Environmental Impact Report
Golden Sands Dairy
Saratoga Township
Wisconsin

March 2014

Environmental Impact Report
Golden Sands Dairy
Saratoga Township
Wisconsin

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Table of Contents

Page

List of Figures xiii
List of Tables xv
List of Appendices xvi
List of Acronyms xvii
1 PROPOSED PROJECT DESCRIPTION 2
1.1 Production Area 5
1.1.1 Site Characteristics 5
1.1.2 Buildings and Structures 5
1.1.3 Materials Storage and Management 7
1.1.3.1 Feed 7
1.1.3.2 Manure 7
1.1.3.2.1 Manure Generation 7
1.1.3.2.2 Storage 7
1.1.3.2.3 Digester 8
1.1.3.2.4 Distribution 9
1.1.3.3 Bedding 9
1.1.4 Roads and Traffic 9
1.1.5 Lighting 10
1.1.6 Monitoring 10
1.1.6.1 Groundwater Monitoring 10
1.1.6.2 Operation and Maintenance 10
1.1.7 Stormwater 10
1.1.8 Domestic Wastewater 11
1.1.9 Solid and Hazardous Waste 11
1.1.10 High Capacity Wells 11
1.1.11 Energy Production and Use 12
1.1.12 Animal Husbandry 12
1.1.12.1 Animals 12

1.1.12.2 Housing and Handling 12
1.1.12.3 Feed, Supplements and Antibiotics 13
1.1.12.4 Mortality Management 13
1.2 Agricultural Crop Fields 13
1.2.1 Manure Spreading Sites 14
1.2.1.1 Locations and Descriptions 14
1.2.1.2 Timber Harvest and Managed Forest Land Conversion 14
1.2.1.3 Crops 14
1.2.1.4 Nutrient Application 15
1.2.1.4.1 Application Methods 18
1.2.1.4.2 Solid Manure 19
1.2.1.4.3 Liquid Manure Traditional 19
1.2.1.4.4 Liquid Manure Center Pivot 19
1.2.1.4.5 Rates 21
1.2.1.4.6 Schedule 21
1.2.1.5 Water Irrigation 22
1.2.1.5.1 Methods 22
1.2.1.5.2 Rates 22
1.2.1.5.3 Schedule 22
1.2.1.5.4 Conservation Efficiency Measures 22
1.2.1.6 Pesticides 23
1.2.2 Stormwater 23
1.2.2.1 Agricultural Crop Fields 23
1.2.2.2 Managed Forest Land Conversion 24
1.2.3 High Capacity Wells 24
1.2.4 Roads and Traffic 26
1.2.5 Lighting 26
1.2.6 Monitoring 26
1.3 Permits and Approvals Required by the GSD Project 28
1.3.1 Wisconsin Department of Natural Resources 28
1.3.2 Other Wisconsin Agencies 29

1.3.3 Wood County ... 29
1.3.4 Federal ... 29
1.3.5 Local Zoning / Approvals ... 29
1.4 Degree of Controversy, Major Issues, and Public Involvement ... 30
1.5 Purpose or Need ... 31
1.6 Products ... 32
1.7 Cumulative Effects ... 32
2 NATURAL ENVIRONMENT AND POTENTIAL IMPACTS ... 36
2.1 Geology ... 36
2.1.1 Existing Conditions ... 36
2.1.2 Potential Impacts ... 36
2.2 Soils and Topography ... 36
2.2.1 Existing Conditions ... 36
2.2.1.1 GSD Production Area ... 36
2.2.1.2 Agricultural Crop Fields ... 37
2.2.2 Potential Impacts ... 37
2.2.2.1 GSD Production Area ... 37
2.2.2.2 Agricultural Crop Fields ... 37
2.2.3 Significance of Potential Impacts ... 39
2.2.3.1 GSD Production Area ... 39
2.2.3.2 Agricultural Crop Fields ... 39
2.3 Water Resources ... 40
2.3.1 Water Quantity ... 41
2.3.1.1 Regulatory Framework ... 41
2.3.1.2 Existing Conditions ... 43
2.3.1.2.1 Water Budget ... 43
2.3.1.2.2 Description of Aquifers and Wells ... 45
2.3.1.2.3 Private/Public Supply Wells ... 46
2.3.1.2.4 Surface Water Features and Streamflows ... 46
2.3.1.2.5 Wetlands ... 50
2.3.1.3 Potential Impacts ... 51

2.3.1.3.1 Groundwater Flow Model 52
2.3.1.3.1.1 Finite-Difference Grid and Boundary Conditions 54
2.3.1.3.1.2 Recharge 55
2.3.1.3.1.3 Model Parameters 56
2.3.1.3.1.4 Model Calibration 56
2.3.1.3.2 Model Calculated Effects of GSD Pumping 58
2.3.1.3.3 Model Calculated Cumulative Effects of Irrigation Pumping 61
2.3.1.4 Significance of Potential Impacts 62
2.3.1.4.1 Private/Public Wells 62
2.3.1.4.2 Rivers and Streams 63
2.3.1.4.3 Cranberry Operations 63
2.3.1.4.4 Wetlands 64
2.3.2 Water Quality 64
2.3.2.1 Regulatory Framework 64
2.3.2.2 Existing Conditions 66
2.3.2.2.1 Groundwater Quality 66
2.3.2.2.2 Surface Water Quality 68
2.3.2.2.2.1 Rivers and Streams 68
2.3.2.2.2.2 Wisconsin River TMDL 69
2.3.2.2.2.3 Wetlands 70
2.3.2.3 Potential Water Quality Impacts 70
2.3.2.3.1 Nutrients, Pathogens, Metals, and Other Chemicals 70
2.3.2.3.1 Nitrogen / Groundwater Quality Model 72
2.3.2.3.2 Potential Groundwater Quality Impacts 75
2.3.2.3.3 Potential Surface Water Quality Impacts 82
2.3.2.3.3.1 Rivers and Streams 82
2.3.2.3.3.2 Wisconsin River TMDL 83
2.3.2.3.3.3 Wetlands 83
2.3.2.4 Significance of Potential Water Quality Impacts 84
2.3.2.4.1 Significance of Groundwater Quality Impacts 84
2.3.2.4.2 Significance of Surface Water Quality Impacts 85

2.3.2.4.2.1 Rivers and Streams 85
2.3.2.4.2.2 Wisconsin River TMDL 86
2.3.2.4.2.3 Wetlands 87
2.4 Flora 87
2.4.1 Existing Conditions 87
2.4.1.1 Plant Communities 89
2.4.1.1.1 Forest 89
2.4.1.1.2 Grasslands 90
2.4.1.1.3 Wetlands 90
2.4.1.1.4 Aquatic 91
2.4.1.2 Natural, Wildlife, and Conservation Areas 94
2.4.1.3 Rare Plants 97
2.4.1.3.1 Plants 98
2.4.1.3.2 Natural Communities 98
2.4.2 Potential Impacts 100
2.4.2.1 Plant Communities 100
2.4.2.1.1 Forest 101
2.4.2.1.2 Grasslands 102
2.4.2.1.3 Wetlands 102
2.4.2.1.4 Aquatic 102
2.4.2.2 Natural, Wildlife, and Conservation Areas 108
2.4.2.3 Rare Plants 108
2.4.3 Significance of Potential Impacts 109
2.4.3.1 Plant Communities 109
2.4.3.1.1 Invasive Species 109
2.4.3.1.2 Forest 109
2.4.3.1.3 Grasslands 110
2.4.3.1.4 Wetlands 110
2.4.3.1.5 Aquatic 110
2.4.3.2 Natural and Conservation Areas 113
2.4.3.3 Rare Plants 113

3/12/2014

2.5 Fauna 113
2.5.1 Existing Conditions 113
2.5.1.1 Habitats 113
2.5.1.1.1 Forest 113
2.5.1.1.2 Grasslands 115
2.5.1.1.3 Wetlands 115
2.5.1.1.4 Aquatic 116
2.5.1.2 Natural, Wildlife, and Conservation Areas 118
2.5.1.3 Wildlife Species 118
2.5.1.3.1 Mammals 118
2.5.1.3.2 Birds 118
2.5.1.3.3 Reptiles and Amphibians 119
2.5.1.3.4 Invertebrates 120
2.5.1.3.5 Fishes 120
2.5.1.4 Rare Animals 120
2.5.1.4.1 Birds 121
2.5.1.4.2 Invertebrates 122
2.5.1.4.3 Reptiles 125
2.5.1.4.4 Other 126
2.5.2 Potential Impacts 127
2.5.2.1 Habitats 127
2.5.2.1.1 Forest 127
2.5.2.1.2 Grasslands 127
2.5.2.1.3 Wetlands 128
2.5.2.1.4 Aquatic 128
2.5.2.1.4.1 Flow Rates 128
2.5.2.1.4.2 Temperature 128
2.5.2.1.4.3 Nutrient Concentrations 129
2.5.2.2 Natural and Conservation Areas 132
2.5.2.3 Wildlife Species 132
2.5.2.4 Rare Animals 132

2.5.2.4.1 Birds 132
2.5.2.4.2 Invertebrates 133
2.5.3 Significance of Impacts 133
2.5.3.1 Habitats 133
2.5.3.1.1 Forest 134
2.5.3.1.2 Grasslands 134
2.5.3.1.3 Wetlands 134
2.5.3.1.4 Aquatic 134
2.5.3.2 Natural and Conservation Areas 136
2.5.3.3 Wildlife Species 136
2.5.3.4 Rare Animals 136
2.6 Air quality 137
2.6.1 Regulatory Framework 137
2.6.1.1 Federal Regulations 137
2.6.1.2 State Regulations 138
2.6.1.2.1 Air Emissions 138
2.6.1.2.2 Odors 138
2.6.2 Existing Conditions 139
2.6.3 Pollutants of Interest and Potential Impacts 139
2.6.3.1 Overview of Air Emission Health Effects 140
2.6.3.1.1 Ammonia 142
2.6.3.1.2 Hydrogen Sulfide 143
2.6.3.1.3 Particulate Matter and Fugitive Dust Emissions 144
2.6.3.1.4 Greenhouse Gases 145
2.6.3.1.5 Volatile Organic Compounds & Other Hazardous Air Contaminants 145
2.6.3.1.6 Odors 145
2.6.3.1.7 Pathogens 146
2.6.4 Quantifying Air Pollutants 147
2.6.4.1 National Air Emissions Monitoring Study – Production Area 147
2.6.4.2 San Joaquin Valley – Production Area 148
2.6.4.3 Land Application Emission Estimation 149

2.6.4.3.1 Traditional Manure Application – Land Application 150
2.6.4.3.2 Center Pivot Manure Irrigation – Land Application 151
2.6.4.4 Housing and Lagoon Emission Factor Selection 152
2.6.5 Production Area Dispersion Modeling 152
2.6.5.1 Model Executables 153
2.6.5.2 Meteorological and Land Use Data 153
2.6.5.3 Receptors 153
2.6.5.4 Coordinate System 153
2.6.5.5 Area Source Facility Emission Configuration 153
2.6.5.6 Point Source Facility Emission Configuration 154
2.6.5.7 Dispersion Modeling Results 154
2.6.6 Land Application Dispersion Modeling 155
2.6.7 Significance of Impacts from Air Emissions 156
2.6.7.1 Feed Management BMPs 157
2.6.7.2 Manure Processing BMPs 157
2.6.7.3 Estimated Potential Air Emissions 158
2.6.7.4 Significance of Estimated Air Emissions 159
3 SOCIOECONOMIC CONDITIONS AND POTENTIAL IMPACTS 161
3.1 Neighbors 161
3.1.1 Existing Conditions 161
3.1.1.1 Residents 161
3.1.1.2 Businesses 161
3.1.1.3 Private/Public Wells 161
3.1.1.4 Property Values 161
3.1.2 Potential Impacts 162
3.1.2.1 Residents 162
3.1.2.2 Businesses 162
3.1.2.3 Private/Public Wells 162
3.1.2.4 Property Values 162
3.1.3 Significance of Impacts 163
3.1.3.1 Residents 163

3.1.3.2 Businesses 163
3.1.3.3 Private/Public Wells 163
3.1.3.4 Property Values 163
3.2 Health, Education and Emergency Services 164
3.2.1 Existing Conditions 164
3.2.1.1 Nearby Hospitals and Clinics 164
3.2.1.2 Nearby Schools 164
3.2.1.3 Emergency Services 164
3.2.2 Potential Impacts 164
3.2.3 Significance of Impacts 164
3.3 Population, Land Use and Economy 165
3.3.1 Employment 165
3.3.1.1 Current Conditions 165
3.3.1.2 Potential Impacts 165
3.3.1.3 Significance of Impacts 166
3.3.2 Agricultural and Rural 166
3.3.2.1 Current Conditions 166
3.3.2.2 Potential Impacts 166
3.3.2.3 Significance of Impacts 167
3.3.3 Service industries 167
3.3.3.1 Potential Impacts 167
3.3.4 Tourism and Recreation 167
3.3.4.1 Parks and Public Lands 167
3.3.4.1.1 Current Conditions 167
3.3.4.1.2 Potential Impacts 167
3.3.4.1.3 Significance of Impacts 167
3.3.4.2 Trails and Scenic Roads 168
3.3.4.2.1 Current Conditions 168
3.3.4.2.2 Potential Impacts 168
3.3.4.2.3 Significance of Impacts 168
3.3.4.3 Hospitality and Recreational Businesses 168

3.3.4.3.1 Current Conditions 168
3.3.4.3.2 Potential Impacts 168
3.3.4.3.3 Significance of Impacts 168
3.3.4.4 Hunting and Trapping 169
3.3.4.4.1 Current Conditions 169
3.3.4.4.2 Potential Impacts 170
3.3.4.4.3 Significance of Impacts 170
3.3.4.5 Fishing 170
3.3.4.5.1 Current Conditions 170
3.3.4.5.2 Potential Impacts 171
3.3.4.5.3 Significance of Impacts 171
3.3.4.6 Wild plant harvesting 171
3.3.4.6.1 Current Conditions 171
3.3.4.6.2 Potential Impacts 172
3.3.4.6.3 Significance of Impacts 172
3.3.5 Taxes 172
3.3.5.1 Current Conditions 172
3.3.5.2 Potential Impacts 172
3.3.5.3 Significance of Impacts 172
3.4 Transportation 173
3.4.1 Roads and Truck Traffic 173
3.4.1.1 GSD Production Area 173
3.4.1.1.1 Current Conditions 173
3.4.1.1.2 Potential Impacts 173
3.4.1.1.3 Significance of Impacts 174
3.4.1.2 Agricultural Crop Fields 174
3.4.1.2.1 Current Conditions 174
3.4.1.2.2 Potential Impacts 175
3.4.1.2.3 Significance of Impacts 175
3.4.2 Railroads 175
3.4.3 Airports 175

3.5 Utilities 175
3.5.1 Public Utilities 175
3.5.1.1 Current Conditions 175
3.5.1.2 Potential Impacts 176
3.5.1.3 Significance of Impacts 176
3.5.2 Town Utilities 176
3.5.2.1 Current Conditions 176
3.5.2.1.1 Water and Septic 176
3.5.2.1.2 Solid Waste Disposal and Recycling Facilities 177
3.5.2.1.3 Telecommunications 177
3.5.2.1.4 Power Plants and Transmission Lines 177
3.5.2.1.5 Cemeteries 177
3.5.2.2 Potential Impacts 177
3.5.2.2.1 Water 177
3.5.2.2.2 Solid Waste Disposal and Recycling Facilities 177
3.5.2.2.3 Telecommunications 177
3.5.2.2.4 Power Plants and Transmission Lines 177
3.5.2.2.5 Cemeteries 178
3.5.2.3 Significance of Impacts 178
3.5.2.3.1 Water 178
3.5.2.3.2 Solid Waste Disposal and Recycling Facilities 178
3.5.2.3.3 Telecommunications 178
3.5.2.3.4 Power Plants and Transmission Lines 178
3.5.2.3.5 Cemeteries 178
3.6 Historic and Archaeological Resources 178
3.6.1 Existing Conditions 179
3.6.2 Potential Impacts 179
3.6.3 Significance of Impacts 179
3.7 Aesthetics 179
3.7.1 Existing Conditions 179
3.7.1.1 GSD Production Area 179

3.7.1.1.1 Visual 179
3.7.1.1.2 Noise 179
3.7.1.1.3 Lighting 179
3.7.1.1.4 Odor 180
3.7.1.2 Agricultural Crop Fields 180
3.7.1.2.1 Visual 180
3.7.1.2.2 Noise 180
3.7.1.2.3 Lighting 180
3.7.1.2.4 Odor 180
3.7.2 Potential Impacts 180
3.7.2.1 GSD Production Area 180
3.7.2.1.1 Visual 180
3.7.2.1.2 Noise 180
3.7.2.1.3 Lighting 181
3.7.2.1.4 Odor 181
3.7.2.2 Agricultural Fields 181
3.7.2.2.1 Visual 181
3.7.2.2.2 Noise 181
3.7.2.2.3 Lighting 181
3.7.2.2.4 Odor 182
3.7.3 Significance of Impacts 182
3.7.3.1 GSD Production Area 182
3.7.3.1.1 Visual 182
3.7.3.1.2 Noise 182
3.7.3.1.3 Lighting 182
3.7.3.1.4 Odor 182
3.7.3.2 Agricultural Fields 182
3.7.3.2.1 Visual 182
3.7.3.2.2 Noise 182
3.7.3.2.3 Lighting 183
3.7.3.2.4 Odor 183

3.8 Lifestyle 183
3.8.1 Rural 183
3.8.1.1 Current Conditions 183
3.8.1.2 Potential Impacts 183
3.8.1.3 Significance of Impacts 183
3.8.2 Urban / suburban 183
3.8.2.1 Current Conditions 183
3.8.2.2 Potential Impacts 184
3.8.2.3 Significance of Impacts 184
4 ALTERNATIVES 185
4.1 Project Alternatives 185
4.1.1 Option I – No Action 185
4.1.2 Option II – Utilize Four Small Dairies 185
4.1.3 Option III – Location West of Proposed Location 186
4.1.4 Option IV – Location SW Quarter of Section 34 186
5 REFERENCES 187

Figures

Tables

Appendices

List of Figures

Figure 1-1 Regional Location Map for Golden Sands Dairy
Figure 1-2 Aerial Photograph of Project Area and Locations of Proposed High Capacity Wells
Figure 1-2a Aerial Photograph of Existing Fields
Figure 1-3 Map of GSD Production Area Reviewable Facilities
Figure 1-4 Topographic Map of Project Area
Figure 1-5 Soil Types in Project Area
Figure 1-6 Soil Borings at GSD Production Area and Depth to Water

Figure 1-7 Proposed Undisturbed Buffer Areas
Figure 1-8 Watersheds and Surface Water Features near the Project Area
Figure 1-9 Depth to Groundwater in Project Area
Figure 1-10 Groundwater Monitoring Plan – GSD Project Area
Figure 1-11 Groundwater Monitoring Plan – GSD Production Area

Figure 2-1 Geologic Map of Project Area
Figure 2-2 Schematic Geologic Cross Section
Figure 2-3 Schematic Block Diagram of Water Budget in Project Area
Figure 2-4 Groundwater Levels in the Sand and Gravel Aquifer (1970 to 1979)
Figure 2-5 Location of Nearby Residences (Wells)
Figure 2-6 Depth of Wells within One Half Mile of Irrigated Areas
Figure 2-7 Saturated Thickness for Wells within One Half Mile of Irrigated Areas
Figure 2-8 Schematic of Drive Point Well Construction
Figure 2-9 Location of Nearby Municipal Wells
Figure 2-10 High Capacity Well Locations near the GSD and Pump Rates
Figure 2-11 Average Monthly Baseflow of Tenmile Creek
Figure 2-12 October 2012 Flow Measurements along Sevenmile Creek
Figure 2-13 Water Resources Map
Figure 2-14 Wetlands near the Project Area
Figure 2-15 Model Domain and Boundary Conditions and Stream Gaging Locations
Figure 2-16 Location of High Capacity Wells in Model Area
Figure 2-17 Base of the Sand and Gravel Aquifer
Figure 2-18 Base of the Sandstone Aquifer
Figure 2-19 Calibrated Hydraulic Conductivity of Sand and Gravel Aquifer
Figure 2-20 Calculated Water Levels in Model Area
Figure 2-21 Observed versus Calculated Water Levels
Figure 2-22 Comparison of Calculated and Measured Streamflows in Tenmile Creek
Figure 2-23 Calculated Flows in Tenmile and Sevenmile Creek with and without Project
Figure 2-24 Cross-Section Profiles of Sevenmile Creek and Tenmile Creek
Figure 2-25 Calculated Drawdowns in July in Dry Year

Figure 2-26 Nitrate Concentrations in Groundwater near the GSD
Figure 2-27 Known Contaminant Sites near the Project Area from BRRTS
Figure 2-28 Nitrate Concentrations in Tenmile Creek at Rangeline Road
Figure 2-29 Total Phosphorus Concentrations in Tenmile Creek at Rangeline Road
Figure 2-30 Stream Sample Locations along Tenmile and Sevenmile Creeks
Figure 2-31 Groundwater Contamination Susceptibility Map
Figure 2-32 Ecological Landscapes of Wisconsin
Figure 2-33 Age of Forest Cover in Project Area
Figure 2-34 Brown Trout Survey Results, Tenmile Creek, Gasline to Rangeline Road
Figure 2-35 Brown Trout Survey Results, Tenmile Creek, Wisconsin River to CTH Z
Figure 2-36 Source Location Plan
Figure 2-37 Property Boundary and Receptor Grid
Figure 2-38 Land Application Parcels

Figure 3-1 Cranberry Operations near the GSD
Figure 3-2 Trout Stream Designations
Figure 3-3 Archeological and Architectural Sites Inventory near the GSD
Figure 3-4 Nearby Archaeological Areas Documented in the Bibliography of Archaeologic Reports

List of Tables

Table 2-1 Streamflow Data for Sevenmile and Tenmile Creeks
Table 2-2 Proposed and Existing High Capacity Wells
Table 2-3 Average Annual Stream Base Flows and Calculated Changes in Average Base Flow Due to Pumping
Table 2-4 Summary of Summer and Annual Stream Flow Declines (%)
Table 2-5 Changes in Stream Characteristics in August – Normal Year
Table 2-6 Calculated Average Annual Stream Flows with Estimated Future Irrigation Pumping
Table 2-7 Groundwater Quality Summary Town of Saratoga – November 2013

Table 2-8 Sites with Potential or Confirmed Soil and/or Groundwater Contamination
Table 2-9 Stream Chemistry Sevenmile and Tenmile Creeks
Table 2-10 Estimated VOC Emission Factors
Table 2-11 Summary of Manure Parameters
Table 2-12 Traditional Manure Application Equation Parameters
Table 2-13 Center Pivot Manure Irrigation Manure Application Equation Parameters
Table 2-14 Potential Air Emission Source Summary
Table 2-15 Potential Ammonia Emission Summary from Landspreading of Manure

Table 3-1 Hospitals and Clinics Near the GSD Project Area
Table 3-2 Schools Near the GSD Project Area
Table 3-3 Projected and Actual Traffic Counts

List of Appendices

Appendix A Nutrient Management Plan
Appendix B Groundwater Monitoring Plan
Appendix C Wetland Delineation Report
Appendix D Groundwater Flow Model Report
Appendix E Analysis of Nitrogen Use Efficiency
Appendix F Traffic Engineering Services Report

List of Acronyms

BMP - Best Management Practice

BRRTS – Bureau of Remediation and Redevelopment Tracking System

CAFO - Concentrated Animal Feeding Operation

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CEM – Conservation Efficiency Measure

CFS - Cubic Feet per Second

CSD – Central Sands Dairy

CTH – County Trunk Highway

DATCP – Wisconsin Department of Agriculture, Trade & Consumer Protection

DMU – Deer Management Unit

EIR – Environmental Impact Report

EIS - Environmental Impact Statement

EPCRA – Emergency Planning and Community Right-to-Know Act

ES – Enforcement Standard

FWS – U. S. Fish and Wildlife Service

GHG – Greenhouse gas

GIS – Geographic Information System

GSD - Golden Sands Dairy

GSD Project – Golden Sands Dairy Project, which includes both the GSD Production Area and the GSD Agricultural Crop Fields

HAP – Hazardous Air Pollutant

HCP - Habitat Conservation Plan

HPR – High Potential Range

KWH – Kilowatt-hour

MCL – Maximum Contaminant Level

MFL - Managed Forest Law

MSL – Mean Sea Level

NAEMS – National Air Emissions Monitoring Study

NMP - Nutrient Management Plan

NPDES - National Pollutant Discharge Elimination System

PAL – Preventive Action Limit

PM – Particulate Matter

PSD - Prevention of Significant Deterioration

RAP – Resource Aid Payment

SBP - Stream Bank Protection

SNA - State Natural Area

STH – State Trunk Highway

SWQMA - Surface Water Quality Management Area

TMDL – Total Maximum Daily Load

USEPA – United States Environmental Protection Agency

USFWS – United States Fish and Wildlife Survey

USGS – United States Geological Survey

USDA - United States Department of Agriculture

UW - University of Wisconsin

VOC – Volatile Organic Compound

WDNR - Wisconsin Department of Natural Resources

WDOT – Wisconsin Department of Transportation

WEPA – Wisconsin Environmental Policy Act

WGNHS – Wisconsin Geologic & Natural History Survey

WHPD – Wisconsin Historic Preservation Database

WPDES - Wisconsin Pollutant Discharge Elimination System

EIR DOCUMENT INTRODUCTION

This environmental impact report (EIR) is for a proposed new operation - Golden Sands Dairy, LLC (GSD), which plans to convert 4,660 acres of existing red pine plantation crops into a dairy and irrigated agricultural crop fields for growing both vegetable and forage crops, and bring 1,800 existing acres of irrigated crop fields into a WDNR-approved nutrient management plan.

This EIR document is divided into four main sections. Section 1, Proposed Project Description, describes the proposed project and is subdivided into different aspects of the proposed project, the production area and the agricultural crop fields, and addresses aspects of the project related to surface and groundwater, stormwater, permits and approvals, roads and traffic, public involvement, purpose and need, products, and cumulative effects.

Section 2 describes the natural environment, potential impacts to the natural environment, and the significance of these impacts. Topics discussed include geology, soils and topography, water resources (including water quantity and water quality), flora, fauna, and air quality. Where appropriate, these discussions are organized into impacts relating to the dairy operation (the Production Area) versus those relating to the irrigated agricultural crops (the GSD Agricultural Crop Fields). Unless noted otherwise, the analyses in this document focus on those GSD Agricultural Crop Fields proposed for conversion from pine plantation to vegetable production and dairy forages. There are no agency actions associated with the *existing* 1,800 acres of irrigated crop fields already in agricultural production, which will be brought into the project as part of the GSD nutrient management plan. With respect to existing irrigated crop fields, there is no planned change in land use, ownership or management practices, other than the incorporation of dairy manure application to build soil health. Additionally, there are no new wells planned for these existing acres. As such, no adverse impacts are expected from continuing to farm these existing acres and indeed only improvements are expected as a result of incorporation of these acres into an approved nutrient management plan.[1] The impacts from continuing production on these fields is accounted for in the existing conditions described in this EIR.

Section 3 describes the socioeconomic conditions near the proposed project and describes and assesses potential impacts. Characteristics of the project area including education and emergency services, population, land use, and economy, transportation, utilities, historic and archaeological resources, aesthetics, and lifestyle are discussed.

Alternatives to the proposed project are discussed in Section 4, including a no-action alternative. References are provided in Section 5.

[1] The existing irrigated crop fields are owned by Ellis Industries, Inc. and operated by the Wysocki Produce Farm. Wysocki Produce Farm has an ownership interest in Ellis Industries. These acres will continue to be owned and operated by these entities, the only change in operation of these acres is that GSD will be permitted, by written agreement, to apply manure to these acres to displace to some extent the use of chemical fertilizer.

1 PROPOSED PROJECT DESCRIPTION

The operation described in this EIR is the Golden Sands Dairy (GSD) Project, which consists of two basic components: 1) the GSD Production Area that includes the dairy animals, dairy buildings, agricultural facilities and equipment; and 2) the GSD Agricultural Crop Fields. The GSD Agricultural Crop fields include both the irrigated areas where crops will be grown and perimeter buffer zones. The proposed GSD Production Area and the majority of GSD Agricultural Crop Fields are located in the Town of Saratoga, Wood County Wisconsin (**Figure 1-1**), with a total project area of approximately 7,838 acres.

GSD is owned by the Wysocki family. The Wysocki family consists of three generations of farmers and agricultural business owners. Together, the family owns and operates 10 existing agricultural companies in Wisconsin, including: the Wysocki Produce Farm, which produces potatoes, canning vegetables, and forage crops; Paragon Potato Farms, which stores and packages potatoes for multiple growers; RPE, which provides marketing and sales services for fresh and packaged vegetable products across the country, serving a network of independent growers; and the Central Sands Dairy (CSD), which is a dairy farm integrated with agricultural fields in the Central Sands area of Wisconsin that produces milk and supplies nutrients and supplements the sandy soils with organic matter; and several land holding companies. In 2013 the Wysocki family companies employed more than 575 full and part time employees. In the last two years, the Wysocki family companies have added almost 40 new full time jobs and invested more than $5 million in capital improvements at its Wisconsin facilities. The GSD Project will be the eleventh Wisconsin agricultural company owned and operated by the Wysocki family.

Permit applications were submitted to the Wisconsin Department of Natural Resources (WDNR) for the GSD Project in June 2012, including all applications identified in Section 1.3. At that time, the GSD Project consisted of a total of approximately 7,790 acres with approximately 6,400 acres proposed for development from red pine plantation to vegetable and forage crops, and 49 high capacity wells to irrigate those acres. The process of developing this EIR required evaluating potential impacts of the proposed project, including impacts to the environment and the community. As a result of significant analysis and consideration by the Wysocki family through the EIR process, approximately 1,500 acres originally proposed for conversion from pine plantation were eliminated from the project to reduce neighbor concerns and potential wetland and waterway impacts, and another approximately 250 acres were eliminated from the project to avoid impacts to a federally-protected endangered species.

The GSD Project now consists of a total of 7,838 total acres subdivided as follows: approximately 6,460 acres of agricultural crop fields, with 4,660 acres of this area proposed for conversion from pine plantation to irrigated vegetable and forage crops and 1800 acres of existing cropped fields, 1,280 acres of pine plantation to remain in place and serve as perimeter buffer zones; a 98-acre GSD Production Area; and 39 high capacity wells – 37 for irrigation and 2 for the GSD Production Area (**Figure 1-2**). Although the total cropped acres will slightly increase from the original proposed project scope, the number of acres converted from pine plantation for irrigation has been reduced by approximately 27 percent since June 2012 and the number of wells has been reduced by more than 20 percent. The addition of 1800 acres of

existing crop fields is significant because those acres are currently receiving only commercial fertilizer; with the addition of those acres in the NMP, they will receive manure for the first time and thus require compliance with nutrient management requirements in NRCS 590 and Ch. NR 243. This additional acreage was added to ensure more than enough land base will be available to manage the nutrients generated at GSD. The scope of the GSD Project was modified as a result of the EIR process which demonstrates the effectiveness of this process in informing the project developer of potential conflicts and facilitating project redesign to minimize such conflicts.

The GSD Production Area is a 98-acre parcel that will contain building structures and equipment to house 3,400 milk cows, 600 dry cows, 300 heifers and 1000 calves, totaling 6,130 animal units. **Figure 1-3** identifies the proposed production area reviewable facilities. Operations in the GSD Production Area will follow the practices established at Central Sands Dairy, LLC located in Juneau County, Wisconsin. The structures in the GSD Production Area also will be used to store and manage feed inputs and manure/organic fertilizer, to milk cows and will include a farm office.

An aerial photo of the GSD Production Area and the GSD Agricultural Crop Fields proposed for conversion from pine plantation are shown on **Figure 1-2**. Note that the dark green circles on the aerial photo are the part of the fields that will be cultivated for crops (approximately 4,660 acres); the areas outside of these circles (1,280 acres) are not planned to be cultivated and will be left in their current state to provide a buffer zone around the irrigated crop fields. These remaining trees will serve as an aesthetic buffer, will connect forest habitat, and will act as a wind break to minimize soil erosion. Vegetables will be grown on the converted fields to support the Wysocki Produce Farm, Paragon Potato Farms, and RPE, and forage crops will also be grown to provide feed for the cows at the GSD Production Area. An aerial photo of the existing irrigated acreage is shown in **Figure 1-2a**; the existing irrigated acreage is depicted with green shading (approximately 1,800 acres).

The GSD Project includes applications for 37 high capacity wells to be used to irrigate crops and 2 high capacity wells to provide water for the dairy. An existing high capacity well in T21N R6E Section 24 (high capacity well # 38632) will be used to irrigate field P76. The additional pumping that will occur from this existing well to irrigate field P76 is included in the evaluation of the GSD Project. The locations for the proposed wells are shown in **Figure 1-2**. The existing 1,800 acres of crop land contains existing irrigation wells which are not the subject of any WDNR agency action. The impacts from continuing use of these existing wells is accounted for in the existing conditions described in this EIR. This EIR does not include a separate evaluation of the continued use of any existing wells.

The majority of land proposed for the GSD Project was formerly owned by Plum Creek Timber Company (under purchase contract to GSD). The majority of the acreage is "fields" of red pine plantation with equally-spaced trees planted in evenly-spaced rows with specific harvest dates. The declining need for paper in the electronic age has reduced the need for this wood crop. Plum Creek has decided to divest these acres from its holdings and no longer manage the property in pine plantation. Developing the GSD Project will maintain the agricultural productivity of these fields by converting them from pine crop to fields of alfalfa, corn silage, and vegetable crops. Incorporating dairy forage crops and dairy manure into irrigated vegetable agriculture transforms traditional vegetable and forage crop agriculture into a dynamic crop

rotation that is less dependent on inorganic fertilizers and improves the quality of the sandy soils by increasing the content of organic matter in the soil. These benefits are derived from the "Farming Full Circle" concept described below, that has been demonstrated at the CSD, also located in the Central Sands area of Wisconsin.

"Farming Full Circle" is a term coined by the Wysocki family to describe its integrated dairy and animal husbandry practices with traditional vegetable production agriculture. The concept was developed with the purpose of protecting water resources in the agricultural regions of the Central Sands area of Wisconsin. The objective is to apply nutrients to actively growing crops and remove the plants (nitrogen) in the off season (winter) to eliminate nitrogen leaching. From its initial inception, Farming Full Circle has been expanded to utilize an anaerobic digester to kill bacteria and utilize the methane gas to produce all the electricity the dairy needs, and to make available to the local electric grid any excess electricity generated. Adding organic matter from the manure to the soils improves the water and nitrogen holding capacity of the soil; which, in turn, reduces the need for irrigation. This concept, combined with more traditional environmental practices (such as planting winter cover crops to minimize soil erosion, installing vegetative wind breaks, and maintaining buffer strips to prevent run off) comprise the basic elements of a solid environmental stewardship program.

