2	91.6	91.0	90.3	89.6
55	92.9	94.4	95.0	95.3	95.4	95.4	95.4	95.3	95.1	94.8	94.4	94.0	93.6	93.1	92.6	92.1	91.5	90.9	90.2	89.6
60	91.6	93.2	93.9	94.3	94.6	94.7	94.7	94.6	94.5	94.2	93.9	93.6	93.2	92.8	92.3	91.8	91.3	90.8	90.2	89.6
65	90.3	92.0	92.8	93.4	93.7	93.9	94.0	93.9	93.8	93.6	93.4	93.1	92.8	92.4	92.0	91.6	91.1	90.6	90.1	89.6
70	89.3	90.9	91.8	92.4	92.8	93.1	93.2	93.2	93.1	93.0	92.8	92.6	92.3	92.0	91.7	91.3	90.9	90.5	90.1	89.6
75	88.5	89.9	90.9	91.5	91.9	92.2	92.3	92.4	92.3	92.2	92.1	92.0	91.8	91.6	91.3	91.0	90.7	90.4	90.0	89.6
80	88.1	89.2	90.0	90.6	91.0	91.2	91.4	91.5	91.5	91.5	91.4	91.4	91.3	91.1	90.9	90.7	90.5	90.2	89.9	89.6
85	87.8	88.6	89.2	89.6	90.0	90.2	90.4	90.5	90.6	90.7	90.7	90.7	90.7	90.6	90.5	90.3	90.2	90.0	89.8	89.6
90	87.5	88.0	88.4	88.8	89.1	89.3	89.5	89.7	89.8	89.9	90.0	90.0	90.0	90.0	90.0	89.9	89.9	89.8	89.7	89.6
95	87.9	88.2	88.4	88.6	88.7	88.9	89.0	89.1	89.2	89.3	89.4	89.4	89.5	89.5	89.5	89.6	89.6	89.6	89.6	89.6
98	88.9	88.9	89.0	89.0	89.1	89.1	89.2	89.2	89.3	89.3	89.4	89.4	89.4	89.5	89.5	89.5	89.5	89.5	89.6	89.6

Mean Annual Mass Removal Efficiencies for 3.00-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.1	99.3	99.3	99.2	99.1	98.9	98.6	98.2	97.8	97.3	96.8	96.3	95.7	95.1	94.5	93.8	93.2	92.5	91.8	91.0
35	98.4	98.8	98.9	98.8	98.7	98.5	98.2	97.8	97.5	97.0	96.6	96.1	95.5	94.9	94.4	93.7	93.1	92.4	91.7	91.0
40	97.5	98.1	98.3	98.3	98.2	98.0	97.7	97.4	97.1	96.7	96.3	95.8	95.3	94.8	94.2	93.6	93.0	92.4	91.7	91.0
45	96.4	97.3	97.6	97.6	97.6	97.4	97.2	96.9	96.7	96.4	96.0	95.5	95.1	94.6	94.0	93.5	92.9	92.3	91.7	91.0
50	95.2	96.3	96.7	96.9	96.9	96.8	96.6	96.4	96.2	96.0	95.6	95.2	94.8	94.3	93.9	93.4	92.8	92.2	91.6	91.0
55	94.0	95.3	95.8	96.0	96.1	96.1	96.0	95.9	95.7	95.5	95.2	94.9	94.5	94.1	93.6	93.2	92.7	92.2	91.6	91.0
60	92.8	94.1	94.8	95.1	95.3	95.4	95.4	95.3	95.2	95.0	94.8	94.5	94.1	93.8	93.4	93.0	92.5	92.1	91.6	91.0
65	91.7	93.0	93.8	94.2	94.5	94.6	94.7	94.7	94.6	94.5	94.3	94.0	93.8	93.5	93.1	92.8	92.4	91.9	91.5	91.0
70	90.7	92.0	92.8	93.3	93.7	93.9	94.0	94.1	94.0	93.9	93.8	93.6	93.3	93.1	92.8	92.5	92.2	91.8	91.4	91.0
75	89.9	91.1	91.9	92.5	92.9	93.2	93.3	93.3	93.3	93.3	93.2	93.0	92.9	92.7	92.5	92.3	92.0	91.7	91.4	91.0
80	89.4	90.5	91.2	91.7	92.1	92.3	92.5	92.6	92.6	92.6	92.5	92.5	92.4	92.3	92.1	92.0	91.8	91.5	91.3	91.0
85	89.3	90.0	90.5	90.9	91.3	91.5	91.6	91.8	91.8	91.9	91.9	91.9	91.9	91.8	91.7	91.6	91.5	91.4	91.2	91.0
90	89.1	89.6	89.9	90.2	90.5	90.7	90.9	91.0	91.1	91.2	91.3	91.3	91.3	91.4	91.3	91.3	91.3	91.2	91.1	91.0
95	89.5	89.7	89.9	90.0	90.2	90.3	90.4	90.5	90.6	90.7	90.8	90.8	90.9	90.9	91.0	91.0	91.0	91.0	91.0	91.0
98	90.3	90.4	90.5	90.5	90.6	90.6	90.6	90.7	90.7	90.8	90.8	90.8	90.9	90.9	90.9	90.9	91.0	91.0	91.0	91.0

