



Summary Report
of the
Norway Dover
Drainage District
Mapping and Benefits
Assessment
February 21, 2013



Nielsen Madsen & Barber S.C.
Civil Engineers and Land Surveyors



INTRODUCTION

The following report was prepared by Nielsen Madsen & Barber, S.C. (NMB), at the request of the Racine County Board of Drainage Commissioners on behalf of the Norway Dover Drainage District hereafter referred to as the "District", to analyze the existing mapping and benefits and update them to reflect the overall drainage boundary served by the District. The benefits were calculated using the method approved by the Department of Agriculture, Trade and Consumer Protection (DATCP) which is described in Chapter ATCP 48 of the Wisconsin Administrative Code.

NORWAY DOVER DRAINAGE DISTRICT

The District encompasses parts of six municipalities within Racine County: the Town of Waterford, the Village of Waterford, the Village of Rochester, the Town of Raymond, the Town of Dover and the Town of Norway. The District contains 31,448 acres of land consisting of 4,572 parcels and road right-of-way. The Town of Waterford contains 324 acres and 34 parcels within the District. The Village of Waterford contains 56 acres and 5 parcels within the District. The Village of Rochester contains 904 acres and 177 parcels within the District. The Town of Raymond contains 1,098 acres and 138 parcels within the District. The Town of Dover contains 7,463 acres and 352 parcels within the District. The Town of Norway contains 21,603 acres and 3,866 parcels within the District. The land within the District is predominantly agricultural with areas of low, medium and high density residential development as well as isolated commercial and manufacturing parcels.

The drainage system within the District includes one branch tile and 23 branch ditches all of which drain to the Wind Lake Canal. The branch ditches, and that portion of Wind Lake Canal that is within the District, add up to a total of 260,717 linear feet (49.38 miles) of drainage way. The single branch tile has a total length of 5,448 linear feet (1.03 miles).

The District is obligated, under Section 88.63 of the State Statutes, to maintain and repair District facilities. The cost of maintenance and repair is assessed based upon the benefits each parcel receives per Section 88.23 of the State Statutes. Property owners are assigned, in part, a proportionate "charge" based on the amount of runoff "generated" by their property.

The amount of runoff a property generates depends on the percent of impervious surface, ground cover / condition, topography and soil type. The total impervious area and percentage of the parcel thereof are the most important factors in generating runoff. Impervious surfaces are defined as solid or semi-solid surfaces that prevent rainfall from infiltrating into the ground thus creating excess "runoff". Runoff from lands with a high percentage of impervious surfaces is generally in greater quantities and at higher velocities than undeveloped (i.e. agricultural, forest, swamp) lands and typically includes increased pollutant loading.

While undeveloped properties typically generate a fraction of the runoff as compared to developed properties of comparable size, such undeveloped or agricultural properties contribute to the District-wide storm water runoff that must be managed. The undeveloped property in the District amounts to approximately 76.2% of the total area and is scattered throughout the District.

The District is a separate entity from the six municipalities within its boundary. Rights-of-way owned by the Federal Government, State of Wisconsin and local municipalities make up 0.19%, 0.85% and 1.88%, respectively, of the land within the District boundary. In accordance with ATCP 48.02(5)(b) the District assesses each municipality (including Racine County) directly for their respective road rights-of-way. Racine County owns CTH D, CTH G, CTH K, CTH S and CTH Y. The Wisconsin Department of Transportation (WisDOT) owns 269 acres of land within the District consisting of STH 20, STH 36, STH 75 and STH 164. The County will be assessed for their rights-of-way. However, in accordance with ATCP 48.02(5)(a), lands owned by the State of Wisconsin cannot be assessed unless the land is being used for agricultural purposes. Therefore, WisDOT will not be assessed for their road rights-of-way within the District. The District also contains 58 acres of USH 45 right-of-way, which was not assessed.

There are a number of parcels within the District whose boundary extends to the centerline of the adjacent roadway. These parcel owners will be assessed for their entire parcel area, including what extends into the public roadway.

The Wisconsin Department of Natural Resources (WDNR) owns 452 acres of land within the District. The vast majority of this land is within the Town of Norway. The remainder of this land is located in the Village of Rochester and Town of Dover. As with WisDOT, any lands owned by the WDNR are exempt from this assessment unless the land is being leased for farming. There no parcels owned by the WDNR that appear to be farmed.

CREATING A PARCEL DATABASE

A database was created which included all parcels within the District boundary. This database was built upon the existing infrastructure developed and maintained by Racine County.