Manure from the GSD Production Area will be land applied as organic fertilizer to the GSD Agricultural Crop Fields. The GSD Project is environmentally-sized to allow for advanced manure handling and nutrient recycling systems. Dairy crop production enhances the sustainable farming methods of vegetable production systems. By applying organic matter to sandy soils, the organic matter content of the soils will increase, and over time this will increase the moisture and nutrient carrying capacity of the soils and reduce the rate of infiltration, ultimately benefitting the local soil and water resources.

The GSD Project includes installation of a manure digester at the GSD Production Area. The digestion process converts dissolved and particulate matter (PM) into gas, which is composed primarily of odorless methane and carbon dioxide (Magbanua *et al.,* 2000). Anaerobic digesters reduce the environmental impact of manure and produce energy as a valuable commodity. The digester, which will aid the dairy in managing manure in an environmentally sound manner, will reduce odor and pathogens from the GSD Production Area, and will generate approximately 11,500 kilowatt-hours (KWHs) of energy per day.

Construction of the GSD Project is estimated to provide 100 new jobs for about six months and 50 jobs for an additional six months. The dairy itself will provide approximately 40 new permanent full time jobs, including veterinarians and assistants, herdsmen, milkers, feed attendants, heavy equipment operators, animal breeders, forage harvesters, transport drivers and office staff. The Wysocki Produce Farm also will require an additional 5-10 people for farm operations and land clearing in support of the GSD Project. When it is fully operational, the GSD Project will have local payroll of $1.5 million and a procurement of $6 million annually; this will increase the local tax base by approximately $11 million on an annual basis.

Much of the GSD Project land, under contract with Plum Creek Timber Company, is currently enrolled in the WDNR Habitat Conservation Plan (HCP) program for the purpose of maintaining and growing the population of the Karner blue butterfly (KBB), an endangered

species. A full description of KBB habitat evaluation and project planning is provided in Section 2.5.1.4.2 of this document.

1.1 Production Area

1.1.1 Site Characteristics

The GSD Production Area is located in the Central Sands Region of Wisconsin approximately five miles southeast of Wisconsin Rapids in Saratoga Township, Wood County. The GSD Production Area will consist of 98 acres of converted red pine plantation and will contain the dairy, farm buildings and reviewable facilities as shown on **Figure 1-3**. The dairy barn and facilities for the GSD Production Area will be located on the west side of State Trunk Highway (STH) 13 where Tower Road intersects STH 13 (shown in yellow as "GSD Production Area" on **Figure 1-1**). This area was selected to minimize land use conflicts, as it is as isolated as possible from existing homes and water resources and it is also in an area that does not support any threatened or endangered species.

The topography of the area is relatively flat as shown on **Figure 1-4**. The soils at the GSD Production Area are classified as Plainfield Sand, with 0 to 2 percent slopes; a soils map is shown on **Figure 1-5**. The GSD Production Area's flat topography and sandy soils are typical of the surrounding Central Sands Area. The GSD Production Area is located within the Tenmile Creek watershed, which drains westward to the Wisconsin River.

A site assessment of the GSD Production Area was performed to determine the site's characteristics that influence the facility design and compliance with technical standards. Thirty-three soil borings were advanced on-site to determine soil type, soil saturation, and depth to water (REA, 2012). The borings depths ranged from 11 feet to 30 feet below the surface. The soil was classified as a poorly graded fine to medium sand throughout the soils profile. Bedrock was not encountered in any of the borings. The depth to water in these borings ranged from 21.5 to 27 feet as shown on **Figure 1-6**.

1.1.2 Buildings and Structures

A map of the proposed GSD Production Area reviewable facilities is shown in **Figure 1-3**. The proposed GSD Production Area will provide housing for 3,400 milk cows, 600 dry cows, 300 heifers and 1,000 calves. The dairy plans to construct two 98' by 1,553' free stall barns, one 113' by 420' dry cow barn, and one 98' by 428' special needs barn to house and care for the cows and heifers. The calves will be housed in calf hutches. A free stall barn provides farm animals with a clean, dry, comfortable resting area and easy access to food and water. Cows that are housed in freestall barns are not restrained and are free to enter, lie down and move about the barn whenever they choose.

The dairy plans to construct two high capacity wells to supply drinking and processing water for the cows and dairy operations. A 650' x 650' concrete pad will be constructed for silage storage and a 120' x 650' asphalt pad will be constructed to store dry hay. A 260' x 100' commodity building will be constructed to store feed supplements, and a scale station will be constructed to weigh feed (REA, 2014).

A 92’ x 370’milking parlor and holding area will be built adjacent to the free stall barns. Cows will be brought to the holding area until they can be milked and returned to the free stall barns after milking. The parlor will have load outs for semi tankers to be filled with milk for delivery to processing facilities.

The barns will be bedded with sand. Manure from the barns will be removed using vacuum tankers. The tankers will haul the manure to the 90’ x 176’ manure processing building (Separation Building in **Figure 1-3**). Here sand will be separated from the liquid manure using mechanical separators. The manure will then be transferred to the digester. After digestion the manure will be transferred back to the processing building and manure solids will be separated from the liquid manure using mechanical separators. Manure solids and the separated sand will be stacked on the 300’ x 400’ concrete separated solids and sand stacking pad. The manure solids will be stored here until land spreading while the separated sand will be stored for reuse or land spreading. Clean and/or recycled sand will be stockpiled on two 40’ by 50’ concrete stacking pads between each end of the freestall barns for use as bedding in the barns. Manure and parlor wastewater from the parlor and holding area will be collected in a 25’ by 25’concrete tank and pumped to the separation building. At the end of each barn will be a concrete channel and tank to collect water from misters that cool the cows during the summer. These tanks will also be pumped to the separation building.

All runoff from the feed storage pad will be collected in a runoff collection basin and pumped to the waste storage facility. Runoff from the separated sand and solids pads will be collected on the pad and pumped to the waste storage facility.

After sand and solids have been removed in the processing building the liquid manure will be pumped to a 6,600,000 gallon concrete waste storage facility. Manure will gravity flow to a second 6,600,000 gallon concrete waste storage facility. Manure from the second storage will be pumped to a 26,900,000 gallon concrete waste storage facility. Manure from the three waste storages will be land applied pursuant to a WDNR-approved nutrient management plan (NMP).

Construction of the GSD Production Area is designed to occur in two phases:

Phase I – Construction of the dairy farm GSD Production Area buildings and WDNR-approved reviewable facilities will begin in the summer of 2015 with completion in 2016. The buildings and reviewable facilities are listed above. The GSD Production Area is expected to be fully populated with animals within 90 days after the completion of construction. Corn silage harvest will begin around the last week of August 2015 and the cement for the silage pad will be poured and be cured prior to harvest.

Phase II – The methane digester and solids separation facility will be the second phase of construction. The methane will be used for electrical generation on-site. Waste heat produced by the electrical generators will be recovered and used in the facility in a highly efficient process called cogeneration (or combined heat and power). The dairy will sell excess power back to the electrical grid. The electricity produced from the digester methane qualifies as a renewable resource for utilities required by law to generate a portion of their energy from renewable resources and through voluntary programs for customers in Wisconsin and other states. The timetable for construction of Phase II will depend on when Phase I construction is completed. The digester will be installed after the buildings and reviewable facilities are completed to ensure that the digester is efficiently sized and fully integrated to the manure handling, electrical and

building heating infrastructure. The digester is planned to be operational at the time the facility is populated with animals.

1.1.3 Materials Storage and Management

1.1.3.1 Feed

The primary feed for the milking and dry cows will be corn silage, high moisture corn, hay and haylage (silage from alfalfa) grown at the GSD Agricultural Crop Fields. Other feed will include baled hay, distiller grains, cotton seed, and processed feed from feed mills. Feed will be shipped to the GSD Production Area from the GSD Agricultural Crop Fields using hired vehicles or will be commercially hauled. The cows housed at the GSD Production Area will be fed a ration of feed that will be mixed in the commodity building before being fed to the cows.

Feed will be stored on the silage feed pad as shown on **Figure 1-3**. The feed pad is concrete and designed to be water tight to prevent leachate and runoff from coming into contact with subsurface soils. The feed storage pad will have a collection basin and transfer system to direct leachate and runoff to the waste storage facility. The collection system is designed to collect leachate and runoff from the feed pad, and retain up to a hundred year rainfall (5.8 inches) in the collection basin and feed pad, and convey it to the waste storage facility. All feed storage facilities are designed and will be constructed to meet or exceed all applicable NRCS technical standards. All facilities will be operated in accordance with an operation and maintenance plan that includes appropriate inspection intervals. In addition, the collection basin and feed pad areas are covered by the facility's groundwater monitoring program described in Section 1.1.6.1.

1.1.3.2 Manure

1.1.3.2.1 Manure Generation

The estimated quantity of manure and process wastewater to be produced by the animals on the farm is approximately 54.9 million gallons of liquid manure and approximately 24,820 tons of separated manure solids per year. These figures include wastewater from the parlor, silage leachate and collected runoff. The manure will contain approximately 1,050,000 lbs. of nitrogen, 269,000 lbs. of phosphorus (as P_2O_5) and 751,000 lbs. of potassium (as K_2O).

1.1.3.2.2 Storage

The locations of the waste storage facilities are shown on **Figure 1-3**. All of the waste storage facilities are designed with water tight concrete liners with a secondary 8" clay liner to prevent waste from coming into contact with subsurface soils. The designs for all of the waste storage facilities meet or exceed the requirements of Wis. Admin. Code § NR 243.15, and the groundwater separation distances for the waste storage facilities meet or exceed the requirements contained in NRCS Practice Standard, Code 313 Waste Storage Facility. All facilities will be operated in accordance with an operation and maintenance plan that includes appropriate inspection intervals. In addition, the collection basin and feed pad areas are covered by the facility's groundwater monitoring program described in Section 1.1.6.1.

Manure generated at the GSD Production Area will be collected, processed and stored in various structures shown on **Figure 1-3**. Manure generated in the barns will be collected by

vacuum tankers and transferred to a tank in the separation building. Each barn has a soaker water collection trench at the lower end of the structure, which collects liquid material, including cow cooling water and manure from the alleys in the cow bedding area. The collection trenches drain to a tank where liquids are pumped to the separation building.

Manure will be processed in the separation building by mechanical separators to remove the sand bedding. The separated sand will be stock piled on the separated solids pad for reuse as bedding. Once the sand is removed from the manure, the manure will be pumped to the digester, where it will be held for approximately 22 to 30 days. The naturally-occurring bacteria in the digester consume organic solids in the manure and biologically transform the nutrients in the manure into forms that increase the efficiency of crop uptake of nutrients.

From the digester, digested manure will be pumped back to the separation building where manure solids will be mechanically separated and stacked on the separated solids pad, piled separately from the separated sand. Separated manure solids will be land applied in accordance with the WDNR-approved NMP; separated sand will be reused as bedding for the cows. The digested liquid manure that remains after the solids are separated will be pumped to the manure storage basin. The separated solids pad is concrete and designed to be water tight to prevent runoff from coming into contact with subsurface soils. The separated solids pad will collect and direct runoff to the separation building. Runoff will be pumped from the separation building to the waste storage facility. The collection system is designed to collect runoff from the separated solids pad up to a hundred year rainfall (5.8 inches) on the separated solids pad.

1.1.3.2.3 Digester

The digester will be installed in the location identified on **Figure 1-3** and will be fully integrated into the manure handling and processing facilities.

The specific make and model of the digester system will be determined at a later date to ensure that the digester is efficiently sized and fully integrated to the manure handling, electrical and building heating infrastructure. Manure digesters are not a new technology, but the long list of environmental benefits of anaerobic digestion for agricultural systems have become increasingly recognized and the use of this process is expanding at farms, cheese making facilities and wastewater treatment systems across the country. According to the U.S. Environmental Protection Agency, manure digesters offer the following environmental benefits to livestock facilities (http://www.epa.gov/agstar/anaerobic/faq.html):

> "*Anaerobic digestion technologies provide air and water quality benefits including pathogen destruction, odor control, organic stability, greenhouse gas (methane) and hydrogen sulfide emissions reductions, and some nutrient management benefits. They also offset the environmental impacts of fossil fuel generation and provide rural electrical benefits, such as green power, distributed generation, and voltage support*."

Wisconsin has been recognized as a leader in anaerobic digestion and numerous state, federal and non-governmental organizations such as the environmental group Clean Wisconsin have been working to identify more opportunities to use anaerobic digesters in agriculture. Clean Wisconsin, one of Wisconsin's largest non-profit environmental organizations, , has produced a number of factsheets about the current environmental benefits of anaerobic digesters and the

potential for increased use of this technology (http://www.cleanwisconsin.org/index.php?module=cms&page=756). In addition to the environmental benefits of anaerobic digestion, Wisconsin is also home to many companies leading the country in the engineering, manufacture and construction of anaerobic digester systems. The Wisconsin Legislative Council held an informational symposium on anaerobic digesters on February 15th, 2012 that described many of the new and expanding opportunities for waste management and renewable energy production from the biogas produced in anaerobic digesters along with a snapshot of 40 businesses in Wisconsin that are expanding employment and economic opportunities within this fast growing technology sector (http://legis.wisconsin.gov/lc/seminars/index.html).

1.1.3.2.4 Distribution

Liquid and solid manure will be land applied in accordance with the NMP, in accordance with Wis. Admin. Code Ch. NR 243 and the Natural Resources Conservation Service (NCRS) Code 590[2] conservation practice standards for nutrient management. These standards and practices are more fully described in Section 1.2.1.4. Manure from the GSD Production Area will be applied to the GSD Agricultural Crop Fields; there are no plans to apply GSD manure to agricultural uses outside of the GSD Project. The NMP for the GSD Project is included as **Appendix A** to this document.

1.1.3.3 Bedding

At the GSD Production Area, animals will be bedded with sand. The sand will come from on-site borrow material excavated during construction of water retention basins and building construction and from leveling fields in preparation for vegetable and forage crop cultivation. Sand will be added to beds several times per week and will be removed with manure during barn cleaning. Most of the sand bedding will be recycled through the manure separation process and re-used. Any unusable sand will be applied to fields in accordance with the WDNR-approved NMP. Because sand will likely be sourced on-site, there will be no truck deliveries and no new impacts to local roads due to sand delivery. Used sand will be stored on-site at the separated solids pad prior to re-use and will be stockpiled with new sand near the entrance of each barn. Sand bedding is widely considered the best material for ensuring cow comfort and will be used in all animal housing at the GSD Production Area.

1.1.4 Roads and Traffic

Roadways to be constructed within the GSD Production Area include asphalt areas around the free stall entrances, the main driveway on the south side, and around the pads and manure processing area. The driveway to the GSD Production Area will be located on STH 13, and the service road on the north side of the GSD Production Area will be gravel.

During construction of the GSD Production Area, traffic will increase due to the delivery of building materials and the daily arrival and departure of construction workers to the site. Once

[2] http://efotg.sc.egov.usda.gov/references/public/WI/590.pdf

construction is completed and the dairy is populated with animals, normal operations at the GSD Production Area will be conducted around the clock. On an average day there will be approximately 5 truckloads of milk leaving the GSD Production Area, 15 to 20 feed loads and an additional 5-10 varied deliveries. The estimate for the average daily traffic would be 60 vehicles made up of 35 cars and 25 semi-trucks.

Traffic in and out of the GSD Production Area will be heaviest in the spring, as the operation applies most of its manure prior to planting of crops, and during crop harvest. Solid manure will be hauled by semi- truck periodically throughout the year. Solid and liquid manure hauling may consist of 3 loads per hour along routes varying by field location. The majority of liquid manure applications will be completed using drag hoses which will be conducted across fields and will not create any additional road traffic.

1.1.5 Lighting

GSD Production Area lighting will be primarily inside buildings with minimal building entrance exterior lighting. Where appropriate, modern energy efficient designs will be incorporated into the lighting. Interior lighting at the facility will be on 24 hours a day. Where occupancy is infrequent, lighting will have dimmer and occupancy sensors. Minimal exterior lighting will be installed to provide for safe operation during non-daylight times. Exterior lighting will be designed to not emit upward.

1.1.6 Monitoring

1.1.6.1 Groundwater Monitoring

A comprehensive groundwater level and water-quality monitoring plan has been developed for the GSD Project that includes monitoring of both the GSD Production Area and the GSD Agricultural Crop Fields. This monitoring plan is described in Section 1.2.6 and is included as **Appendix B**. Groundwater use will be monitored and recorded monthly and submitted to WDNR annually, as required pursuant to Wis. Admin. Code Ch. NR 820.

1.1.6.2 Operation and Maintenance

An Operations and Maintenance plan will detail the monitoring and inspection frequency for the GSD Production Area structures and the respective collection and transfer systems in accordance with Wis. Admin. Code Ch. NR 243 and any Wisconsin Pollutant Discharge Elimination System (WPDES) permit conditions.

1.1.7 Stormwater

Stormwater discharges from the GSD Production Area construction site are regulated pursuant to Wis. Stat. Ch. 283, Wis. Admin. Code Ch. NR 216, and in accordance with WPDES General Permit No. WI-S067831-3, Construction Site Stormwater Runoff (Stormwater General Permit).

Once construction begins, the GSD Production Area site will be an active construction site that must be operated, inspected, and maintained in accordance with Stormwater General Permit requirements until construction is completed and permit coverage is terminated. A proper Notice

of Intent has been submitted to the WDNR for the GSD Production Area construction and appropriate best management practices (BMPs) will be used to control erosion during construction. Stormwater during construction will be directed to constructed depressions and adjacent cropland where the stormwater will infiltrate.

Pursuant to the WPDES Stormwater General Permit, conformance with a WDNR-approved site-specific erosion control plan is required. Erosion and sediment-control BMPs and treatment devices must be installed and operated as indicated by the erosion control plan and stormwater management plan. The following erosion and stabilization practices will be applied, as appropriate, on the construction site: mulching, seeding, and stone tracking pad. All applicable WDNR Technical Standards will be adhered to, including Mulching for Construction Sites (1058), Seeding (1059), and Stone Tracking Pad (1057).

Weekly inspections of installed erosion and sediment controls are required during construction. Inspections of erosion and sediment controls within 24 hours after a rainfall event of 0.5 inches or larger are also required. Repair or replacement of erosion and sediment control BMPs is required, as necessary, within 24 hours of an inspection or notification indicating that repair or replacement is needed. Inspection records will be retained on site.

Once construction is complete, the disturbed areas will be vegetated and stabilized with grass cover. The completed facility is designed such that clean stormwater will be collected, directed to depressions to infiltrate, or directed to farmland adjacent to the GSD Production Area to infiltrate. Clean runoff from the roof and access drives will be directed to depressions or adjacent cropland to infiltrate. Due to the sandy soils in this area runoff potential is low. Stormwater that comes into contact with manure, feed materials, or feed pads and the separated solids pad will be collected and pumped to the manure storage.

1.1.8 Domestic Wastewater

A private on-site domestic sewage system is designed to serve the approximately 40 employees of GSD Project. A Wood County sanitary permit has been issued for a non-pressurized in ground septic system. Potable water will be drawn from the high capacity wells at the GSD Production Area and will be subject to the requirements of the Safe Water Drinking Act, codified in Wisconsin at Wis. Adm. Code Chs. NR 809-812. See Section 1.1.10.

1.1.9 Solid and Hazardous Waste

The only chemicals stored on site are associated with the business of dairy farming, including sanitary and veterinary supplies, inoculants to aid in feed fermentation and fuel tanks for on-site equipment use. These chemicals are not considered solid or hazardous wastes.

No solid waste will be generated or stored on site, with the exception of solid waste generated in the ordinary course of business at the GSD Production Area. This solid waste will be collected by a commercial solid waste hauler and disposed of at a licensed landfill. No hazardous waste will be generated or stored on site.

1.1.10 High Capacity Wells

The proposed GSD Production Area will require two high capacity wells to supply an estimated 72.5 million gallons of water per year. Proposed well locations are shown on **Figure**

1-2. One of the two wells will be designed with a capacity of 504,000 gallons per day (350 gpm), the other well will be designed with a capacity of 360,000 gallons per day (250 gpm). The larger capacity well will be the primary well serving the GSD Production Area and will be located about one-half mile south of the GSD Production Area. The smaller capacity well will be a backup well for use only when the primary well is not functioning and for testing purposes to ensure the well remains in good operating condition.

The two dairy production wells will be considered "non-community, non-transient wells" and will be subject to the water testing requirements of NR 809. Both wells will be constructed in the sand and gravel aquifer and in accordance with NR 812 construction standards. Prior to operation, the wells will be tested for bacteria. WDNR recommends testing annually for bacteria and nitrate and additional sampling whenever there is a change in the taste or smell of the drinking water. The proposed high capacity wells to serve as irrigation wells for the Agricultural Crop Fields are discussed in Section 1.2.3.

1.1.11 Energy Production and Use

The GSD Production Area is designed and proposed to be operated in a similar manner to the way in which the CSD was designed and is currently operated. At CSD, a daily average of about 11,500 kilowatt–hours of renewable energy is produced by the manure digester; it is expected the GSD energy production will be similar to or greater than the amount generated at CSD. The CSD energy consumption is less than the amount of energy produced, and about one third of the energy produced is sold back to the utility. Thus, CSD is a net producer of renewable energy and provides numerous benefits to the local rural electrical system. Surplus renewable energy generated at the GSD Production Area also will be sold back to the utility.

Electrical service in the GSD area is provided by Adams Columbia COOP and Alliant Energy, both of which are members of Wisconsin's Focus on Energy, Wisconsin utilities' statewide energy efficiency and renewable resource program that has operated since 2001 to install cost-effective energy efficiency and renewable energy projects. Focus on Energy has an active program specifically targeting renewable energy produced from the biogas generated at anaerobic digesters, which is described at http://www.focusonenergy.com/learning-center/technology/biogas.

1.1.12 Animal Husbandry

1.1.12.1 Animals

When fully populated, the GSD Production Area will house 3,400 milking cows, 600 dry cows, 300 heifers and 1,000 calves. These numbers will fluctuate from time to time, but should always be within approximately 15-20 percent of these numbers.

1.1.12.2 Housing and Handling

The mature animals will be housed in four barns while the calves will be housed in calf hutches. The majority of mature animals will be housed in two freestall barns. Dry cows will be housed in a separate, smaller barn, and animals in need of veterinary care or special attention will be housed in the special needs barn. Site buildings are shown on **Figure 1-3**. A free stall barn provides farm animals with a clean, dry, comfortable resting area and easy access to food and

water. Cows that are housed in freestall barns are not restrained and are free to enter, lie down and move about the barn whenever they choose. As reflected by its facility designs and longtime management at CSD, cow comfort will be a very high priority at GSD.

1.1.12.3 Feed, Supplements and Antibiotics

The cows at the GSD Production Area will be fed a mix of feed and protein additives to facilitate optimal milk production. Animals that are sick will be treated as needed, including the use of antibiotics, all under the care or direction of a licensed veterinarian. Although heavy metals such as arsenic, copper and zinc are sometimes provided to poultry and swine to increase growth rate, that practice is not done in the dairy industry and will not be done at the GSD.

1.1.12.4 Mortality Management

Animal mortalities due to injury or other causes (mortality rate is generally highest for newborn animals) will be disposed of through a mortality disposal company, which will remove all mortalities within 24 hours of death. There will be no rendering, composting, burning or incineration of trash, refuse of mortalities at the GSD Production Area. All mortalities will be stored out of public view.

In the unlikely event of a catastrophic number of mortalities, the GSD Project will contact the State Veterinarian and the following professionals to assist with proper management and disposal:

- Granite Stock Removal, W4391 Cumberland Rd, Redgranite, WI, 54970 (phone 920-566-2563)
- O.J. Krull & Sons, W5188 Rock Road, Black Creek, WI 54106 (phone 800-637-6310)

1.2 Agricultural Crop Fields

Currently, the land use in the GSD Project Area[3] is almost entirely red pine plantation crop fields. Plum Creek, the prior owner of the majority of the GSD Project Area, has decided to divest these acres from its holdings and no longer maintain the property in pine plantation. The GSD Project involves the conversion of 4,660 acres of these lands to irrigated fields to be used for growing vegetable and feed crops. Approximately 1,280 acres of existing red pine plantation crop will be retained as buffer zones between and around the converted GSD Agricultural Crop Fields (**Figure 1-7**). These areas will remain undisturbed and provide a buffer area around the agricultural crop fields. An additional 1,800 acres of existing irrigated crop land will be included in the NMP, will receive manure for the first time, and will be managed in accordance with NRCS 590 and Wis. Admin. Code Ch. NR 243. The converted and existing irrigated fields and the buffer zone comprise the GSD Agricultural Crop Fields.

[3] Throughout this report the term GSD Project Area is used to reference the acreage in the Town of Saratoga proposed for conversion from pine plantation, and does not include the existing 1,800 acres of irrigated fields included in GSD's nutrient management plan.

1.2.1 Manure Spreading Sites

1.2.1.1 Locations and Descriptions

Manure will be applied to the approximately 6,460 acres of irrigated fields in the GSD Project shown on **Figure 1-2** and **Figure 1-2a**. The fields are located in the watersheds of Sevenmile, Tenmile and Fourteenmile Creeks, all of which are tributaries of the Wisconsin River, as shown on **Figure 1-8.** The estimated depth to groundwater beneath the majority of fields ranges from 7 feet to 48 feet below ground surface (**Figure 1-9**). The majority of fields in the western and southern portions of the GSD Project Area are estimated to have depth to groundwater greater than 20 feet below ground surface. Generally, the fields in the northern and eastern portions of the project area are estimated to have depth to groundwater less than 20 feet below ground surface. Some areas of the 1,800 acres of existing crop land contain "w" soils and areas identified as wetlands or waterways. Several of the NRCS maps for these 1,800 irrigated acres incorrectly identify surface waters. NRCS is aware of these inaccuracies and GSD will work with the agency to field verify and update the NRCS maps and the GSD restriction maps accordingly. There are no drain tiles on these acres. Because these acres will now be managed in accordance with a WDNR approved NMP, GSD will comply with the WDNR guidance on "w" soils and no manure will be applied to areas of fields with depth to groundwater less than 24 inches from the surface. In addition, waterway areas will be identified as Surface Water Quality Management Areas (SWQMAs) and will be managed with manure application setbacks in accordance with Wis. Admin. Ch. NR 243. Any wetland areas within the 1,800 acres of existing irrigated crop land are prior converted wetlands, as determined by the Farm Service Agency. Before manure applications occur on the existing irrigated crop land, all water resources and drainage features will be identified and restriction maps will be updated accordingly. The estimated depth to bedrock beneath the GSD Agricultural Crop Fields ranges from about 110 feet to 200 feet.

1.2.1.2 Timber Harvest and Managed Forest Land Conversion

The timber crop currently growing on 4,660 acres of the GSD Agricultural Fields will be harvested by Plum Creek Timber Company. All harvesting activity will occur according to the practices historically employed by Plum Creek Timber Company and in compliance with industry guidelines. Slash and stump removal will be done via bulldozer-pulled custom built root picking machines. Wood material will be chipped and sold for biomass fuel.

Conversion of managed forest land to agricultural land use is anticipated to begin shortly after permits are issued for the GSD Project. Conversion activities will occur in phases and the entire 4,660 acres are expected to be converted over a three to five year period.

1.2.1.3 Crops

On any given year, the fields in the GSD Agricultural Crop Fields to be converted from pine plantation may be planted as follows:

- 35 percent of fields planted in alfalfa
- 12 percent in alfalfa that will cut in spring and then planted in sweet corn
- 20 percent of fields planted in potato

- 5 percent in grain corn
- 18 percent of fields planted in corn for silage
- 10 percent of fields planted in peas/beans -- double crop

This crop rotation, which differs from that originally proposed for the acres converted from pine plantation, was developed to minimize the potential for leaching of nutrients to groundwater. The crop rotation was selected to maximize to the extent technically and economically feasible nitrogen use efficiency, which is the ratio of nitrogen in the harvest crop to the applied nitrogen. Nitrogen use efficiency is a critical factor in minimizing the potential for leaching, as a higher use efficiency leaves less nitrogen remaining to potentially leach. This crop rotation consists of 51 percent legume crops which require much less applied nutrients than other agricultural crops because some of their nitrogen requirements are met by atmospheric fixation. The rotation also consists of 18 percent corn silage which reduces nutrient leaching potential because almost all of the above ground plant matter is removed at harvest. This crop rotation was developed exclusively for GSD's use at the converted acres and is not reflective of technically or economically feasible crop rotations for any other acreage or dairy farm in Wisconsin. The existing 1,800 acres will continue to be planted in the current crop rotation for those fields, as they are currently in production. It is not economically feasible at this time to fully implement crop rotation on the existing 1,800 acres of irrigated crops. All currently planned crops and rotations are outlined in the WDNR-approved NMP, attached as **Appendix A** and the nitrogen use efficiency of the rotation is described in **Appendix E**. Over time, crop rotations may be adjusted through the NMP.

1.2.1.4 Nutrient Application

The WDNR-approved NMP describes the plan for crop fertilization and soil management on the GSD Agricultural Crop Fields. The NMP is drafted to meet and exceed the criteria of the United States Department of Agriculture (USDA) Natural Resources Conservation Service 590 Nutrient Management Code and requirements in Wis. Admin. Code Ch. NR 243. The NMP for the GSD Project is included as **Appendix A** to this document. The BMPs listed below are included in the NMP to prevent pollution in accordance with Wis. Admin. Code sec. 243.14(2)(b)(1) – (13).

1. Manure or process wastewater may not pond on the application site.
2. During dry weather conditions, manure or process wastewater may not run off the application site, nor discharge to waters of the state through subsurface drains.
3. Manure or process wastewater may not cause the fecal contamination of water in a well.
4. Manure or process wastewater may not run off the application site nor discharge to waters of the state through subsurface drains due to precipitation or snowmelt except if the permittee has complied with all land application restrictions in this subchapter and the WPDES permit, and the runoff or discharge occurs as a result of a rain event that is equal to or greater than a 25-year, 24-hour rain event.
5. Manure or process wastewater may not be applied to saturated soils.
6. Land application practices shall maximize the use of available nutrients for crop production, prevent delivery of manure and process wastewater to waters of the state, and minimize the loss of nutrients and other contaminants to waters of the state to

prevent exceedances of groundwater and surface water quality standards and to prevent impairment of wetland functional values. Practices shall retain land applied manure and process wastewater on the soil where they are applied with minimal movement.
7. Manure or process wastewater may not be applied on areas of a field with a depth to groundwater or bedrock of less than 24 inches.
8. Manure or process wastewater may not be applied within 100 feet of a direct conduit to groundwater.
9. Manure or process wastewater may not be applied within 100 feet of a private well or non-community system as defined in ch. NR 812 or within 1000 feet of a community well as defined in ch. NR 811.
10. On a field with soils that are 60 inches thick or less over fractured bedrock, manure or process wastewater may not be applied on frozen ground or where snow is present.
11. Manure or process wastewater may not be applied on fields when snow is actively melting such that water is flowing off the field.
12. Where incorporation of land applied manure is required under NRCS Standard 590, the incorporation shall occur within 48 hours of application.
13. Manure or process wastewater may not be surface applied when precipitation capable of producing runoff is forecast within 24 hours of the time of planned application.

Nutrient applications are designed to maximize to the extent economically and technically feasible the nitrogen use efficiency and as a result GSD's nutrient management will far exceed the minimum requirements of a NMP. The following specific features of GSD's nutrient applications and crop management are unique to the Farming Full Circle concept and are included for all GSD Agricultural Crop Fields specifically to maximize nitrogen use efficiency.

- Rotate crops from year to year and include crops in the rotation that have minimal nutrient requirements (alfalfa, peas, beans);
- Minimize fall applications of manure/fertilizers;
- Maximize multiple in-season application of nutrients such that nutrients are supplied when needed by the crops;
- Analyze plant tissue from crops frequently during growing season to determine nutrient status of the crop and adjust nutrient applications accordingly;
- Plant fall cover crops for additional nutrient uptake and to minimize wind erosion;
- Raise crops, to the extent practicable, in which the harvest removes most of the plant matter (silage, alfalfa);
- Raise crops, to the extent practicable, that are deep rooted (corn and alfalfa);
- Manage crops for high yield and uniform stand conditions (single soil type, uniform irrigation application, uniform tillage, uniform nutrient application);
- Use precision planting methods, pest management, promotion of healthy crops, and

- Use manure to increase soil water and nutrient retention capacities and to stimulate microbial activity that increases crop resistance to pathogens and decreases need for pesticides.

The NMP tailors the application of nutrients in accordance with the specific, measured, needs of crops and specific soils of each field. The anaerobic digester and diversity of crops in GSD's NMP provide an even greater ability to fine tune the specific applications of nutrients as compared to traditional (i.e., non-integrated) dairy or produce operations.

The NMP describes the amount of liquid and solid manure that will be land applied. One of the benefits of the use of a manure digester is that the nutrients in raw manure are segregated during the digestion and liquid/solid separation process which allows for more effective nutrient management. The GSD Project anticipates applying manure according to the following schedule:

- Spreading will occur in spring before planting, both liquid and solid manure.
- Summer applications will be applied between each cutting of alfalfa and prior to planting of second canning crops and cover crops.
- Fall manure applications will be made only to fields that receive a fall cover crop.

As described more fully below, GSD plans to eventually apply liquid manure via center pivot equipment.

Beginning in the spring and extending through the growing season, the GSD will apply manure solids before planting. Solid applications will be hauled to the field, spread with field equipment and incorporated in the planting process. Fields with solids applications will receive one application per year, except if the field is double cropped in which case there will be two applications per year. Liquid applications will be applied via injection, surface applications on established alfalfa fields, and potentially eventually by center pivot drop nozzle irrigation. Food crops will not receive manure applications after the start of fruiting.

In the fall, liquid manure may be applied to 1) established cover crops (winter wheat being the most common cover crop), 2) established alfalfa fields, and 3) fields prior to cover crop establishment (if fields and weather conditions allow, crops will be planted within 3 days of application). All applications will be conducted in accordance with the WDNR-approved NMP. Commercial fertilizers will be used in addition to manure on fields, as appropriate, to meet the nutrient requirements of the crops. Fertilizers that may be used include 32 percent UAN (urea and ammonium nitrate), ammonium sulfate, potash and urea.

The NMP addresses the application and budgeting of nutrients for plant production on a field by field basis. The NMP describes, in specific detail, field characteristics, soils information, soil nutrient content, planned crops, tillage, nutrient application rates, locations, and methods of application. The NMP accounts for all nutrient sources, including commercial fertilizer, manure, organic byproducts, and crop residues to ensure proper utilization and to minimize the risk of impacts to water quality. The NMP is written to ensure all manure and process wastewater applied to fields is incorporated into the soil as a fertilizer for plant uptake and does not exceed the crop requirement.

The NMP was developed using Wisconsin's nutrient management planning software "Snap-Plus Version 1.13.8"[4] to plan cropping sequences, tillage practices, field data, and nutrient applications of manure and commercial fertilizer, and to project expected soil loss for specific soil types over the cropping rotation. Pursuant to NR 243, the NMP will be amended and updated at least annually. All NMP amendments and updates will be reviewed and approved by the WDNR.

