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## **Appendix D**

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### **GIS Analysis for Unit Area Load Model Inputs**



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## TECHNICAL MEMORANDUM

**TO:** John R. Thene, P.E., Project Manager  
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**FROM:** Pamela Massaro, P.E., Project Engineer

**DATE:** August 30, 2007

**SUBJECT:** Comfort Lake Forest Lake Watershed District  
Development of GIS Land Cover Groups for Unit Area Loading Analysis

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This memorandum summarizes the procedure used to group GIS land cover types for use in Unit Area Loading analysis. The Unit Area Loading analysis required that the land use/land cover classifications be grouped in nine simple types.

- Cropland
- Forest
- Grassland
- Developed – High
- Developed – Med
- Developed – Low
- Golf Course
- Sand and Gravel Mining
- Wetlands

Four GIS coverages for the CLFLWD were used to define the nine land use/land cover classifications:

- Washington Co 2005 Landuse (Met Council)
- Chisago Co 1990 Landuse (SRF)
- Minnesota Land Cover Classification System (MLCCS)
- National Wetland Inventory (NWI) Types

These coverages were intersected and assigned to one of the nine land use/land cover classifications.

- Cropland
  - Washington Co (2005 Landuse (Met Council) intersected with NWI)
    - Agricultural [Uplands]
    - Agricultural [Type 1 = Seasonally flooded basin or Flat]
    - Agricultural [Type 2 = Wet Meadow]
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - Cultivated Land [Uplands; Type 1; Type 2]

- Forest
  - Washington Co (MLCCS & NWI)
    - Altered/non-native deciduous forest [Uplands; Type 1; Type 2]
    - Altered/non-native deciduous woodland [Uplands; Type 1; Type 2]
    - Altered/non-native deciduous woodland - saturated [Uplands; Type 1; Type 2]
    - Altered/non-native deciduous woodland - seasonally flooded [Uplands; Type 1; Type 2]
    - Altered/non-native dominated saturated shrubland [Uplands; Type 1; Type 2]
    - Altered/non-native dominated seasonally flooded shrubland [Uplands; Type 1; Type 2]
    - Altered/non-native dominated semipermanently flooded shrubland [Uplands; Type 1; Type 2]
    - Altered/non-native saturated soils deciduous forest [Uplands; Type 1; Type 2]
    - Altered/non-native seasonally flooded deciduous forest [Uplands; Type 1; Type 2]
    - Aspen woodland [Uplands; Type 1; Type 2]
    - Coniferous trees on upland soils [Uplands; Type 1; Type 2]
    - Lowland hardwood forest [Uplands; Type 1; Type 2]
    - Oak forest [Uplands; Type 1; Type 2]
    - Oak forest dry subtype [Uplands; Type 1; Type 2]
    - Oak forest mesic subtype [Uplands; Type 1; Type 2]
    - Oak forest red maple subtype [Uplands; Type 1; Type 2]
    - Oak woodland-brushland [Uplands; Type 1; Type 2]
    - Red pine trees on upland soils [Uplands; Type 1; Type 2]
    - Upland soils with planted, maintained or cultivated coniferous shrubs [Uplands; Type 1; Type 2]
    - Upland soils with planted, maintained or cultivated deciduous trees [Uplands; Type 1; Type 2]
    - Upland soils with planted, maintained or cultivated mixed coniferous/deciduous trees [Uplands; Type 1; Type 2]
    - Upland soils with planted, maintained, or cultivated coniferous trees [Uplands; Type 1; Type 2]
    - White pine trees on upland soils [Uplands; Type 1; Type 2]
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - Deciduous Forest [Uplands; Type 2]
    - Coniferous Forest [Uplands]
- Grassland
  - Washington Co (MLCCS & NWI)
    - Dry prairie [Uplands; Type 1; Type 2]
    - Fallow [Uplands; Type 1; Type 2]
    - Grassland with sparse deciduous trees - altered/non-native dominated vegetation [Uplands; Type 1; Type 2]
    - Long grasses and forbs on upland soils [Uplands; Type 1; Type 2]
    - Long grasses on upland soils [Uplands; Type 1; Type 2]
    - Long grasses with sparse tree cover on upland soils [Uplands; Type 1; Type 2]
    - Short grasses on upland soils [Uplands; Type 1; Type 2]
    - Short grasses with sparse tree cover on upland soils [Uplands; Type 1; Type 2]