As part of Racine County's Real Estate Description department, the Real Property Lister Division maintains the real estate tax roll for all municipalities within Racine County with the exception of the City of Racine. The County-maintained data applicable to the District's database includes the owner's name, tax key ID number, parcel size, mailing address, land use classification codes and acreages. The "land use" portion of the data originates from the assessors of the municipalities and is of particular importance to the District's database in that it contains a breakdown (by area) of each land use type for each individual parcel.

There are 16 land use classifications within the District. They are as follows:

- (1) High-Density Residential less than 1/3 Acre (G1)
- (2) Medium-Density Residential 1/3 Acre to 1 Acre (G1)
- (3) Low-Density Residential greater than 1 Acre (G1)
- (4) Commercial (G2)
- (5) Manufacturing (G3)
- (6) Agricultural (G4)
- (7) Swamp Land (G5)
- (8) Production Forest Land (G6)
- (9) Agricultural – Improved (G7)
- (10) State (X2)
- (11) County (X3)
- (12) Local / Institutional (X4)
- (13) Agricultural Forest (5M)
- (14) Woodland (W6)
- (15) Managed Forest, Closed (W8)
- (16) Road Right of Way (R/W)

The District also contains several parcels of land with common owners, listed as Condominium, Common Element or Outlot. The assessments for these parcels were split equally among the common ownership.

A breakdown by land use of all parcels within the District is shown is as follows:

Breakdown of Land Use Classification by Area

District-wide Land Use Classification	Land Use Classification Code	Total Area (Acres)	Percentage of Total Area
Residential less than 1/3 Acre (High-Density)	G1	113.82	0.36%
Residential 1/3 Acre to 1 Acre (Medium-Density)	G1	952.60	3.03%
Residential greater than 1 Acre (Low-Density)	G1	3,336.36	10.61%
Commercial	G2	741.73	2.36%
Manufacturing	G3	19.20	0.06%
Agricultural	G4	18,212.90	57.91%
Swamp/Wasteland	G5	3,474.54	11.05%
Forest Land	5M / G6 / W6 / W8	989.01	3.14%
Agricultural - Improved	G7	339.58	1.08%
State	X2	436.09	1.39%
County	X3	63.90	0.20%
Local / Institutional	X4	285.44	0.91%
Common Land	C/E, Condo, Outlot	56.48	0.18%

Local Road Right of Way	R/W	591.46	1.88%
State Road Right of Way	-	268.74	0.85%
US Road Right of Way	-	58.36	0.19%
District Corridor	-	387.43	1.23%
Undefined / Water Bodies	-	1,120.53	3.56%
	Total	31,448.17	

EXISTING BENIFITS ANALYSIS METHODOLOGY

The District has an existing methodology in place to determine the benefits for each parcel. This analysis was based on parcel runoff which is the product of two factors: parcel area (in acres) and the runoff coefficient as a function of underlying soil composition.

PROPOSED BENEFITS ANALYSIS METHODOLOGY

NMB is proposing to use the same basic method as previous assessments, in which benefit points were determined by parcel size and runoff coefficient, for determining the total benefit points for each parcel. For assessment purposes, the individually calculated runoff amounts were used to determine the total “benefit points” for each parcel. The District has historically assigned a minimum number of benefit points for smaller residential and commercial parcels. These parcels typically contain more improvements and run the risk of suffering higher damages should the District system not be properly maintained. To determine the assessment rate for each parcel, the overall District assessment was divided by the total benefit points for all parcels producing a cost per benefit point. This cost was then multiplied by the total benefit points for each parcel, producing the overall assessment. This method can be utilized uniformly for all developed, undeveloped and agricultural parcels. This method also allows for ease of future benefits analysis updating since changes in the runoff coefficient and parcel size are easily calculated.

The runoff coefficient ranges from 0 to 1 and is the ratio of the amount of rainfall that is not absorbed by the surface to the total amount of rainfall during any given storm event. Parcels which have a larger proportion of “impervious” surface (streets, rooftops, sidewalks, patios, parking lots, driveways and other similar surfaces) will have a larger runoff coefficient than parcels which have a larger proportion of “pervious” surface (lawn, landscaping, agricultural lands and other similar surfaces).

NMB believes that the use of runoff coefficients satisfies the consideration requirements of ATCP 48.08(1)(c) through 48.08(1)(f). These considerations are as follows:

- 48.08(1)(c) – Consider the amount of drainage required by, or provided to the assessed land.
- 48.08(1)(d) – Consider the thoroughness and reliability of drainage provided.