The NMP describes how the following NR 243 requirements will be met on a field-by-field basis:

- Applications near navigable waters, wetlands and their conduits [referred to as Surface Water Quality Management Area (SWQMA) restrictions in NR 243.14.(4)].
- Applications near private or community wells, direct conduits to groundwater, and fields containing drain tiles [NR 243.14(2)(b)].
- Timing of manure and process wastewater, depending on field conditions [saturated soils, forecasted precipitation, frozen or snow covered ground, and areas of fields with depth to groundwater of less than 24 inches [NR 243.14(2)(b)]].
- Nutrient crediting [NR 243.14(3)].
- Phosphorus-based nutrient management and managing for nutrient impaired waters [NR 243.14(5)].
- Tolerable Soil Loss for the rotation (NRCS 590 V.A.2).
- Ephemeral field erosion is minimized or eliminated via BMPs (e.g., contour strips, filter strips, maintaining more than 30 percent crop residue on soils after planting, and fall cover crops) (NRCS 590 V.C.1).
- All nutrient applications consistent with NRCS 590 nutrient management criteria (yield goals attainable under average conditions) and soil fertility recommendations found in UW-Extension Publication A2809 (Laboski and Peters, 2012).

The requirements of the WPDES Permit, NR 243, NRCS 590 and the significant management practices listed and described above will protect surface and groundwater. The agricultural fields proposed for conversion from pine plantation have been laid out to minimize potential impacts to surface water bodies and streams. The smallest buffer width between a converted field and a surface water feature is at field P48 where the buffer is approximately 430 feet between the field edge and Tenmile Creek. The wide buffers that will be maintained between the fields and surface water features are far in excess of the 25-foot buffer required in NR 243.14(4)(1) and are voluntarily implemented by GSD to further minimize potential negative impacts of its activities on the land and water resources. The existing crop fields will be brought into compliance with all setback requirements in chapter NR 243.

1.2.1.4.1 Application Methods

GSD anticipates using the following equipment to spread solid and liquid manure on fields in accordance with the NMP:

[4] http://www.snapplus.net/

- Solid manure will be surface applied using box spreaders and transported to fields by truck
- Liquid manure will be pumped by hose and injected, hauled by truck and injected, surface applied and incorporated, or potentially in the future applied via center pivot drop nozzle irrigators.

In the spring and fall, liquid manure will be injected when possible, or else incorporated within 48 hours of surface application. With the exception of applications to growing crops, all liquid or solid manure not injected will be incorporated with tillage equipment, or in the case of no-till or alfalfa, it will be surface applied in accordance with all NR 243 and NRCS 590 rules. In the summer, liquid manure may be top-dressed on some alfalfa fields. Liquid manure and solid manure spread on the GSD Agricultural Crop Fields will be applied by GSD or Wysocki Produce Farms.

GSD has planned for the option of applying manure via center pivots; however, such applications will not be made upon startup of the dairy farm. Indeed, the use of center pivot irrigation equipment for the land application of manure has been met with a fair amount of controversy and GSD understands that the State, via the UW Extension, is currently studying the practice and that the practice has been banned by a number of local units of government. As such, when this method of application will be used by GSD is undeterminable at this time. When manure application via center pivot equipment is pursued, then GSD will follow whatever BMPs or regulatory restrictions that exist at that time and pursue an evaluation and approval of the irrigation and transfer equipment pursuant to Wis. Admin. Code § NR 243.16.

1.2.1.4.2 Solid Manure

Solid manure applications will be targeted to fields that will not receive liquid applications. Loads will be weighed at the Production Area scale prior to hauling to the fields. Loads will be documented and adjusted on a per field basis to assure that the correct amount of manure is spread per acre. Manure will be incorporated when pre-plant and post-harvest applications are made.

1.2.1.4.3 Liquid Manure Traditional

The Airway Bar method, which applies liquid manure from 6-inches above the ground surface with a tractor-pulled implement, will be used for liquid manure applications. These applications will be monitored to assure that no runoff or ponding occurs. Immediate incorporation may be necessary if the Airway Bar applications present a runoff risk.

1.2.1.4.4 Liquid Manure Center Pivot

If in the future GSD uses center pivot irrigation systems to apply liquid manure, such systems will be used on fields that are supplied by an underground pipeline, above ground hoses, or both. Eventually, pipeline systems may transfer liquid manure to the approximately 6,460 acres represented in the NMP. The physically engineered sprinkler packages for each field will be provided to WDNR in accordance with Wis. Admin. Code Ch. NR 243.

Any proposed irrigation system used by GSD will include a drop tube with a Nelson Rotator with a trash buster body and Brown (potato) plate. This is the same system used at the CSD and provides very uniform distribution as well as facilitates easy maintenance and cleaning.

All applications from this equipment will take place approximately 8 feet from the ground surface. It is impractical to deliver nutrients from a lower height because the canopy of some crops exceeds this height. Most of the irrigation equipment will be nozzled between 800 and 1000 gallons per minute and run at pressures from 30-45 psi. All of the irrigation systems will likely be equipped with computer panels to allow for remote operation and monitoring and precise applications. This coupled with a telemetry package will allow the farm to operate and monitor the equipment from virtually anywhere. Information from these panels will download via the internet to the farm office, operator stations and employee smart phones. If a problem occurs with the irrigation equipment, employees can shut these units down or switch to a default control from anywhere.

End gun controls as well as optional valves will allow GSD to control individual sprinklers whether it is for adjustment or changes needed due to weather factors.

Calibration of nozzle outputs are all pre-calculated and engineered by the factory. Consistent with practices at CSD, GSD will conduct annual fall test pumping of irrigation water to provide information on system performance, including indicators of poor sprinkler performance. If performance is determined to be sub-par, equipment can be repaired, or new equipment packages can be installed to update the system.

Application through center pivots will allow smaller applications of nutrients throughout the season which increases flexibility to apply based on crop needs and to appropriately manage varying field and weather conditions. Another benefit is an ability to apply less manure in the fall because a diverse cropping rotation allows for applications during every month of the growing season.

If GSD pursues liquid manure applications by center pivot, it will implement the following additional BMPs, as well as other additional BMPs developed as a result of the ongoing studies on the topic by WDNR and UW-Extension:

- GSD will follow the phosphorus based nutrient management planning as required by NR 243 and NRCS 590. Irrigation applications will not exceed the WPDES limitations for volume, nitrogen or phosphorus.
- GSD will use anaerobic digestion of manure liquids to reduce pathogens and odor.
- GSD will not apply irrigated manure to field areas within the 500-foot setback for occupied dwellings, and will instead apply to these fields areas via traditional application methods. This BMP will help avoid conflicts with neighboring private residences.
- GSD will have the ability to remotely monitor and shut off sprinkler nozzles and end guns of the center pivots if needed to avoid off-site movement of nutrients.
- All manure application requirements of WPDES Permit will be followed to protect surface and ground water.

- In accordance with crop needs and SNAP-Plus recommendations, liquid manure application rate will not exceed the nutrient rate approved by NMP.
- GSD will wait a minimum of 5 days between specific field applications.
- Field specific manure sampling will more accurately monitor nutrient loads.
- Plant tissue testing will monitor nutrient needs of crops through the growing season.
- GSD will sample soil on fields on an annual basis to monitor nutrient levels.
- GSD will monitor weather conditions at application fields to avoid off site drift. (See **Appendix A**).
- No ponding or runoff will be allowed.
- Manure applications by trained GSD personnel and recently purchased equipment will allow for better control of the manure application in a timely manner.
- Additional practices to minimize leaching potential of nutrients:
    a. Pivot irrigation allows better management to shorten the window between application and cover crop planting;
    b. GSD will work to apply the majority of manure to actively growing crops;
    c. GSD will reduce fall nitrogen per acre applications to exceed requirements of the NMP (**Appendix A**);
    d. Where appropriate, GSD will dilute manure liquids with irrigation water to facilitate incorporation of nutrients into the soil organic matter and facilitate nutrient up take;
    e. Oats, or another cover crop, will be applied as a temporary cover crop to fields with spring manure if crop planting will be delayed;
    f. Pivot irrigation allows fall applications to growing cover crops, including alfalfa, to facilitate nutrient tie-up and further reduce leaching potential; and
    g. GSD will utilize split applications for fall applied manure.

1.2.1.4.5 Rates

Liquid and solid manure will be applied at rates consistent with crop need and the recommendations of the UW and the Natural Resource Conservation Service. All application rates are included in the WDNR-approved NMP.

1.2.1.4.6 Schedule

GSD anticipates applying manure in the spring, summer and fall. Spreading of both liquid and solid manure will occur in spring before planting. Summer applications will be applied between each cutting of alfalfa and prior to planting of second canning crops and cover crops. Fall manure applications will be made only to fields that receive a fall cover crop.

There will be no planned winter applications of manure. Solid manure will be applied in winter as an emergency measure when manure is frozen and cannot be digested, and the prohibition period of February and March will be followed if the ground is snow covered and/or frozen. For all winter applications, fields will first be evaluated for compliance with NR 243

criteria, Tables 4 and 5. GSD will also determine if proposed winter spreading fields represent the lowest potential for pollutant delivery to waters of the state, having a winter acute loss index value of 4 or less using the Wisconsin Phosphorus Index.

1.2.1.5 Water Irrigation

1.2.1.5.1 Methods

Crop fields will be irrigated with water via center pivot irrigation systems. Proposed center pivot systems will be equipped with technologically advanced hardware and GPS software to ensure crops receive an appropriate amount of water to achieve crop yield goals and that minimizes infiltration below the root zone.

The GSD center pivots will be equipped with low pressure irrigation systems to increase the size of the water droplets applied to the crop, placing them closer to the developing crop. Variable speed drives added to irrigators allow the farm to vary the application rate to meet the crop need. Center pivots will also be equipped with telemetry, wind meters and rain gauges to remotely monitor and control the systems. GSD will measure evapotranspiration losses from the crops daily, allowing irrigation personnel to replace the exact amount of water lost. Finally, professional meteorologists' short-range local forecasts will be consulted to reduce the amount of irrigation water needed. These practices will ensure crops receive an appropriate amount of water while reducing overwatering.

The use of state of the art irrigation equipment, as is planned for the GSD Agricultural Crop Fields, has been found to provide desirable benefits to agricultural projects, including a reduction in the total amount of water applied to fields, a 68% improvement in crop yield and quality, a 57% reduction in energy costs and energy consumption, 16% reduction in the loss of fertilizer and pesticide loss caused by overwatering, and 26% reduction in soil erosion (USDA, 2008).

1.2.1.5.2 Rates

Irrigation rates will depend upon seasonal and site-specific field and crop conditions. In an average year, irrigation application rates in the GSD Agricultural Crop Fields may average 14 inches of water. In very dry years, with conditions similar those in 2012 irrigation application rates in the GSD Agricultural Crop Fields may exceed 21 inches per year.

1.2.1.5.3 Schedule

The Wisconsin Irrigation Scheduling Program (WISP) will be used to assist with irrigation scheduling. This program considers estimated potential evapotranspiration, crop transpiration, and precipitation in calculating a daily water balance. Use of irrigation software combined with in-field evaluations of soil moisture will ensure crops receive appropriate water to achieve yield goals and maximize water conservation.

1.2.1.5.4 Conservation Efficiency Measures

The GSD Project will be the first agricultural operation to receive approvals pursuant to Wisconsin's Water Loss statute and rules. One requirement of a Water Loss approval is to implement significant Conservation Efficiency Measures (CEMs) to ensure efficient water use at the GSD Production Area and GSD Agricultural Crop Fields. In accordance with the CEMs

identified in its Water Loss Application, GSD has committed to implementing water use audits, leak detection and repair protocols for pipes and pumps, drift reduction measures for irrigation and water reuse at the GSD Production Area. In addition, the GSD Production Area has been designed to ensure integrated water management practices are employed, that high infiltration areas are planted with low-water use grasses and that stormwater collection basins facilitate infiltration of precipitation back to the aquifer. GSD is proud to be the only dairy farm and irrigated agricultural operation in Wisconsin that is required to implement these CEMs and hopes to promote the development of additional water conservation measures appropriate for Wisconsin's dairy and irrigated vegetable farmers. The GSD Water Loss application will be submitted to the WNDR under separate cover.

1.2.1.6 Pesticides

Depending on the crop, pesticides may be applied with protective fungicides and insecticides on a weekly basis. For example, potatoes require more pesticide applications than corn crops. All pesticide applications will be completed by state-certified pesticide applicators, in accordance with labels. No pesticides will applied with irrigation water through center pivots.

The Wysocki Family of Companies, including GSD, participates in the Healthy Grown/Healthy Farm program, which requires the participant to track the use of certain pesticides. Further information about this program can be found at: http://www.healthygrown.com/. The program has a scoring threshold, whereby if a participant does not receive a high enough score for good practices, participation is no longer allowed. Through its participation in this program, GSD will maintain the high standards that have been historically implemented throughout the Wysocki Family of Companies. In general, pesticide use on the GSD Agricultural Crop Fields will be less than typical dairy farm crop rotations due to longer rotations between potato crops and improved soil health, which allows integrated pest management systems to lower the insect and disease pressures.

1.2.2 Stormwater

1.2.2.1 Agricultural Crop Fields

Stormwater runoff and soil losses are expected to be minimal as the majority of precipitation will infiltrate quickly due to the highly permeable soils and flat topography in fields included in the NMP. Notwithstanding the above, pursuant to Wis. Admin. Code Chapters NR 151 and 243 and ATCP 50, fields must be managed to meet tolerable soil loss rates as prescribed in promulgated rules, NRCS technical standards and UW recommendations.

The land application areas, as discussed throughout this report, will be managed in accordance with a WDNR-approved NMP. The NMP uses Snap-Plus Version 1.13.8 to plan and record cropping sequences, tillage practices, field data, and nutrient applications of manure and commercial fertilizer to project expected soil loss for specific soil types over the cropping rotation. Field-specific soil loss values are compared to the acceptable "T" values for the soil type. Snap-Plus uses the revised Universal Soil Loss Equation, version 2 (Rusle2 Version 1.37.0.0) to calculate the field specific "T" values.

The soil types associated with the GSD Agricultural Crop Fields have a tolerable soil loss rate of 5 tons per acre. Field erosion will be minimized using the following BMPs, as appropriate:

- Conservation tillage practices
- Maintaining adequate crop residue after planting
- Use of fall cover crops on all production fields
- Cropping rotations that include perennial crops
- Protection of concentrated flow areas
- Organic matter additions to improve physical condition of cropland soils

The NMP and Snap-Plus projections for the 2015 through 2019 crop years indicate that the maximum expected soil loss on fields converted from pine plantation is 0.3, and on the existing irrigated fields is 0.4 tons per acre per year, which is well below the standard of 5 tons per acre per year set by NRCS 590 and NR 243.

GSD will evaluate fields on an ongoing basis for the presence of ephemeral soil erosion and concentrated flow channels. If fields show evidence of concentrated flow channels resulting in recurring gullies or ephemeral erosion, one or more of the following actions will be taken:

- Spreading maps will be updated to reflect areas with concentrated flow channels.
- Manure will not be spread on fields with concentrated flow channels until perennial vegetative cover is established in all areas of concentrated flow.
- A schedule for establishing perennial vegetative cover in all areas of concentrated flow, as well as implementation dates, will be recorded and kept with the NMP.
- One or more NRCS 590 runoff reduction practices for crop fields with ephemeral erosion will be selected and implemented. Practices selected and implementation dates will be recorded and kept with the NMP.

If vegetated flow channels/grassed waterways are established within fields, such areas will be maintained to perform their intended function and manure will not be applied within these areas.

1.2.2.2 Managed Forest Land Conversion

During conversion of the land from red pine plantation to irrigated crops, erosion will be managed using BMPs consistent with current forestry practices and industry-wide standards. Generally water erosion potential is low since the sandy soils have little runoff potential and the slopes are flat. Once converted to agricultural fields, agricultural BMPs such as cover crops and wind breaks will be employed to control wind erosion consistent with conservation practices being employed by Central Sands Dairy, LLC on its existing fields.

1.2.3 High Capacity Wells

GSD proposes to install and operate 37 new high capacity wells, and operate one existing high capacity well, to irrigate the land converted to cultivated vegetable and forage crop production. GSD will also operate existing high capacity wells located on the existing 1,800 acres of crop land. The locations of the high capacity irrigation wells proposed for installation on converted fields are shown on **Figure 1-2;** the existing nearby well is located in T21N R6E Section 24 and is high capacity well No. 38632. The existing 1,800 acres of crop land are shown

on **Figure 1-2a.** The proposed high capacity wells have been grouped into six high capacity well systems, with each system representing a single high capacity well property. Permit applications for the six high capacity well systems have been submitted to the WDNR. No permit applications or modifications are required for the wells located on existing crop land.

As described above, the GSD Project will be the first agricultural operation to receive approvals pursuant to the Water Loss statute and rules. Before WDNR may approve a Water Loss Application, it must determine the following:

1. No public water rights in navigable waters will be adversely affected.
2. The proposed withdrawal does not conflict with any applicable plan for future uses of the waters of the state.
3. Both the applicant's current water use, if any, and the applicant's proposed plans for withdrawal, transportation, development and use of water resources incorporate reasonable conservation practices.
4. The proposed withdrawal and uses will not have a significant adverse impact on the environment and ecosystem of the Great Lakes basin or the upper Mississippi River basin.
5. The proposed withdrawal and uses are consistent with the protection of public health, safety and welfare and will not be detrimental to the public interest.
6. The proposed withdrawal will not have a significant detrimental effect on the quantity and quality of the waters of the state.
7. Any other conditions, limitations and restrictions that the department determines are necessary to protect the environment and the public health, safety and welfare and to ensure the conservation and proper management of the waters of the state.
8. Any requirements for metering, surveillance and reporting that the department determines are necessary to ensure compliance with other conditions, limitations or restrictions of the approval.

WDNR has determined that the CEMs listed in the Water Loss Application and identified in Wis. Admin. Code Ch. NR 142 are appropriate and reasonable conservation practices for the GSD Project.

The proposed high capacity wells will be drilled in accordance with Wis. Admin. Code Ch. NR 812 construction requirements and will be operated in accordance with all permit conditions and applicable regulatory requirements. Each well will have the capacity to supply 8 gpm to each acre serviced by the well; actual water use will depend on field and weather conditions and crop water requirements. All proposed high capacity irrigation wells will be constructed in the sand and gravel aquifer, with expected well depths of about 100 feet below ground surface.

A closed town landfill is located adjacent to the western most fields as shown on **Figure 1-7** centered between fields P01A and P01B. The nearest proposed wells are wells W01 and W02, both located about ½ mile to the southeast (**Figure 1-2**). Both wells W01 and W02 are located hydraulically upgradient or sidegradient of the landfill and water quality in the proposed wells is not expected to be affected by prior land use at the closed landfill.

1.2.4 Roads and Traffic

Fire lanes and farm field access roads currently exist throughout the GSD Project Area and will be used to transport manure and crops to and from the GSD Agricultural Crop Fields. Field lanes are proposed to follow field edges to allow for nutrient application and harvest. Existing roadways are shown on **Figure 1-1** and lanes are visible between the red pine plantation crop areas in the aerial photograph on **Figure1-2**. Public roadways will also be used to transport manure and crops to and from the GSD Agricultural Crop Fields.

1.2.5 Lighting

There will be no new lighting installed at any of the crop fields. Headlights and other lighting may be attached to field equipment, but such lighting is not permanent.

1.2.6 Monitoring

The applicant has proposed a groundwater monitoring program for the GSD Project that includes components to monitor the GSD Agricultural Crop Fields proposed for conversion from pine plantation and the GSD Production Area. The groundwater monitoring plan is included as **Appendix B**. GSD is the first dairy farm or vegetable grower in Wisconsin to voluntarily propose to install groundwater monitoring wells at land application fields.

The monitoring plan consists of eleven monitoring wells in the northwestern part of the GSD Project Area north of Tenmile Creek and west of STH 13 to monitor the GSD Agricultural Crop Fields proposed for conversion from pine plantation. Water that infiltrates from these fields will flow toward and into Sevenmile Creek in the northern part of the area, will flow toward and into the Wisconsin River in the middle part of the area, and will flow toward and into Tenmile Creek in the southern part of this area[5]. In addition, the monitoring plan consists of five monitoring wells at the GSD Production Area. The locations of the monitoring wells proposed for the GSD Project are shown on **Figure 1-10**, a map of the entire GSD Project Area, and on **Figure 1-11**, a map of the GSD Production Area.

As the GSD Production Area is located in the eastern part of the agricultural fields that are proposed for monitoring, the monitoring wells proposed for the GSD Production Area will also provide information to understand long-term water quality changes, if any, from the GSD Agricultural Crop fields.

The monitoring wells proposed for the GSD Agricultural Crop Fields proposed for conversion from pine plantation consists of seven monitoring wells screened across the water table and four deeper monitoring wells (piezometers) screened below the New Rome member (depicted on the cross section discussed in Section 2.1) and built and completed in accordance with the requirements for groundwater monitoring wells in Wis. Admin. Code Ch. NR 141[6].

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[5] The direction of groundwater flow is perpendicular to the ground water level contour lines, as shown in **Figure 1-1**0. Groundwater flows primarily toward the west and the Wisconsin River.

[6] The water-table monitoring wells will be constructed with 15-foot screens and the deeper monitoring wells will be constructed with 5-foot screens.

The locations of these proposed wells and groundwater flow paths in the vicinity of the wells are shown on **Figure 1-10**. Three of the monitoring wells are located upgradient of the GSD Agricultural Crop Fields proposed for conversion from pine plantation and the purpose of these wells is to quantify the quality of groundwater flowing into the fields from upgradient of the GSD Project. Five water-table monitoring wells, and three deeper wells, are located downgradient of the GSD Agricultural Crop Fields proposed for conversion from pine plantation and upgradient of clusters of residences to quantify the quality of water flowing beneath the fields.

The monitoring system is spatially configured to provide information on potential changes in groundwater quality from upgradient to downgradient of the GSD Agricultural Crop Fields proposed for conversion from pine plantation and to provide data that will serve as a sentinel to potential adverse changes in downgradient private wells. The distances from the upgradient wells to the downgradient wells range from about two miles to three miles. Sufficient monitoring wells have been proposed to evaluate potential water quality changes along five separate groundwater flows that traverse the GSD Agricultural Crop Fields proposed for conversion from pine plantation. With monitoring along five flow paths, sufficient data will be collected to quantify spatial variability in potential water quality effects.

The monitoring wells to be located near the GSD Production Area are shown on **Figure 1-11**, a map of the GSD Production Area (and on **Figure 1-10**). The monitoring wells proposed for the GSD Production Area consist of an upgradient water-table monitoring well, three downgradient water-table monitoring wells, and a downgradient deeper monitoring well. The downgradient monitoring wells are located immediately downgradient of the manure and wastewater storage basins and the feed storage pad.

The monitoring wells associated with the GSD Agricultural Crop Fields proposed for conversion from pine plantation will be constructed such that sampling can commence at least eight months prior to the planned first application of manure on these fields via center pivot irrigation equipment, and the monitoring wells associated with the GSD Production Area will be constructed within 60 days of completion of construction of the GSD Production Area reviewable facilities. The use of center pivot irrigation for the land application of manure has been met with a fair amount of controversy and we understand that the State via UW Extension is currently studying the practices and that the practice has been banned by a number of local units of government. As such, when this method of application will be used by GSD is undeterminable at this time, particularly given the length of time between this monitoring proposal, the final project development, manure generation and application. When manure application via center pivot equipment is pursued, then GSD will follow whatever BMP or regulatory restrictions that exist at that time and pursue an evaluation of the approval of the irrigation and transfer equipment pursuant to §NR 241.16, Wis. Admin. Code.

The monitoring wells will be sampled within one month of well installation. All wells will be tested using the slug-test method for the determination of hydraulic conductivity within two months of well construction.

All monitoring wells initially will be sampled monthly for eight months to establish background conditions. The monitoring wells associated with the GSD Production Area will be sampled quarterly thereafter. All other monitoring wells will be sampled once every fifteen

months after the first eight monthly sampling events as water-quality changes, if any, in the vicinity of the GSD Agricultural Crop Fields proposed for conversion from pine plantation are expected to occur over a decadal time frame. Fifteen months is chosen so that in a five-year sampling cycle, each well will be sampled during each of the major seasons, and 15 months is a frequency consistent with potential water-quality changes. The duration of groundwater quality monitoring will continue as required by the WDNR.

Water samples collected from the wells will be analyzed for nitrate, nitrite, total organic nitrogen, ammonia, chloride, coliform, total dissolved solids, chemical oxygen demand, pH, specific conductivity and temperature.

The water-quality results from the groundwater monitoring program will be reviewed annually to determine if changes in cultivation practices are needed to reduce the potential for adverse water-quality changes. Changes in cultivation practices that may result from this review include: 1) incorporate more or different legume crops in the rotation, 2) conduct additional nutrient testing and/or modify nutrient application rates; 3) plant more and/or different cover crops, 4) reduce fall applications of nutrients, or 5) look ahead to new technologies that will assist in more precise management and application of nutrients.

1.3 Permits and Approvals Required by the GSD Project

1.3.1 Wisconsin Department of Natural Resources

The WDNR has the authority to regulate this operation pursuant to the WPDES Permit for Concentrated Animal Feeding Operations (CAFOs) under Wis. Stats. Ch. 283 and Wis. Admin. Code Ch. NR 243.

The purpose of a CAFO WPDES permit is to protect water quality. The GSD CAFO WPDES permit will contain numerous restrictions and requirements that the farm must comply with, including, but not limited to: (1) proper design, construction and operation of structures associated with manure and process wastewater handling at the site; (2) a zero-discharge effluent limitation for the production area; (3) development and implementation of emergency response and operation, maintenance and monitoring plans; (4) requirements to contain and properly manage runoff from animal housing, feed storage and manure storage facilities to meet effluent limitations and ground and surface water standards; (5) daily, weekly, monthly and quarterly inspection requirements for facilities; (6) a requirement to maintain at least 180 days of manure and process wastewater storage on-site; (7) restrictions on the amount, location, and timing of applications of manure and process wastewater through a NMP; and (8) significant recordkeeping and reporting requirements for land application activities.

Additional sources of WDNR's regulatory authority include:

- Stormwater discharge from the GSD Production Area construction site, Wis. Stats. Ch. 283 and Wis. Admin. Code Ch. NR 216, and in accordance with WPDES General Permit No. WI-S067831-3, Construction Site Stormwater Runoff. Permit coverage under WPDES General Permit No. WI-S067831-3 was granted on February 5, 2008.
- Review and approval authority of manure storage facilities, transfer systems, feed storage and runoff control systems, Wis. Stats. §281.16.

- Nutrient Management Plan review and approval, Wis. Admin. Code Ch. NR 243, and NCRS technical standard 590.
- High capacity well permits, Wis. Stats. §281.34, and Wis. Admin. Code Chs. NR 812 and 820.
- Water withdrawal registration and reporting, Wis. Admin. Code Ch. NR 856.
- Drinking water standards for non-transient, non-community wells, Wis. Admin. Code Ch. NR 812; § NR 809.04.
- Protection of endangered and threatened species, Wis. Stats. §29.604, and Wis. Admin. Code Chs. NR 27 and NR 29.

1.3.2 Other Wisconsin Agencies

The Department of Agriculture, Trade and Consumer Protection (DATCP) requires dairy farms to obtain a Premise ID and a Grade A Dairy Permit. The Wisconsin Department of Transportation (WDOT) requires a driveway permit for the GSD Production Area access drives.

1.3.3 Wood County

Permits required by Wood County include: 1) approval of on-site domestic wastewater system; 2) manure storage permit; 3) fire number/address; 4) permit to install utilities in a county road right-of-way; 5) permit to haul oversized loads on county roads; and 6) and a driveway permit to access county highways.

1.3.4 Federal

The U.S. EPA - National Pollutant Discharge Elimination System (NPDES) permit program for CAFOs (40 CFR) (USEPA, 2012a) is implemented through the delegation of WDNR's authority to implement the NPDES permit program under the state WPDES permit program. There will be no wetland impacts associated with the GSD Project, so no permits are required from the Army Corps of Engineers. No other Federal permits or approvals are required.

1.3.5 Local Zoning / Approvals

The Town of Saratoga adopted a Comprehensive Plan in 2007 (see Ordinance No. 8-15-2008-A), but at the time the GSD Production Area permit applications were submitted to WDNR, the Town of Saratoga did not administer its own zoning ordinance. At that time, the Town had elected, pursuant to Wis. Stat. § 59.69 (5)(c), to be governed by the zoning ordinance adopted and administered by Wood County. Wood County's zoning ordinance has only two districts: i) the Forestry and Recreation District and ii) the Unrestricted District (*see* Wood County Code of Ord. Chapter 700.01)[7]. All of the property proposed to be occupied by the GSD Production Area and the GSD Agricultural Crop Fields are located within the Unrestricted District. The county's zoning ordinance provides that:

> *"In the unrestricted district, any land may be used for any purpose whatsoever, not in conflict with law."* (Wood County Code of Ord. Ch. 700.03)

[7] See http://www.co.wood.wi.us/Departments/Clerk/Ordinances/700-Zoning%20Ordinance.pdf

Accordingly, agricultural uses, including the proposed dairy and associated crop land, are permitted uses of the property under the County's zoning ordinance.

At the time the GSD dairy permit applications were submitted to WDNR, Wood County was the applicable zoning authority governing all land within the Town of Saratoga. As noted above, all of the GSD Production Area was zoned "unrestricted" under the county's zoning ordinance, which provided that "land may be used for any purpose whatsoever, not in conflict with law." Accordingly, agricultural uses, including a dairy and associated agricultural land base, were legally-permitted uses of the GSD Production Area at the time the GSD dairy permit applications were submitted to WDNR.

All of the GSD dairy permit applications were submitted to WDNR and to other authorities on June 6, 2012. After permit applications were submitted, the Town denied GSD's building permit application, and took steps to implement town-level zoning, including adoption of a moratorium, an interim zoning ordinance and, ultimately, a permanent town-level zoning ordinance. The town-level ordinance zones the GSD Production Area in a way that prohibits a dairy from being developed.

GSD has filed two lawsuits against the Town in response to these actions. In the first lawsuit, the court ruled that GSD had acquired vested rights to a town-level building permit for the dairy under the laws that existed prior to Town's enactment of the moratorium. Pursuant to the court's order in the first lawsuit, the Town issued the building permit. The second lawsuit, in which GSD claims the same vested rights and argues that it is entitled to rely on the unrestricted zoning in place at the time it filed its dairy permit applications with the WDNR, is still pending.

1.4 Degree of Controversy, Major Issues, and Public Involvement

This project has generated public controversy. Issues to be addressed in this EIR were identified through a scoping process that included public comment and requirements issued by the WDNR. Concerned citizens from the project area and beyond submitted comments to the Department during the Department's EIS scoping period. Concerns were expressed regarding:

- Water quality – for both surface and groundwater and including excess nutrients (nitrate and phosphorus), pesticides, ammonia, volatile organic compound (VOCs), herbicides, heavy metals, antibiotics, hormones, soil fumigants (metham sodium), arsenic, and hoof disinfectants, as well as cumulative impacts from other CAFOs and sources of nutrients in the area and impacts on receiving waters.
- Water quantity – including impacts on residential, municipal, commercial, and industrial water users, reduced flows in nearby surface water bodies, impacts on fisheries, and recharge rates and cumulative impacts based on other existing and reasonably anticipated similar related activities conducted nearby.
- Air quality – including odor, health effects on children, elderly and workers, increased dust from gravel roadways, air monitoring, and effectiveness of BMPs proposed.
- Effects on the community –including the cost of repairing impacted wells, increase in fly population and disease exposure, decrease in property values, loss of 4,660

acres of forest land (and additional effects on wildlife), harmful effects on roadways and tax burden for increased road maintenance.

- Effects on nearby businesses – including impacts on nearby cranberry farms and impacts of potential pathogens and increased nitrate in surface and groundwater.
- Facility design and operation – installation and design of manure lagoon liner, inspections and monitoring, emergency contingency (in cases of power failure or storm damage), set-back distances and resident notifications for manure spreading, erosion control measures, effectiveness of stormwater and runoff controls, storage facility design, runoff of nutrients, over-application of nutrients.
- The owners of GSD also have an ownership interest in CSD, where impacts from spraying wastewater from center pivots too close to homes, roads and wells have been alleged, and elevated nitrate concentrations have been observed in monitoring wells.

The GSD Project and the Department's EIS process has been the subject of numerous articles and editorials in newspapers and media outlets.

Throughout the duration of the permitting process, the public was invited to attend multiple meetings and hearings, including a June 24, 2012 Open House, a July 19, 2012 informational presentation at the Wisconsin Rapids Performing Arts Center, weekly tours in August and September at CSD, hosted by the Wysocki Family Companies, and an August 23, 2012 Public Meeting to Accept Comments on the EIR/EIS Scope, hosted by the WDNR. The public will also be invited to attend the public hearings on the draft EIS and on the draft WPDES permit for the GSD Project, which will be hosted by WDNR.

1.5 Purpose or Need

The GSD Project is the result of changing economic and business factors in the Central Sands area of Wisconsin. The closing of several paper mills and reduction in production at several others has reduced the need for pine plantation agriculture in the area. This development may also be the result of movement toward a "paperless" or electronic society. This has resulted in a large block of pine plantation being harvested and the land sold, a business decision made by Plum Creek Timber. Conversion of the use of land from pine plantation will occur by Plum Creek regardless of whether the GSD Project proceeds or not. The GSD Project preserves the productivity of this land by modifying the use from pine plantation/agriculture to vegetable and forage crop agriculture. Incorporating dairy forage crops into the irrigated vegetable agriculture, as has been demonstrated in CSD, transforms traditional vegetable and forage crop agriculture into a rotation that is less dependent on inorganic fertilizers, and improves the quality of the sandy soils by increasing the content of organic matter in the soil.

The GSD Project will be a sister operation to the CSD located west of the Wisconsin River in Juneau County, Wisconsin. The purpose of this project is to construct a dairy farm utilizing advanced manure handling and nutrient recycling systems that will promote crop rotations with vegetable and forage crops allowing the area's pine plantation to transition to a sustainable farming production system.

The milk produced from bringing additional cows to Wisconsin will solidify the Wysocki Family Company's dairy processing infrastructure and will help stabilize the Wisconsin dairy

industry by providing much-needed high-quality raw product to the milk processing plants in our state, replacing milk currently being imported from as far away as New Mexico. Milk produced in Wisconsin assists in supporting existing in-state milk processing infrastructure, preserving those jobs at those plants given that Wisconsin is a milk-deficit state. Reducing milk imports from other states has the added benefit of reducing the use of petroleum based fuels used to transport milk which reduces carbon emissions. Wood County is home to a large number of our state's dairy farms and the GSD Project is proud to be among them.

The increased value of the dairy and irrigated vegetable crops being produced will also improve the financial stability of the area and provide jobs to the local area. Because of the size of the GSD Project, many of these jobs will be high-paying, full-time employment for veterinarians, heavy equipment operators, animal breeders, managers, agronomists, farm equipment operators, truckers, and office and maintenance personnel.