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.3	99.4	99.5	99.4	99.3	99.1	98.9	98.6	98.2	97.8	97.4	96.9	96.4	95.8	95.3	94.7	94.1	93.5	92.9	92.2
35	98.7	99.0	99.1	99.0	99.0	98.8	98.5	98.2	97.9	97.5	97.1	96.7	96.2	95.7	95.2	94.6	94.1	93.5	92.9	92.2
40	98.0	98.4	98.6	98.6	98.5	98.4	98.1	97.8	97.5	97.2	96.9	96.5	96.0	95.5	95.0	94.5	94.0	93.4	92.8	92.2
45	97.0	97.7	98.0	98.0	98.0	97.8	97.7	97.4	97.1	96.9	96.6	96.2	95.8	95.3	94.9	94.4	93.9	93.4	92.8	92.2
50	96.0	96.9	97.3	97.4	97.4	97.3	97.1	96.9	96.7	96.5	96.3	95.9	95.5	95.1	94.7	94.3	93.8	93.3	92.8	92.2
55	94.9	96.0	96.4	96.6	96.7	96.7	96.6	96.4	96.3	96.1	95.9	95.6	95.3	94.9	94.5	94.1	93.7	93.2	92.7	92.2
60	93.9	95.0	95.5	95.8	96.0	96.0	96.0	95.9	95.8	95.7	95.5	95.2	94.9	94.6	94.3	93.9	93.5	93.1	92.7	92.2
65	92.8	94.0	94.6	95.0	95.2	95.3	95.4	95.4	95.3	95.2	95.0	94.8	94.6	94.3	94.0	93.7	93.4	93.0	92.6	92.2
70	91.9	93.0	93.7	94.1	94.4	94.6	94.8	94.8	94.8	94.7	94.6	94.4	94.2	94.0	93.8	93.5	93.2	92.9	92.6	92.2
75	91.1	92.2	92.9	93.4	93.7	94.0	94.1	94.2	94.2	94.1	94.1	94.0	93.8	93.6	93.5	93.3	93.0	92.8	92.5	92.2
80	90.6	91.5	92.2	92.7	93.0	93.3	93.4	93.5	93.5	93.6	93.5	93.4	93.4	93.3	93.2	93.0	92.8	92.6	92.4	92.2
85	90.5	91.2	91.7	92.0	92.3	92.5	92.7	92.8	92.9	92.9	92.9	92.9	92.9	92.9	92.8	92.7	92.6	92.5	92.4	92.2
90	90.5	90.9	91.2	91.5	91.7	91.9	92.0	92.1	92.2	92.3	92.4	92.4	92.4	92.5	92.4	92.4	92.4	92.3	92.3	92.2
95	90.7	90.9	91.1	91.2	91.4	91.5	91.6	91.7	91.8	91.9	92.0	92.0	92.1	92.1	92.1	92.2	92.2	92.2	92.2	92.2
98	91.6	91.6	91.7	91.7	91.8	91.8	91.8	91.9	91.9	92.0	92.0	92.0	92.1	92.1	92.1	92.1	92.2	92.2	92.2	92.2

Mean Annual Mass Removal Efficiencies for 3.50-inches of Retention for Zone 5 by Percent DCIA

