I’ve looked at a handful of documents containing language on liners. The following bullets sum some of the approaches.

* A single set of criteria (e.g. Virginia). In addition to material specs, they use a rate of 10-6 cm/sec (3.94 X 10-7 in/hr)
* Two liner criteria, one for treatment (stricter) and one for permeable liner (e.g. may be used in high perm materials such as gravel)
* Wisconsin uses a 3-step approach based on pollution potential

Other info:

* Wisconsin guidance: <http://dnr.wi.gov/topic/stormwater/documents/wetpondstd1001.pdf>
* D.C.: <http://green.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Ch3.9StormwaterPonds_0.pdf>; see Table 3.9.1 and associated section on liners on page 198
* Washington: <https://fortress.wa.gov/ecy/publications/parts/1210030part6.pdf>; Section 4.4, page 4-7
* Virginia: <http://www.vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/DCR%20BMP%20Spec%20No%2014_WET%20PONDS_Final%20Draft_v1-9_03012011.pdf>; section 6.8.
* Texas: <http://www.tceq.state.tx.us/publications/rg/rg-348/chapter3.html/at_download/file>; section 3.4.2, page 3-38
* Seattle: [http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web\_informational/p2145421.pdf](http://www.seattle.gov/dpd/cs/groups/pan/%40pan/documents/web_informational/p2145421.pdf); page E-18; section E-7
* MPCA guidance for wastewater
	+ [HDPL guidance](http://www.pca.state.mn.us/index.php/view-document.html?gid=16186)
	+ [PVC guidance](http://www.pca.state.mn.us/index.php/view-document.html?gid=16187)

Manual language on liners

* Found on 56 pages
* Bottom of BMP but for different uses, including infiltration prevention (karst, water table) and slowing of infiltration to allow permanent pool (ponds in A soils)
* Barrier against buildings and other structures; against adjacent soil
* PPavement design: minimum 30mil PVC liner covered by 12 ounce/square yard non-woven geotextile. [EPDM](http://stormwater.pca.state.mn.us/index.php/Glossary) and [HDPE](http://stormwater.pca.state.mn.us/index.php/Glossary) liner material is also acceptable.
* Ponds in A soils and some B soils
* With liner, 3 ft separation from pond bottom and karst; 1 ft with ppavement
* Pond liners: <http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_stormwater_ponds#Pond_liners>
* [CSW permit](http://stormwater.pca.state.mn.us/index.php/III._STORMWATER_DISCHARGE_DESIGN_REQUIREMENTS#III.D._PERMANENT_STORMWATER_MANAGEMENT_SYSTEM): impervious vs. impermeable
* [Bioretention with liner detail](http://stormwater.pca.state.mn.us/images/f/f7/07_Biofiltration_with_Liner.pdf)
* Industrial permit: synthetic liner that is chemically compatible with materials expected to enter the pond, must be Ultra Violet (UV) stable, and must be designed to restrict infiltration to less than 500 gallons per acre per day; this is 2.13 X 10-7 in/sec or 5.4 X 10-7 cm/sec
* [Sand material specifications](http://stormwater.pca.state.mn.us/index.php/Sand_material_specifications)

Recommendation: create a single page with liner guidance and refer to that page elsewhere in the Manual

**Excerpts from the Manual**

* For systems with impermeable liners, a minimum of one foot clearance is required between the liner and the seasonal high water table. [link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_permeable_pavement)
* To avoid harmful seepage, permeable pavement should not be hydraulically connected to building foundations unless an impermeable liner is placed against the foundation or basement wall. [link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_permeable_pavement)
* Use a minimum 30mil PVC liner covered by 12 ounce/square yard non-woven geotextile. [EPDM](http://stormwater.pca.state.mn.us/index.php/Glossary) and [HDPE](http://stormwater.pca.state.mn.us/index.php/Glossary) liner material is also acceptable. [link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_permeable_pavement)
* If ponds are used in karst areas, impermeable liners and a minimum 3 foot vertical separation from the barotic rock layer are *Recommended*. [Link](http://stormwater.pca.state.mn.us/index.php/Sector_S_-_Air_Transportation)
* It is *Highly Recommended* that pond liners be considered in circumstances where a permanent pool is needed but difficult to maintain due to site conditions, or where seepage from the pond into the groundwater would otherwise occur but must be avoided. This includes:
* Areas with Hydrologic Group A [soils](http://stormwater.pca.state.mn.us/index.php/Design_Infiltration_Rates), gravel, or fractured bedrock
* [Potential stormwater hotspots](http://stormwater.pca.state.mn.us/index.php/Potential_stormwater_hotspots) (PSHs)
* [Karst](http://stormwater.pca.state.mn.us/index.php/Karst) terrain

If geotechnical tests confirm the need for a liner, acceptable options include: (a) 6 to 12 inches of clay soil, including bentonite, (minimum 15 passing the #200 sieve and a maximum permeability of 1 x 10-5 centimeters per second, (b) a 30 mil poly-liner, or (c) engineering design as approved on a case-by-case basis by MPCA or appropriate review agency. [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_stormwater_ponds)