- Upland soils with planted or maintained grasses and forbs [Uplands; Type 1; Type 2]
- Chisago Co (1990 Landuse (SRF) intersected with NWI)
  - Grassland [Uplands]
  - Grassland - Shrub - Tree (Deciduous) [Uplands]
  - Transitional Agricultural Land [Uplands]
- Developed – High
  - Washington Co (2005 Landuse (Met Council) intersected with NWI)
    - Multifamily [Upland; Type 1; Type 2]
    - Manufactured Housing Park [Upland; Type 1; Type 2]
    - Retail [Upland; Type 1; Type 2]
    - Office [Upland; Type 1; Type 2]
    - Mixed Use Residential [Upland; Type 1; Type 2]
    - Industrial [Upland; Type 1; Type 2]
    - Institutional [Upland; Type 1; Type 2]
    - Major Highway [Upland; Type 1; Type 2]
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - Urban & Industrial [Upland; Type 1; Type 2]
- Developed – Med
  - Washington Co (2005 Landuse (Met Council) intersected with NWI)
    - Seasonal Vacation [Upland; Type 1; Type 2]
    - Single Family Detached [Upland; Type 1; Type 2]
    - Single Family Attached [Upland; Type 1; Type 2]
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - Rural Residential Development Complex [Upland; Type 1; Type 2]
- Developed – Low
  - Washington Co (2005 Landuse (Met Council) intersected with NWI)
    - Farmstead [Upland; Type 1; Type 2]
    - Park & Recreation [Upland; Type 1; Type 2]
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - Farmstead & Rural Residences [Upland; Type 1; Type 2]
    - Other Rural Developments [Upland; Type 1; Type 2]
- Golf Course
  - Washington Co (2005 Landuse (Met Council))
    - Golf Course; Web Searching & Aerial Photo Searching
  - Chisago Co
    - Web Searching & Aerial Photo Searching
- Sand and Gravel Mining
  - Washington Co (2005 Landuse (Met Council))
    - Extractive
  - Chisago Co (1990 Landuse (SRF))
    - Gravel Pits & Open Mines

- Wetlands
  - Washington Co (2005 Landuse (Met Council) intersected with NWI)
    - All remaining Wetland combos [Types 1- 8]
      - Type 1 = Seasonally flooded basin or Flat
      - Type 2 = Wet Meadow
      - Type 3 = Shallow Marsh
      - Type 4 = Deep Marsh
      - Type 5 = Shallow Open Water
      - Type 6 = Shrub Swamp
      - Type 7 = Wooded Swamp
      - Type 8 = Bogs
  - Chisago Co (1990 Landuse (SRF) intersected with NWI)
    - All remaining Wetland combos [Types 1- 8]

The CLFLWD is described, for the purposes of this study, by the following table of land use/land cover. The areas indicated as “Remainder” land use did not provide adequate information to allow these areas to be classified into the nine land use categories as described above. These areas were reviewed as part of the model input process and, based on their location topographic position and other factors; their land use category was estimated and input into the unit area load model.

Land Use	Area		Percent of Watershed
	Acres	Sq. Miles	
Cropland	5,546	8.7	18%
Forest	3,738	5.8	12%
Golf	211	0.3	1%
Grassland	3,172	5.0	10%
Sand & Gravel	40	0.1	0%
Developed – High	736	1.1	2%
Developed – Low	577	0.9	2%
Developed – Medium	4,701	7.3	15%
Wetlands Types 1-2	2,193	3.4	7%
Wetlands Types 3-5	2,097	3.3	7%
Wetlands Types 6-8	1,839	2.9	6%
Lakes	5,548	8.7	18%
Remainder	1,122	1.8	4%
<b>Grand Total</b>	<b>31,520</b>	<b>49.2</b>	