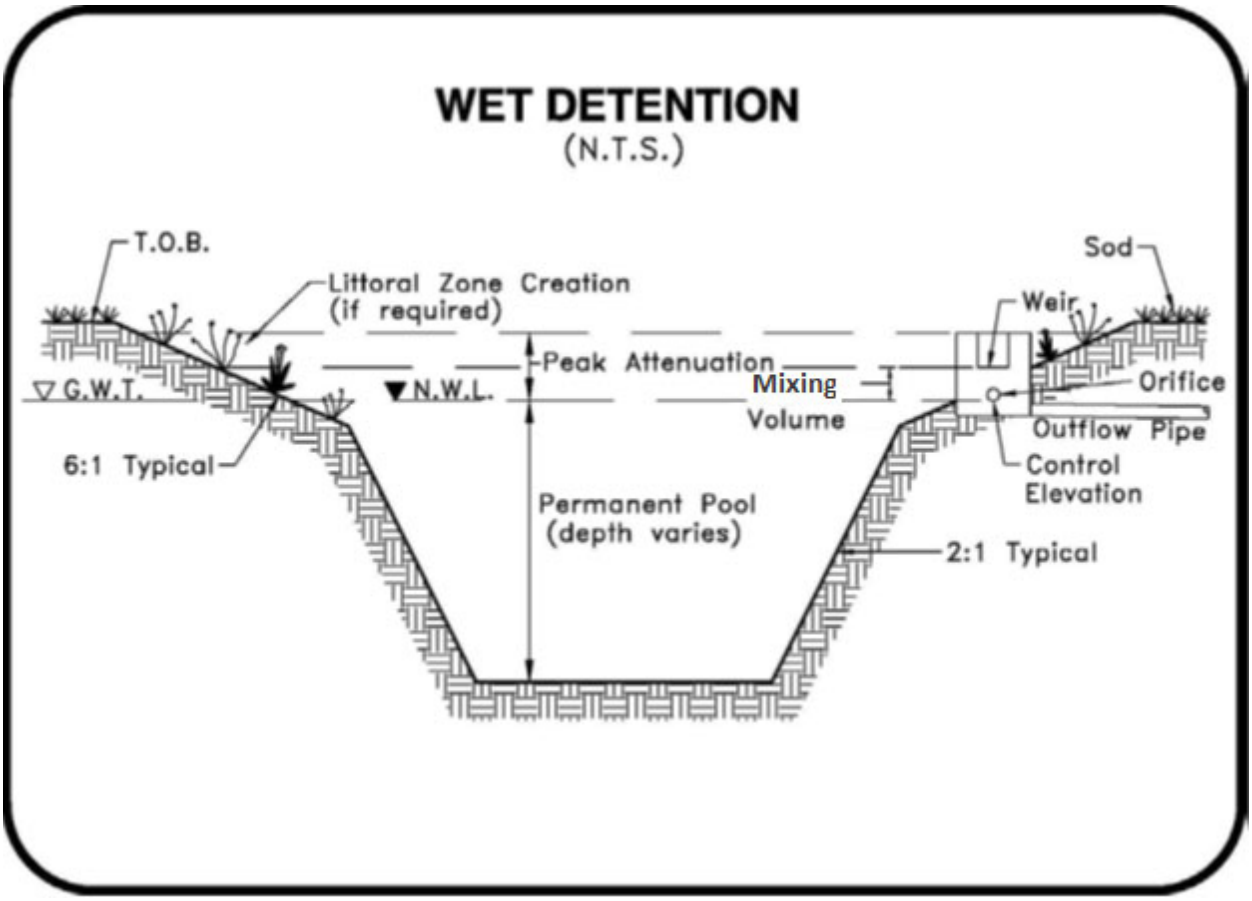
Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.5	99.6	99.6	99.5	99.4	99.3	99.1	98.9	98.5	98.2	97.8	97.4	96.9	96.5	96.0	95.4	94.9	94.4	93.8	93.2
35	98.9	99.2	99.2	99.2	99.1	99.0	98.8	98.6	98.3	97.9	97.6	97.2	96.8	96.3	95.8	95.4	94.9	94.3	93.8	93.2
40	98.3	98.7	98.8	98.8	98.8	98.7	98.5	98.2	97.9	97.6	97.3	97.0	96.6	96.2	95.7	95.3	94.8	94.3	93.8	93.2
45	97.5	98.1	98.3	98.4	98.3	98.2	98.0	97.8	97.6	97.3	97.1	96.8	96.4	96.0	95.6	95.1	94.7	94.2	93.7	93.2
50	96.6	97.4	97.7	97.8	97.8	97.7	97.6	97.4	97.2	97.0	96.7	96.5	96.1	95.8	95.4	95.0	94.6	94.2	93.7	93.2
55	95.7	96.6	97.0	97.2	97.2	97.2	97.1	96.9	96.8	96.6	96.4	96.2	95.9	95.6	95.2	94.9	94.5	94.1	93.7	93.2
60	94.8	95.8	96.2	96.4	96.5	96.5	96.5	96.4	96.3	96.2	96.1	95.9	95.6	95.3	95.0	94.7	94.4	94.0	93.6	93.2
65	93.8	94.8	95.4	95.7	95.8	95.9	95.9	95.9	95.9	95.8	95.7	95.5	95.3	95.1	94.8	94.5	94.2	93.9	93.6	93.2
70	93.0	94.0	94.5	94.9	95.1	95.3	95.4	95.4	95.4	95.4	95.3	95.1	95.0	94.8	94.5	94.3	94.1	93.8	93.5	93.2
75	92.2	93.1	93.7	94.1	94.4	94.7	94.8	94.9	94.9	94.9	94.8	94.7	94.6	94.4	94.3	94.1	93.9	93.7	93.5	93.2
80	91.7	92.5	93.1	93.5	93.8	94.1	94.2	94.3	94.3	94.3	94.3	94.3	94.2	94.1	94.0	93.9	93.7	93.6	93.4	93.2
85	91.5	92.1	92.6	93.0	93.2	93.4	93.6	93.7	93.7	93.8	93.8	93.8	93.8	93.7	93.7	93.6	93.6	93.5	93.3	93.2
90	91.6	91.9	92.2	92.5	92.7	92.9	93.0	93.1	93.2	93.2	93.3	93.3	93.4	93.4	93.4	93.4	93.4	93.3	93.3	93.2
95	91.9	92.0	92.2	92.3	92.4	92.5	92.6	92.7	92.8	92.9	92.9	93.0	93.1	93.1	93.1	93.2	93.2	93.2	93.2	93.2
98	92.6	92.6	92.7	92.7	92.8	92.8	92.9	92.9	92.9	93.0	93.0	93.0	93.1	93.1	93.1	93.1	93.2	93.2	93.2	93.2

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.7	99.7	99.7	99.6	99.5	99.4	99.3	99.1	98.8	98.5	98.2	97.8	97.4	97.0	96.5	96.1	95.6	95.1	94.6	94.1
35	99.1	99.3	99.4	99.3	99.3	99.2	99.0	98.8	98.6	98.3	98.0	97.6	97.3	96.9	96.4	96.0	95.5	95.1	94.6	94.1
40	98.6	98.9	99.0	99.0	99.0	98.9	98.7	98.5	98.3	98.0	97.7	97.4	97.1	96.7	96.3	95.9	95.4	95.0	94.5	94.1
45	97.9	98.4	98.6	98.6	98.6	98.5	98.4	98.2	98.0	97.7	97.5	97.2	96.9	96.5	96.2	95.8	95.4	95.0	94.5	94.1
50	97.1	97.8	98.1	98.2	98.2	98.1	98.0	97.8	97.6	97.4	97.2	96.9	96.7	96.4	96.0	95.7	95.3	94.9	94.5	94.1
55	96.4	97.1	97.5	97.6	97.6	97.6	97.5	97.4	97.2	97.0	96.9	96.7	96.4	96.2	95.9	95.5	95.2	94.8	94.5	94.1
60	95.5	96.4	96.8	96.9	97.0	97.0	97.0	96.9	96.8	96.7	96.6	96.4	96.2	95.9	95.7	95.4	95.1	94.7	94.4	94.1
65	94.7	95.5	96.0	96.3	96.4	96.5	96.4	96.4	96.4	96.3	96.2	96.1	95.9	95.7	95.5	95.2	94.9	94.7	94.4	94.1
70	93.9	94.7	95.3	95.5	95.7	95.8	95.9	95.9	95.9	95.9	95.9	95.7	95.6	95.4	95.2	95.0	94.8	94.6	94.3	94.1
75	93.2	94.0	94.5	94.8	95.1	95.2	95.4	95.5	95.5	95.5	95.4	95.4	95.3	95.1	95.0	94.8	94.7	94.5	94.3	94.1
80	92.6	93.3	93.8	94.2	94.5	94.7	94.9	95.0	95.0	95.0	95.0	95.0	94.9	94.8	94.7	94.6	94.5	94.4	94.2	94.1
85	92.5	93.0	93.4	93.8	94.0	94.2	94.3	94.4	94.5	94.5	94.5	94.6	94.5	94.5	94.4	94.4	94.3	94.3	94.2	94.1
90	92.6	92.9	93.1	93.3	93.5	93.7	93.8	93.9	94.0	94.1	94.1	94.1	94.2	94.2	94.2	94.2	94.2	94.1	94.1	94.1
95	92.9	93.0	93.1	93.2	93.3	93.4	93.5	93.6	93.7	93.7	93.8	93.8	93.9	93.9	94.0	94.0	94.0	94.0	94.0	94.1
98	93.5	93.5	93.6	93.6	93.6	93.7	93.7	93.8	93.8	93.8	93.9	93.9	93.9	93.9	94.0	94.0	94.0	94.0	94.0	94.1