1.6 Products

The GSD Production Area will house 3,400 milking cows that are estimated to produce 300,000 pounds of milk per day. It is expected that most of this milk will be sold and used for fluid milk or sold to cheese makers in Wisconsin. All milk products will be tested to confirm the absence of antibiotics using the Charm SL Test and the Disc Assay Test for milk prior to processing. Milk from antibiotic treated animals is intercepted separately and discarded. Laws exist to protect consumers from the presence of unacceptable levels of drugs in milk and meat. For example, see Wis. Stat. Chapters 97 and 98; Wis. Admin. Code Chs. ATCP 55-88; US Code Title 9, Parts 300-599. The slaughter of meat is also heavily regulated by state and federal inspectors; however, no slaughtering or meat processing will occur at the GSD Production Area.

The GSD Agricultural Crop Fields will produce forage and vegetable crops. Forage products include alfalfa, which is harvested 5 times a year, and sweet field corn, which is harvested in September as silage and grain. Vegetable crops include potatoes harvested in July – October, sweet corn planted in May – July, snap beans planted May – July (sometimes 2 crops per year), and peas planted in May usually followed by a snap bean crop. Alfalfa is planted after a vegetable crop and may not be harvested its first year, and after the final harvest the field is often planted to a vegetable crop. Occasionally alfalfa is grown as a cover crop and harvested only once the following spring.

1.7 Cumulative Effects

The evaluation of cumulative effects in an EIR process considers the impacts of the proposed action on existing environmental and socio-economic conditions in combination with other present or reasonably-foreseeable planned actions that also may impact the environmental or socioeconomic resources.

Wisconsin law requires that the environmental impact analysis conducted by WDNR include an analysis of cumulative effects. WDNR has recently revised its rule which sets forth the scope and process of environmental review required by §1.11, Wis. Stats., the Wisconsin Environmental Policy Act (WEPA). This proposed revision to Wis. Admin. Code Ch. NR 150, was filed with the Legislature on November 19, 2013, and becomes effective April 1, 2014. The rule defines "cumulative effects" as "compounding effects resulting from repeated or other

proximal actions, activities or projects." See NR 150.03(4) (proposed). As such, to evaluate cumulative effects one must consider both existing activities and reasonably foreseeable future activities of the same type and that are proximal or local to the project.

For purposes of evaluating cumulative effects of existing activities, all of the potential impacts identified and analyzed in this EIR have been evaluated based on the current condition of the resource. The current condition of the resource necessarily takes into consideration the cumulative effect of all existing activities. For example, the groundwater model developed for the GSD Project includes and accounts for all existing withdrawals for which there are data available from the WDNR. As such, the modeled baseflow reduction of the proposed wells is evaluated and compared to the current resource condition, including any current baseflow reduction due to existing wells or activities on the landscape.

As for consideration of reasonably foreseeable future actions of the same type, the Town of Saratoga and the neighboring Town of Rome recently enacted zoning ordinances that limit permitted agricultural use to very small areas of the townships. Because GSD's permit applications were submitted to the Town of Saratoga, Wood County and the State of Wisconsin prior to Saratoga's zoning enactment, GSD is not subject to the new, more restrictive zoning ordinance. However, any new or proposed agricultural operations (including those that are either CAFOs or would require the installation of high capacity wells, or both) are unlikely to be sited in either Saratoga or Rome, due to the restricted areas zoned for agricultural use. As such, it is very unlikely that there will be any future irrigation or dairy farming activities that are proximal or local to the GSD Project.

The WDNR high capacity well website identifies only one application for a new high capacity irrigation well located within about three miles of the GSD Project Area. However, if additional high capacity wells are permitted in close proximity to the GSD Project, additional water level drawdowns and streamflow reductions could occur in the nearby surface waters. At some point in the future, if enough high capacity well approvals are issued in proximity to the GSD Project, there could be a significant environmental impact on the groundwater levels and nearby surface waters. Such future impacts could result in shallow residential wells that can no longer produce water from a lowered water table, and the reduction of habitat for aquatic species and/or an increase in temperature in surface waters sufficient to significantly affect a species' ability to propagate. Such impacts have not yet occurred in proximity to the GSD Project and will not occur as a result of the GSD Project. Such impacts are also not reasonably foreseeable in proximity to the GSD Project given the land use restrictions imposed by the Towns of Saratoga and Rome noted above.

Conflicts among existing competing uses for water resources in the Central Sands area from residential wells, municipal wells, crop irrigation needs, cranberry farmers, dairy farmers and beef cattle pasturing may occur if more CAFOs are sited in the region. In this case, the applicant has gone above and beyond what is required to satisfy the WEPA cumulative impact analysis requirement for the high capacity well permits, and has evaluated the potential land base that may be available for development into irrigated agriculture, and the potential impacts to surface and groundwater from associated high capacity wells over the next 20 years. There is no statutory or regulatory requirement for this type of analysis, nor is there any EPA or WDNR guidance suggesting this analysis should be required, or how it may be conducted. As such, and because it is an attempt to look into the future, this analysis has no bearing whatsoever on the

ability or reasonableness of WDNR's decision to approve the proposed high capacity wells for the GSD Project.

This EIR has evaluated the effects of additional high capacity well pumping for irrigation, beyond that which is already occurring, in the Tenmile Creek and Sevenmile Creek watersheds. The applicant used existing plat maps to evaluate land in proximity to the GSD Project Area for local zoning restrictions, residential and conservation uses, parcel sizes that may or may not accommodate an irrigated field, and natural characteristics such as wetlands or waterways that could limit the use of the land for agriculture. The result of these evaluations indicates that, at the very most, there are approximately 4,500 acres within the Sevenmile and Tenmile Creek watersheds that could be developed and used for irrigated agriculture. This represents an overly conservative estimate, as it includes land within the entire Sevenmile and Tenmile watersheds that is arguably not "proximate" to the GSD Project and it assumes many parcels could be converted from their current use to irrigated agriculture. Groundwater pumping to supply irrigation water to these 4,500 acres was then added to the groundwater model to determine what the potential impact on the Sevenmile and Tenmile Creeks could be if all of that acreage is converted to irrigated agriculture. The additional 4,500 acres was assumed to be supplied with between 12 inches and 14 inches of irrigation water in an average year. The groundwater model run used to simulate these potential future impacts indicates that negligible flow changes are likely in the flow of Sevenmile Creek and an average annual flow reduction, relative to existing conditions, of approximately one cubic foot per second in Tenmile Creek. This change is equivalent to an annual flow reduction in Tenmile Creek of approximately two percent from the potential issuance of additional high capacity well permits in the future.

There are no known additional CAFO WPDES permitting actions under consideration near the GSD Project that would result in cumulative impacts on the environmental and socio-economic resources in the area. The closest existing CAFO is CSD, about 8.5 miles southwest of the GSD Project. However, if additional CAFO WPDES permits were approved by WDNR in the vicinity of the GSD Project, it is possible there would be a limitation on the availability of land for nutrient applications. That said, if more land in the Central Sands came under the nutrient management planning requirements of Wis. Admin. Code Ch. NR 243, there would likely be a significant reduction in over-applications of nutrients, and more fields would be managed to minimize the risk of nutrient runoff and leaching to groundwater. Further, soil conditions would likely improve given the additional organic material via dairy manure applications as a source of nutrients. Implementation of the NR 243 nutrient management requirements can have significant positive impacts on groundwater quality. Moreover, the increased application of organic nutrients to sandy soils will increase the soil carrying capacity over time, eventually reducing the amount of water withdrawals needed to appropriately irrigate crops during the growing season. Finally, if more CAFOs are located near the GSD Project Area, the addition of more forage crops to potato and vegetable rotations will further increase soil quality and reduce the need for chemical pesticides commonly associated with potatoes and vegetables.

If more CAFOs are built in the Central Sands area, there may be more farm-related odors and more truck traffic associated with milk deliveries, manure applications and corn/hay harvest, especially if the other CAFOs do not employ manure digesters such as those incorporated in the CSD and the GSD Project. At the same time, if more of these activities occur in the Central

Sands, residents and neighbors would become more accustomed to this type of farming activity which is typical throughout Wisconsin. The development of further CAFOs proximate to the GSD Project is not likely to occur given the land use restrictions imposed by the Towns of Saratoga and Rome noted above.

The presence of the red pine plantation crop and the decline in demand for paper products may lead to additional conversion of lands from red pine plantation to other land uses by other land owners; however, the GSD Project is not aware of any specific plans for additional development or conversion of red pine plantation crop in the area near the GSD Project. Broad trends in forest conversion have identified many alternative scenarios to the proposed maintenance of these lands as working lands in agriculture. A recent report on the conversion of forest land by the UW – Madison and the U.S. Forest Service titled "Forest Land Conversion, Ecosystem Services and Economic Issues for Policy: A Review" identifies the cost and impact of conversion of forest land to non-agricultural uses, such as residential parcels (http://www.fs.fed.us/pnw/pubs/pnw_gtr797.pdf, page 6).

"*Over the last several decades, the demographic and ownership trends on and adjacent to U.S. forest lands have begun to change. For example, one recent study documents that in the Northeast and upper Great Lakes States, immigration rates are significantly higher in counties with large amounts of public land—particularly national forests—than those counties with less public land (Lewis et al. 2002). Although changes in forest ownership have resulted from many different social and market forces, the end result has been the conversion of private forest land to smaller, more intensively used residential parcels (Johnson and Beale 2002, Johnson and Stewart 2007, Radeloff et al. 2005).*"

2 NATURAL ENVIRONMENT AND POTENTIAL IMPACTS

2.1 Geology

A geologic map of the area near the proposed facility is shown on **Figure 2-1**. This map depicts the Pleistocene and younger geologic units that occur at the land surface in the project area.

2.1.1 Existing Conditions

The proposed GSD Project site is located in the Central Sand Plain of Wisconsin. The area is underlain by unconsolidated sand and gravel of glacial origin, which overlies bedrock. The glacial sand and gravel sediments are approximately 130 feet thick at the GSD Project Area and overlie Cambrian-age sandstone of the Mt. Simon Formation, and pre-Cambrian age crystalline bedrock. The Mt. Simon Formation does not occur in the western portion of the GSD Project Area, as shown by the hatch pattern on **Figure 2-1**. In this area, the glacial sand and gravel sediment directly overlie the crystalline bedrock.

A regionally extensive silt/clay unit, referred to as the New Rome member, occurs throughout much of the sand plains. This unit, as mapped by Brownell (1986), is about ten feet thick in the GSD Project Area and occurs at an elevation of about 950 feet MSL to the south and west to greater than 1000 feet above MSL towards the north and west. A schematic geologic cross section across the GSD Project Area is shown on **Figure 2-2**.

2.1.2 Potential Impacts

There are no potential impacts to the geology of the site area as a result of the proposed operations.

2.2 Soils and Topography

2.2.1 Existing Conditions

A soils map of the GSD Project and nearby areas is shown on **Figure 1-5**. The topography of the area is relatively flat; a topographic map of the project area is shown on **Figure 1-4**.

2.2.1.1 GSD Production Area

The GSD Production Area soils are classified as Plainfield sand, PfA, 0 to 2 percent slopes of the Plainfield Series (**Figure 1-5)**. The Plainfield sand is a deep excessively drained, rapidly permeable soil formed on outwash plains, stream terraces, uplands, and basins of glacial lakes. This soil has a high infiltration rate and low runoff potential.

The topography of the area is relatively flat as shown on **Figure 1-4**. Thirty-three soil borings were advanced on-site to confirm soil type and to characterize saturation at the GSD Production Area. The borings depths ranged from 11 feet to 30 feet below the surface. The soil is classified as a poorly graded fine to medium sand throughout the soils profile. Groundwater

was encountered in 16 of the deeper borings at a depth of 21.5 to 27 feet below the ground surface (**Figure 1-6**). Consolidated bedrock was not encountered.

The topography of the GSD Production Area is relatively flat with surface elevations ranging from 1000 to 1010 feet above mean sea level (MSL). Combined with the high infiltration rate of the Plainfield Series soils present at the proposed GSD Production Area, precipitation infiltrates rapidly and surface runoff is minimal.

2.2.1.2 Agricultural Crop Fields

The soil types in the proposed GSD Agricultural Crop Fields in the Town of Saratoga, Wood County are predominately Plainfield Series soil, PfA 0 to 2 percent slope and PfB 0 to 6 percent slope (see **Figure 1-5**). The soil types on the majority of the 1,800 acres of existing crop fields are Meehan and Friendship series soils. The topography of the GSD Agricultural Crop Fields is relatively flat with surface elevations ranging from 990 in the west to over 1,050 feet MSL in the east along the boundary between Wood County and Portage County.

2.2.2 Potential Impacts

2.2.2.1 GSD Production Area

Approximately 36 acres of the soils at the GSD Production Area will be covered with buildings, concrete storage structures and pads, and graveled access roads to accommodate the construction of the dairy farm facilities. The impervious surfaces will reduce recharge directly beneath the surfaces but because clean runoff will be directed to nearby permeable soils to infiltrate, the impervious surfaces do not have the potential to reduce groundwater recharge. Rather, because the impervious surfaces will replace vegetation, there will be less transpiration from the site as a result of the impervious surfaces and there is a potential to increase recharge above current levels. In addition, because the soils are permeable and the topography is flat, runoff from the impermeable surfaces is unlikely to flow into any nearby surface water bodies.

Topography will be affected by constructed grades associated with facility structures and runoff control systems, although the area will remain relatively flat.

2.2.2.2 Agricultural Crop Fields

The application of organic matter to sandy soils is known as a beneficial measure to condition the soil to create more productive growing conditions for crops. Increased organic matter content in soils helps to retain nutrients in the root zone for uptake by plants, aggregates soil particles, helps soil resist compaction which promotes infiltration and reduces runoff, aids growth of crops by improving the soil's ability to store and transmit water and air, and provides a source of carbon and energy for soil microbes which cycle nutrients and fight plant diseases. The benefits of manure applications on agricultural fields in Wisconsin have been described by M. Dawson and K. Kelling (2002) of the Department of Soil Science at the UW, by F. Madison and others at the UW-Extension (Madison and others, 1995), and L. Cooperbrand of the Center for Integrated Agriculture at the UW (2002).

Dawson and Kelling (2002) noted that benefits of manure applications include: the addition of macro and micro nutrients, increased soil cation exchange capacity, increased soil organic matter content, decreased bulk density, increased moisture holding capacity, and increased yields

and crop quality. Studies at the UW Hancock Agricultural Research Station found that the application of organic matter to fields increases soil porosity and nutrients and helps prevent plant diseases by supporting a rich and varied population of soil organisms (Cooperband, 2002). Foley and Cooperband (2002) found that after the second year of amending the soil with organic matter the water retention of the sandy soil increased 16 to 45 percent over the control soil. The water retention characteristics of the loamy sand shifted to those of a sandy loam with the amendments (Price and Voroney, 2007; Foley and Cooperband, 2002).

According to Cooperband (2002), when organic material is added to soils, polysaccharides released by microbes connect soil particles to form larger soil particles or macro-aggregates. These macro-aggregates create a more stable soil structure which increases water retention. Cooperband (2002) concluded that the application of organic matter increases the number of soil microorganisms. These microorganisms compete with or create an unfavorable environment for plant pathogens. There is also evidence of microorganisms triggering systemic acquired resistance in vegetable crops which reduces crop susceptibility to pathogens (Cooperband, 2002). As a result, the application of organic matter reduces the need for pesticides on the vegetable crops. The application of organic matter to sandy soils also buffers changes to the soil pH and can bind organics to prevent them from leaching into groundwater.

All land converted to irrigated cropland will be managed in accordance with a WDNR-approved NMP. The NMP is designed to ensure proper nutrient applications for agronomic success and to limit impacts to the environment. All of the fields to be converted to irrigated cropland contain permeable sandy soils. The permeable soils represent a potential risk for nutrient and bacterial contamination of groundwater from manure spreading activities, inorganic fertilizers, and pesticides. However, adherence to approved spreading rates will minimize these impacts and overall the impacts to soils are expected to be largely beneficial due to the addition of organic material to the soil profile. Additionally, both NRCS 590 and NR 243 contain provisions, prohibitions, practices and setbacks to further minimize impacts to water resources from land application activities. Potential groundwater quality impacts are discussed further in Section 2.3.2.

Tillage, planting, harvesting and irrigation practices have the potential to cause impacts such as soil loss, concentrated flow areas due to soil erosion and increased soil nutrient concentrations. These potential impacts are unlikely to result in runoff that affects surface and groundwater quality because of the flat topography and permeable sandy soils.

The GSD Agricultural Crop Fields proposed for conversion from pine plantation do not contain any riparian wetlands and all known delineated wetlands are located outside of the converted GSD Agricultural Crop Fields and will remain undisturbed. The small wetland areas classified as “too small to delineate” in the southwest corner of the quarter section south of field P68 will not be impacted because the field initially proposed for this quarter section has been eliminated from the GSD Project. Some areas of the 1,800 acres of existing crop land contain “w” soils and wetlands or waterways. There are no drain tiles on these acres. Because these acres will now be managed in accordance with a WDNR approved NMP, GSD will comply with the WDNR guidance on “w” soils and no manure will be applied to areas of fields with depth to groundwater less than 24 inches from the surface. In addition, waterway areas will be identified as Surface Water Quality Management Areas (SWQMA) and will be managed with manure application setbacks in accordance with Wis. Admin. Code Ch. NR 243. Any wetland areas

within the 1,800 acres of existing irrigated crop land are prior converted wetlands, as determined by the Farm Service Agency. Prior to manure applications on the existing irrigated crop land, all water resources and drainage features will be identified and restriction maps will be updated accordingly.

2.2.3 Significance of Potential Impacts

2.2.3.1 GSD Production Area

The anticipated impacts resulting from changes in topography in the GSD Production Area resulting from site grading and construction are insignificant as the area is relatively flat and will remain relatively flat. The 36 acres of soils at the GSD Production Area that will be covered by project structures are considered insignificant when compared with the thousands of acres inside and outside the GSD Project Area that will remain forested, or that will be converted to irrigated cropland. Moreover, due to the site development, stormwater from the GSD Production Area, including from the buildings and other impervious surfaces, will be directed either to depressions to infiltrate, or directed to farmland adjacent to the GSD Production Area to infiltrate. As a result, after development of the GSD Production Area, a larger percentage of the annual precipitation will infiltrate into the soil and recharge the water table than currently occurs with red pines growing at the site. This increase in recharge is the result of significantly less evapotranspiration from developed areas of the site than occurs from red pines. The increased infiltration of precipitation that occurs at the GSD Production Area will offset some of the groundwater pumping for the dairy as a result of increasing groundwater recharge. Additional analyses of groundwater impacts are provided in Section 2.3.

2.2.3.2 Agricultural Crop Fields

The significance of impacts resulting from the GSD Project in terms of changes in soils and topography in the GSD Agricultural Crop Fields is expected to be negligible and improvements in the soil water retention and nutrient retention capacity are anticipated. The impacts to soils from the addition of organic material to the soil profile will be beneficial. The increased organic material will result in a more productive soil profile. Consistent applications of organic materials over the long-term will increase soil holding capacity and the ability of the soil to retain water and nutrients in the crop root zone for ready uptake by the crops. This benefit will be material for the 1,800 acres of existing crop land which, to date, has only received commercial fertilizer.

The limited slopes of the Plainfield Series soils result in very few areas that produce surface runoff. All fields will be investigated for concentrated flow features that can produce runoff as they are put in to production. Concentrated flow features that are identified will be treated as a SWQMA and managed according to NR 243.14(4). This management option will establish a 25-foot buffer with nutrient applications prohibited and immediate incorporation or injection within 300 feet of the concentrated flow feature.

The soils will be managed in accordance with GSD's NMP to supply sufficient nutrients to the crops for optimum growth throughout the season and to minimize infiltration of nutrients below the root zone and leaching to groundwater or runoff to surface waters. The elements of the NMP intended to keep soil nutrients balanced for crop yield include the following:

- Development and implementation of an annual field-specific nutrient application plan based on yield goals that are attainable under average growing conditions. This plan shall account for the source, rate, timing, form and method of application of all major nutrients.
- Soils shall be tested for pH, phosphorus, potassium and organic matter more frequently than required.
- Available nitrogen from all sources shall not exceed the annual nutrient requirement of the crops.
- Adherence to phosphorus management procedures when applying manure and process wastewater to fields

The risk of infiltration of nutrients through the soil profile, manure spills on roadways and fields and runoff into surface or groundwater are minimized by legal requirements for compliance with the NMP, including the specific NR 243 criteria listed above, and WPDES permit conditions, which directly address manure transport and spill response. Compliance with all regulatory criteria is expected to reduce or eliminate most of the risk caused by the GSD Project's proposed manure spreading activity. The risks to water quality are discussed more thoroughly in Section 2.3, where groundwater and surface water impacts are discussed.

Direct impacts resulting from disturbing riparian wetlands are not expected since all known and delineated wetland areas are outside of the GSD Agricultural Crop Fields to be converted from pine plantation and will remain undisturbed. The small wetland areas classified as "too small to delineate" in the southwest corner of the quarter section south of field P68 will not be impacted because the field initially proposed for this quarter section has been eliminated from the GSD Project to avoid impacts. Any waterways identified on the 1,800 acres of existing crop land will be managed as SWQMAs in accordance with Wis. Stat. Ch. NR 243, which will minimize the potential for impacts to these areas.

The GSD Agricultural Crop Fields have been laid out such that a significant buffer is maintained along the fields that are adjacent to stream corridors of Sevenmile Creek, Tenmile Creek and Spring Branch and adjacent wetlands. The minimum width of this stream corridor buffer on fields converted from pine plantation is more than 400 feet. The width of the buffer is significantly greater than the 25-foot buffer required in NR 243.14(4)(1) and will be voluntarily implemented by GSD to further minimize potential negative impacts of its activities on the land and water resources. The 1,800 acres of existing cropland will be brought into compliance with all buffers, spreading restrictions and setbacks required in chapter NR 243.

2.3 Water Resources

Water resources in the area near the GSD Project, including both surface water and groundwater, are discussed in this section. Issues related to the quantity of surface water and groundwater are discussed initially, followed by a discussion of surface water and groundwater quality. This analysis focuses on the land proposed for development into the GSD Production Area and GSD Agricultural Crop Fields to be converted from red pine plantation. The existing 1,800 acres of crop land that will be in the NMP is currently farmed with traditional practices, including existing irrigation wells. Some areas of the 1,800 acres of existing crop land contain "w" soils and wetlands or waterways. There are no drain tiles on these acres. Because these

acres will now be managed in accordance with a WDNR approved NMP, GSD will comply with the WDNR guidance on "w" soils and no manure will be applied to areas of fields with depth to groundwater less than 24 inches from the surface. In addition, waterway areas will be identified as Surface Water Quality Management Areas (SWQMA) and will be managed with manure application setbacks in accordance with Wis. Admin. Code Ch. NR 243. Any wetland areas within the 1,800 acres of existing irrigated crop land are prior converted wetlands, as determined by the Farm Service Agency. Prior to manure applications on the existing irrigated crop land, all water resources and drainage features will be identified and restriction maps will be updated accordingly. The existing irrigation wells are not the subject of any WDNR action, and the existing crop land is only subject to approval in the NMP. No new adverse impacts are expected from the continued farming of these acres and continued seasonal pumping of existing wells. Indeed, adding manure applications and bringing 1,800 acres into the NMP program and compliance with chapter NR 243 will benefit the soil and water quality beneath those existing crop fields.

2.3.1 Water Quantity

2.3.1.1 Regulatory Framework

All residential, industrial and agricultural wells proposed to withdraw groundwater must meet construction standards identified in Wis. Admin. Code Ch. NR 812. In the Central Sands area of Wisconsin, many residential wells are "sand point" or "driven point" wells. The construction standards for sand point wells are included in sec. NR 812.23 which, among other things, requires such wells to be driven either 25 feet below ground surface or 10 feet below the static water table, whichever is deeper. In the area surrounding the GSD Project Area, the static water table is typically 20-25 feet below ground surface, so sand point wells in this area should be driven 30-35 feet or deeper to comply with the construction code. In addition, all wells are subject to locational requirements for installation (e.g., must be located on the highest point on the premises and as far removed from all potential contamination sources (NR 812.23(1)) and numerous minimum setback requirements, as provided in sec. NR 812.08 (e.g., eight feet from a buried gravity flow sanitary or storm building drain, rainwater downspout outlet, cistern and nonpotable well (§§ NR 812.08(4)(a)(1), (6), (7), (10)); twenty five feet from a septic tank, liquid tight barn gutter, animal pen with concrete floor, and buried fuel oil tank serving a single family residence, including any associated piping (§§ NR 812.08(4)(b)(2), (9), (10), (12)). Industrial and agricultural wells are typically high capacity wells and are also subject to construction standards, locational requirements and setbacks.

In 2004, the Wisconsin legislature enacted Wisconsin's current comprehensive groundwater law, including requirements for the approval and regulation of high capacity wells (2003 Wisconsin Act 310, Wis. Stat. §§ 281.34, .35). Since then, WDNR has promulgated, and the legislature has enacted administrative code chapters that also regulate the approval of high capacity wells throughout the state (Wis. Admin. Code Chs. NR 812, 820). High capacity wells are those wells with the capacity to pump more than 100,000 gallons per day (70 gpm) or properties with multiple wells which, when totaled, have a cumulative capacity of 100,000 gallons per day. All high capacity wells must be approved by WDNR prior to construction.

As a general matter, the majority of high capacity wells are considered a "Type III" action pursuant to the WEPA and typically do not require an environmental evaluation prior to WDNR issuing a high capacity well approval. Pursuant to WEPA, WDNR may conduct an environmental review of a proposed high capacity well if it is part of a larger project that also requires a WEPA environmental review as is the case with the GSD Project.

High capacity wells that do require WEPA review include those wells proposed to be located within a "Groundwater Protection Area" (GPA) or "Groundwater Management Area" (GMA), wells that have a water loss of more than 95 percent of the water withdrawn, and wells that may have a significant impact on a spring. The regulatory definition of a spring is one that discharges 0.25 cubic feet per second (cfs) or more. Wis. Stat. §281.34(1)(f). A GPA is an area within 1,200 feet of an outstanding water resource, an exceptional water resource, or a trout stream. Wis. Stat. §281.34(1)(a). To prevent environmental impacts from such wells, WDNR is authorized to include restrictions in those well approvals, including conditions on the location, depth, pumping capacity, rate of flow, and ultimate use of the well. Additionally, if the WDNR determines that the proposed well could impact a public water supply, additional restrictions may be incorporated into a well approval, including approval conditions for location, depth, pumping capacity, rate of flow, and use.

If the combined water use from all wells on the same property will average more than 2 million gallons per day in any 30-day period, the applicant is required to submit an application for a "Water Loss Approval" pursuant to Wis. Stat. §281.35. The term "water loss" means a loss of water from the basin from which it is withdrawn as a result of interbasin diversion or consumptive use or both. Wis. Stat. § 281.34(1)(g). The GSD Project includes six high capacity well properties, each with a high capacity well system as defined in § NR 812.07. Five of these high capacity well systems could average more than 2 million gallons of water loss per day in any 30-day period. As such, an application has been prepared for a Water Loss Approval for these high capacity well systems.

The Water Loss Approval process is outlined in §281.35, and before WDNR may issue such an approval, it must determine that the conditions described in Section 1.2.3 are met.

WDNR has promulgated chapter NR 852 to provide water conservation and efficiency measures that are to be evaluated and implemented, as appropriate, by Water Loss Approval recipients. In addition to the practices identified in NR 852, WDNR and GSD have developed an additional set of conservation and efficiency measures that will be implemented at the GSD Production Area and at irrigation fields as described in the Water Loss Approval. No other CAFO or farmer in Wisconsin has been subject to the Water Loss approval process or required to comply with the conservation measures GSD will be required to implement upon startup.

In 2011, the Wisconsin Supreme Court issued an opinion in *Lake Beulah Management District v. State of Wisconsin DNR*, (2011 WI 54, 335 Wis. 2d 47, 799 N.W.2d 73) (*Lake Beulah),* that broadened the scope of WDNR's high capacity regulatory authority beyond that originally delineated by the legislature. The *Lake Beulah* decision requires WDNR to consider any credible scientific information concerning potential impacts from a proposed well that is submitted to the agency during the high capacity well permit process. As noted above, prior to the *Lake Beulah* decision, WDNR was only obligated to undertake an environmental review for the types of wells specifically identified in the groundwater statute. The effect of the *Lake*

Beulah decision is to allow WDNR to undertake a more thorough environmental review of proposed wells that are not specifically identified in the groundwater statute, provided that the agency receives credible scientific information of potential impacts that may result from the installation and/or operation of the proposed well. The *Lake Beulah* decision also noted that when and under what circumstances WDNR undertakes an additional review is a highly fact-specific determination that is based on the agency's discretion. The *Lake Beulah* decision did not provide any additional guidance to the agency or the regulated community concerning when, how or to what extent WDNR may or must consider credible scientific information; nor did the decision state if or how WDNR could or should alter its high capacity well permitting program to accommodate this new review process. To date, WDNR has not undertaken any rulemaking to implement the directives from the *Lake Beulah* decision.

In September 2013, Senate Bill 302 was introduced which, if passed, would limit the conditions which WDNR may include in an approval of proposed high capacity well(s) to location, depth, pumping capacity and rate of flow unless the WDNR is authorized by the legislature to include other conditions. The bill would also require WDNR to approve or deny any high capacity well permit within a certain time period; failure to do so would constitute WDNR approval by operation of law. Legislative action on Senate Bill 302 is expected in the 2014 legislative session.

2.3.1.2 Existing Conditions

The GSD Project is located in a region with very productive aquifers and several groundwater-fed streams, including Sevenmile Creek, Tenmile Creek, Fourteenmile Creek and Chester Creek. In this geographic region of Wisconsin, groundwater and surface water are closely connected, and as a result withdrawals of groundwater can affect both surface water resources and groundwater resources.

2.3.1.2.1 Water Budget

A schematic block diagram of the water budget and subsurface in the project area in the vicinity of the project area is shown on **Figure 2-3**.

The source of groundwater and surface water in the GSD Project Area is precipitation. Average annual precipitation in the GSD Project Area is about 32 inches per year (NOAA, 2004a and 2004b). Much of the precipitation that falls on the land surface is either evaporated or transpired by vegetation and thereby returns to the atmosphere. The total amount of water that is either evaporated or transpired (evapotranspiration) averages about 22 inches per year. The difference between average annual precipitation and average annual evapotranspiration, about 10 inches per year, is the total amount of water that recharges the groundwater system annually or is surface water runoff. In the average year surface water runoff is estimated to be about 1 inch per year, thus groundwater recharge is estimated to be about 9 inches per year. The 9 inches of recharge is equal to the amount of water that discharges from the groundwater systems to the streams in the area.

The effect of irrigated agriculture on the water budget is to alter the amount of evapotranspiration that occurs. Irrigation using groundwater provides additional water to crops during periods when insufficient water is available to meet the transpiration needs of the plants. Groundwater that is pumped for irrigation that is not evaporated or transpired by the crops

returns to the groundwater; thus, the effect of groundwater pumping from irrigation can be determined by comparing the increase in evapotranspiration that occurs as the result of converting lands to irrigated crops to the evapotranspiration that occurs under existing vegetated conditions.

Most of the GSD Project Area is currently red pine plantation. Red pine is a variety of evergreen conifer and red pine roots can penetrate to depths of greater than 10 feet in sandy soils (Canadell and others, 1996; WDNR, 2003). The soils beneath the land surface of the GSD Project Area are estimated to have an available soil water capacity in the upper ten feet of about 8.4 inches (USDA, 1977). As such, red pines can tap significant water stored in the subsurface soil, water that would otherwise be recharged during the spring season. Typically during the summer months, evapotranspiration on the pine lands exceeds precipitation.

Relevant research that has evaluated evapotranspiration from red pines in similar environments include Weeks and Strangland (1971), Sun (2008), and Mao and Cherkauer (2009). The recent study by Sun and others (2008) evaluated evapotranspiration from red pines growing on sandy soils in northern Wisconsin. This study included the operation of several eddy covariance towers for collection of micrometeorological data. Eddy covariance methodology is a statistical approach used to measure the exchange rates of trace gases in the environment. The results of this study indicated that annual evapotranspiration from the red pines was in the range of 22.6 to 23.4 inches per year.

Mao and Cherkauer (2009) studied evapotranspiration from various vegetative land covers throughout the Great Lakes region. They concluded that average evapotranspiration from evergreen forests in the Great Lakes region was about 22.4 inches per year, and that average precipitation in this region was about 28.7 inches per year.

Weeks and Strangland (1971) used a water budget approach to estimate evapotranspiration from "pine trees" in the Central Sands region and concluded that average annual rate of evapotranspiration was 19.4 inches in the period 1948 to 1967; a period of below normal precipitation with average precipitation during this period of 28.8 inches per year. Recent studies by Motew and Kucharik (2013) have shown that average evapotranspiration in the Central Sands region increased by between 1.6 and 3.9 inches between 1948 and 2007 as the result of changes in climatic conditions. Thus, adjusting the evapotranspiration rate determined by Weeks and Stangland for changing climatic conditions, results in an estimated current annual evapotranspiration rate for evergreen forests of 21.0 to 23.3 inches per year.

Weeks and Strangland also measured soil moisture in the upper five feet below lands with pine trees during the growing season in 1967. Although Weeks and Strangland did not specify that the study focused on "red pines", these data show that pines in the Central Sands region effectively utilized available water in the soil during the summer.

These studies of evapotranspiration rates in the upper Midwest indicate that evapotranspiration rates of evergreens are estimated to be the range of about 21 to 23.4 inches per year, a relatively narrow range. These estimated evapotranspiration rates are consistent with the water budget described above for the project region.

2.3.1.2.2 Description of Aquifers and Wells

The main aquifer in the GSD Project Area is a water table aquifer consisting of glacial sands that are up to 130 feet thick. The depth to the water table is greater than 20 feet over much of the GSD Project Area, but ranges from 7 feet in the southeastern fields to over 48 feet in the southwestern most fields. Underlying the glacial sands in the eastern part of the GSD Project Area and to east and south of the GSD Project Area is an aquifer consisting of Cambrian-aged sandstones of the Mt. Simon Formation. The Mt. Simon Formation overlies pre-Cambrian aged crystalline bedrock, which is not a productive aquifer. This region is often referred to as the Central Sands region and/or the Central Sand Plain of Wisconsin.

The water-table aquifer in the GSD Project Area is regionally extensive and extends beyond the regional drainage systems; i.e., the Wisconsin River to the west and the Wolf River to the east. In the GSD Project Area groundwater flow is primarily from east to west as shown on the water table map on **Figure 2-4**[8]. The map on **Figure 2-4** depicts water levels from the groundwater divide between the Wisconsin and Wolf River drainages, located along the north-south trending moraine about 13 miles east of the project area, to the Wisconsin River, which is the regional groundwater discharge area.