- 48.08(1)(e) – Consider the amount and frequency of flooding on the assessed land.
- 48.01(1)(f) – Consider the difficulty of draining the assessed land.

NMB is proposing to use runoff coefficient values as specified by Procedure 13-10-5 of the Wisconsin Department of Transportation’s Facilities Development Manual (FDM). The FDM has standard values for runoff coefficients based on land use, hydrologic soil group and land slope range. The vast majority of the land uses fall under one of these standard runoff coefficient values. However, the FDM does not have standard runoff coefficients for forest, agricultural-improved or swamp / wasteland. NMB used a commonly accepted average coefficient (0.13) for forested land and used the same value for agricultural-improved as residential greater than 1 acre (0.25). Swamp / wasteland was neglected from the assessment and assigned a runoff coefficient of 0.00 per ATCP 48.06(4). The District corridor was neglected from the assessment per ATCP 48.08(3)(a). The FDM presents options for low intensity and high intensity design storm events. Low intensity design storm events have a 2 to 10 year design recurrence. High intensity design storm events have a 25 to 100 year design recurrence. Since the typical design storm for a study of this nature is a 10 year event, the low intensity option was used for the analysis. Current topographic data for the entire District was unavailable for this analysis. Therefore, an average slope range of 2% to 6% was assumed for the entire District.

Runoff coefficients for the remaining land uses within the District were generated based on individual calculations. This method was employed due to the land uses (and individual parcels) containing substantially different characteristics and levels of imperviousness. The land uses for which these individual runoff coefficients were calculated are commercial, institutional, municipal (County) and the properties with common ownership (condominium, common element and outlots). These parcel specific coefficients were calculated based on percentages of pervious and impervious surface, agricultural use, road right-of-way, forest land and water surface. Impervious surfaces were assigned a runoff coefficient of 0.95 and pervious surfaces were assigned a runoff coefficient of 0.17. Water surfaces were treated the same as swamp / wasteland since water bodies accept runoff rather than generate it.

A breakdown of the District land uses by area and percentage as well as the standard runoff coefficients which were used is as follows:

Land Use Classifications for which Standard Runoff Coefficients were used

District-wide Land Use Classification	Land Use Classification Code	Total Area (Acres)	Percentage of Total Area	Runoff Coefficient
Residential less than 1/3 Acre (High-Density)	G1	113.82	0.36%	0.51
Residential 1/3 Acre to 1 Acre (Medium-Density)	G1	952.60	3.03%	0.33
Residential greater than 1 Acre (Low-Density)	G1	3,336.36	10.61%	0.25

Agricultural	G4	18,212.90	57.91%	0.19
Swamp/Wasteland	G5	3,474.54	11.05%	0.00
Forest Land	G6 / 5M / W6 / W8	989.01	3.14%	0.13
Agricultural - Improved	G7	339.58	1.08%	0.25
Local Road Right of Way	R/W	591.46	1.88%	0.61
		Total 28,010.27	89.06%	

A breakdown of the District land uses by area and percentage for the individually calculated runoff coefficients is as follows:

Land Use Classifications for which Individual Runoff Coefficients were Calculated

District-wide Land Use Classification	Land Use Classification Code	Total Area (Acres)	Percentage of Total Area
Commercial	G2	741.73	2.36%
Common Land	C/E, Condo, Outlot	56.48	0.18%
County	X3	63.90	0.20%
Institutional	X4	285.44	0.91%
		Total 1,147.55	3.65%

In addition, several underlying soil conditions are more conducive than others to the absorption of storm water runoff. Sandy and gravelly soils with large particle sizes will absorb runoff quicker than clayey and silty soils with very small particle sizes. The National Resource Conservation Service (NRCS), a division of the United States Department of Agriculture (USDA), has defined four major soil groups which are explained as follows:

Group A soils have low runoff potential and high infiltration rates. They consist mainly of well drained sand and gravel.

Group B soils have moderate infiltration rates. They consist of moderately well drained soils with moderately fine to coarse textures.

Group C soils have low infiltration rates and have a moderately fine to fine texture.

Group D soils have high runoff potential and low infiltration rates. They consist mainly of clay soils.

Runoff coefficients were analyzed using the percentages of all four soil types in accordance with ATCP 48.08(1)(b).