Mean Annual Mass Removal Efficiencies for 4.00-inches of Retention for Zone 5 by Percent DCIA

Non DCIA CN	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	99.8	99.8	99.7	99.7	99.6	99.5	99.4	99.2	99.0	98.8	98.5	98.1	97.8	97.4	97.0	96.6	96.2	95.7	95.2	94.8
35	99.3	99.5	99.5	99.5	99.4	99.3	99.2	99.0	98.8	98.6	98.3	98.0	97.7	97.3	96.9	96.5	96.1	95.7	95.2	94.8
40	98.8	99.1	99.2	99.2	99.1	99.1	99.0	98.8	98.6	98.3	98.1	97.8	97.5	97.2	96.8	96.4	96.0	95.6	95.2	94.8
45	98.3	98.6	98.8	98.8	98.8	98.8	98.6	98.5	98.3	98.1	97.8	97.6	97.3	97.0	96.7	96.3	96.0	95.6	95.2	94.8
50	97.6	98.1	98.4	98.4	98.5	98.4	98.3	98.1	98.0	97.8	97.5	97.3	97.1	96.8	96.5	96.2	95.9	95.5	95.1	94.8
55	96.9	97.6	97.8	98.0	98.0	97.9	97.9	97.7	97.6	97.4	97.3	97.1	96.9	96.7	96.4	96.1	95.8	95.4	95.1	94.8
60	96.2	96.9	97.2	97.4	97.5	97.5	97.4	97.3	97.2	97.1	97.0	96.8	96.7	96.4	96.2	96.0	95.7	95.4	95.1	94.8
65	95.5	96.2	96.6	96.8	96.9	96.9	96.9	96.9	96.8	96.8	96.7	96.6	96.4	96.2	96.0	95.8	95.6	95.3	95.0	94.8
70	94.7	95.4	95.9	96.2	96.3	96.4	96.4	96.4	96.4	96.4	96.3	96.3	96.1	96.0	95.8	95.6	95.4	95.2	95.0	94.8
75	94.1	94.8	95.2	95.5	95.7	95.8	95.9	96.0	96.0	96.0	96.0	95.9	95.8	95.7	95.6	95.5	95.3	95.1	95.0	94.8
80	93.5	94.1	94.5	94.9	95.1	95.3	95.4	95.5	95.6	95.6	95.6	95.6	95.5	95.4	95.4	95.3	95.1	95.0	94.9	94.8
85	93.3	93.8	94.1	94.4	94.7	94.8	95.0	95.1	95.1	95.2	95.2	95.2	95.2	95.2	95.1	95.1	95.0	94.9	94.9	94.8
90	93.4	93.7	93.9	94.1	94.3	94.4	94.5	94.6	94.7	94.8	94.8	94.8	94.8	94.9	94.9	94.9	94.8	94.8	94.8	94.8
95	93.7	93.8	93.9	94.0	94.1	94.2	94.3	94.3	94.4	94.5	94.5	94.6	94.6	94.6	94.7	94.7	94.7	94.7	94.8	94.8
98	94.2	94.3	94.3	94.3	94.4	94.4	94.4	94.5	94.5	94.5	94.6	94.6	94.6	94.6	94.7	94.7	94.7	94.7	94.8	94.8

Wet Detention



The most significant factor impacting the performance efficiency of a wet detention pond is the residence time within the system - specifically, the volume of the permanent pool with respect to the volume of runoff entering the pond. Since the specified treatment volumes are negligible in comparison to the permanent pool volume contained within the wet detention pond, the treatment volume criteria primarily regulates the drawdown characteristics of the wet detention pond and has little impact on the overall water quality performance efficiency of the system.

Residence time within a wet detention pond is determined by the relationship between the permanent pool volume and the annual runoff inputs, as follows:

$$Average\ Annual\ Detention\ Time, t_d(days) = \frac{PPV}{RO}\ x\ \frac{365\ days}{year}$$

where:

PPV = permanent pool volume (ac-ft)

RO = annual runoff inputs (ac-ft/yr)

For purposes of this calculation, the permanent pool volume is considered to include the total volume of water within the pond below the control elevation.

TP percent removal equation

$$Percent\ TP\ Removal\ =\ 40.13\ +\ 6.372 * ln(t_d) + 0.213 * (ln(t_d))^2$$

$$t_d = Average\ Annual\ Residence\ Time\ (days)$$

TN percent removal equation

$$Percent\ TN\ Removal\ =\ \frac{43.75 * t_d}{(4.38 + t_d)}$$

$$t_d = Average\ Annual\ Residence\ Time\ (days)$$

Limits to Average Annual Residence Time throughout the State

Maximum Average Annual Residence Time: 200 Days

Maximum Treatment Efficiency for TP at 200 days: 79.9

Maximum Treatment Efficiency for TN at 200 days: 42.8

Designers may use a longer maximum residence time if they provide evidence to support it.