The hydraulic conductivity of the water table aquifer was estimated, based on specific capacity data in the WDNR water well database, to range between 46 feet per day and 734 feet per day in the vicinity of the GSD Project Area. The hydraulic conductivity of the sandstone aquifer was estimated based on specific capacity data to range between 1 and 159 feet per day. As described below, in the GSD Project Area the hydraulic conductivity of the water table aquifer is estimated to be about 125 feet per day and the hydraulic conductivity of the sandstone aquifer is estimated to be about 10 feet per day.

Groundwater resources in the vicinity of the GSD Project Area have been investigated by a number of researchers over the years. A study of groundwater conditions in the Buena Vista basin, which is located immediately to the north of the GSD Project Area, was conducted by staff at the Wisconsin Geological and Natural History Survey (Bradbury and others, 1992). Recently researchers at the Center for Watershed Science and Education at the UW – Stevens Point have completed a number of studies of groundwater conditions in the Central Sand Plain with an emphasis on understanding the effects of irrigation pumping on water resources (Kraft and Mechenich, 2010; Mechenich and others, 2009; Kraft and others, 2012). Other studies of hydrogeologic conditions in the area include a study by the U.S. Geological Survey titled "Effects of Irrigation on Streamflow in the Central Sand Plain of Wisconsin" (Weeks and Stangland, 1971), another study by the U.S. Geological Survey titled "Hydrology of the Little Plover River Basin Portage County, Wisconsin and the Effects of Water Resource Development" (Weeks and others, 1965), and the U.S. Geological Survey study "Low-Flow Characteristics of Streams in the Central Wisconsin River Basin, Wisconsin" (Gebart, 1982). These studies document relatively consistent characteristics of the aquifer in the Central Sands region. A

[8] **Figure 2-4** depicts water levels measured in the period 1970 through 1979; a period in which a large number of water levels measurements were made. This data continues to be relevant today, as it demonstrates the overall groundwater flow direction in the region, which is not subject to significant changes over time.

summary of water resource studies in the Central Sands is contained in a recently published paper by Kniffin and others (2013).

2.3.1.2.3 Private/Public Supply Wells

Residences in the vicinity of the project area obtain water supply from wells completed in the water table aquifer. Residences located within ½ mile of the GSD irrigated areas are shown on **Figure 2-5,** with residence locations determined using aerial photography**.** Based on the assumption that each residence has a single private well, this figure illustrates the approximate location of wells within ½ mile of the GSD irrigated areas. There is one residence located within ½ mile of the GSD Production Area, with the closest residence located 2,350 feet from the GSD Production Area, and approximately 440 residences located within ½ mile of the field areas proposed for irrigation.

To understand the characteristics of private wells within ½-mile of the irrigated areas, well records were obtained for private wells from the WDNR water well database and the Wisconsin Historical and Geological Society. Based on these data, private well depths within ½ mile of the field areas proposed for irrigation range from 15 to 102 feet below ground surface with an average depth of 49 feet for wells and with only one well, located in the floodplain of the Wisconsin River, shallower than 25 feet (refer to **Figure 2-6**). The estimated saturated thickness of these private wells range from 8 to 94 feet with an average saturated thickness of 25 feet (**Figure 2-7**). Some shallow wells in the area may be sand point wells with well construction as shown on **Figure 2-8** with an open screen interval in the sand and gravel aquifer.

The nearest municipal supply well is located in Nekoosa about 4 miles northwest of the GSD Project Area on the west side of the Wisconsin River. Municipal wells are shown on **Figure 2-9**.

The locations and average annual pumping rates for existing high capacity wells that had pumping data reported through 2012 in the vicinity of the GSD Project are shown on **Figure 2-10**. The average pumping rates shown in **Figure 2-10** are the average annual 2007 to 2011 pumping rates as reported by the WDNR; for wells that only had 2012 pumping rates reported, the 2007 to 2011 average rates were estimated based on the ratio between the 2012 pumping rates and the average rates in 2007 to 2011 reported for wells in the area. Most of these high capacity wells are used for irrigated agriculture, and most of the high capacity irrigation wells in the area are located to the east of the GSD Project Area. The locations of high capacity wells that were permitted in 2012 to 2013 and did not have pumping data are also shown in **Figure 2-10**.

2.3.1.2.4 Surface Water Features and Streamflows

The surface water features in the vicinity of the GSD Project Area are shown on **Figure 1-8** and are discussed below.

Tenmile Creek: The major stream in the GSD Project Area is the groundwater fed Tenmile Creek, a tributary of the Wisconsin River. The flow in Tenmile Creek is the result of groundwater discharge to the stream along most of its length. The watershed for Tenmile Creek is approximately 84 square miles in size. Other than a system of drainage ditches in the headwaters of Tenmile Creek to the east of the GSD Project Area in Portage County, Tenmile

Creek has no tributaries, and discharges into the Wisconsin River. Tenmile Creek is a Class 3 trout stream along the two mile long reach from County Trunk Highway (CTH) U to Bell Road, and a Class 2 trout stream along the reach from Bell Road to the Wisconsin River. The WDNR has classified the natural community in Tenmile Creek in the 7.58 mile reach upstream from the Wisconsin River to Bell Road as "cool-water warm transition", and classified the temperature regime as "warm" (WDNR, 2012a).

The U.S. Geological Survey maintains a stream gaging station on Tenmile Creek at STH 13, with a drainage area of about 73 square miles upstream of this gage. Daily flow data at this location are available for the periods 1965 to 1979, 1987 to 1994, and 1998 to the present. The most recent average annual flow at this gage, based on the period 2000 through 2011, is 55 cfs. Almost all of the flow in Tenmile Creek is derived from groundwater discharge. Surface water contribution to creeks in this area is small due to the flat topography and very permeable soils. Flow varies seasonally with the highest flows occurring in the late winter and spring when much of the groundwater recharge occurs and generally declines from these peak flows until the following late winter. Average monthly base flows in Tenmile Creek based on the past eleven years of data are shown on **Figure 2-11.**

Stream flow measurements at Tenmile Creek are summarized in **Table 2-1**. A set of flow measurements were taken on August 28, 2012, as part of the work in preparation of this EIR, at several road crossings of Tenmile Creek from CTH U at the upstream and eastern boundary of the GSD Project to downstream at Rangeline Road to determine groundwater discharge to Tenmile Creek during the low flow conditions that prevailed during the summer of 2012. Measured flows on August 28th were: 2.2 cfs at CTH U, 12.5 cfs at Bell Road, 23 cfs at STH 13 (from USGS gage), and 32 cfs at Rangeline Road. These data indicate that significant groundwater discharge occurs to Tenmile Creek in the vicinity of the GSD Project during extended dry periods.

The WDNR also collected stream flow data on Tenmile Creek at CTH U during the late summer of 2012 during the period of very low flows in the stream. Stream flow measurements were made on August 7th, August 23rd, August 29th, September 13th, September 20th, and October 16th. Measured flows on these dates were 2.4 cfs, 2.0 cfs, 3.1 cfs, 2.0 cfs, 1.1 cfs, and 10.4 cfs, respectively.

Spring Branch and Fourteenmile Creek: The southeastern portion of the GSD Project Area lies within the drainage basin of Spring Branch, a tributary of Fourteenmile Creek, and a portion of the existing 1,800 acres of irrigated fields are located near the upper reaches of Fourteenmile Creek. The existing 1,800 acres currently receive nutrients for growing crops, but those fields are not included in any nutrient management plan and those applications are not currently regulated by WDNR. Much of the Spring Branch watershed was altered by the construction of Kingsway Dam, which created Upper Lake Camelot, and Sherwood Dam, which created Sherwood Lake in the late 1960's and early 1970's (Evans 2007a, 2007b).

Spring Branch was observed on five occasions as part of the EIR evaluation, although no flow measurements were obtained due to dry creek bed conditions. During each field reconnaissance the channel was observed where the stream crosses Akron Road, which is located about 3,000 feet upstream of the upper bay of Upper Lake Camelot (this upper impounded area is known as Walden Pond). No water was present in the channel on June 14, July 17, and

August 16, 2012, or on July 4, 2013. Water was present on May 30, 2013; however, it was in discrete, non-flowing puddles. The month of May 2013 was an extremely wet time of year in this area, and the puddles observed in this area were not flowing and are attributed to the significant rainfall. The channel at Akron Road was also observed to have significant vegetation growing in the channel, including woody plants. Based on these observations, it is concluded that this portion of the stream is typically dry. At the Adams County line and upstream from that location, the creek bed was dry when observed in August 2012 and June 2013. The stream channel was characterized and determined to meet wetland status, and was delineated as jurisdictional wetland on June 18, 2013 (**Appendix C**).

Much of the remainder of the Fourteenmile Creek drainage system has been dammed and is occupied by a series of lakes. Spring Branch drains into Upper Lake Camelot, which has a surface area of 191 acres. Fourteenmile Creek drains into Lower Lake Camelot, which has surface area of 260 acres. Both Upper and Lower Camelot Lake flow through dams into Lake Sherwood near STH 13. These three lakes, often referred to as the 'Tri-Lakes", have an average depth of 8 feet. A channel connects Lower Lake Camelot to Upper Lake Camelot (Adams County Land and Water Department, 2013)[9]. Groundwater discharge to Upper Lake Camelot and Sherwood Lake are qualitatively described in Shaw and others (2001). Total groundwater discharge to Upper Lake Camelot was estimated to be on the order of one cubic foot per second in the study by Shaw and others (2001).

Sevenmile Creek: Located about two and one-half miles to the north of Tenmile Creek is Sevenmile Creek. Sevenmile Creek is significantly smaller than Tenmile Creek and it is likely that historical drainage activities diverted a portion of the headwater flow of Sevenmile Creek into Tenmile Creek. Sevenmile Creek has a watershed size of approximately 23.7 square miles, and has two unnamed intermittent tributaries. Sevenmile Creek from Rangeline Road to the Wisconsin River, a 3.2-mile long reach, is a designated Class I trout stream and is a designated Exceptional Resource Water. This reach is approximately the perennial reach of the stream, where the creek flows year round (except when diverted for the cranberry operation), as it is this reach where the stream is significantly incised in the topography and where significant groundwater discharge occurs to Sevenmile Creek. Upstream of Rangeline Road Sevenmile Creek is ephemeral, meaning this area of the creek may not be wet every year, and during the years it is wet, it may only be wet for a short period of time. The WDNR has classified the natural community in Sevenmile Creek in the GSD Project Area as cool-water cold transition, and classified the temperature regime as cold (WDNR, 2012b).

A cranberry farm operation (Nekoosa East) is located on Sevenmile Creek about two miles upstream of the Wisconsin River, and water is diverted via constructed dam from Sevenmile Creek to the cranberry operations as needed. Historic and continued water diversions from the cranberry operation have and will continue to periodically reduce or eliminate the flow of Sevenmile Creek in this area. The water diverted by Nekoosa East is not discharged back to Sevenmile Creek, but rather is discharged directly into the Wisconsin River. During a field reconnaissance of the creek on October 3, 2012, the cranberry farm was diverting 100 percent of

[9] http://www.adamscountylwcd.net/Lakes.html

the flow of Sevenmile Creek at the diversion dam. Sevenmile Creek began flowing a short distance downstream of the diversion dam and from there flow increased along most of the lower reach of the creek upstream of the Wisconsin River. Based on these observations, Sevenmile Creek downstream of the diversion dam was fed entirely by groundwater flow in October 2012.

Inquiries were made at the UW-Stevens Point and WDNR files were reviewed to obtain historical flow data from Sevenmile Creek. A single measurement of the flow in Sevenmile Creek was found in the files at the WDNR; a flow of 1.62 cfs where the stream crosses Hollywood Road measured on July 14, 1999. This location is directly upstream from the diversion dam.

Flows in Sevenmile Creek were measured as part of the work in preparation of this EIR in late spring of 2012 (May-June), on August 28, 2012, on October 3, 2012, on May 24, 2013, on August 30, 2013 and on September 4, 2013. In addition, flows were measured by the WDNR on August 7, 2012. All of the available flow data are listed on **Table 2-1** and the locations for stream flow measurements on Sevenmile Creek downstream of Rangeline Road are shown on **Figure 2-12**.

On a site visit on May 24, 2012, flow was measured at two locations in Sevenmile Creek; at CTH Z (just upstream of the Wisconsin River) and at Rangeline Road about 2.5 miles upstream of the Wisconsin River. Measured flows at these two locations were 5.5 cfs and 4.8 cfs, respectively. Subsequently on June 14, 2012 a flow of 5.6 cfs was measured at CTH Z just upstream of the Wisconsin River. These flows represented average late spring conditions.

During the hot and droughty summer of 2012, flows in Sevenmile Creek were measured in August and in October. On August 7th and 28th, the measured flows at Rangeline Road were 0.45 cfs and 0.38 cfs, respectively. On August 7th, the measured flow downstream at CTH Z was 2.1 cfs.

On October 3, 2012, Sevenmile Creek was traversed from Rangeline Road to the Wisconsin River and flows were measured at several locations to determine the amount of groundwater discharge occurring to Sevenmile Creek downstream of Rangeline Road. The results of these flow measurements are shown on **Figure 2-12**. Stream flows varied from 0.6 cfs at approximately 2,000 feet downstream of Rangeline Road to 2.3 cfs just upstream of CTH Z. Just upstream of Hollywood Road a flow of 1.8 cfs was measured but downstream of Hollywood Road, just below a dam for the nearby cranberry operation, very little flow was observed (documented in **Figure 2-12** as 0.0 cfs). Flow then increased downstream of the dam to about 2.3 cfs at CTH Z. These data indicate that significant fluctuations occur in this system, but groundwater discharge occurs in this lower reach of Sevenmile Creek even following a very hot and dry summer.

Other Surface Water Features: Other nearby surface water features include: Ross Lake, located in the floodplain of the Wisconsin River just west of the of the GSD Project Area; Nepco Lake to the north that was formed by the damming of Buena Vista Creek in 1972; Petenwell Lake created by damming the Wisconsin River downstream of the project area in 1948, and Chester Creek located on the eastern side of the floodplain of the Wisconsin River about two miles to the south of Tenmile Creek along CTH Z (**Figure 1-1**). The lower 1.2 mile reach of Chester Creek, just upstream of the Wisconsin River, is a designated Class I trout stream. Flow data are not available for Chester Creek.

Floodplain areas in the Town of Saratoga are shown on **Figure 2-13**. These floodplains encompass an area of about 5,373 acres (17 percent of the land area) within the Town, much of it in the floodplain of the Wisconsin River.

2.3.1.2.5 Wetlands

Wetlands were identified based on the Wisconsin Wetland Inventory available through the WDNR.[10] Wetlands identified near the GSD Project Area are shown on **Figure 2-14**. Riparian wetlands occur along Sevenmile Creek, Tenmile Creek, Fourteenmile Creek and Chester Creek.

Approximately 2,700 acres of wetlands are present in Saratoga Township. Approximately 154 acres of riparian wetlands are located along Sevenmile Creek, with approximately 8 acres located north of field P05 and within the GSD Project Area but outside of the GSD irrigated areas and will not be disturbed by the GSD Project. About 330 acres of riparian wetlands are present along Tenmile Creek but are outside of the GSD Project Area and will not be disturbed by the GSD Project. Wetlands associated with Fourteenmile Creek (258 acres) and Chester Creek (127 acres) also are outside the GSD Project Area. Because all of these wetlands are located outside of the GSD irrigated areas, none will be disturbed by conversion to crop fields, cultivation or nutrient applications. These riparian wetlands will remain as natural riparian habitat and appropriate setbacks will be maintained and BMPs implemented as required in the NMP.

Spring Branch (a tributary of Fourteenmile Creek) is an intermittent stream that contains some wetland plant communities in select stretches of the stream. Spring Branch was previously channelized into a linear ditch in southwest Portage County and this action changed the nature of the surface and groundwater connection to the original stream course. As a result, Spring Branch is ephemeral in nature, meaning that it typically only flows during spring snow-melt or significant precipitation events. Consistent with the five field observations made for this EIR and described in Section 2.3.1.2.4, the stream bed for most of the year is dry and contains some wetland species in lower spots or stretches that are ponded for short periods of time before the surface water infiltrates into the sandy soils.

Three small wetland areas identified in the Wisconsin Wetland Inventory as "too small to delineate'" are present along Spring Branch in the southwest corner of the quarter section south of field P68. These wetlands were delineated in June 2013; the Wetland Delineation Report is included as **Appendix C** (Eco-Resource Consulting, LLC, 2013). The wetland delineation confirmed the presence of three small wet meadow wetland areas – 0.19 acre, 0.15 acre and 0.08 acre in size. All three wetland areas are confined to the stream channel and banks of Spring Branch. Due in part to the locations of these wetlands, this quarter section was removed from the GSD Project. As such, these small isolated wetland areas will not be affected by the GSD Project.

The wetland delineation along Spring Branch also identified stream flow blockages which constitute "significant disturbances" in these areas. Two areas of stream flow blockages were identified – one is described as earthen fill, the other is described as a partially crushed culvert

[10] http://dnr.wi.gov/topic/Wetlands/inventory.html; May 2013

that is 60 percent filled with sand. The significant disturbances indicate the stream resource and delineated wetlands may be of limited quality.

One potential isolated wetland was identified along STH 73 in the quarter section west of field P68; however, no wetlands were found during a field survey in June 2013 (Steve Hjort, personal communication, 2013), and the area of interest was not identified as a wetland on the WDNR Wetland Inventory map. This quarter section was removed from the GSD project.

Three small wetland areas classified as "too small to delineate" are present east of field P68 in Portage County and additional wetlands are present in Portage County east of the GSD Agricultural Crop Fields. These wetlands are located outside of the GSD Project.

2.3.1.3 Potential Impacts

Anticipated groundwater usage by the total GSD Project is estimated to be about 1,800 million gallons per year. Approximately 98.5 percent of the water will be used to irrigate the GSD Agricultural Crop Fields converted from pine plantation during the growing season; the remaining 1.5 percent will be used at the GSD Production Area year round. The water pumped from new irrigation wells will be applied to the approximately 4,660 acres of GSD Agricultural Crop Fields that will be converted from pine plantation and planted in forage crops and vegetables at an average annual rate estimated to be about 14 inches per year. The estimated average water usage is based on irrigated fields in Juneau County that are part of the CSD and fields that are currently farmed by the Wysocki Family Companies, and fields that are located east of the GSD Project. Pumping from existing irrigation wells on existing crop land will remain consistent with past pumping. Crops will be rotated among the fields with a typical rotation consisting of 35 percent alfalfa, 20 percent potatoes, 18 percent field corn for silage, 5 percent field corn for grain, 12 percent alfalfa first cut followed by sweet corn, and 10 percent double cropped with peas and beans.

Groundwater for irrigation of the GSD Agricultural Crop Fields to be converted from pine plantation will be obtained from 37 new high capacity wells and from an existing high capacity well[11]. The high capacity wells will be sized to provide 8 gpm per acre of fields irrigated with the well; the largest well, which will provide irrigation water to 161 acres, will have a capacity of 1.87 million gallons per day (1,300 gpm). The existing irrigation well has a capacity of 1.73 million gallons per day (1,200 gpm). A listing of proposed high capacity wells and characteristics are listed on **Table 2-2**.

Groundwater for the GSD Production Area will be obtained from two new high capacity wells; one with a capacity of 504,000 gallons per day (350 gpm) that will be the primary well and one with a capacity of 360,000 gallons per day (250 gpm) that will serve as a backup well for use when the primary well is not functioning and for testing to ensure proper operation. The total groundwater requirement for the GSD Production Area is estimated to be 72.5 million

[11] The existing high capacity well, well no. 38632, is used to irrigate existing agricultural fields and will also be used to supply water to field P76. Additional existing wells are located on the existing 1,800 acres of existing crop land added to the NMP, but these wells are not part of any proposed high capacity well system and are not the subject of any WDNR action.

gallons per year. The groundwater used in the GSD Production Area is needed for animal watering and cleaning with the remainder utilized for summer cooling of the barn and other operational needs. For purposes of the evaluations conducted for this EIR, 100 percent of the water use for the GSD Production Area is considered to be consumptively used; however, this is a very conservative assumption, as on average 45 million gallons of the water used at the dairy (62 percent of the water use) will be incorporated in the manure that will be spread on the fields and some water will be returned to the groundwater via infiltration.

The potential effects of new withdrawals by the GSD Project are a lowering of groundwater levels in the vicinity of the GSD Project and reductions in stream flows. In general, the lowering of groundwater levels, if of sufficient magnitude, has the potential to reduce the capacity of existing residential wells in the vicinity of the GSD Project and in the unlikely extreme case, could cause existing shallow residential wells to dry up. Stream flow reductions have the potential to affect the fishery resources and other aquatic resources in streams, including riparian wetlands, as well as to affect recreational uses of streams. The recently published U.S. Geological Survey Publication "Streamflow Depletion by Wells – Understanding and Managing the Effects of Groundwater Pumping on Streamflow" (Barlow and Leake, 2012) describes the current understanding of the physical process that controls how groundwater pumping results in a lowering of groundwater levels and reductions in stream flow.

Wetland loss may result from draining of wetlands. If groundwater reductions result in a decrease in wetted stream channel, wetland plant colonization may occur on these saturated substrates in riparian wetlands and isolated wetlands. Such colonization often happens on a seasonal basis, due to fluctuations in water levels and stream volume. A permanent colonization could result in a change in the wetland plant community. Therefore, a change in water level has the potential to result in a change in plant communities. Biodiversity support, water quality improvement, flood abatement, and carbon sequestration are key functions that can be impaired when wetlands are lost or degraded (Mitsch and Gosselink, 2000).

For purposes of this EIR, the magnitude and distribution of reductions in groundwater levels and in groundwater discharge to surface water bodies were evaluated using a three-dimensional groundwater model of the project area, which is discussed below. The groundwater flow model was used to evaluate the potential impacts to groundwater levels and groundwater discharge in the GSD Project Area. See Section 2.3.1.3.2 for the model calculated effects, and Section 2.3.1.4 for an evaluation of the significance of the potential impacts.

2.3.1.3.1 Groundwater Flow Model

The best method available for estimating the potential effect of pumping groundwater on water levels and stream flows is a numerical groundwater model. Numerical groundwater models can represent the spatial geometries of the groundwater system, such as thickness of geologic units and spatial locations of pumping wells and headwater streams, and the hydraulic properties of the aquifers. The appropriate representation of spatial geometries and hydraulic properties is essential for estimating the water level changes that have the potential to occur as the result of pumping and the potential rate of propagation of the water level changes to groundwater discharge areas. There are a number of computer programs that are used to develop numerical models of groundwater systems; the most commonly used program is MODFLOW developed by the U.S. Geological Survey.

A regional model of groundwater flow in the Central Sands region has been developed by Mechenich and others (2009) using the MODFLOW program (the model is referred to in this report as the "regional model" and "regional groundwater model"). As this model was based on a compilation of available groundwater data, and was consistent with available data, a model similar in structure to the regional groundwater model was used to estimate the effects of new withdrawals proposed for the GSD Project.

The groundwater model that was developed for the GSD Project encompasses an area of approximately 600 square miles. This model is referred to in this report as the "site-specific model" and this model is described in **Appendix D**. The site-specific model domain is much smaller than the model domain used in the regional model, but is sufficiently large to include all of the important factors and processes that are relevant to understanding the effects of pumping for irrigation of the GSD Agricultural Crop Fields and the proposed GSD Production Area. The eastern boundary of the model domain is the groundwater divide between the Wisconsin River and Wolf River drainages, the western boundary is the Wisconsin River and Petenwell Lake, the northern boundary is the Little Plover River and the southern boundary is the downstream portion of Big Roche-A-Cri Creek. Major streams in the site-specific model domain, all of which are tributaries to the Wisconsin River, include headwaters of Big Roche-A-Cri Creek, Fourteenmile Creek, Tenmile Creek, Sevenmile Creek, Fivemile Creek, Buena Vista Creek, Twomile Creek, and Onemile Creek (**Figure 2-15**).

A modified version of the finite-difference computer program MODFLOW-2000 developed by the U.S. Geological Survey was used for the site-specific model. This version of MODFLOW (Bedekar *et al*. 2011) was developed by S.S. Papadopulos & Associates, Inc. for the U.S. Department of Energy (CHPRC-00258 Rev 2) to handle dry cells in a manner similar to MODFLOW-SURFACT and MODFLOW-NWT. The graphic-user-interface Groundwater Vistas was used to prepare groundwater model input files and to evaluate model results. The model finite-difference grid and model input parameters are described below.

The modeled effect of the long-term pumping of groundwater within the model domain is to lower groundwater levels in the immediate vicinity of the pumped wells and to decrease groundwater discharge to streams. The modeled reduction that occurs in groundwater discharge is a function of the length of time that the well is pumped. When a well is initially pumped, all of the water that is pumped comes from groundwater in storage in the aquifer which results in an initial lowering of the water table in the vicinity of the well, and initially there is no reduction in groundwater discharge to streams. As a well is pumped for a longer period of time, water-table declines eventually propagate to the groundwater discharge areas at the headwater streams, and a reduction in groundwater discharge occurs. Theoretically, if a well is pumped at a constant rate for a very long period of time, water-table declines stabilize and the reduction in groundwater discharge to streams equals the pumping rate.

Groundwater pumping currently occurs within the model domain for irrigated agriculture. The locations of high capacity wells in the model domain, with average annual pumping rates, are shown on **Figure 2-16**. Most of the high capacity wells are located in the eastern part of the model domain to the east of the GSD Project Area. Almost all of the high capacity wells are used for irrigation. This pumping primarily occurs during the summer growing season of May through September. Irrigation pumping has resulted in a lowering of the water table, has resulted in a decrease in groundwater discharge, and has resulted in a decrease in stream flows relative to

conditions that would have existed had no pumping ever occurred. The magnitudes of the lowering of the water-table and stream flow reductions that have occurred in the area as a result have not, however, been measured. Existing conditions, which include the current irrigation pumping, were used as the baseline conditions from which impacts of the proposed pumping for the GSD Project were determined.

2.3.1.3.1.1 Finite-Difference Grid and Boundary Conditions

The site-specific model grid used in the groundwater flow model consists of 117 rows and 142 columns. A model grid spacing of 650 feet by 650 feet is used in the vicinity of the proposed GSD Project where most effects on groundwater levels and stream flows will occur; larger grid spacings are used elsewhere. Four layers are represented in the model: model layer 1 represents approximately the upper saturated portion of the sand and gravel aquifer; model layer 2 represents fine-grained (silt/clay) layer that occurs within the sand and gravel aquifer in the project area[12], model layer 3 represents the lower part of the sand and gravel aquifer and model layer 4 represents the sandstone aquifer where present.

The base of the sand and gravel layer (model layer 3) was developed from an analysis of available data on the elevation of the top of the bedrock in the model domain. The base of the sand and gravel unit (equivalent to the top of the bedrock surface) was estimated based on the top of rock as reported for individual wells in the WDNR 2012 Well Information database[13] and the WiscLith[14] database. These data were used to develop a structure contour map of the top of the bedrock surface. Additional data on the base of the sand and gravel unit were obtained by reviewing paper logs available from the Wisconsin Geological and Natural History Survey for wells greater than about 120 feet deep (for wells constructed prior to about 1988). The contoured surface was adjusted in some areas of the model domain based on the depth of wells completed in the sand and gravel aquifer where the bottom elevation of the well could provide a maximum elevation of the bedrock surface.

The base of the sandstone unit was developed based on the bottom of the sandstone unit as defined in Mechenich and others (2009), in addition to lithologic data in the WiscLith database, where the top of the sandstone was defined by 20 borings located in or near the model area that penetrated through the sandstone into an underlying stratigraphic unit. WiscLith point data, where the sandstone unit was encountered but not fully penetrated by a boring, also were used to determine the maximum elevation of the base of the sandstone unit. The sandstone thickness contours of Mechenich and others (2009) were found to be generally consistent with the WiscLith point data. The area where the sandstone unit is not present was based on Mechenich and others (2009) and was used to define the extent of the sandstone unit. The base of the sand and gravel aquifer as represented in the site-specific model is shown on **Figure 2-17** and the base of the sandstone aquifer as represented in the site-specific model is shown on **Figure 2-18**.

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[12] Where the fine-grained layer is not present within the model domain, layer 2 is assigned a nominal thickness of 1 foot and a high vertical conductivity .

[13] Wisconsin Department of Natural Resources, 2012. Well Data, CD 2102 Well Data.exe

[14] Wisconsin Geological and Natural History Survey, 2009. Wisclith, Open File Report 2009-03.

A no-flow boundary is used to represent the regional groundwater divide, while the rivers and streams that bound the domain to the north, west and south are simulated with constant head boundaries. The heads specified along these constant-head boundaries were derived from 1:24,000 scale U.S. Geological Survey topographic maps.

Tenmile Creek and Sevenmile Creek were modeled with the MODFLOW streamflow routing (SFR) package so that losing reaches of the streams that could potentially be caused by irrigation pumping could be accurately simulated. Other streams within the model domain were modeled with the MODFLOW drain package as these streams are groundwater discharge areas. Nepco Lake was simulated with the MODFLOW river package so that groundwater inflow and outflow from the lake could be accurately simulated (Karnauskas and Anderson, 1978). Elevations at each model cell were determined based on visual analysis of 1:24,000 United States Geological Survey (USGS) topographic maps.

2.3.1.3.1.2 Recharge

Variable recharge rates were specified for the model domain. A value of 8.7 inches per year was used in the western part of the model domain where there are extensive conifers, and a value of 10.2 inches per year was specified in the eastern part of the model domain. These recharge values were estimated during the model calibration process as described below. These recharge rates result in stream flows within the model domain that are consistent with measured stream flows.

Modeled recharge is a direct function of annual precipitation and evapotranspiration. As noted above, the effect of irrigated agriculture on the water budget is to alter the amount of evapotranspiration that occurs. As a result, in this case the effect of groundwater pumping can be determined by evaluating the increase in evapotranspiration that occurs when lands are converted from pine plantation to irrigated crops. Evapotranspiration from irrigated crops is a well-researched topic. An excellent primer on crop evapotranspiration is the book "Crop Evapotranspiration – Guidelines for Computing Crop Water Requirement" by the Food and Agriculture Organization of the United Nations (Allen and others, 1998). The process of calculating irrigation requirements based on evapotranspiration is concisely described for upper Midwest conditions in training materials prepared by Northcott (2010).

Average evapotranspiration rates for the GSD Project Area were calculated using standard procedures. A concept called "reference evapotranspiration" or "potential evapotranspiration" is the starting point for estimating irrigated crop evapotranspiration. The "reference evapotranspiration" is the evapotranspiration that occurs from a well-watered reference surface; the reference surface closely resembles an extensive area of green grass of uniform height, actively growing, that completely shades the adequately watered ground. A number of standard methods have been developed to estimate reference evapotranspiration from climatic data. The UW-Extension provides real-time daily values[15] (and historical data) of reference evapotranspiration throughout Wisconsin based on the Priestley Taylor (1972) method and climatic data from atmospheric observations and satellite-derived estimates.

[15] http://www.soils.wisc.edu/uwex_agwx/sun_water/et_wimn

The evapotranspiration that occurs from an irrigated crop is estimated by multiplying the reference evapotranspiration (ETo) by a crop coefficient (Kc). The crop evapotranspiration differs from the reference evapotranspiration as the ground cover, canopy properties and aerodynamic resistance of the crops are different from grass. The crop coefficient incorporates the characteristics that distinguish field crops from grass and provides an estimate of evapotranspiration for crops grown in large fields under excellent agronomic and soil water conditions (refer to Allen and others 1998, Chapter 6 for a good discussion of crop coefficients). Typical crop coefficients for vegetable crops grown in Wisconsin are listed in Northcott (2010). As described in a publication for estimating irrigation scheduling in Wisconsin, the main factor affecting the crop coefficient is the canopy cover (Curwen and Massie, 1994), which gradually increases from time of planting until full cover is reached in early summer.

Based on the calculated evapotranspiration rates for the proposed irrigated crops, it is determined that the groundwater used for irrigated crops will result in a net increase in evapotranspiration from the converted GSD Agricultural Crop Fields in a normal year of about 2.2 inches per year relative to evapotranspiration from the existing red pine plantations. Thus, the proposed withdrawals for irrigation will result in a reduction in net groundwater recharge of about two inches per year. In an average year, this is equal to about 300 million gallons per year, and equivalent to 580 gpm or 1.3 cfs.

The difference in recharge under pre-irrigation conditions and net recharge under irrigated conditions is termed the "irrigation effect". Researchers at the UW-Stevens Point have published a number of papers in recent years that have attempted to quantify the irrigation effect in the Central Sands Region (Kraft and others, 2012; Kraft and others, 2010; Mechenich and others, 2009). This research has concluded that the irrigation effect is about 2 inches per year (Kraft and others, 2010), which is consistent with the expected irrigation effect for the converted GSD Agricultural Crop Fields. Kraft and others (2010) noted that there is uncertainty associated with the estimated irrigation effect and that the potential range of the irrigation effect is between 1.6 inches and 4 inches per year depending on the pre-irrigation vegetation type.

2.3.1.3.1.3 Model Parameters

The important parameters in the groundwater model are the horizontal hydraulic conductivity in the different aquifers, and the vertical hydraulic conductivity of the fine-grained layer (model layer 2). The horizontal and vertical hydraulic conductivity in the sand and gravel aquifer and the vertical hydraulic conductivity of model layer 2 were estimated in the model calibration process described below. Based on well testing data, the horizontal hydraulic conductivity in the sand and gravel aquifer within the model domain was estimated to be between 46 and 734 feet per day. The horizontal hydraulic conductivity of the sandstone aquifer is represented by a single zone and estimated to be 7 feet per day. The vertical hydraulic conductivity of the fine-grained layer was calibrated as 0.3 foot per day as described below.

2.3.1.3.1.4 Model Calibration

The automated model calibration computer program "PEST - Model Independent Parameter Estimation" (PEST) was used to assist with model calibration (Doherty, 2009). A groundwater model is deemed calibrated when the difference between model outputs and field observations, referred to as calibration targets, has been reduced to a minimum in the weighted least squares

sense [i.e., the sum of squared differences between model outputs and measurements, termed the objective function or PHI (Φ)]. Model calibration is an iterative process that seeks to reduce Φ by determining the sensitivity of the model parameters to the calibration data. When the calibration process can no longer reduce Φ (i.e., $\Phi = \Phi_{min}$), the parameters are considered optimal with respect to the measured data set and may be used to make predictions under conditions comparable to the calibration conditions. The computer program PEST automates the procedure of determining the minimum value of Φ.

The first step in the model calibration process is the identification of measured hydrologic data that can be used as calibration targets. Two sets of calibration targets were identified: water levels in monitoring wells, and measured stream flows. Water levels at 572 wells in the sand and gravel aquifer, and base stream flows at nine locations were used in the model calibration process. These water levels were collected over several decades but as an analysis of annual and seasonal variations in water levels indicated that the range of variation in small to the spatial variation in water levels. Therefore, it is appropriate to use these water levels as calibration targets since there is no extensive synchronous set of water-level measurements.