NMB analyzed the soils within the entire District to determine the areas where each of the four soil types were present. This analysis was performed utilizing soils maps

from the NRCS. The soils within the District break down into the four major soil groups as follows:

NRCS Soil Type	Percentage Within District
Type A	0.68%
Type B	19.95%
Type C	51.65%
Type D	23.49%
Water	4.23%

NMB took the soils analysis a step further and separated the District into the six municipalities. The soils within each municipality break down into the four major soil groups as follows:

NRCS Soil Type	Percentage Within Town of Norway	Percentage Within Town of Dover	Percentage Within Town of Raymond	Percentage Within Town of Waterford	Percentage Within Village of Waterford	Percentage Within Village of Rochester
Type A	1.00%	0.00%	0.00%	0.00%	0.00%	0.06%
Type B	17.90%	23.92%	22.92%	18.15%	26.39%	30.77%
Type C	47.03%	61.36%	67.26%	67.54%	45.48%	50.57%
Type D	28.21%	14.24%	9.43%	14.01%	28.13%	14.03%
Water	5.86%	0.48%	0.39%	0.30%	0.00%	4.57%

Since soil type has an effect on the runoff coefficient, NMB chose to calculate average runoff coefficients for each municipality. However, after these averages were calculated it was determined that the average runoff coefficients varied “very little” from municipality to municipality. Also, the runoff coefficients were consistent with that of Type C soils. Therefore, the runoff coefficients for Type C soils specified in Procedure 13-10-5 of the WisDOT FDM were used to determine the total benefits for each parcel.

TOWN OF NORWAY SANITARY DISTRICT NO. 1 ASSESSMENT ANALYSIS

In addition to the runoff produced by lands within the District, the Town of Norway Sanitary District No. 1 (NSD) has a sanitary sewer treatment plant which discharges its treated effluent into the Waubeesee Outlet Channel. Since NSD utilizes District facilities to convey its outfall discharge it is appropriate that they be included in the benefits analysis and receive an appropriate assessment.

In order to calculate an appropriate assessment charge for NSD, their annual discharge into District maintained facilities was compared with the overall runoff from the lands within the District. Annual treatment plant discharges from 2001 to the present were provided to NMB by NSD in a transmittal dated July 5, 2012. This

information can be found in Appendix “B” of this report. In order to determine an average annual outflow during this period of time the lowest (2003) and the highest (2006) annual outflows were removed and the remaining annual flows were averaged. This resulted in an average annual outflow of 342.6 million gallons.

According to SEWRPC Community Assistance Planning Report No. 198 (“A Lake Management Plan for Wind Lake”) the Wind Lake area receives an average of 34.81 inches of precipitation per year. The District is 31,448 acres in area but only 26,466 acres produces runoff. The 4,982 acres which do not produce runoff includes water bodies, District corridors and wetlands. The 26,466 acres which produces runoff includes State and Federal rights-of-way which, although are not being assessed, still produce runoff. The average runoff coefficient for the 26,466 acres which produce runoff is 0.217. The product of the area, the annual rainfall and the average runoff coefficient is the total annual District runoff. Per this calculation procedure, the annual District runoff is 5,428.6 million gallons. When the annual District runoff is added to the 342.6 million gallons of outflow from NSD the total annual flow within District facilities is 5,771.2 million gallons. The average annual outflow from NSD is 5.94% of the total flow through the District facilities. Therefore, the Town of Norway Sanitary District No. 1 should be responsible for 5.94% of the overall Norway-Dover Drainage District assessment.

APPENDIX A
WISDOT FDM RATIONAL COEFFICIENT TABLE

Detail A - Runoff Coefficients (C), Rational Formula

Land Use	Percent Impervious Area	Hydrologic Soil Group											
		A			B			C			D		
		Slope Range Percent			Slope Range Percent			Slope Range Percent			Slope Range Percent		
		0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over
Industrial	90	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
		0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	95	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
		0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
High Density Residential	60	0.47	0.49	0.50	0.48	0.50	0.52	0.49	0.51	0.54	0.51	0.53	0.56
		0.58	0.60	0.61	0.59	0.61	0.64	0.60	0.62	0.66	0.62	0.64	0.69
Med. Density Residential	30	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
		0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Low Density Residential	15	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.28	0.35
		0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Agriculture	5	0.08	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
		0.14	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Open Space	2	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
		0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Freeways & Expressways	70	0.57	0.59	0.60	0.58	0.60	0.61	0.59	0.61	0.63	0.60	0.62	0.64
		0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78