Detention with Engineered Media and Filtration
The treatment efficiency for these systems is calculated based on the following equation:

$$Treatment\ efficiency\ for\ Detention\ Pond\ with\ Filtration = (Detention\ efficiency\ for\ Volume\ of\ the\ water\ Detained\ in\ the\ system\ ) + (Volume\ of\ water\ filtered\ and\ not\ detained * Treatment\ Efficency\ \ of\ Media)$$

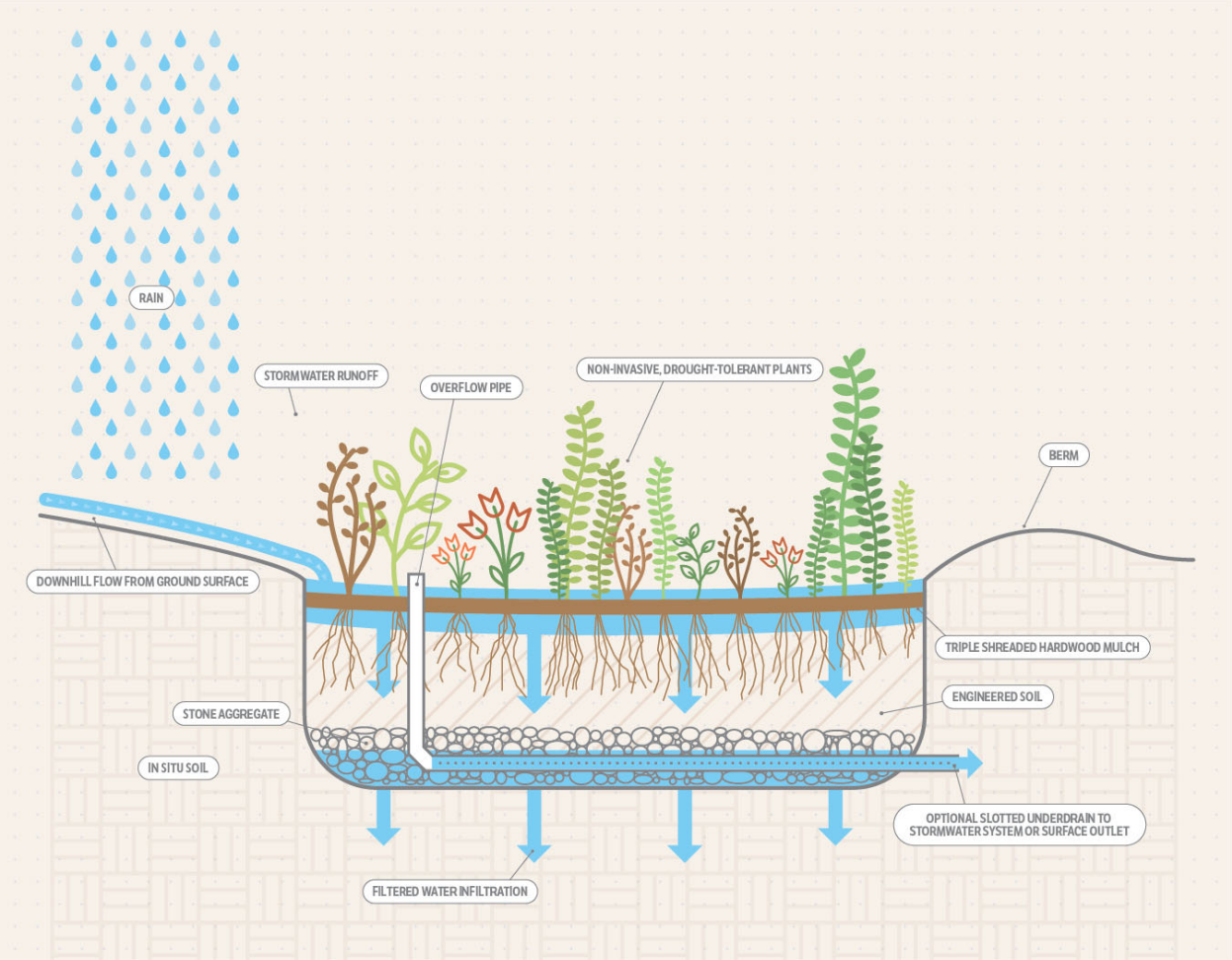
Green Stormwater Infrastructure
GSI and LID reduces pollution and treats stormwater by retaining rainfall near its source instead of directing it to a centralized pond or treatment system. When applied early in the design process, low impact design techniques can reduce stormwater runoff volume and pollutants generated from project sites. Thus, the use of GSI and LID may reduce stormwater treatment BMP size requirements. GSI and LID, depending on the technology, can also treat stormwater similar to a traditional BMP by treating TN and TP as a retention system.

Swale
Swales are defined in Chapter 403.803(14), Florida Statutes, as follows: "Swale means a manmade trench which:

1. Has a top width to depth ratio of the cross-section equal to or greater than 6:1, or side slopes equal to or flatter than 3 feet horizontal to 1-foot vertical;
2. Contains contiguous areas of standing or flowing water only following a rainfall event;
3. Is planted with or has stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake; and
4. Is designed to take into account the soil erodibility, soil percolation, slope, slope length, and drainage area so as to prevent erosion and reduce pollutant concentration of any discharge."

1. Swales are online retention systems and their treatment effectiveness is directly related to the amount of the annual stormwater volume that is infiltrated. Swales designed for stormwater treatment can be classified into two categories:
    - Swales with swale blocks or raised driveway culverts
    - Swales without swale blocks or raised driveway culverts
2. The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.