All calibration targets that were identified are intended to represent average, baseline hydrologic conditions. As a result, the calibration process consisted of the development of a groundwater model to simulate average, baseline conditions. In the calibration of this model, because monthly flows were available for Tenmile Creek, the model was run in monthly time steps. The median monthly flows in Tenmile Creek and calculated average annual water levels and estimated base flows at other targets were used to judge the accuracy of the model calibration[16]. In this groundwater model, the variable parameters are the distribution of hydraulic conductivity, the magnitude of hydraulic conductivities, and the storage properties of the aquifer units. For purposes of model calibration the storage properties were specified as a specific yield of 0.25 and a specific storage of 10^{-6} per foot. In some circumstances, a model of this type has other variable parameters (such as thickness of geologic units and recharge rate), but in this study, the thickness of the permeable glacial aquifer and the recharge rates were assumed to be known.

The second step in the model calibration process is the identification of conditioning information on model parameters. Two types of conditioning information were identified: geologic information and estimates of aquifer hydraulic conductivity from specific capacity tests on 60 high capacity wells within the model domain. The known geologic information was the presence of the fine-grained unit. The hydraulic conductivity of the sand and gravel aquifer based on the specific capacity tests ranged between 46 feet per day and 734 feet per day and the hydraulic conductivity of the sandstone aquifer ranged between 1 and 159 feet per day[17].

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[16] The calibration targets for Tenmile Creek were the median monthly flows in Tenmile Creek during the period 2000 through 2011. The flow used as the calibration target for each month was calculated as the median of the average monthly flows during each year during the period 2000 through 2011. The median flow, rather than the average flow, was used because the median flow represents better than the average flow the creek flow that is expected to be exceeded about fifty percent of the time.

[17] In an area to the north of the model domain in the Central Sand Region, Bradbury and others (1992) estimated based on 10 pumping tests that the hydraulic conductivity of the sand and gravel aquifer ranged from 70 feet per

The third step in the calibration process is automated calibration using the computer program PEST. The result of this step is the calibrated groundwater model. In using PEST, a technique known as pilot-points was used to estimate the spatial distribution of parameter values. The parameter estimation program, PEST, estimates values for each pilot-point and these discrete estimates are then transformed (*via* kriging-interpolation) into a continuous hydraulic conductivity field that is used by the model. The calibration introduced variability or heterogeneity that was supported by the calibration data; the degree of heterogeneity introduced was controlled by using preferred-value regularization (Doherty, 2009). The preferred-value scheme is used here because of the available specific capacity tests. By using a preferred-value scheme a calibrated pilot-point value differed from its initial value only if there was a marked improvement in the fit of the model to the calibration data (a reduction in Φ). While the specific capacity tests in the sandstone aquifer suggested some variability in the hydraulic conductivity, there is insufficient head data in this unit to warrant a pilot-point calibration, so a uniform zone is used.

The calibrated hydraulic conductivity of the sand and gravel aquifer varied from about 100 feet per day in the western portion of the model domain to 250 feet per day in the eastern portion of the model domain (**Figure 2-19**). The calibrated vertical hydraulic conductivity of the fine-grained unit (model layer 2) is 0.3 foot per day, but sensitivity analyses indicated that model results are not very sensitive to this parameter if it is varied by plus or minus an order of magnitude. The calibrated hydraulic conductivity of the sandstone aquifer was 10 feet per day.

The calculated average water table in the calibrated model is shown on **Figure 2-20**. Also shown on **Figure 2-20** are the differences between model-calculated water levels and observed water levels at locations included in the calibration process. Overall the model calculated water levels and the observed water levels are similar. The conventional way to qualitatively judge the goodness of a model calibration is to examine a plot of observed versus calculated water levels; if the match between observed and calculated water levels is excellent all of the data points plot on a straight line. Such a plot is shown on **Figure 2-21**. A comparison of model calculated stream flow to measured stream flow under normal and dry conditions is shown on **Figure 2-22**; the correspondence is very good. The model calculated base stream flows are listed and compared to measured stream flows in **Table 2-3**. Except at a few headwater streams, calculated and measured stream flows are similar.

2.3.1.3.2 Model Calculated Effects of GSD Pumping

As a result of the favorable comparison of calculated and measured groundwater levels and stream flows, the site-specific model appropriately represents the groundwater system in the GSD Project Area, and the site-specific model is an appropriate method to evaluate the effects of proposed withdrawals for the GSD Project. The effect of proposed withdrawals by the GSD Project was estimated by simulating, using the site-specific model as described above, the pumping of groundwater for irrigation of the GSD Agricultural Crop Fields to be converted from

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day to 200 feet per day in the region investigated. The hydraulic conductivity of the Mt. Simon Sandstone was estimated by Bradbury and others (1999) to the south of the model domain in Dane County to range between 6 and 31 feet per day based on 14 pumping tests.

pine plantation from a total of 38 high capacity wells (37 proposed wells and one existing well) and pumping for the dairy from two proposed high capacity wells. All of the high capacity wells were specified as being completed in the lower portion of the water table aquifer (model layer 3).

The model was used to evaluate the effects of the proposed withdrawals for the GSD Project on stream flows and groundwater levels under normal conditions and dry conditions. Normal conditions are based on median monthly hydrologic conditions during the twelve year period 2000 through 2011 and dry conditions are based on hydrologic conditions in 2012. In the normal year, two irrigation scenarios were simulated: one in which 14 inches of irrigation water are applied to the converted fields during the irrigation season (this is the expected irrigation rate in a normal year) and a second in which 11.5 inches of irrigation water are applied to the converted fields during the irrigation season.[18] In the dry year, in the modeling analyses it was specified that 21.2 inches of water were applied during the irrigation season. The dry year irrigation rate is based on actual irrigation rates in 2012 on fields farmed by the Wysocki Family Companies east of the GSD Project Area and fields at the CSD and it corresponds to the consumption by the crops of 70 percent of the applied water during the irrigation season. Groundwater pumping for the dairy was specified as pumping at 0.36 million gallons per day (250 gpm) during the three summer months and 0.15 million gallons per day (103 gpm) during the remainder of the year (annual pumping of 72.5 million gallons), 100% of water pumped for the dairy is assumed to be consumed.[19]

The groundwater pumping rates were based on the irrigation application rates with the pumping rate for each well calculated as the irrigated acreage associated with the well multiplied by the application rate. Recharge rates on the converted irrigation fields were calculated based on a crop-soil water balance. The recharge rate at the GSD Production Area site was adjusted to reflect increased infiltration following development of the site.[20] The details of the simulation of the GSD Project with the groundwater model are described in **Appendix D**.

To calculate the long-term effects of the proposed groundwater pumping, the model was run with monthly time steps for fifty years. Normal climatic conditions were simulated for the first 48 years and for the 50th year, and dry climatic conditions were simulated for the 49th year. The model was initially run in this sequence with only the existing irrigation pumping within the model domain and then the model was run with the addition of the irrigation pumping for the GSD Project. The difference between model calculated groundwater levels and stream flows between the two model runs is the effect of the GSD Project. For purposes of presenting the effects of the proposed withdrawals for the GSD Project under normal climatic conditions, model

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[18] The second scenario was simulated in response to comments from WDNR suggesting that 14 inches of irrigation water in a normal year was inconsistent with common practices in the Central Sands region. The irrigation rate of 11.5 inches per year is based on 80 percent of the water applied to fields during irrigation season (irrigation water plus precipitation) being consumptively used. The first scenario with 14 inches of irrigation water applied corresponds to approximately 70 percent of applied water being consumptively used.

[19] As described in Section 2.3.1.3, the 70% and 100% consumptive use coefficients are not realistic or representative of the water use and management practices planned at GSD, but were used in this EIR to be overly conservative.

[20] The recharge rate at the GSD Production Area was increased by 3.8 inches per year to reflect a decrease in evapotranspiration as a result of site development.

results from simulation year 48 are presented, and for purposes of presenting the effects of the proposed withdrawals for GSD Project under dry climatic conditions, model results from simulation year 49 are presented.

On the basis of initial evaluations of modeled effects of the GSD Project on stream flows, irrigation and dairy well locations were adjusted to minimize declines in the flow of Sevenmile Creek. Adjusting well locations included designing an underground piping system to transport water from particular wells to the fields they will serve. The well locations were moved to the south such that effects on Tenmile Creek became larger and effects on Sevenmile Creek became smaller relative to those calculated with initial proposed well locations. The effect of adjusting well locations and pumping water to fields from remote wells is that modeled base flow reductions in Sevenmile Creek are significantly lower than in the originally proposed well and field configuration. The results described below are based on the final well locations.

The calculated stream flows in Sevenmile Creek and Tenmile Creek in the normal year and in the dry year both without and with proposed pumping for the GSD Project are shown on **Figure 2-23**. Calculated stream flows are shown for Tenmile Creek at STH 13 (location of U.S. Geological Survey gage) and at CTH Z (just upstream of the mouth of the creek) and stream flows are shown for Sevenmile Creek at Rangeline Road (near the beginning of the perennial reach of this stream) and at CTH Z (just upstream of the mouth of the creek).

The effects of proposed withdrawals for the GSD Project are small as shown on **Figure-2-23**. On most of the hydrographs shown on **Figure 2-23** it is difficult to distinguish calculated flows without the project from calculated flows with the project as the graphs overlap due to the very small percentage change in flows. In a normal year, the effect of GSD's proposed withdrawals is an average annual decrease in the flow of Tenmile Creek by about two percent and an average annual decrease in the flow of Sevenmile Creek by less than one percent.

The modeled average annual flow reduction in all streams in the vicinity of the GSD Project under normal climatic conditions is about 1.6 cfs as a result of reductions in groundwater discharge to streams due to the proposed withdrawals. Most of the modeled flow reductions occur in Sevenmile Creek and Tenmile Creek whose average annual flows are reduced 0.03 cfs, and 1.26 cfs, respectively. The remainder of the modeled flow reductions, about 0.3 cfs, occurs as a result of decreased groundwater discharge directly to the Wisconsin River and small flow changes in other streams in the model domain, including 0.1 cfs in the Fourteenmile Creek drainage system and 0.01 cfs in Chester Creek.

The change in median monthly flows during the summer months, especially the month of August, is often used to evaluate potential impacts to the ecological health of the stream[21]. The median monthly flow in the month of August is often referred to as the "index flow". The calculated changes in monthly flows in Tenmile Creek and Sevenmile Creek in August, and September, the summer months with the lowest stream flows, based on the normal year (which simulates median monthly flows) and the dry year are tabulated on **Table 2-4.** Results are shown both for normal year simulation with 14 inches of irrigation water and in parentheses for

[21] In Michigan, the determination of adverse resource impacts is based on changes in the median August flow of a stream (Hamilton and Seelbach, 2010).

normal year simulation with 11.5 inches of irrigation water. The calculated changes in median monthly flows during the summer months in Sevenmile Creek are far less than 4 percent, which is the threshold used in Michigan for determining an adverse resource impact in a stream classified as cold-water transitional in the month of August. The calculated median monthly changes in Tenmile Creek are less than 5 percent, which are significantly less than the 25 percent threshold used in Michigan for determining an adverse resource impact in a stream classified as cool-water warm transitional in the month of August.

In a dry year, such as occurred in 2012, the stream flow in Sevenmile Creek is expected to increase as a result of the proposed withdrawals from the GSD Project and the flows of Tenmile Creek are estimated to decline about 10 percent in the month of August (**Table 2-4).** The flow in Sevenmile Creek increases in dry years as the result of the GSD Project because of recharge that occurs beneath irrigated fields that are located in close proximity to Sevenmile Creek as result of obtaining irrigation water for these fields from wells located south of the fields in the Tenmile Creek watershed. In other words, irrigation wells located in the Tenmile Creek watershed will be used to apply water to fields in close proximity to the Sevenmile Creek. The water applications in close proximity to Sevenmile Creek will increase recharge to the Sevenmile Creek, in some cases significantly, and increase baseflow over and above the dry year summer flow conditions the creek would naturally experience in August.

A summary of calculated flow changes, changes in stream characteristics and stream temperature in the month of August for the normal year with 14 inches of irrigation water are listed in **Table 2-5**. Cross-section profiles at selected locations along Sevenmile Creek and Tenmile Creek are shown on **Figure 2-24** to illustrate stream depths and widths. The magnitude of the changes in depth and width due to proposed withdrawals for the GSD Project are listed on the cross sections in **Figure 2-24** but are not displayed graphically because the changes are indistinguishable on the figures from existing conditions.

2.3.1.3.3 Model Calculated Cumulative Effects of Irrigation Pumping

All existing impacts to the flow of Sevenmile and Tenmile Creeks, including existing irrigation wells are incorporated into the groundwater flow model and, as such, are considered as part of this evaluation. See **Figure 2-7.**

An estimate of the changes in the base flows of streams in the model domain that may occur in the future as the result of increases in irrigation pumping was calculated using the groundwater model. For this analysis, land use on each parcel shown on published plat maps and aerial photos within the Sevenmile Creek and Tenmile Creek watersheds was assessed for likelihood of conversion to irrigated agriculture. A parcel within the watershed that is not currently irrigated was deemed to have the potential for irrigated agriculture unless: 1) the parcel is too small for conversion or is a residential site; 2) the parcel is government owned, owned by a conservation group, or has a deed restriction prohibiting irrigated agriculture, 3) parcel is identified as a wetland, 4) parcel is located within a city, is commercial, is a farmstead, or is a gravel pit; or 5) conversion of parcel is prohibited by zoning (Townships of Saratoga and Rome have zoning that prohibits conversion to irrigated agriculture). Currently about 12,000 acres with the watersheds are used for irrigated agriculture; a total of approximately 4,500 acres within the watersheds were identified as having the potential for conversion to irrigated agriculture. In addition, all irrigation wells permitted in 2012 and 2013 by the WDNR in the model domain

were identified. The locations of these wells are shown on **Figure 2-16**. Groundwater pumping from these wells and groundwater pumping for the lands identified as having potential for conversion to irrigated agriculture within the Sevenmile and Tenmile watersheds were then included in the analysis of potential future changes in base flow of streams[22].

The additional irrigation pumping that could occur in the future is calculated to reduce, in the long term, the annual flow of Tenmile Creek by approximately one cfs (2%) and to have a negligible effect on flow of Sevenmile Creek. These calculated cumulative flow reductions were developed to provide an understanding of the magnitude of potential flow changes in Sevenmile Creek and Tenmile Creek in the future, if land in the surrounding area is later converted to irrigated agriculture. The calculated cumulative flow reductions are small as listed on **Table 2-6**.

2.3.1.4 Significance of Potential Impacts

2.3.1.4.1 Private/Public Wells

Proposed groundwater withdrawals for the GSD Project will lower groundwater levels in the vicinity of the GSD Project. Modeled groundwater level changes in the vicinity of the GSD Project are greatest during the summer months when the highest rates of irrigation pumping is proposed to occur. Although the month of August is typically used to evaluate potential impacts, in this case the maximum modeled change in groundwater levels is represented by calculated declines in groundwater levels during the month of July under dry climatic conditions when irrigation pumping sufficient to apply 8.8 inches of water to the fields is simulated. Calculated groundwater level changes (drawdown) from existing conditions at the end of July in a dry year are shown on **Figure 2-25** along with the location of nearby residences. Drawdowns at all other times, including the month of August, are less than those shown on **Figure 2-25**. Water level declines in July in a dry year range from over 10 feet in the immediate vicinity of the proposed high capacity wells to less than 0.5 foot at a distance of one mile from the proposed high capacity wells. Calculated declines in groundwater levels are less than five feet beyond the boundaries of the GSD Agricultural Crop Fields.

The WDNR's common practice is to evaluate impacts to private wells based on a threshold of "significance" of 5 feet. In other words, if the expected groundwater drawdown near a private well will be less than 5 feet, that drawdown is assumed to not cause a significant impact to nearby private wells. This threshold of significance is based on the fact that most, if not all private wells are currently, or should be constructed and screened such that a water level decline of 5 feet will have no significant effect on well yield.

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[22] The irrigation wells permitted in 2012 and 2013 were specified as pumping sufficient water to supply 12 inches of water per year to irrigated fields. Wells with permitted maximum capacities of 900 gpm or greater were specified as supplying water to 130 acres, smaller wells were specified as supplying water to 65 acres. The lands identified in the watershed for conversion to irrigated agriculture were specified as being supplied with 14 inches per year of irrigation water annually, except for lands in areas with a shallow water table for which 12 inches per year of irrigation water were specified. For these lands it was specified that 130 acres would be irrigated in each 160 acre parcel.

As explained above, estimated groundwater level declines from existing conditions at all residential wells near the GSD Project are less than five feet; however, whether or not a water level decline causes a significant impact at a specific residential well depends primarily on well construction, the depth of the well, and the depth setting of the pump. For a residence with, for example, a fifteen foot drive point well, water level declines of less than five feet could potentially have an adverse effect on well yield. These types of details regarding private wells are unknown at this time. As described earlier in this EIR, sand point residential wells are required to be driven 25 feet below ground surface or 10 feet below the static water table, whichever is greater. If residential wells near the western and southern portions of the GSD Project Area comply with the regulatory construction standards, the modeled water table decline of 3 feet or less will not impact those compliant wells. As such, code compliant sand point wells will not be significantly impacted by the GSD Project.

The nearest public water supply wells are located at least 3 miles from the proposed irrigation wells and/or are on the west side of the Wisconsin River. Due to the distance from the proposed irrigation wells and the modeled reduction in water levels, groundwater level declines at nearby public water supply wells will be negligible and the GSD Project will have no effect on these wells.

2.3.1.4.2 Rivers and Streams

The estimated flow reductions in Tenmile Creek will not result in measurable changes in the depth and width of the stream including impacts to the headwater portions of the creek. Small changes are estimated to occur in the average width and depth of Sevenmile Creek. A cross-sectional profile of Sevenmile Creek at CTH Z, which is located about 0.3 miles upstream of the mouth, is shown on **Figure 2-24**. The water level at the August median flow under existing conditions (3.59 cfs) and the calculated water level at August median flow with the GSD Project (3.55 cfs) are shown on the figure. The calculated change in water level (or stream depth) as a result of the GSD Project is a reduction in the August median level of about 0.01 foot. The calculated change in the width of the steam is less than one tenth of a foot.

Flow reductions estimated to occur in Sevenmile Creek, Tenmile Creek and tributaries of Fourteenmile Creek as a result of groundwater pumping are much smaller than annual and seasonal variations in flows in the respective streams (as described in Section 2.3.1.2.4) and the estimated changes in stream width and depth are very small. The significance of these changes in stream flow are a function of how these flow changes impact the fisheries, other aquatic resources, biologic resources and recreation benefits of the streams. These potential effects are described in Sections 2.4 and 2.5 of this document.

2.3.1.4.3 Cranberry Operations

Only one existing cranberry operation may potentially be impacted by the declines in stream flow that result from proposed groundwater withdrawals for the GSD Project; the Nekoosa East cranberry operation located north of Sevenmile Creek and west of Hollywood Road. The other nearby cranberry operations are located upstream of stream reaches where stream flow reductions have been modeled as a result of GSD Project operations and therefore will be unaffected by GSD Project. In early October 2012, the Nekoosa East cranberry operation was noted to be diverting the entire flow of Sevenmile Creek which was measured upstream of

the diversion at approximately 1.8 cfs. With the GSD Project the estimated changes in Sevenmile Creek flows are small in normal years during the autumn months and the impact of the GSD Project in dry years is expected to increase the flow in Sevenmile Creek beyond existing conditions. As such, the GSD Project will not negatively affect the water available for diversion to this cranberry operation.

Moreover, **Figure 2-25** illustrates the modeled water level drawdown near the GSD Project in a dry year. As described above, the groundwater model used climate conditions from 2012 as the "dry year" conditions. **Figure 2-25** demonstrates that during 2012 at the location of the Nekoosa East cranberry operation, there would have been negligible drawdown. As such, the withdrawals proposed for the GSD Project will not affect water levels in water storage reservoirs.

2.3.1.4.4 Wetlands

Water level changes in riparian wetlands will be similar to those that occur in adjacent streams. The water levels in Sevenmile Creek and the nearby riparian wetlands are estimated to remain approximately the same as the result of groundwater withdrawals for the GSD Project. Water levels in Tenmile Creek and the nearby riparian wetlands are estimated to decline less than 0.05 foot from existing conditions in late summer conditions. These estimated changes in riparian wetland levels are smaller than those that can be reliably measured. As such, these changes do not have a physical significance and are not considered significant for purposes of this EIR. The riparian wetlands are not expected to be impacted by the small reduction in flows during dry periods of the year. The water level changes expected in the isolated wetlands along Spring Branch and east of the project in Portage County are expected to be less than 0.05 foot, which also cannot be reliably measured and are not considered significant. Water level reductions in Chester Creek and Fourteenmile Creek are modeled to be much less than 0.05 foot in late summer conditions which are essentially non-measureable, and not expected to impact the stream or riparian wetlands.

Isolated wetlands in the GSD Project Area are all located in depressions in the land surface and are sourced by surface waters resulting from snow melt and large precipitation events. Because they are not sourced from groundwater, reduction in groundwater levels are not expected to eliminate or reduce the size of these wetlands and water levels in these wetlands will not be affected by groundwater withdrawals for the GSD Project.

Potential effects on aquatic and biologic resources as a result of these small water level changes in wetlands are described in Sections 2.3.2, and 2.4.2 of this document.

2.3.2 Water Quality

2.3.2.1 Regulatory Framework

Wisconsin statutes grant the WDNR the authority to develop and enforce groundwater quality standards. Wisconsin's groundwater quality protection standards are based on the United States Environmental Protection Agency's (USEPA's) safe drinking water standards, and include Enforcement Standards (ESs) and Preventive Action Limits (PALs). ESs are standards for substances of public health or public welfare concern and are often but not always equivalent to the Federal Maximum Contaminant Level (MCL). ESs define when a water quality violation has

occurred. PALs represent a lesser concentration of the substance than the ES; the PAL may be 10 percent, 20 percent, or 50 percent of the ES based on the health-related characteristics of the substance. The PALs are used in design and management practices so that groundwater quality impacts are minimized through stringent designs and management responses, and also may serve as a 'trigger' for further monitoring or analysis. PALs are intended to provide regulatory agencies time to initiate preventive measures to ensure that the ES is not attained or exceeded. When a PAL or ES is exceeded, Wis. Admin. Code Ch. NR 140 provides a range of response action options that may be required to evaluate the exceedance and determine the most appropriate next steps for delineating impacts, identifying potential sources and evaluating the possibility of remedial action.

Surface water quality is regulated by WDNR through promulgated water quality standards and effluent limits. Water quality standards are "provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses." See CWA §303 and Wis. Stat. § 281.15. In other words, a water quality standard represents the criteria or concentration of pollutants an entire waterbody should maintain for its identified use. By contrast, effluent limits are imposed on specific dischargers and may include "schedules of compliance, on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into waters of the state." Wis. Stat. § 283.01(6). Effluent limits allow specific facilities to discharge pollutants at a rate and concentration sufficient to allow operation, but with the goal of maintaining water quality standards. Except in limited circumstances, WDNR is prohibited by statute from imposing on a discharger an effluent limit that is more stringent than a federal effluent limit. Wis. Stat. §283.11(2).

The primary water quality pollutants of concern related to dairy farming and forage and vegetable crop production are phosphorus and nitrogen. In 2010 WDNR finalized a new surface water quality standard for phosphorus, which includes an in-stream standard of 0.075 parts per million for streams such as the Sevenmile and Tenmile Creeks. Wisconsin has not developed a numeric surface water quality standard for nitrogen. In fact, no other state in the country has developed or implemented a statewide numeric water quality standard for nitrogen. In 2010, EPA attempted to impose very stringent numeric nitrogen water quality standards in the State of Florida. The EPA's nitrogen standards were challenged in court and have not been implemented statewide.

The Wisconsin River is currently federally listed as an impaired water for both phosphorus and total suspended solids (TSS). In response, WDNR is in the process of developing a Total Maximum Daily Load (TMDL) for the portion of the watershed in which the GSD Project Area sits. This TMDL will evaluate all sources of phosphorus and TSS impacting the Wisconsin River, and recommend strategies for reductions. While it is possible that the TMDL reduction strategy may call for additional reductions from nonpoint sources of phosphorus and TSS, WDNR will need to engage in rulemaking to promulgate a performance standard more stringent than the existing phosphorus index (PI) and tolerable soil loss (T) standards. This rulemaking process must follow the procedures in Wis. Stat. Ch. 227. The Wisconsin River TMDL is not expected to be finalized by WDNR, approved by EPA, and ready for implementation until at least 2017.

2.3.2.2 Existing Conditions

The quality of the groundwater and surface water in the GSD Project Area is similar due to the close interconnection between groundwater and surface water. Both surface water and groundwater in the area are calcium-magnesium bicarbonate waters typically with total dissolved solids concentrations of less than 200 milligrams per liter (mg/L). As surface water in the region primarily originates from groundwater discharge to streams, surface water quality at a point in a stream can reflect the quality of groundwater in upstream areas. As surface water quality reflects an integration of upgradient groundwater quality, total dissolved solids concentrations in surface water samples are typically higher than in many groundwater samples because of longer groundwater flow paths to groundwater discharge areas at the streams, which results in more time for dissolution of the aquifer matrix. Known data on water quality is summarized below.

2.3.2.2.1 Groundwater Quality

Historic agricultural activities are a common source of groundwater contamination throughout Wisconsin. The agricultural-associated chemicals that are the most frequently detected in groundwater include the nutrient nitrate, chloride as the leachable component of potassium chloride fertilizers, and organic pesticides and the degradation products of pesticides. The herbicides, atrazine, alachlor, metribuzin and their degradation products, are the most commonly detected organic agricultural compounds in groundwater in the Central Sands region (Kraft and others, 1999; Wisconsin Agriculture, Trade and Consumer Protection, 2008).

In addition to agricultural activities, private residents' septic systems are also a known source of nitrates in groundwater. Typically, a residential septic system includes a concrete waste holding tank that settles solids and promotes degradation of associated pathogens, and a piping system to allow liquid waste to flow out of the tank and be discharged to a drain field or "leach field." Just as the sandy soil profiles in and around the GSD Project Area create a risk that GSD's nutrient applications could affect groundwater quality, the sandy soils also create a risk that liquid septic waste discharged to drain fields will travel quickly through the permeable soil and enter groundwater. For purposes of this EIR, it is assumed that each residence identified on aerial photographs in and around the GSD Project Area contains a private septic system that contributes nitrogen, and potentially phosphorus, to the groundwater beneath those properties in addition to e-coli bacteria.

Water quality samples collected during the past 12 years from residential wells within two miles of the GSD Project Area provide information on baseline groundwater quality near the GSD Project Area; however, no groundwater quality samples have been taken at the GSD Production Area or at any GSD Agricultural Crop Fields proposed for conversion from pine plantation. The reported nitrate concentrations in groundwater from nearby residential wells ranged from less than 1 mg/L to 16 mg/L in the residential wells. The location of sampled residential wells and reported nitrate concentrations in the vicinity of the project are shown on **Figure 2-26**. Elevated nitrate concentrations in some wells are likely the result of septic contamination, residential activities, and/or historic agricultural practices.

Groundwater sampling that was conducted by the UW Stevens Point Extension at 79 residential wells near the GSD Project Area in November 2012 provides the best data set for characterizing groundwater-quality in the vicinity of the GSD Project Area. Based on these data

the typical groundwater has a calcium concentration of 12 mg/L, magnesium concentration of 4 mg/L, sodium concentration of 7 mg/L, sulfate concentration of 10 mg/L, and total dissolved solids concentration of 81 mg/L. The groundwater is classified as a soft water with hardness of about 70 mg/L. A summary of groundwater quality characteristics based on data from these 79 residential wells is listed on **Table 2-7**. The mineral content of groundwater reflects the dissolution of more soluble components of the aquifer matrix as groundwater migrates from the point of recharge to the point of discharge. The relatively low total dissolved solid content of the groundwater reflects the fact that much of the aquifer matrix is relatively insoluble sand grains.

Nitrate concentrations in these 79 water samples had an average value of 1.6 mg/l, a median value of 0.8 mg/L and a maximum value of 6.7 mg/L. The large difference between the average and median value indicates that nitrate concentrations in residential wells vary significantly from well to well. A further evaluation of the data indicates that 35 percent of the wells had nitrate concentrations of 0.3 mg/L or less and about 33 percent of the wells had nitrate concentrations greater than the (PAL) of 2 mg/L. The large variability in concentrations likely reflects the influence of septic tanks, and possibly lawn fertilizers, on groundwater quality in the residential wells. Background nitrate concentrations in groundwater that is not influenced by residential and agricultural activities, appears to be on the order of 0.3 mg/L. Thirty-one residential water samples collected in November 2012 were analyzed for the atrazine degradation product diaminochlorotriazine (DACT) and it was not detected in any of the wells.

Data for three active non-community public wells located in the vicinity of the GSD Project Area are available in the WDNR's Drinking Water System. In these three wells, only 7 sample analytical results exceeded the nitrate groundwater PAL and all nitrate concentrations were less than 4 mg/L. Nitrate results for an additional 21 public wells located within the Town of Saratoga had an average concentration of 2.1 mg/L and a mean concentration of 1.2 mg/L. The highest reported nitrate concentration in these wells was 9.3 mg/L.

Public municipal wells in the Town of Rome located just south of the GSD Project Area in Adams County have been impacted by nitrates. Wells #1 and #2 were replaced due to nitrate concentrations above 10 mg/L.

The Department of Agriculture, Trade and Consumer Protection (DATCP) monitored groundwater in private wells in Atrazine Prohibition areas between 1987 and 2011 for pesticides and nitrate. No samples were collected in Wood County. Samples were collected in adjacent counties with similar hydrogeologic conditions (Adams, Portage and Waushara counties) where land use is predominately agricultural. Nitrate concentrations in 176 of 204 samples that were collected exceeded 10 mg/L and the highest nitrate concentration reported was 117 mg/L. A total of 19 different pesticides and pesticide metabolites were detected; metribuzin and atrazine were the pesticides most commonly detected.

The WDNR Bureau of Remediation and Redevelopment Tracking System (BRRTS) was searched for sites near the GSD Project Area with potential or confirmed soil and groundwater contamination. A BRRTS map of the area near the GSD Project Area is shown on **Figure 2-27**. No sites are located within the immediate GSD Project Area; however, seven sites are within approximately 1 mile, and further research was completed for those sites (numbered on **Figure 2-27**), as summarized in **Table 2-8**.

For contaminated sites, the WDNR requires that the responsible party demonstrate that the plume of contaminated groundwater is not spreading and that no receptors are susceptible to contaminants before issuing closure. As such, sites identified on the WDNR BRRTS website as "closed" should not present a potential for groundwater contamination in the GSD Project Area. The WDNR BRRTS website identified seven sites within 2 miles of the GSD Project Area, five of which are closed (**Table 2-8**). The two sites listed as 'open' are Pritzl's Corner Market and Elmer Dye. Pritzl's Corner Market, located approximately 2 miles south of the GSD Project, is a petroleum site that is still active; however, the site is not upgradient of the GSD Project and therefore is not a potential threat to the GSD Project Area. The WDNR indicates that there have been "chronic" releases of used motor oil and transmission oil at the Elmer Dye site. The Elmer Dye site is located on the north side of Sevenmile Creek greater than a mile north of the GSD Project; therefore this site is not hydraulically upgradient from the GSD Project. Further, petroleum products typically degrade quickly in the environment, and it is rare for petroleum compounds to be found more than a few hundred feet from the source (Newell and Connor, 1998). Because of the rapid degradation of petroleum products and the fact that the Elmer Dye site is located north of Sevenmile Creek, it is not anticipated that the GSD Project Area would be impacted by the Elmer Dye site, nor is GSD Project pumping expected to capture groundwater impacted by the Elmer Dye site.

In addition to the sites listed in the BRTTS inventory, there is an historic solid waste landfill (town dump) that is located just to the west of the GSD Project Area (**Figure 1-7**). The historic landfill was accessed from Tower Road and is located about one-quarter mile east of Hollywood Road. This landfill has been closed and there is no evidence that there is any groundwater contamination associated with the landfill.

2.3.2.2.2 Surface Water Quality

2.3.2.2.2.1 Rivers and Streams

Tenmile Creek: The Tenmile Creek watershed contains a fair amount of agricultural activity that is currently not regulated by the WPDES permit program or the DATCP Livestock Siting Law. In fact, a significant amount of baseflow contribution to the Tenmile Creek is from agricultural drainage ditches. Water quality samples from Tenmile Creek at Rangeline Road collected by WDNR between November 2009 and March 2012 for nutrient analyses provide a baseline for understanding the water quality in Tenmile Creek. During this period nitrate concentrations averaged 3.8 mg/L (based on 55 samples) and nitrate concentrations ranged from a minimum of 1.5 mg/L to a maximum of 8.5 mg/L (**Figure 2-28**); Kjeldahl nitrogen (a measure of total organic nitrogen) concentrations averaged 0.7 mg/L and ranged from 0.2 mg/L to 1.6 mg/L; and total phosphorus concentrations averaged 0.05 mg/L and ranged from 0.025 to 0.16 mg/L (**Figure 2-29)**. On August 16, 2012 water samples were collected from Tenmile Creek during a period of very low stream flows, as part of the work involved in preparing this EIR. Water samples were collected at four road crossings of Tenmile Creek from the eastern end of the project at CTH U to just upstream of the Wisconsin River at CTH Z (locations 1 through 4 on Tenmile Creek on **Figure 2-30**). The locations of the sampling sites are shown on **Figure 2-30** and the analytical results are listed in **Table 2-9**. Flow in Tenmile Creek at the time of the sample collection was only about 2 cfs at CTH U and 27 cfs at the gage at STH 13 due to the drought conditions.

During the August 2012 sampling event, measured nitrate concentrations gradually decreased from a maximum of 1.7 mg/L at the upstream location at CTH U to 0.68 mg/L at CTH Z. During the August 2012 sampling event, phosphorus concentration ranged from a low of 0.047 mg/L to a high of 0.5 mg/L at STH 73. Nitrate concentrations during this sampling event were lower than those reported by the WDNR in the sampling conducted between November 2009 and March 2012. This may be the result of the low flows in the upstream reaches of Tenmile Creek during August 2012; flows in Tenmile Creek at County U were much larger in the summers of 2010 and 2011 when the water quality samples were collected by the WDNR. As described above, there is no surface water quality standard for nitrate. During the low flow period in August 2012, most of the flow in Tenmile Creek downstream of County U was the result of groundwater discharge. As a result, the nitrate concentrations in the stream downstream of County U reflect the discharge of groundwater with relatively low nitrate concentrations. All of the data above demonstrates that groundwater discharging to Tenmile Creek currently complies with the drinking water standard of 10 mg/L.