Detail B - Runoff Coefficients for Specific Land Use

Land Use	Hydrologic Soil Group											
	A			B			C			D		
	Slope Range Percent			Slope Range Percent			Slope Range Percent			Slope Range Percent		
	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over
Row Crops	.08	.16	.22	.12	.20	.27	.15	.24	.33	.19	.28	.38
	.22	.30	.38	.26	.34	.44	.30	.37	.50	.34	.41	.56
Median Strip Turf	.19	.20	.24	.19	.22	.26	.20	.23	.30	.20	.25	.30
	.24	.26	.30	.25	.28	.33	.26	.30	.37	.27	.32	.40
Side Slope Turf			.25			.27			.28			.30
			.32			.34			.36			.38
PAVEMENT												
Asphalt	.70 - .95											
Concrete	.80 - .95											
Brick	.70 - .80											
Drives, Walks	.75 - .85											
Roofs	.75 - .95											
Gravel Roads Shoulders	.40 - .60											

NOTE: The lower C values in each range should be used with the relatively low intensities associated with 2 to 10 year design recurrence intervals whereas the higher C values should be used for intensities associated with the longer 25 to 100 year design recurrence intervals.

APPENDIX B
OUTFLOW DATA RECEIVED FROM TOWN OF NORWAY SANITARY DISTRICT
NO. 1

TOWN OF NORWAY SANITARY DISTRICT #1

6419 Heg Park Road, Wind Lake, WI 53185

Phone: Office 262-895-6400 Plant 262-895-2400 Fax 262-895-2480

Nielsen, Madsen, & Barber S.C.
1458 Horizon Blvd.
Suite 200
Racine, WI 53406

July 5, 2012

Gentlemen:

Thank you for coming to us for this flow information as the last time the lawyer of the Drainage Board obtained data from the Department of Natural Resources. They were not aware that since the plant upgrade done in the year 2000, the water is metered into our facility and again when it is discharged. They added the data together and basically doubled the flow of the Sanitary District.

The Sanitary District has attempted to reduce flows over the past few years and have been quite successful. In the winter of 2007-2008 we installed a cure in place liner in 1700 feet of East Wind Lake Road which kept us from having a sanitary sewer overflow during the flooding of June 2008. Many houses in this area and some others had surface water inside which went down the drains and stressed our system. The June flows of 2008 was more than double the normal flows and is looked at as an outlier in our opinion.

Repairs were also done at the intersection of County G and County S. A large hole had developed in a 10 inch ductile iron pipe and was replaced and supported with a helical pier system. This last winter work was done on the north side of Wind Lake on both sides of the canal from Big Muskego Lake. Based on the reduction in lift station run time that happened immediately and on average run times over the previous year, we feel this repair decreased flow by at least 40,000 gallons per day.

I have included with this letter a report that I give the Sanitary District Commissioner in the yearend report showing flow histories by the year and by the month. These are the effluent totals from the past eleven years and the first half of this year. 2012 flows are not figured into the average numbers at the bottom. I also included the flows for the month of June showing how out of line 2008 was from normal.

I hope this information will help you in completing your work.



P.J. Nolan
District Manager
Town of Norway Sanitary District #1

TOWN OF NORWAY SANITARY DISTRICT #1

6419 Heg Park Road, Wind Lake, WI 53185

Phone: Office 262 895-6400 Plant 262 895-2400 Fax 262 895-2480

Annual Flow History

Effluent

2001 ----- 341.3744 M.G.

2002 ----- 287.8966 M.G.

2003 ----- 248.6569 M.G.

2004 ----- 332.5351 M.G.

2005 ----- 278.7019 M.G.

2006 ----- 424.3857 M.G.

2007 ----- 369.5868 M.G.

2008 ----- 423.8903 M.G.

2009 ----- 369.1925 M.G.

2010 ----- 365.9667 M.G.

2011 ----- 314.5025 M.G.

2012 ----- 148.2628 M.G.(First half of year)

Average Annual Flow ----- 341.5172 M.G.

Average Flow-----935,664 Gallons Per Day

TOWN OF NORWAY SANITARY DISTRICT #1

6419 Heg Park Road, Wind Lake, WI 53185

Phone: Office 262 895-6400 Plant 262 895-2400 Fax 262 895-2480

Monthly Flow History

June

2001 ----- 37.8 M.G.

2002 ----- 30.7 M.G.

2003 ----- 22.6 M.G.

2004 ----- 42.2 M.G.

2005 ----- 20.6 M.G.

2006 ----- 37.0 M.G.

2007 ----- 24.9 M.G.

2008 ----- 67.2 M.G.

2009 ----- 32.3 M.G.

2010 ----- 43.8 M.G.

2011 ----- 24.3 M.G.

2012 ----- 17.1 M.G.

Average Monthly Flow 01-07+09-12 ----- 30.3 M.G.

Average Monthly Flow ----- 33.4 M.G.

Average Daily Flow ----- 1.11 M.G.