Raingarden/Bioretention Cell

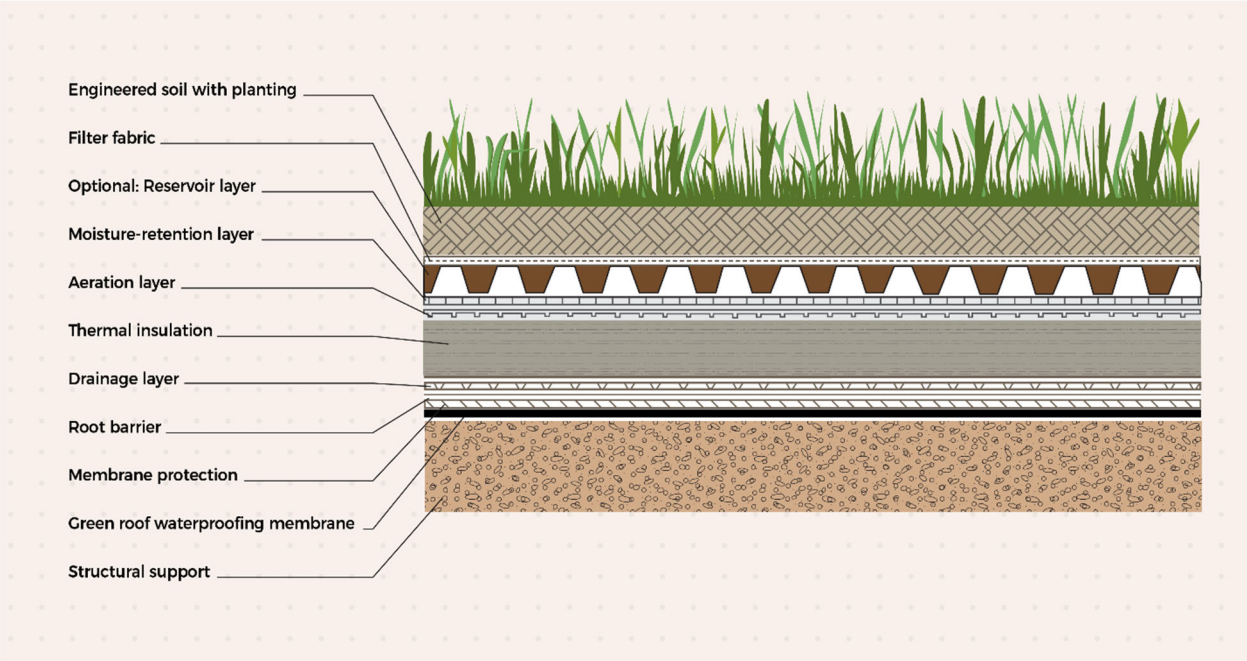


Bioretention cells, or commonly referred to as rain gardens, are shallow depressions with resilient plants that can handle temporary inundation/flooding and periods of drought. They allow stormwater to collect and soak directly into the soil.

Rain gardens vary in size and complexity. They can be planted to provide a food source for butterflies and other wildlife and can make a beautiful addition to the landscape.

The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.