Sevenmile Creek: Water quality samples were collected from Sevenmile Creek on August 16, 2012 and October 10, 2012. A tabulation of water quality results from Sevenmile Creek is listed in **Table 2-9** and the locations of the sampling sites are shown on **Figure 2-30.**

On August 16, 2012, samples were collected at the crossing of Young Street and at Hollywood Road (locations 1 and 4 on Sevenmile Creek on **Figure 2-30**). Nitrate concentrations (nitrogen, nitrate plus nitrite) were 0.21 mg/L and 0.45 mg/L, Kjeldahl nitrogen concentrations were 0.51 mg/L and 0.58 mg/L, and phosphorus concentrations were 0.065 mg/L and 0.11 mg/L, respectively. On October 10, 2012, samples were collected at CTH Z and Rangeline Road (**Figure 2-30**). The nitrate concentrations at CTH Z and Rangeline Road were 0.36 mg/L and less than 0.052 mg/L, and phosphorus concentrations were 0.079 mg/L and 0.30 mg/L, respectively. As described above, there is no surface water quality standard for nitrate. During both sampling events, Sevenmile Creek was dry a short distance upstream of the easternmost stream sampling location and the flow in the creek represented groundwater discharge to the creek. Thus, the measured nitrate concentrations in the stream reflect nitrate concentrations in the groundwater near Sevenmile Creek. All of the data above demonstrates that groundwater discharging to Sevenmile Creek currently complies with the drinking water standard of 10 mg/L. The water samples from Sevenmile Creek collected in October 2012 were analyzed for chlorinated organic pesticides; none were detected (**Table 2-9**).

2.3.2.2.2.2 Wisconsin River TMDL

The water quality of the Wisconsin River is currently impaired for phosphorus and total suspended solids and the river is being assessed through the Wisconsin River Total Maximum Daily Load (TMDL) Water Quality Study. A TMDL is the amount of pollutant a stream, river, or lake can receive before exceeding water quality standards. Part of the GSD Project Area is within the Wisconsin River TMDL study area and Tenmile, Sevenmile, and Chester Creeks are tributaries to the Wisconsin River. Despite the slightly elevated levels of phosphorus identified in Sevenmile and Tenmile Creeks, neither creek is currently listed as impaired and neither is proposed to be included in the 2014 impaired waters list.

The Wisconsin River TMDL is in the early stages of development and, based on the WDNR website, will not become an enforceable regulatory tool until 2017.

2.3.2.2.2.3 Wetlands

Wetlands provide nutrient and sediment attenuation functions that clean and filter surface water flowing through the wetlands. Water quality in wetlands along Tenmile Creek and Sevenmile Creek is expected to be similar to the water quality of the groundwater discharging to these wetlands and to the water quality in the creeks. No sampling was performed in the wetlands and no water quality data from wetlands were found in the WDNR file.

2.3.2.3 Potential Water Quality Impacts

Potential impacts to groundwater and surface water quality due to the GSD Project are associated with the production and handling of manure and process wastewater at the GSD Production Area and the application of manure, wastewaters, inorganic fertilizers, and pesticides to the GSD Agricultural Crop Fields. Nitrogen, phosphorus, and pathogens associated with manure and process wastewater produced at dairy operations and nitrogen and phosphorus associated with inorganic fertilizers can have detrimental impacts on groundwater and surface water if not properly stored, handled, and land applied. The EPA (2004) recognizes that measures for groundwater protection focus on minimizing seepage of manure and wastewater to groundwater and implementing and adopting specific nutrient management best practices.

The USEPA assessed the potential environmental impacts of CAFOs through a risk assessment evaluation of CAFOs (USEPA, 2004). This assessment provides a description of the common environmental stressors and their movement in the environment, including transport in air and water. Stressors to watersheds related to dairy CAFOs include nutrients, pathogens, sediments, and antibiotics. These compounds may be released either directly into surface water bodies, or indirectly following surface runoff, migration into groundwater, wind-driven movement, or for ammonia, volatilization and redeposition. The following is a discussion of the potential impacts of the GSD Project on water quality.

2.3.2.3.1 Nutrients, Pathogens, Metals, and Other Chemicals

Nutrients contained in dairy manure include nitrogen, phosphorus, and mineral salts. The manure produced at the GSD, on an annual basis, is estimated to contain about 1,050,000 lbs. of nitrogen, 269,000 lbs. of phosphorus (as P_2O_5), and 751,000 lbs. of potassium (as K_2O).

Nitrogen in the environment is present in both organic and inorganic forms. Ammonia, an inorganic form of nitrogen, is immediately available to plants as an ammonium ion. Ammonium ions dissolved in water may lead to eutrophication, excessive oxygen demand, fish kills, reduced biodiversity, taste and odor issues, and growth of toxic organisms. Through the nitrification process, ammonia may be converted to nitrite and nitrate. Nitrite is rapidly converted to nitrate through oxidation by aerobic bacteria and thus does not accumulate in the environment. Nitrate, the end member constituent of the nitrification process, is highly mobile in water and may impact both surface and groundwater systems. Nitrate is the most widespread agricultural contaminant in drinking water wells (USEPA, 1998) and a MCL of 10 mg/L has been established for nitrate in drinking water.

Management practices and soil profile characteristics can significantly affect the leaching potential of nitrate and ammonium applied to crop fields (Saint-Fort *et al*., 1995). High concentrations of nitrate in groundwater are often associated with high permeability soil and

aquifer materials (Hitt *et al*., 1999). Where soils have high permeability, nitrogen in manure and inorganic fertilizers applied to fields is susceptible to leaching and transport to the groundwater. Runoff is the primary mechanism for the transport of sediment-bound and solution phase ammonium, and groundwater flow is the primary contributor of nitrate to surface water from agriculture (Follet, 1995). Groundwater transport of ammonia compounds is generally not significant as ammonia is sorbed to soils and organic matter and transformed into organic forms by microorganisms (Follet, 1995).

Phosphorus exists as organic and inorganic forms in manure, with the organic phosphorus compounds generally more water soluble and subject to leaching (Sweeten, 1991). Organic phosphate may be easily metabolized to inorganic phosphate which is a useful nutrient; however, inorganic phosphate is a major contributor to eutrophication and phosphate is a rate limiting factor in the growth of algae and other surface water plants. While phosphorus is a critical component of crop growth, excessive phosphorus that is applied on land can make its way to surface waters through soil erosion and runoff where it can contribute to excessive algal growth. There is no federal or state groundwater quality standard for phosphorus.

Phosphorus is less susceptible to leaching to groundwater because it is adsorbed onto soil particles and the adsorption-desorption reactions in soil regulate the rate at which phosphorus may be released (Siddique *et al*., 2000). Phosphorus leaching may occur in sandy soils where over-application has increased the phosphorus levels in soil in excess of crop requirements (Sims *et al*., 1998). The potential for phosphorus transport via sediment and groundwater increases greatly when the adsorption capacity of the soil is exceeded. Adherence to BMPs and a WDNR-approved NMP minimize the likelihood of this occurring. The NMP uses management tools such as the total soil loss formula, soil testing, nutrient content analysis and crop rotation planning to limit the amount of phosphorus that can accumulate in the soils and thus prevents the application of excess phosphorus.

Mineral salts in dairy manure include ions of sodium, calcium, magnesium, potassium, chloride, sulfate, bicarbonate, carbonate, and nitrate. These mineral salts may accumulate in the soil to levels that are toxic to plants and animals, and runoff and infiltration to the groundwater may lead to surface and groundwater impacts. Pathogens that may be present in dairy manure include bacteria, fungi, protozoa, viruses and worms. Without treatment to reduce pathogen loads, storage and disposal practices for dairy manure may disseminate the pathogens more widely in the environment. Some of these pathogens may be transported via overland flow of impacted surface water or in groundwater following release to the environment. Pathogens present in manure may also pose a risk to other animals, including wild animal populations, and spread to other farm animals, where increased veterinary costs or destruction of infected animals may occur. Although unlikely, spreading of pathogens offsite could occur if pathogens remain viable for a period of time that would allow transport.

The use of antibiotics in animal production may lead to the presence of antibiotic residue in manure and urine. These waste products may affect surface or groundwater through run off or leaching, and may lead to the development of antibiotic resistance among microorganisms.

Hormones, both natural and FDA-approved for cattle, may be present in manure and urine from dairy operations and may be sources of hormones to the environment. Although there are little data, the USEPA acknowledges that hormones should be considered in assessing the

environmental impact of dairy operations (USEPA, 2004). An EPA funded study found efficient removal of steroid hormones from dairy operations in groundwater (Sedlak and others, 2012).

2.3.2.3.1 Nitrogen / Groundwater Quality Model

As part of this EIR, WDNR requested GSD calculate or model a nitrogen mass balance to evaluate potential nitrate leaching to groundwater from nutrient applications to fields converted from pine plantation. GSD understands this request is based on concerns regarding the potential increased risk of nitrogen leaching due to the permeable soils in and around the areas currently managed as pine plantation. Pursuant to Wis. Admin. Code Ch. NR 140, the PAL for nitrate is 2 mg/L and the ES is 10 mg/L. Based on sampling of 79 residential wells in the Town of Saratoga in November 2012 conducted by the UW Stevens Point Extension, the average nitrate concentration in groundwater present beneath and around the GSD Project Area is less than the PAL of 2 mg/L.

The state-of-the-science is that, due to a significant dearth of reliable data depicting the rates of complex processes in sandy soils, a reliable, accurate estimate of nitrogen loss to groundwater beneath the GSD Agricultural Crop Fields after conversion from pine plantation to vegetable and forage crops cannot be made using available methods. Although nitrogen models do exist, their application here does not result in reliable or accurate estimations. Those models were designed for the purposes of comparing and contrasting methods of nitrogen application on a macro level and not for predicting nitrogen losses in an "as applied" or project-specific basis. Moreover, although nitrogen mass balances have been calculated in an attempt to understand the amount of nitrogen loss occurring on agricultural fields generally, soil and harvest sample data have not corroborated these mass balance calculations, in part because various complexities of soil and nutrient behavior are not yet well understood based on existing research. The lack of actual corroboration renders these models suspect in reliability. Despite these significant uncertainties in calculating a nitrogen mass balance, WDNR insisted the exercise be completed. As such, GSD retained experts in the fields of soil science and hydrology and collected and reviewed information, data and research – both published and unpublished – to develop a nitrogen mass balance to depict, to the extent reasonably and scientifically possible, an average nitrogen leaching potential from nutrient applications to GSD Agricultural Crop Fields converted from pine plantation (the GSD Nitrogen Balance). The development of the nitrogen mass balance is described in **Appendix E.**

Although significant research and data are incorporated into the GSD Nitrogen Balance, inherent in any model of this type are significant material assumptions. In this case, the assumptions in the GSD Nitrogen Balance are considered "most likely" conditions concerning irrigation rates, crop nutrient applications, annual crop yield, crop protein content, crop residuals, soil organic matter content, nitrogen content in harvested crops, atmospheric fixation, atmospheric deposition, volatilization losses to atmosphere, denitrification losses, direct gaseous losses from crops, among other model inputs. In any real world scenario, these values will vary from year to year and even from month to month or day to day. As such, the model output is a snapshot in time of nitrogen leaching potential modeled at average steady state conditions. The model assumes constant rates of numerous conditions over a long period of time that, in real time, would likely vary significantly. Some elements of the model require input of data for

which the quantity and reliability of research is very thin or not well understood or agreed upon by the scientific community. As such, the GSD Nitrogen Balance output is sensitive to minor adjustments in input values. To account for the sensitivity, the GSD Nitrogen Balance identifies the "most likely" conditions, and also the "best-case" and "worst case" conditions for potential nitrogen leaching to groundwater. The combination of resources brought to bear on this effort, utilizing experts in the field, using data where available and, in the absence of data, the newest research available – published and unpublished, targeting a very specific crop rotation for fields converted from pine plantation, and incorporating significant best practices over and above those required by law make the GSD Nitrogen Balance the most appropriate and scientifically valid approach for the GSD Project. The use of any approach other than that described in **Appendix E** would not be scientifically valid.

Nitrogen/nitrate is the only nutrient evaluated in the modeling exercise and was the only compound requested by WDNR to be evaluated. Phosphorus was not modeled as part of this exercise for three important reasons. First, there is no groundwater water quality standard for phosphorus against which to judge impacts. Second, phosphorus binds to soil particles and the primary concern with this constituent is soil erosion and runoff that can contribute to surface water quality phosphorus concentrations. Third, the risk of surface water phosphorus discharges from the GSD Agricultural Crop Fields is minimized by adherence to a WDNR-approved NMP, which strictly regulates the amount of phosphorus-containing soil that could discharge to surface waters as a result of nutrient applications. See Wis. Admin. Code §§ NR 243.03(69), .14(5). All WPDES permitted CAFOs are required to manage fields to meet tolerable soil loss (T) of five tons per acre over the crop rotation. The GSD NMP contains T values calculated using the NRCS RUSLE 2 model, as required by WDNR. The maximum estimated annual T for the fields to be converted from pine plantation is 0.3, and the maximum estimated annual T for the existing irrigated fields is 0.4. In addition, in accordance with Wis. Stat. § NR 243.14(5), the GSD NMP calculates a phosphorus index (PI) for each field included in the NMP. Fields in a WDNR NMP are required to maintain a PI of 6 or less; all of the fields in the GSD NMP have a PI of 0.4 or less. Any precipitation-related surface runoff from Agricultural Crop Fields that received nutrients in accordance with a WDNR-approved NMP and the requirements of a WPDES permit is an agricultural stormwater discharge, is not considered a point source discharge and is not regulated pursuant to the WPDES permit program.

As described in further detail below, the GSD Nitrogen Balance estimated the amount of potential nitrogen that would be most likely expected to leach into groundwater below the GSD Agricultural Crop Fields that will be converted from pine plantation. The 1,800 acres of existing irrigated crop land is not included in this analysis because there is no land conversion and those acres are already in crop production and no new adverse impacts will occur from continuing production. Indeed, implementing NR 243 nutrient management planning requirements on those acres will reduce impacts and promote surface and groundwater protections.

The outputs from the GSD Nitrogen Balance were used as inputs to a numerical groundwater model (Nitrate Groundwater Model) as a "fate and transport" element to evaluate the potential nitrate concentrations in groundwater downgradient of the GSD Project at specific distances. The Nitrogen Groundwater Model was run for fifty years, but calculated nitrate concentrations in groundwater reached steady state conditions after approximately twenty years

of GSD applying nutrients to the GSD Agricultural Crop Fields converted from pine plantation. As such, all modeled impacts are reported in this document as impacts calculated after twenty years of GSD operations.

The Nitrate Groundwater Model identified a hypothetical residential well located 300 feet from the edge of a GSD Agricultural Crop Field and estimated slight increases in nitrate concentrations that could occur after the next twenty years of GSD's operations. However, these modeled increases do not exceed the chapter NR 140 ES for nitrate in groundwater. Moreover, the modeled increases are not the result of any groundwater sampling or monitoring, as is required for WDNR to take action pursuant to chapter NR 140. As such, although the Nitrate Groundwater Model represents a potential increase in nitrate in groundwater, the WDNR regulatory authority over groundwater quality is triggered only when an actual change in groundwater quality occurs. Actual changes in groundwater quality near the GSD Project Area will be voluntarily measured by GSD via monitoring wells constructed in accordance with chapter NR 141 and monitored in accordance with the Groundwater Monitoring Plan, included as **Appendix B.**

Because Sevenmile and Tenmile Creeks are groundwater fed, and because during low flow periods, the surface water in these creeks is reflective of groundwater conditions, the modeling exercise included an evaluation of nitrate concentrations of groundwater that may discharge to those two creeks as a result of nutrient applications to converted fields. The Nitrate Groundwater Model indicates slight increases in nitrogen concentration in Sevenmile and Tenmile Creeks may occur under the most likely conditions as a result of nutrient applications to converted fields. However, these modeled increases are not a result of a point source discharge, are speculative and are not subject to the antidegradation provisions of Wis. Admin. Code Ch. NR 207. See NR 207.02(8). In any event, the very small nitrogen increases do not demonstrate that any water quality degradation will occur. Indeed, without any promulgated surface water quality standard for nitrogen and no regulatory framework for the treatment of modeled nutrient increases in surface waters, there is no basis for a regulatory finding that potential nitrogen increases, based on modeled calculations, will degrade a surface water system. Finally, any slight change in water quality of Sevenmile and Tenmile Creeks would be justified as a result of necessary economic and social development and preservation of productive agriculture land, and the modeled slight increase in nitrogen will not interfere with or become injurious to any current use of these waterways. The biological impacts from the modeled most likely nitrogen increase are described in Sections 2.4 and 2.5 of this document.

Given the inherent uncertainties in the GSD Nitrogen Balance and the Nitrate Groundwater Model and the lack of any promulgated surface water quality standards for nitrogen, the GSD Nitrogen Balance and Nitrate Groundwater Model output is presented only to inform the public for purposes of this EIR, and does not rise to the level of the standard set forth in *Lake Beulah* of "sufficient concrete, scientific evidence" on which to base a regulatory response. The GSD Nutrient Model should not be used or relied upon for any regulatory purpose other than to satisfy the WDNR's obligations to fully evaluate a proposed project pursuant to Wis. Stat. § 1.11 and Wis. Admin. Code Ch. NR 150. There is no regulatory authority or scientific justification for the use of the GSD Nitrogen Balance or the Nitrate Groundwater Model to promote the approval or denial of any permit issued by WDNR, or to justify the inclusion of any new, unique or

unpromulgated conditions in any permit issued by WDNR for the GSD Project in contravention of §227.10(2m), Wis. Stats.

2.3.2.3.2 Potential Groundwater Quality Impacts

Groundwater in the GSD Project Area, and throughout the Central Sands region, is classified as susceptible to contamination (USGS, 2008); a groundwater contamination susceptibility map is shown on **Figure 2-31**. Susceptibility is defined as the relative ease in which a contaminant can be transported from the land surface to the water. In the Central Sands region, groundwater is relatively susceptible to contamination because travel times for water infiltrating from the land surface to the water table is relatively rapid as the sandy materials are very permeable and the nominal depth to groundwater is about 20 feet. In addition, the sandy materials do not strongly adsorb and/or retard the migration of most contaminants.

As discussed above, there is a potential for nitrate, phosphorus, pathogens, metals and other compounds to impact groundwater quality in the vicinity of the GSD Production Area and GSD Agricultural Crop Fields. Historical agricultural practices in the Central Sands region and elsewhere in Wisconsin have been documented to have had adverse impacts on groundwater quality. A state wide survey of wells in 2007 indicated that nine percent of the wells in Wisconsin had nitrate concentrations that exceeded the MCL of 10 mg/L and that about one third of the wells in the state had a detectable level of agricultural pesticides or pesticide metabolites (Wisconsin Agriculture, Trade & Consumer Protection, 2008). Sources of these impacts include failing septic systems and over application of lawn fertilizer in addition to historic agricultural operations.

A study of the Central Sands region in the late 1970's concluded that nitrate and chloride concentrations in the groundwater of the Central Sands region were significantly above background and that the main source is irrigated agriculture (Saffigna and Keeney, 1977). A detailed study of the impacts of agriculture on groundwater was conducted in the Town of Port Edwards in Wood County, just west of the Wisconsin River and the GSD Project Area, in the mid-1990's (Kraft and others, 1995). The results of this study indicated that irrigated vegetable agriculture affected groundwater quality. Nitrate and chloride concentrations in groundwater affected by irrigated agriculture were found to be elevated above concentrations in non-agricultural areas. In addition, it was found that herbicide residues were common in agriculturally impacted groundwater, but concentrations of these compounds in groundwater was usually very low (Kraft and others, 1999).

Groundwater quality data from monitoring wells and private wells in the vicinity of the CSD and land application area, which is located only a few miles south of the Town of Port Edwards, was cited in comments to WDNR by K. Wade (2013) and by Montgomery Associates (2012) with the allegation that adverse impacts to groundwater were caused by the application of organic nutrients to cropland near the CSD. Water samples from several wells in the vicinity of the CSD have had reported nitrate concentrations of greater than 10 mg/L. Importantly, these data indicate that agricultural practices prior to construction and operation of the dairy have impacted groundwater in this area as monitoring wells directly downgradient of the CSD had nitrate concentrations greater than 30 mg/L prior to start of operation of the dairy in the spring of 2008. These elevated nitrate concentrations in the downgradient wells are consistent with past agricultural practices in this area; similar ranges of nitrate concentrations were observed in

groundwater in wells sampled as part of the Port Edwards Study. A. Craig, Statewide Nutrient Specialist, at the Department of Natural Resources, testified when asked about the nitrate concentrations in the wells near the CSD that *"The data, however, doesn't show significant increases in correlation with land application amounts by Central Sands Dairy… Most of the data has either flat lined or it's gone down from what I see. Not much to go on*[23]*."*

The amount of nitrate in groundwater beneath fields in the Central Sands that are managed with BMPs has not been well documented. In the 1995 Port Edwards Groundwater Priority Watershed report, a nitrogen balance for four fields on which sweet corn and potatoes were grown in 1992 and 1993 was presented (Kraft and others, 1995). In that study, based on the nitrogen balance, it was determined that on average 163 lbs of nitrogen per acre leached to groundwater. Based on average recharge rate determined for the irrigated fields studied (20.4"), the average calculated concentration of nitrate in groundwater beneath the fields was 37 mg/L. In fact measured nitrate concentrations in groundwater beneath the fields only averaged 22.4 mg/L, suggesting that the nitrogen balance method overestimated nitrate concentrations by about a factor of 1.6. This example illustrates that a nitrogen balance can only produce a rough estimate of the amount of actual nitrogen leached as nitrate to groundwater. Also, agricultural and nutrient management practices have improved significantly in the two decades since the Port Edwards study was conducted.

The water-quality impacts of the GSD Project cannot be estimated by assuming that the impacts will be similar to those at other agricultural fields in the Central Sands or those previously studied. The "Farming Full Circle" principles that will be followed at the GSD will ensure that nutrient and pesticide losses to groundwater and surface water are significantly reduced relative to those that occur with conventional unregulated agricultural practices that dominate in the Central Sands. A recent study conducted at a research farm operated by Iowa State University indicated that multi-year crop rotation, such as will be practiced by the GSD, and the use of animal manure to provide most of the needed nutrients, such as will be practiced by GSD, can reduce the amounts of pollutants in groundwater by 200 fold over conventional agricultural practices using inorganic nutrients and no crop rotation (Bittman, 2012; Davis and others, 2012).

As has been noted many times, crop cultivation and nutrient applications on all fields at the GSD will be planned to maximize to the extent technically and economically feasible nutrient utilization efficiency by crops and nutrient applications will follow a WDNR approved NMP. In addition, numerous other measures, that are not required by law or any nutrient management planning standard but are part of the Farming Full Circle concept, will be followed to minimize nutrient and pesticide losses. These measures include:

- Rotate crops from year to year and include crops in the rotation that have minimal nutrient requirements (alfalfa, peas, beans);
- Minimize fall applications of manure/fertilizers;

[23] In the matter of Milk Source Holdings, LLC High Capacity Well Approval, August 22, 2013

- Maximize multiple in-season application of nutrients such that nutrients are supplied as needed by the crops;
- Analyze plant tissue from crops frequently during growing season to determine nutrient requirements;
- Plant fall cover crops for additional nutrient uptake and to minimize wind erosion;
- Raise crops, to the extent practicable, in which the harvest removes most of the plant matter (silage, alfalfa);
- Raise crops, to the extent practicable, that are deep rooted (corn and alfalfa);
- Manage crops for high yield and uniform stand conditions (single soil type, uniform irrigation application, uniform tillage, uniform nutrient application); and
- Use manure to increase soil water and nutrient retention capacities and to stimulate microbial activity that increases crop resistance to pathogens and decreases need for pesticides.

All of the measures listed above, none of which are required by a conventional NMP, will ensure that nitrate leaching is significantly less than occurs elsewhere in the Central Sands beneath fields that are farmed with conventional unregulated practices. These measures go far beyond the requirements of conventional NMPs and are consistent with recommendation of the U.S. EPA Science Advisory Board (USEPA, 2011) for management practices to reduce nitrogen leaching to groundwater and recommendations in a recent report prepared for the California Water Resources Control Board to reduce nitrogen leaching in agricultural areas in California (2012)

As described above, a mass nitrogen balance was calculated for this EIR. A mass balance is the practice of analyzing physical systems by accounting for the amount of material entering and leaving a system of interest. This approach provides a means to approximate flows of materials, such as nitrate, that otherwise are unknown or difficult to measure. One example of estimating the magnitude of groundwater nitrogen concentrations (nitrate[24]) is the nitrogen mass balance calculated for nitrogen in the Port Edwards Groundwater Priority Watershed Study (Kraft and others, 1995). In that study, it was calculated that the average nitrogen available for leaching was 163 lbs per acre per year and based on groundwater monitoring data that average groundwater concentrations beneath the fields investigated was 22.4 mg/L. Thus, based on the Port Edwards Study it is projected that the leaching of 7.3 lbs per acre has the potential to increase groundwater nitrate concentrations by 1 mg/L directly beneath the field and that the leaching of 73 lbs per acre has the potential to increase the nitrate concentration by 10 mg/L directly beneath the field.

[24] In sandy soils such as those that exist at the GSD Project, most of the nitrogen that leaches from the agricultural fields will be in the nitrate form. Some nitrogen that leaches maybe in the form of organic compounds or complexes and in the form of an ammonium ion, but these forms are expected to be insignificant relative to the nitrate form.

Water-quality data from monitoring wells installed downgradient of fields receiving manure application indicate that the nitrate concentrations in recharge from these fields is closely related to the nitrogen losses estimated from a field-scale nitrogen mass balance (Burow and others, 2008; VanderSchans and others, 2009).

The calculation of the potential nitrate loading to groundwater from a nitrogen mass balance requires as a minimum: 1) estimation of nitrogen inputs to a field including fertilizer, manure, atmospheric sources and nitrogen in irrigation waters ($\mathbf{N_{inputs}}$), and 2) the amount of nitrogen outputs from the fields including nitrogen in harvested crops and atmospheric losses ($\mathbf{N_{outputs}}$). The nitrogen balance equation then is:

$\mathbf{N_{gw} = N_{inputs} - N_{outputs}}$ where $\mathbf{N_{gw}}$ is the nitrogen in groundwater.

A nitrogen mass balance of this type assumes long-term steady state dynamics of soil nitrogen. That is, the amount of nitrogen mineralized from soil organic matter is equal to that immobilized by microbes. Long-term in this sense is likely decades or longer.

In calculating the nitrogen potentially available for leaching to groundwater with the equation listed above, it is important to note that any uncertainty in the estimation of the terms in $\mathbf{N_{inputs}}$ and $\mathbf{N_{outputs}}$ is propagated to the estimate of $\mathbf{N_{gw}}$. As a result, the estimate of $\mathbf{N_{gw}}$ may have a large uncertainty associated with it.

A partial nitrogen balance was calculated for the GSD Agricultural Fields to be converted from pine plantation using the best available data to estimate long-term average nitrogen inputs and outputs from the converted agricultural fields. This estimate is referred to as the "most likely" estimate. The development of the nitrate mass balance and the uncertainties associated with this estimate and a "best-case" and "worst-case" estimates are described below and in the final section of **Appendix E**. The nitrogen balance for the converted GSD Agricultural Fields is based on a crop rotation that includes alfalfa, corn silage, grain corn, sweet corn, peas and snap beans. The estimated annual partial nitrogen balance for the converted GSD Agricultural Crop Fields based on the best estimates of mostly likely conditions is the following:

$\mathbf{N_{inputs}}$ = 287 lbs/acre

N in manure and fertilizer	231 lbs/acre
N from atmospheric fixation	48 lbs/acre
N from atmospheric deposition (wet and dry)	6 lbs/acre
N in irrigation water	1.6 lbs/acre

$\mathbf{N_{outputs}}$ = 250 lbs/acre (excluding leaching to groundwater)

N in harvested crops	239 lbs/acre
N in ammonia volatilization	11 lbs/acre
N losses from denitrification	0 lbs/acre

N atmospheric losses from plants 0 lbs/acre

Thus, the most likely potential nitrogen loss to groundwater is approximately 37 lbs/acre per year ($\mathbf{N_{gw} = N_{inputs} - N_{outputs}}$ = 287 – 250 = 37). Based on the dissolution of this nitrogen in the volume of water that recharges the groundwater annually, the most likely potential loss of 37 lbs/acre per is equivalent to a nitrogen concentration of approximately 8 mg/L in the water that infiltrates beneath the rooting depth of the plants and recharges the groundwater table[25]. In the groundwater, almost all of the nitrogen will be present as nitrate. In the initial years of farming the converted GSD Agricultural Fields, some of the nitrogen applied as manure will go into storage in the soils. As a result, the most likely average annual potential loss to groundwater will be less than 37 lbs/acre. The most likely annual loss to groundwater is also likely to be less than 37 lbs/acre because potential losses of nitrogen to the atmosphere directly from the plants and from denitrification have been assumed to be zero. Because these atmospheric losses are assumed to be zero, such losses are conservatively assumed as losses to groundwater.

The outputs from the GSD Nitrogen Balance were used as inputs to the Nitrate Groundwater Model as a "fate and transport" element to evaluate the potential nitrate concentrations in groundwater downgradient of the GSD Project at specific distances after twenty years of GSD applying nutrients to the GSD Agricultural Crop Fields converted from pine plantation. The Nitrate Groundwater Model identified a hypothetical residential well located approximately 300 feet from the edge of a GSD Agricultural Crop Field and estimated that after twenty years of GSD's operations under the "most likely" conditions, groundwater in the hypothetical residential well could increase to 4 mg/L over the current assumed baseline of 0.3 mg/L. This modeled increase does not exceed the chapter NR 140 ES for nitrate in groundwater and is therefore not significant.

Based on the significantly overestimated results of the Port Edwards Study, as described above, the calculated loss of 37 lbs/acre per year of nitrogen is likely to produce nitrate concentrations at the water table directly beneath the field of 5 mg/L, rather than 8 mg/L as calculated above, resulting in an even lower potential increase in a hypothetical residential well located 300 feet from the edge of a GSD Agricultural Crop Field. The difference in the two estimates of nitrate concentrations at the water table illustrates the uncertainties inherent in using the nitrogen mass balance approach to estimate nitrogen losses to the water table, which are primarily a result of a propagation of the uncertainties in estimates of all components of the nitrogen balance to the loss to groundwater value.

In the "most likely" nitrogen balance described in detail in **Appendix E**, the only nitrogen losses considered from the fields was nitrogen in the harvested crops, ammonia volatilization, and leaching to groundwater. It is very possible that other significant losses have not been accounted for, such as denitrification and direct atmospheric losses from the plants. As noted above, in the nitrogen balance prepared for the Port Edwards Study there were apparently some significant losses that were not included in the analysis as the

[25] The average recharge rate beneath the irrigated fields is estimated to be 20.5 inches per year as described in Appendix D to the EIR.

measured groundwater concentrations implied that nitrogen leaching as calculated by the nitrogen balance approach was overestimated by a factor of 1.6. Denitrification was specified in the most likely estimate of potential nitrogen leaching as zero because the organic matter content in the subsurface materials beneath the GSD Agricultural Fields to be converted from pine plantation currently is low and no studies have quantified the magnitude of denitrification in groundwater in the Central Sands. However, we know denitrification occurs so assigning a zero value to this pathway in the model results in a conservative estimate. A study of groundwater conditions in the Central Sands near Stockton by Kraft and others (2004) found some evidence for denitrification in groundwater, though the amount of denitrification appeared to be small except possibly in areas treated with manure. Saad (2008) in a study of nitrate in groundwater in the Central Sands suggested that some denitrification may occur in deeper groundwater. As the organic matter content in the soils at the GSD Agricultural Fields increases with time as the result of manure applications, denitrification will be enhanced and may become an important component in the nitrogen balance.

To evaluate the potential impact of both an overestimate and underestimate of potential nitrogen losses to groundwater a "best-case" scenario and a "worst-case" scenario were also evaluated. The best-case and worst-case scenarios are included in the EIR for completeness, but are not considered realistic estimations of potential impacts to groundwater and surface water resources. As such, this EIR only analyzes in detail the potential impacts from the most likely scenario.

In the best-case scenario, it is assumed that technological improvements will occur within the twenty year period modeled that brings this nitrogen balance to steady state, such that the long term potential impacts to groundwater are significantly reduced. It is estimated that in a best-case scenario, the potential nitrogen loss to groundwater could be one-half the amount estimated in the "most likely" scenario. Best-case circumstances include, but are not limited to:

- Higher yield and nitrogen recovery rates than expected due to varietal changes and/or other technological improvements;

- Water management and weather prediction technologies improve to allow better planning and management to avoid leaching due to precipitation events;

- Alfalfa roots mining more nitrogen from the soil than is currently and conservatively assumed in the "most likely" scenario;

- Improvements in the understanding of actual losses due to denitrification;

- Improvements in cover crop ability to capture applied nitrogen and retain it until the following growing year; and

- Improvements in nitrogen inhibitor technology.

The Nitrate Groundwater Model indicates that under the "best-case" conditions noted above, nitrate concentrations in a hypothetical residential well located approximately 300 feet from the edge of a GSD Agricultural Crop Field after twenty years of GSD's operations could increase to

2 mg/L over the assumed baseline of 0.3 mg/L. This modeled increase does not exceed the chapter NR 140 PAL or ES for nitrate in groundwater and is therefore not significant.

In the worst-case scenario, it is assumed that technology will not improve at all within the twenty year period that brings the Nitrate Groundwater Model to steady state. The worst-case scenario also assumes significant crop losses, which if realistic would also assume significant economic losses that could not be sustained for a twenty year period. In sum, the worst-case scenario described herein is extremely unlikely to occur. It is estimated that in a worst-case scenario, the potential nitrogen loss to groundwater could be twice the amount estimated in the "most likely" scenario. Worst-case circumstances include, but are not limited to:

- Significant and consistent crop failures and yield reductions beyond those assumed in the "most likely" scenario;

- Significant and consistent rainfall events ("climate change") greater than those assumed in the "most likely" scenario; and

- No improvement in yield and nitrogen recovery rates and no other technological improvements.

The Nitrate Groundwater Model indicates that under the "worst-case" conditions noted above, nitrate concentrations in a hypothetical residential well located approximately 300 feet from the edge of a GSD Agricultural Crop Field after twenty years of GSD's operations could increase to 8 mg/L over the assumed baseline of 0.3 mg/L. This modeled increase does not exceed the chapter NR 140 ES for nitrate in groundwater and is therefore not significant.

As noted above, manure potentially contains a number of pathogens that can pose a threat to groundwater quality. Common pathogens in manure from cows include the bacterium *Escherichia coli* (E coli), bacterium in the genus *Listeria*, bacterium in genus *Salmonella*, bacterium *Mycobacterium paratuberculosis*m, the protozoan *Cryptosporidia* and *Giardia,* and the bovine viruses. Research indicates that due to limited mobility of most cattle-related pathogens in the subsurface and the effective short half-lives of the pathogens, that cattle-related pathogens do not pose a significant threat to groundwater quality. A recent detailed evaluation of potential migration of E coli beneath agricultural fields has indicated that a NMP will protect groundwater supplies from microorganism contamination (Bradford and Segal, 2009). Viruses are potentially more mobile in groundwater than other pathogens because of their small size and in many instances they lack a surface electrical charge (Borchardt and others, 2003). Recent studies of the incidence of human viruses in groundwater in Wisconsin found that significant virus transport was most likely in fractured bedrock environments where fractures can result in rapid flow systems where pathogens can travel quickly, with minimal filtration (Borchardt and others, 2007; Gellasch and others, 2012). As a result, it is unlikely that virus transport would be significant in the sand aquifer beneath the GSD Agricultural Crop Fields where groundwater is naturally filtered by the aquifer as it flows through the pores of the sandy material rather than rapidly flowing through fractures in bedrock. The planned installation of an anaerobic digester at the GSD Project Production Area will significantly reduce the potential for pathogen and virus survival and transport to off-site surface or groundwater.