* [Table](http://stormwater.pca.state.mn.us/index.php/Climate%2C_soil%2C_terrain_factors_affecting_BMP_selection)
* [Table](http://stormwater.pca.state.mn.us/index.php/BMP_selection_based_on_physical_feasibility)
* [Link](http://stormwater.pca.state.mn.us/index.php/Cold_climate_impact_on_runoff_management#Infiltration_basin.2Fsurface_filter) – page has one sentence that needs editing
* [Link](http://stormwater.pca.state.mn.us/index.php/Karst) – review
* [Link](http://stormwater.pca.state.mn.us/index.php/Shallow_groundwater) - If a stormwater hotspot is identified as a contributor, then it is the recommendation of the MPCA that the pond include a liner to protect against groundwater contamination.
* If the iron-enhanced sand filter lies below the groundwater table, an impermeable liner may be necessary to prevent groundwater inflows. The MPCA *Highly Recommends* that a filtration system with less than 3 feet of separation to the seasonally saturated water table have an impermeable liner. [Link](http://stormwater.pca.state.mn.us/index.php/Types_of_iron_enhanced_sand_filter)
* In addition to the 48-hour drain dry time, to prevent pond drawdown below the normal water level and allow the trench to dry and aerate, a geomembrane liner needs to be placed or the soils between the pond and the sand bench needs to be prepared to inhibit infiltration from the pond into the trench. [Link](http://stormwater.pca.state.mn.us/index.php/Types_of_iron_enhanced_sand_filter)
* Karst: There are no special requirements for iron-enhanced sand filters in karst terrain. All of the iron-enhanced sand filters require underdrains that serve to convey filtered and treated stormwater and to aerate the filter bed between storms. It is recommended that an impermeable liner along the bottom of the filtration media be used if the filtration system is located in active karst areas. [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_iron_enhanced_sand_filter)
* impervious barrier (typically geotextile liner, for example HDPE) between the pond and the trench to minimize seepage from the pond into the trench [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_iron_enhanced_sand_filter)
* Stormwater wetlands are a preferred management technique over stormwater ponds in karst areas, but it is *Recommended* that maximum pool depths be 3 to 5 feet. If stormwater wetlands are used in areas, impermeable liners may be needed. [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_stormwater_wetlands)
* If a liner is required for the stormwater wetland, it should be designed following the same guidance as for stormwater ponds [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_stormwater_wetlands)
* It is *HIGHLY RECOMMENDED* that [bioinfiltration](http://stormwater.pca.state.mn.us/index.php/Glossary#B) practices not be used in active karst formations without adequate [geotechnical assessment](http://stormwater.pca.state.mn.us/index.php/Karst#Investigation_for_karst_areas). Underdrains and an impermeable liner may be desirable in some karst areas. [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_bioretention)
* The industrial stormwater pond must be lined with a synthetic liner that is chemically compatible with materials expected to enter the pond, must be Ultra Violet (UV) stable, and must be designed to restrict infiltration to less than 500 gallons per acre per day. [Link](http://stormwater.pca.state.mn.us/index.php/Sector_M_-_Automobile_Salvage_Yards) and [link](http://stormwater.pca.state.mn.us/index.php/Sector_N_-_Scrap_Recycling_and_Waste_Recycling_Facilities) and [link](http://stormwater.pca.state.mn.us/index.php/Sector_A_-_Timber_Products) and [link](http://stormwater.pca.state.mn.us/index.php/Sector_K_-_Hazardous_Waste_Treatment%2C_Storage%2C_or_Disposal_Facilities) and
* [Table](http://stormwater.pca.state.mn.us/index.php/Sand_material_specifications)
* It is HIGHLY *RECOMMENDED* that [underdrains](http://stormwater.pca.state.mn.us/index.php/Glossary) and an impermeable liner be used for sand filters in Karst terrain [Link](http://stormwater.pca.state.mn.us/index.php/Design_criteria_for_filtration)
* The Permittee shall ensure the use of a pond is not part of a spill containment plan, including spill plans required under Federal Spill Prevention Containment and Control (SPCC requirements or [Minnesota Statutes 115E](https://www.revisor.mn.gov/statutes/?id=115E)), unless appropriate controls are provided to contain the spill. If a pond is used as part of a spill containment plan, the pond must have a chemically compatible liner for spilled chemicals expected to enter the pond and must have outlet controls to contain a spill. A plan must also be in place to clean up a spill so that the pond will not continue to be a source of spilled pollutants. Evaluations shall be documented with the SWPPP. [Link](http://stormwater.pca.state.mn.us/index.php/PART_III._STORMWATER_CONTROL_MEASURES)
* Use impermeable liner as needed to separate tree BMP from road, parking lot, sidewalk or adjacent walls or building foundation [Link](http://stormwater.pca.state.mn.us/index.php/Fact_sheet_for_tree_trenches_and_tree_boxes)
* Other common components of bioretention systems may include a stone aggregate layer to allow for increased retention storage and an impermeable liner on the bottom or sides of the facility if located near buildings, subgrade utilities, or in [karst](http://stormwater.pca.state.mn.us/index.php/Karst) formations. [Link](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_bioretention)
* Other common components may include a stone aggregate layer to allow for increased retention storage and an impermeable liner on the bottom or sides of the facility if located near buildings, subgrade utilities, or in [karst](http://stormwater.pca.state.mn.us/index.php/Karst) formations. [Link](http://stormwater.pca.state.mn.us/index.php/Calculating_credits_for_tree_trenches_and_tree_boxes)
* [Table](http://stormwater.pca.state.mn.us/index.php/Types_of_bioretention_basins)