Green Roof

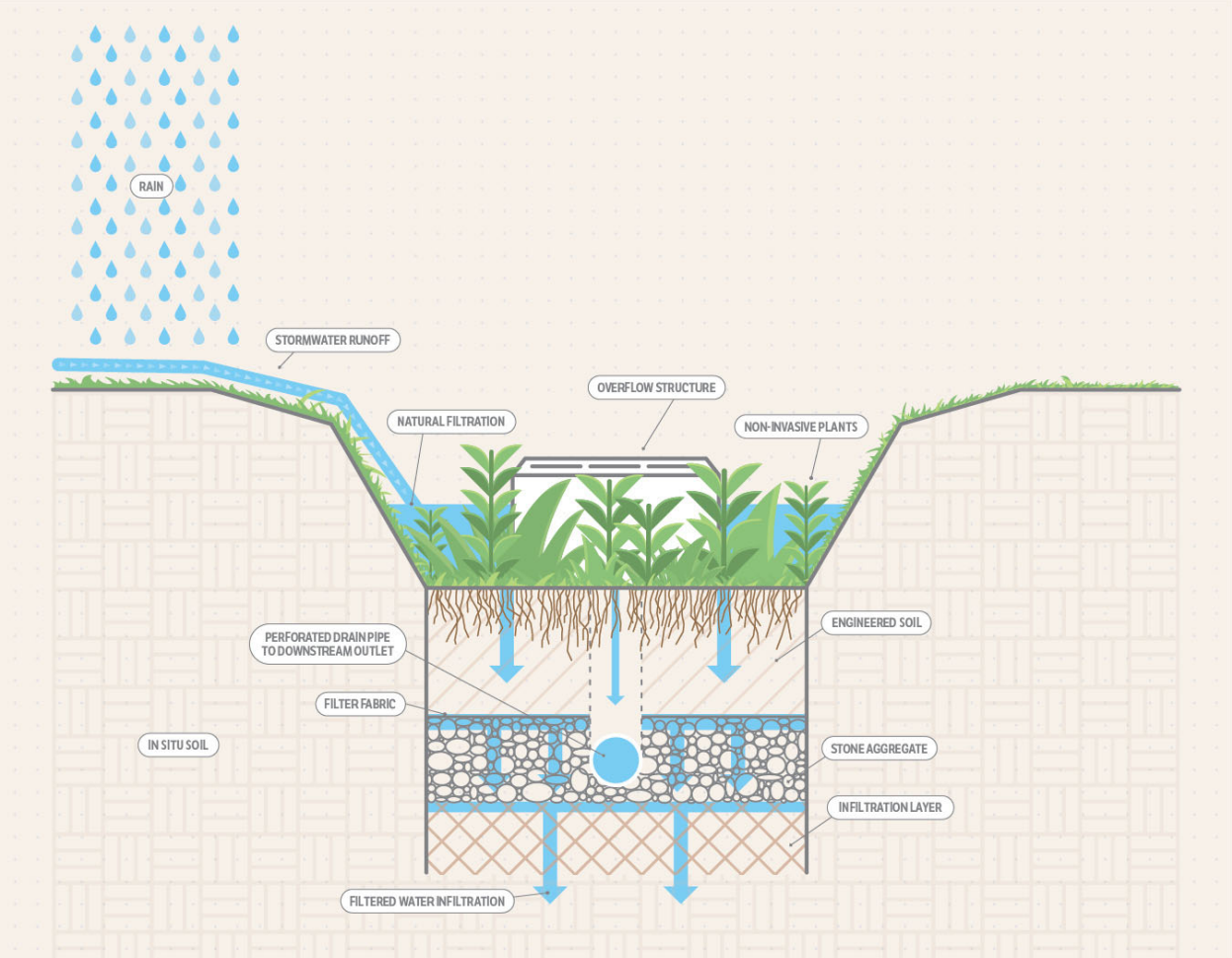


A green roof is a vegetated roof system where rainwater is taken up by plants and transpired into the air to reduce rainwater runoff from the roof. Green roofs provide an extra layer of insulation that reduces heating and cooling costs and are likely to extend the life of the roof by up to 10-20 years. Green roof vegetation enhances the building's appearance, improves air quality and reduces the urban heat island effect.

Well-designed green roofs include subsystems for drainage, plant nourishment and support, and protect underlying waterproofing systems. Green roofs maintain growing conditions and manage heavy rainfall without sustaining damage from high winds, erosion or pooling water. Green roof engineered soil meets specific requirements, including grain-size, air spaces and moisture retention to store rainfall and support plants that meet site-specific "right plant-right place" requirements.

The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.

Bio Swale



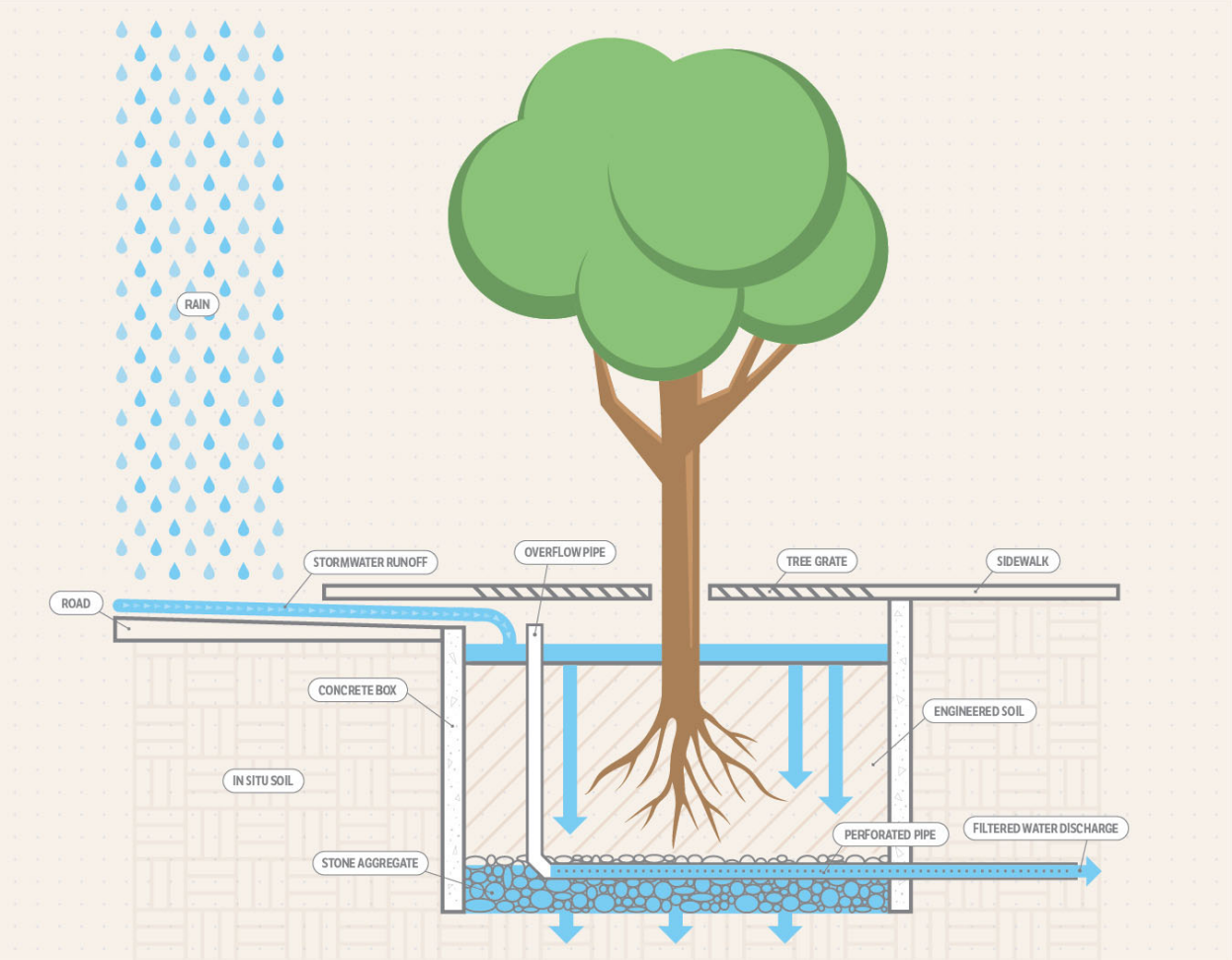
A Bioswale is an alternative to concrete gutters and storm sewers for directing stormwater away from roadways or structures. They use vegetated low-lying areas and specialized soil mixes to treat, absorb and convey lower volumes of stormwater runoff to larger treatment systems.

In many ways, bioswales imitate the function of small natural creeks or streams. Because they are linear, bioswales are effective when placed along streets and within parking lots. Essentially a shallow trench or ditch, bioswales can be cost-effective to implement and can help slow foot traffic near businesses.

Bioswales provide landscaping that, depending on the plant species chosen, may create habitats for birds, butterflies and local wildlife.

The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.

Tree Well

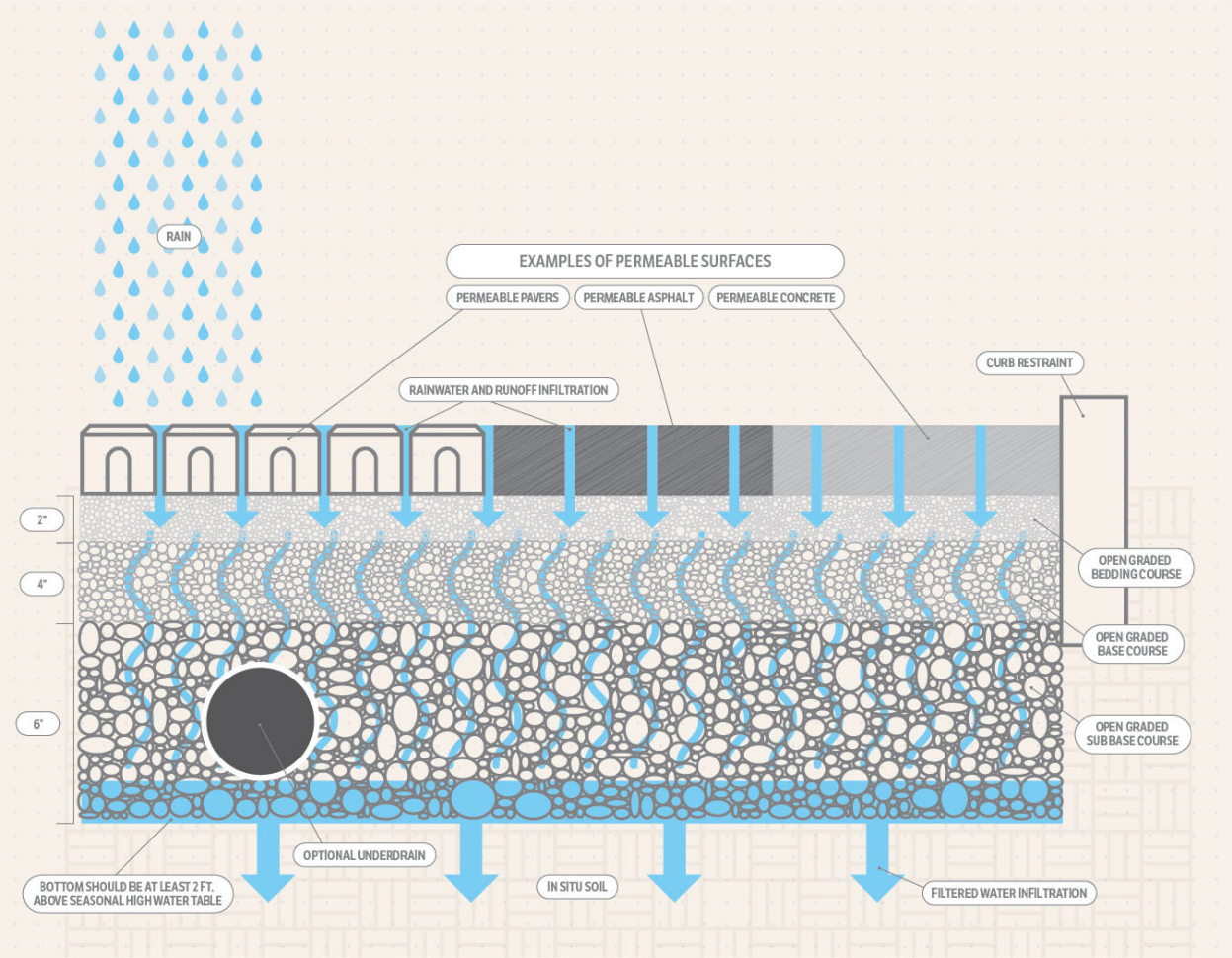


Tree boxes provide direct filtration of runoff while also intercepting rain as it falls onto the leaves and branches of the non-invasive plant life. Tree boxes also reduce the urban heat island effect, offer shady relief from the sun and draw foot traffic to nearby business based on their aesthetically pleasing nature.

The boxes are typically installed on the street side of sidewalks, with long, narrow storage volumes below the pavement. Runoff is eliminated through a combination of trees taking up water (and nutrients), percolating into the ground and discharging to stormwater systems. Pollutants are removed as they pass through the soil media in the “box” and as trees absorb and filter pollutants.

The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.

Pervious pavement



Permeable pavement, which can be composed of pervious concrete, porous asphalt or interlocking pavers, quickly percolate rainwater where it falls as well as runoff from adjacent areas, allowing it to slowly soak into ground.

Parking lots, which make up a substantial portion of developed land areas, can be retrofitted or built with pervious surfaces from the start to significantly reduce runoff volumes.

Pervious pavement can be constructed to be similar in appearance to conventional asphalt surfacing, while pavers can be used to create intricate pavement designs. The implementation of pervious pavement of all types is often particularly cost-effective in places with high land values and recurrent nuisance flooding.

The nutrient reduction capability of these systems can be calculated in the same way as Dry Retention System.