2.3.2.3.3 Potential Surface Water Quality Impacts

The GSD Agricultural Crop Fields are located on a very flat plain that is incised by a narrow stream valley as shown on **Figure 1-4**, a topographic map of the GSD Project Area. The fields are all situated on the flat plain and not in the incised valleys. The relatively flat land surface and very permeable sands that are present allow the water to be filtered through the aquifer matrix with little runoff. During rare large storm events or rapid snowmelt events, surface runoff from the GSD Agricultural Crop Fields may occur resulting in discharge of sediments, manure, and associated compounds to adjacent streams. Except during those rare large storm events or rapid snowmelt, water will infiltrate the ground surface, and migrate by means of groundwater flow to the streams. Leaching of nitrate to groundwater and the subsequent discharge of groundwater containing elevated concentrations of nitrate to surface water is the most significant potential impact of the GSD on surface water quality.

2.3.2.3.3.1 Rivers and Streams

Infiltrating surface water from the GSD Agricultural Crop Fields will migrate vertically downward to the groundwater table and then migrate in the direction of groundwater flow. Most of the infiltrating water at the GSD Agricultural Crop Fields will migrate toward and into Tenmile Creek and Sevenmile Creek. Throughout this migration, nitrogen concentrations will be naturally diluted due to the large aquifer resource, and in addition some denitrification of nitrate will occur in the wetlands along the creeks where the groundwater discharges. Although portions of the GSD Project Area lie within the Fourteenmile Creek watershed (**Figure 1-8**), groundwater flow contours indicate that the direction of groundwater flow near Spring Branch and the northern portions of the Fourteenmile Creek watershed is toward the Wisconsin River and Tenmile Creek and not toward Spring Branch or Fourteenmile Creek (**Figure 1-10**).

The long-term potential for increases in nitrate concentrations in Sevenmile Creek and Tenmile Creek from the application of nutrients to the GSD Agricultural Crop Fields proposed for conversion from pine plantation was quantitatively evaluated using the GSD Nitrogen Balance and Nitrate Groundwater Model described above. The groundwater flow model was used to delineate the contribution area for the perennial reach of Sevenmile Creek between Rangeline Road and CTH Z and the contribution area for the perennial reach of Tenmile Creek between CTH U and CTH Z. The contribution area is defined as that area where the groundwater discharge to the stream within the specified reach originates as infiltration from the surface. The contribution area for the reach of Sevenmile Creek between Rangeline Road and CTH Z totals 2,647 acres, of which 407 acres are GSD Agricultural Fields to be converted from pine plantation. The contribution area for the reach of Tenmile Creek between CTH U and CTH Z totals 22,030 acres of which 3,930 acres are GSD Agricultural Fields to be converted from pine plantation.

These contribution areas define the surface area where the groundwater discharging to the streams in these reaches originates from infiltrating precipitation and irrigation waters. For purposes of this analysis it was then specified that water infiltrating to the water table beneath the GSD Agricultural Crop Fields converted from pine plantation would have an average nitrate concentration of 8 mg/L and that precipitation infiltrating elsewhere in the contribution areas would have a nitrate concentration at background concentrations. During periods when Sevenmile Creek is dry upstream of Rangeline Road, it was calculated that the average nitrate

concentration at County Road Z would increase from 0.3 mg/L under existing conditions to 1.6 mg/L after approximately 20 years of operation of the GSD Project. Average nitrate concentration in Tenmile Creek under existing conditions at Rangeline Road is approximately 3.8 mg/L and this average concentration is calculated to increase to about 4.15 mg/L after about 20 years of operation of the GSD Project. If the GSD Nitrogen Balance overestimates the nitrogen available to leach to groundwater, as the Port Edwards calculations did, nitrate concentrations at the water table beneath the converted GSD Agricultural Crop Fields would be 5 mg/L, rather than 8 mg/L, and the projected nitrate concentrations in Sevenmile Creek and Tenmile Creek at County Road Z would be 1.1 mg/L and 4.0 mg/L, respectively.

Based on the GSD Nitrogen Balance, the "best-case" potential nitrogen available to leach to groundwater is 18.5 lb/acre and 4 mg/L beneath the fields. The modeled best-case concentration in Sevenmile Creek after twenty years is about 0.95 mg/L, and in Tenmile Creek is about 3.9 mg/L. The "worst-case" potential nitrogen available to leach to groundwater is 74 lb/acre and 16 mg/L beneath the fields. The modeled worst -case concentration in Sevenmile Creek after twenty years is about 3 mg/L, and in Tenmile Creek is about 4.6 mg/L.

As described above, the discharge of phosphorus from the GSD Agricultural Crop Fields is heavily regulated pursuant to the GSD NMP, which includes a calculation of tolerable soil loss and phosphorus index for each field, as well as significant setbacks from nutrient applications to waterways. The permeable soil type and very minimal slopes of the fields in the NMP significantly minimize the potential for erosion and surface runoff from the GSD Agricultural Crop Fields. As such, the GSD Project is expected to contribute a neglible amount of phosphorus into Sevenmile and Tenmile Creeks.

2.3.2.3.3.2 Wisconsin River TMDL

The GSD Production Area is not anticipated to be a factor in the development of the Wisconsin River TMDL because it is located a sufficient distance from tributaries to the Wisconsin River, is subject to a zero discharge standard for normal operating conditions, and is not expected to cause any direct impacts to that resource.

Given the flat topography and the relatively permeable soil types in the GSD Agricultural Crop Fields proposed for conversion from pine plantation, runoff of applied nutrients to the Wisconsin River, either directly or via nearby tributaries, is unlikely. The significant best management practices to be implemented by GSD to minimize soil and wind erosion further minimize the risk of sediment or phosphorus runoff to the Wisconsin River or its nearby tributaries.

2.3.2.3.3.3 Wetlands

The potential for adverse impacts to wetlands is from contaminants being transported from overland flow and from groundwater flow. Impacts from manure may increase available nutrients and degrade isolated wetlands. Pesticide applications may drift in the air, or be carried by surface water to isolated wetlands and degrade wetland plant communities. In addition, if water quality in the groundwater that supplies wetland hydrology to isolated and riparian wetlands are compromised by pollutants, adverse impacts to wetland flora and fauna may occur. Potential contaminants are described in detail in Sections 2.3.2.3.1 and 2.3.2.3.2. Adverse

impacts that could result include loss of habitat, wildlife degradation, loss or reduction in wetland plant communities and degraded water quality.

2.3.2.4 Significance of Potential Water Quality Impacts

The significance of potential impacts from the GSD Project to groundwater and surface water quality is largely dependent on the management of manure, other fertilizers, and pesticides, and adherence to the BMPs described in the NMP.

In many environments, surface water transport of sediment is an important mechanism for migration of nutrients and organic contaminants from agricultural fields to streams, but this process is not relevant in the analysis of GSD Agricultural Crop Fields because the high permeability soils and flat topography combine to create an environment with extremely low potential for surface water runoff. As such, the primary mechanism through which environmental stressors applied at the GSD Agricultural Crop Fields could reach the environment is through migration to the groundwater.

2.3.2.4.1 Significance of Groundwater Quality Impacts

The most significant potential impact of the GSD Project on groundwater quality is a potential increase in nitrate concentrations in groundwater. In the long term, most likely nitrate concentrations directly beneath the GSD Agricultural Crop Fields converted from pine plantation are expected to increase from less than 2 mg/L to between 5 and 8 mg/L. Based on the most likely scenario, nitrate concentrations in groundwater downgradient of the fields are expected to remain well below the drinking water standard of 10 mg/L, as groundwater beneath the fields will further disburse and concentrations will further dilute prior to reaching receptors. A monitoring plan has been developed to monitor long-term changes in groundwater quality downgradient of the GSD Agricultural Crop Fields to be converted from pine plantation. This monitoring plan is described in **Appendix B**. In the event that nitrate concentration increase above expected levels, changes in cultivation practices could be implemented to improve nitrogen efficiency, including 1) incorporate more or different legume crops in the rotation, 2) conduct additional nutrient testing and/or modify nutrient application rates; 3) plant more and/or different cover crops, 4) reduce fall applications of nutrients, or 5) look ahead to new technologies that will assist in more precise management and application of nutrients.

Concentrations of major ions that are constituents of manure and fertilizer and are relatively mobile in groundwater, such as chloride and sodium, are expected to increase in the long term in groundwater, but concentrations will remain far below water-quality standards. These constituents have such high water quality standards and the potential increase is so low, that they were not included in the nutrient modeling exercise. Other ions that occur in manure and fertilizers, such as calcium, magnesium, and potassium are less mobile in groundwater and changes in concentrations in these ions in groundwater are not expected to be significant. As noted above, because GSD will construct a digester, the transport of bacteria and viruses in groundwater also is not expected to be significant.

Approximately 440 private supply wells are located within ½-mile of the irrigated areas of the GSD Project and about one-half of these wells are located downgradient of the GSD Agricultural Crop Fields to be converted from pine plantation. The groundwater monitoring

conducted pursuant to the monitoring plan will provide early warning of any potential adverse effects to water quality in this area.

2.3.2.4.2 Significance of Surface Water Quality Impacts

2.3.2.4.2.1 Rivers and Streams

The only surface water bodies that have the potential for water-quality impacts from the conversion of pine plantation to irrigated crop production are Sevenmile Creek, Tenmile Creek, and the Wisconsin River. The GSD Project will not affect the water quality of Spring Branch, Fourteenmile Creek or Chester Creek because of the location of these watersheds relative to the GSD Agricultural Crop Fields to be converted from pine plantation as shown on **Figure 1-10**. Water infiltrating from the GSD Agricultural Crop Fields converted from pine plantation to the water table will flow toward and discharge into Sevenmile Creek, Tenmile Creek, or directly into the Wisconsin River. As described above, the most likely average nitrate concentration in Sevenmile Creek is estimated to increase from less than 1 mg/L to between 1.1 and 1.6 mg/L, and the average nitrate concentration in Tenmile Creek is estimated to increase from 3.8 mg/L to between 4.0 and 4.15 mg/L. These increases in nitrate concentrations are not expected to have an adverse impact on these streams, and therefore will not have an impact on the Wisconsin River. Surface water quality in the upper reaches of Fourteenmile Creek may improve because 1,800 acres of existing irrigated crop fields will be brought into GSD's nutrient management plan and will be regulated for the first time.

The "best-case" potential nitrogen available to leach to groundwater is 18.5 lb/acre and 4 mg/L beneath the fields. The modeled best-case concentration in Sevenmile Creek after twenty years is about 0.95 mg/L, and in Tenmile Creek is about 3.9 mg/L. The best-case impacts indicate very minor potential impacts to surface waters, which would not be significant. The "worst-case" potential nitrogen available to leach to groundwater is 74 lb/acre and 16 mg/L beneath the fields. The modeled worst -case concentration in Sevenmile Creek after twenty years is about 3 mg/L, and in Tenmile Creek is about 4.6 mg/L. The highly unlikely worst-case impacts indicate slightly greater impacts to surface waters compared to the most likely scenario; however, these increases are not expected to be significant due to the long period of time it will take to reach those concentrations. The biological impacts from the modeled most likely nitrogen increase are described in Sections 2.4 and 2.5 of this document.

As described above, the transport of other manure constituents and other agricultural chemicals associated with the GSD Project to the creeks and other surface water bodies by surface water transport is expected to be negligible.

Nekoosa East a nearby cranberry operation that diverts water from Sevenmile Creek has raised a concern that cranberry crops are susceptible to damage caused by elevated nutrient concentrations in cranberry irrigation water or in water applied for freeze protection (Montgomery Associates, 2012). It was noted by Montgomery Associates that in 2011 a cranberry operation located in Adams County, well south of the proposed GSD Project Area, experienced an increase in nitrate concentration in water applied to the cranberry fields from what it describes as summer nitrate concentrations of 6-8 mg/L to 12-15 mg/L, and that this increase resulted in a decrease in yield of 50 percent. Montgomery Associates assigned a "background concentration" of 7 mg/L of nitrate in Sevenmile Creek and concluded that

increased nitrogen concentrations above this background level in water used by cranberry operations could be detrimental to yields. The information provided by Montgomery Associates is not relevant to the GSD Project, because, as described above, background concentrations of nitrogen in Sevenmile Creek are considerably lower than those identified in Adams County, south of the GSD Project Area, and the modeled nitrate concentration in Sevenmile Creek from the GSD Project is much lower than 7 mg/L. Even the worst-case modeled scenario does not approach the 7 mg/L concentration that Montgomery Associates assigned as "background" for Sevenmile Creek. No impacts to Nekoosa East are expected due to the GSD Project.

Nekoosa East also raised a concern about its ability to maintain the "organic" status for its cranberry farm if the water quality is impacted by the nitrate or e. Coli as a result of the GSD Project[26]. As described above, nitrate concentrations in Sevenmile Creek are expected to increase less than 2 mg/L, and will remain well below the groundwater ES of 10 mg/L after the GSD Project has operated for twenty years. In addition, GSD will install and utilize an anaerobic digester which will eliminate 95-98 percent or more of pathogens found in manure (Saunders and Harrison, 2012). As such, the GSD Project will not significantly impact water quality in Sevenmile Creek and will have no effect on the company's "organic" status. In addition, as all other cranberry operations are located west and upstream of the GSD Project, the GSD Project will have no effect on groundwater and surface water quality at these operations.

2.3.2.4.2.2 Wisconsin River TMDL

The GSD Project should not be a factor in the development of the Wisconsin River TMDL because it is unlikely to contribute either sediment or phosphorus directly or indirectly to the Wisconsin River or its tributaries. The GSD Project is located a sufficient distance from the Wisconsin River and is not expected to cause any direct impacts to that resource. Pursuant to Wis. Admin. Code Ch. NR 243, the GSD Production Area is subject to a zero discharge standard, i.e., no discharge of pollutants is permitted under normal operating conditions, which will prevent nutrients and sediment generated in the production area from reaching any tributaries to the Wisconsin River. The nutrients generated at the GSD Production Area will be managed in accordance with a WDNR-approved NMP which requires all nutrient applications to be made in accordance with state law requirements, including appropriate setbacks to certain resources and specific criteria for application location, rate and timing.

The fields in any WDNR-approved NMP must satisfy specific criteria that are designed to minimize runoff of phosphorus and sediment to surface waters, including a phosphorus index (PI) of 6 or less and a tolerable soil loss (T) of 5 pounds per acre per year. All GSD Agricultural Crop Fields have a phosphorus index of 0.4 or less. The fields to be converted from pine plantation have a maximum T of 0.3, and the existing irrigated acres have a maximum T of 0.4 All of these values are well below the state-wide agricultural performance standard, demonstrating that the GSD Project will not likely contribute phosphorus or total suspended solids to Sevenmile or Tenmile Creek, tributaries to the Wisconsin River. Finally, if the final Wisconsin River TMDL recommends that a performance standard more stringent than the

[26] Letter from Christa Westerberg of McGillivray Westerberg & Bender to Russ Anderson, WDNR, September 21, 2012.

current promulgated PI and T standards is necessary to meet the load allocation in the EPA-approved TMDL, WDNR must promulgate those more stringent standards in accordance with rulemaking procedures in Wis. Stat. Ch. 227. The TMDL is not expected to approved until 2017.

2.3.2.4.2.3 Wetlands

The water quality effects that occur in riparian wetlands along Sevenmile Creek and Tenmile Creek will be similar to those that occur in the groundwater that discharges to these wetlands. The most significant potential impact of the GSD project on groundwater quality is an increase in nitrate concentrations in groundwater. Nitrate concentrations in groundwater downgradient of the fields, which may discharge to nearby riparian wetlands, are expected to remain well below the drinking water standard of 10 mg/L. There is no wetland or surface water quality standard for nitrogen or nitrate.

Concentrations of major ions that are constituents of manure and fertilizer and are relatively mobile in groundwater, such as chloride and sodium, are expected to increase in the long term in groundwater, but concentrations will remain far below water-quality standards. Other ions that occur in manure and fertilizers, such as calcium, magnesium, and potassium are less mobile in groundwater and changes in concentrations in these ions in groundwater are not expected to be significant. As noted above, transport of bacteria, viruses and/or hormones in groundwater is not expected. The transport of other manure constituents and other agricultural chemicals associated with the GSD Project to the wetlands and other surface water bodies by surface water transport is expected to be negligible. The same protection for groundwater resources discussed above will protect against impacts to wetlands. Impacts of water quality changes on flora and fauna in these wetlands are discussed in Sections 2.4 and 2.5.

2.4 Flora

2.4.1 Existing Conditions

Wisconsin is divided into sixteen eco-regions with each region referred to generally as an 'Ecological landscape" as shown on **Figure 2-32** (Cleland, *et al*., 1997). Ecological landscapes are based on similar ecology and management opportunities. The WDNR classifies the southern two-thirds of Wood County as the "Central Sand Plains Ecological Landscape" and the northern one-third of Wood County as the "Forest Transition Zone." Saratoga Township lies in the south-eastern corner of Wood County (within the "Central Sand Plains Ecological Landscape"). This region can be generally characterized by "a mosaic of cropland managed grasslands and scattered woodlots of pine, oak, and aspen."[27]

The tension zone of floristic transition divides Wisconsin predominantly from northwest to southeast and runs through the southern-half of Wood County. The tension zone in Wisconsin is defined as "a band between two floristic provinces marked by the intermingling of species from

[27] WDNR Web page; http://dnr.wi.gov/topic/landscapes/index.asp?mode=detail&Landscape=7; Jan, 2012.

the "northern forest floristic province" to the north and the "prairie- forest floristic province" to the south" (Curtis, 1971). This tension zone is also indicative of many species (floral and faunal) overlapping and sharing common boundaries within their normal range of distribution.

Historic (pre-settlement) vegetation in Wood County consisted of Mixed Pine Barrens in the southeast (jack pine and native prairie grasses), Conifer-Bog/Sedge Meadow Wetlands in the south-central and south-west (black spruce, tamarack, cedar, blue joint grass, sedges, cordgrass), and Isolated Pine Forests (red pine, white pine). The remaining northern two-thirds of the county were characterized as Northern Mesic Forest (maple, hemlock, yellow birch).

Most of the current agricultural lands within Wood County are in the northern two-thirds of the county. Scattered hardwood forest woodlots are also common in this area. There are a number of low depressions in this region of the county that support large forested wetlands. Two examples of such forested wetlands on public lands include the Sherry Flats and the Mead Wildlife Area, each about 25 miles northwest of the GSD Project Area.

The southern one-third of the county is situated on the lake plain of Glacial Lake Wisconsin. This low, sandy region is home to very large wetland areas, conifer forest tracks, and over 5,000 acres of cranberry marshes. Common forest species here are red pine and cedar, with black spruce and tamarack within the conifer bogs. (Update to the Wood County Park, Recreation, and Open Spaces Plan, 2011).

Post settlement agricultural and urban land use practices have dramatically altered the land cover of the region. Land cover in Wood County is currently comprised of aspen (48 percent), pine (11 percent), oak (9 percent), scrub oak (5 percent), bottomland hardwoods (3 percent), other forest, including birch and maple (2 percent) and brush, grass, swamp, wetlands, and non-forest areas (22 percent)[28].

The majority of the GSD Project Area is currently being utilized for commercial timber production. The individual commercial timber stands are planted and maintained as "even-age" single species (monotypic) timber stands as each stand is managed for a single age class of trees. The majority of the GSD Project Area is comprised of numerous individual even-aged timber stands, but age class categories vary widely within the full scope of the GSD Project Area. To sustain timber production from year to year, only specific stands are harvested in any single season. As a stand is harvested, that stand is re-planted with bare root stock trees of the same age class. Over time, numerous age-classes are represented on a landscape scale, creating a mosaic of "mixed-age" timber stands on the ecological landscape.

Commercial even-age class red pine plantations are managed for the singular purpose of maximizing timber production as quickly and efficiently as possible. This means site preparation, planting, stand densities, maintenance, timing of stand rotation, and harvesting is all conducted with methods and timing that does *not* prioritize wildlife habitat value. Due to a lack of vegetative structure (a variety of vertical and horizontal plant variety) and species diversity within monotypic red pine plantations, wildlife habitat is lacking scale, diversity and quality.

[28] Wood County's Land and Water Department web page; 2009; http://www.co.wood.wi.us/Departments/Parks/Forestry.aspx

Younger age class pine stands or older stands that have been thinned will support more plant structure and diversity due to an increase in sunlight that reaches the forest floor. As the pine stands age and the canopy gets more dense, light infiltration to the forest floor is greatly reduced leading to a reduction in understory shrubs and herbs. This reduction in plant diversity leads to a reduction in food and cover available to wildlife. Ground level and understory vegetation can be diverse within red pine stands planted at non-commercial densities (8 feet x 10 feet spacing or greater), but most commercially planted red pine stands are planted at 6 feet x 8 feet spacing or less (Ek, *et al.*, 2006).

The GSD Project Area also consists of 1,800 acres of existing irrigated crop land. The use of this acreage will remain as irrigated crop land. No material changes to the landscape or existing habitat are expected.

2.4.1.1 Plant Communities

2.4.1.1.1 Forest

Forestlands occupy approximately 215,400 acres, or 42 percent of Wood County (USDA, 1996). The predominant species are aspen, conifers and oak. In 1932, Wood County established a county forest by entering 13,270 acres into the "Forest Crop Law". Additional acreage obtained through the years has increased the size of the county forest to approximately 37,606 acres. Most of the county forestland in the southern portion of the county consists of flat, sandy, lake plain topography. In addition to county and state-owned forestland, there are 12,740 acres of privately-owned forestlands that are under the Forest Crop Law (FCL) or the Managed Forest Law (MFL). The total of county-owned, state-owned, and private land under FCL or MFL is 70,444 acres or approximately 110 square miles of land. (Update to the Wood County Park, Recreation, and Open Spaces Plan, 2011).

Wood County contains approximately 45,450 acres of woodlands enrolled in MFL. Of these acres, approximately 11,350 acres are Open MFL (lands open to the public for recreational use) and approximately 34,600 acres are Closed MFL (lands not open to the public for recreational use) (WDNR Forestry Division).

Within Saratoga Township, approximately 22,000 acres (69 percent) remain forested (Saratoga Township Comprehensive Plan, MSA, 2007- page 77). Approximately 10,175 acres are enrolled in MFL in Saratoga Township, of which approximately 8,367 acres are classified as Open MFL and approximately 1,808 acres are classified as Closed MFL (WDNR Forestry Division). The MFL Forestland in Saratoga Township is predominately comprised of monotypic red pine plantations historically cultivated and harvested for the pulp and paper industry. Other tree species in low density within the red pine plantations include jack pine, pin oak, aspen, black cherry, paper birch, and red maple. Typical shrubby woody understory species include prickly ash, hazelnut, and sumac. Herbaceous species found within the understory of the red pine plantations include fine fescue, Pennsylvania sedge, several fern species, stiff goldenrod, prairie larkspur, meadowrue, wild geranium, sand coreopsis, leadplant, smooth blue aster, lupine and prairie dropseed. The density of herbaceous species increases near woodland edges, openings (patch clear-cuts or wind blow areas) road right-of-ways, and within zones of over-story canopy reduction, or in younger age-class red pine plantations that have been clear-cut and re-planted.

2.4.1.1.2 Grasslands

Grasslands within Wood County are mainly found within grass-shrub dominated emergent wetlands and within utility corridors in the west and southwest portion of the GSD Project. About 50 acres of grassland exist in these utility corridors. Remnant or restored dry-mesic prairies or oak savanna grasslands (with some sedge components) and sand prairies make up a much smaller grassland component and are mainly found on public lands such as WDNR Wildlife Management Areas. Isolated non-native cool season grasslands also exist in areas of eastern Wood County. These areas are also interspersed with shrub-carr habitat types.

Historically grass or wet sedge-dominated communities comprised a much larger portion of the landscape in the region. Species common to these communities include tussock sedge, Canada bluejoint grass, woolly sedge and/or few-seeded sedge. Frequent associates include blue flag, marsh fern, marsh bellwort, manna grasses, panicled aster, joe-pye weed, and bulrushes. (WDNR web site).

Most of the remnant dry-mesic native grasslands, oak savanna grasslands, and sand prairies have been developed, plowed or converted to other agricultural use (grazing, haying, or row cropping). Remnant sand prairies are dry native grassland communities characterized by native grass species such as little bluestem, sideoats grama, june grass, poverty oats, and panic grass. Common herbaceous species found in sand prairies include sand cress, field sage-wort, western ragweed, several sedge species, flowering spurge, frostweed, round-headed bush-clover, western sunflower, false-heather, long-bearded hawkweed, stiff goldenrod, horsebalm, and spiderwort (WDNR web site). A few isolated sand prairies or native grass strands remain in Wood County and Saratoga Township, but none have been observed within the footprint of the Saratoga Township GSD Project.

2.4.1.1.3 Wetlands

The majority of wetlands in Wood County are located along the major stream corridors. Within the Town of Saratoga, wetlands encompass an area of about 2,462 acres (8 percent of the land area) within the Town (Saratoga Comprehensive Plan). Wetlands identified based on the Wisconsin Wetland Inventory available through the WDNR[29] are shown on **Figure 2-14**. Riparian wetlands associated with Sevenmile Creek, Tenmile Creek, Chester Creek and Spring Branch (a tributary of Fourteenmile Creek) are located near the GSD Project Area. Approximately 154 acres of riparian wetlands are located along Sevenmile Creek but all of these wetlands are outside of the GSD Agricultural Crop Fields to be converted from pine plantation, and none will be disturbed due to the GSD Project. Approximately 330 acres of riparian wetlands occur along Tenmile Creek and also are outside of the GSD Project Area and will not be disturbed under the GSD Project. Wetlands associated with Fourteenmile Creek (258 acres) and Chester Creek (127 acres) are outside the GSD Project Area. Any wetland areas within the 1,800 acres of existing irrigated crop land are prior converted wetlands, as determined by the Farm Service Agency, and have been farmed for decades or longer.

[29] http://dnr.wi.gov/topic/Wetlands/inventory.html (2013)

The riparian wetlands of Sevenmile Creek and Tenmile Creek consist of primarily forested or shrub dominated wetlands according to the WDNR Wisconsin Wetland Inventory. These wetlands are dominated by broad-leaved deciduous species in a wet soil, palustrine setting. Alder, cottonwood, aspen, willow and dogwood species are common in these wetlands. Riparian wetlands are primarily wet or sedge meadows containing numerous grass, sedge and forb species.

Spring Branch (a tributary of Fourteenmile Creek) is ephemeral in nature, meaning that it typically only flows during spring snow-melt or significant precipitation events. The stream bed for most of the year is dry and contains some wetland species and hydric soils in lower spots or stretches that are ponded for short periods of time. Two small wetland areas classified in the Wisconsin Wetland Inventory as "too small to delineate'" are present along Spring Branch in the southeast corner of the quarter section located south of field P68. Spring Branch within this quarter section was investigated in June 2013 and determined to be, and was delineated, as wetland habitat. In part due to the presence of these wetlands, fields formerly planned for crop production in this quarter section have been removed from the GSD Project.

The wetland types of Spring Branch include emergent/wet meadow and scrub/shrub. The ephemeral nature of this stream and the channel impedances cause temporary backwater conditions that result in ponded conditions that likely created the wetland habitat. These stream flow impedances include a vehicle crossing approximately midway between CTH U and State STH 73 in the quarter section south of field P68, and a plugged corrugated metal pipe culvert on the south end of the same quarter section (Adams Avenue, County Line). No fields in this quarter section are included in the final project scope due in part to the presence of the wetlands.

One potential isolated wetland was identified within the quarter section located west of field P68 and located adjacent and east of STH 73 based on a map provided by WDNR. Subsequently, a field survey in June 2013 found that this area did not contain wetlands.

Three small wetland areas classified as "too small to delineate" are present east of field P68 in Portage County and additional wetlands are present in Portage County east of the quarter section located south of field P68. These wetlands appear to be stretches of the former Spring Branch before it was re-routed and channelized. These wetland areas are not within the GSD Agricultural Crop Fields and will not be affected by the GSD Project.

2.4.1.1.4 Aquatic

The aquatic plant communities include the in-stream habitat associated with Sevenmile Creek, and Tenmile Creek in Wood County. Spring Branch in southeastern Wood County has intermittent flow, does not contain an aquatic habitat, and is a tributary of Fourteenmile Creek in Adams County. Fourteenmile Creek and Chester Creek in Adams County have aquatic habitat similar to Sevenmile and Tenmile Creeks in Wood County (Scott Provost, personal communication). These aquatic plant communities consist of in-stream and adjacent submergent, emergent and floating-leaved species. Emergent plant communities are largely in the riparian wetlands in the floodplains or in shallow water portions of the streams. Species that were observed in Sevenmile and Tenmile Creeks in 2012 include rice cut-grass, reed canary grass, hard-stem bulrush, woolgrass, jewelweed and numerous sedge, and wet meadow species. Floating-leaved species observed include small duckweed (Steve Hjort, personal communication,

2013). A listing of the species observed in Sevenmile Creek during a stream survey conducted on October 4, 2012 as part of this EIR are listed below, with non-native species shown in italics.

Common Name	**Scientific Name**
Speckled alder	Alnus rugosa
Red osier dogwood	Cornus sericea
Calico aster	Symphyotrichum lateriflorum
Heath aster	Symphyotrichum ericoides
Sensitive fern	Onoclea sensibilis
Bracken fern	Pteridium aquilinum
Lady fern	Athyrium filix-femina
Red maple	Acer rubrum
Silver maple	Acer saccharinum
Hybrid Asian honeysuckle	*Lonicera X bella*
River birch	Betula nigra
Bur oak	Quercus macrocarpa
Large-leaved aster	Eurybia macrophylla
Bergamot	Monarda fistulosa
Scouring rush	Equisetum hyemale
Wild goldenglow	Rudbeckia lacinata
Smooth sumac	Rhus glabra
Grey dogwood	Cornus racemosa
American elm	Ulmus americana
Red elm	Ulmus rubra
Pin oak	Quercus palustris
Pennsylvania sedge	Carex pensylvanica
Maple-leaved viburnum	Viburnum acerifolium
Common milkweed	Asclepias syriaca
Giant foxtail	*Setaria faberi*
Woolgrass	Scirpus cyperinus
Softstem bulrush	Schoenoplectus tabernaemontani
Smooth blue aster	Aster laevis
New England Aster	Symphyotrichum novae-angliae
Reed canary grass	*Phalaris arundinacea*
Rice cut-grass	Leersia oryzoides
Canada goldenrod	Solidago canadensis
Jewelweed	Impatiens capensis
Wiregrass sedge	Carex lasiocarpa
Porcupine sedge	Carex hystericina
Bottlebrsuh sedge	Carex comosa
Lake sedge	Carex lacustris
Spotted Joe-pye weed	Eutrochium maculatum
Purple willowherb	Epilobium coloratum

Boneset	Eupatorium perfoliatum
Swamp milkweed	Asclepias incarnata
Common waterweed	Elodea canadensis
Watercress	*Nasturtium officinale*
Slender pondweed	Potamogeton pusillus
Forget-me-not	*Myosotis scorpioides*
Lesser duckweed	Lemna minor

Sevenmile Creek

WDNR habitat survey work was conducted by WDNR in 1999 in Sevenmile Creek and no submergent or emergent plants were identified.

Submergent plant communities were observed in Sevenmile Creek between Rangeline Road and the Wisconsin River in 2012 during stream surveys conducted as part of this EIR. Those observed communities include rooted macrophytes that live in the streams and consist of sago pondweed, eelgrass, waterweed, and watercress. Upstream of Rangeline Road the stream widens out into a ponded area that contains similar rooted macrophytes for a short stretch and then the stream becomes intermittent in nature.

During the October 2012 stream survey conducted as part of this EIR, an increase in aquatic vegetation, primarily in watercress, in Sevenmile Creek downstream of the Nekoosa East cranberry operation was observed in the middle section of the stretch from Hollywood Road to CTH Z (Steve Hjort, personal communication, 2012). During this stream survey, a dam associated with the Nekoosa East cranberry operation was diverting nearly 100% of the stream flow. As such, the flow downstream of the diversion dam on the Nekoosa East property was not measurable for about 100 feet and the stream contained a red-colored flocculent organic material. Samples were not collected for analysis but the flocculent material appeared to be cranberry peel and/or pulp (most likely from the cranberry operation). Downstream of the first 100 feet below the dam, stream flow rates increased for much of the stretch between the Nekoosa East dam and CTH Z. The approximate upstream one-half of this stretch contained an unusually high density of in-stream aquatic vegetation that reduced in density and area coverage in the lower one-half of the stretch. The increased vegetation in the upstream one-half of this stretch may be attributed to the occurrence of a dry creekbed resulting from the diversion dam. The water quality observed in October 2012 may not be reflective of conditions when Sevenmile Creek is naturally flowing. Photographs from the October 2012 survey are shown below.

Nekoosa East Dam on Sevenmile Creek

Downstream of Nekoosa East box culvert showing minimal flow and red flocculent material in Sevenmile Creek.

Red flocculent material in Sevenmile Creek approximately 30 feet downstream of box culvert with no observable flow.

WDNR habitat survey work was conducted in 1999 in Tenmile Creek and no submergent or emergent plants were identified. In 1999, aquatic plant communities in Tenmile Creek were reported to be similar in nature and extent to Sevenmile Creek as described above (Scott Provost, personal communication, 2012). This creek was observed and evaluated as part of this EIR, but was not thoroughly surveyed because it is not considered a sensitive resource.

Spring Branch and Fourteenmile Creek

No aquatic plant communities are persistent in Spring Branch due to the intermittent nature of the stream. This is consistent with the field survey completed in 2012 as part of this EIR. The June 2013 wetland determination/delineation confirmed that no aquatic plant communities exist in this stretch of Spring Branch.

Aquatic plant communities in Fourteenmile Creek were reported to be similar in nature and extent to Sevenmile Creek and Tenmile Creek as described above (Scott Provost, personal communication, 2012). This creek was not surveyed as part of this EIR. Downstream of Spring Branch, Fourteenmile Creek has been dammed to form Upper Lake Camelot, Lake Sherwood and Lake Arrowhead. Thus, the natural stream no longer exists.

Chester Creek

In 1999, aquatic plant communities in Chester Creek were reported to be similar in nature and extent to Sevenmile Creek as described above (Scott Provost, personal communication, 2012). This creek was not surveyed as part of this EIR.

2.4.1.2 Natural, Wildlife, and Conservation Areas

State Wildlife Areas in the Central Sands Region are managed to sustain a wide variety of wildlife and natural communities found on the properties, and to provide traditional outdoor recreational uses such as hunting, fishing, trapping, hiking, nature study, and berry picking. Between state and county-owned lands, there are approximately 34,106 acres that are part of four State Wildlife Areas in Wood County. (Wood County Parks, Recreation, and Open Spaces Plan,

2011 Update – Page 38). Including WDNR Wildlife Management Areas in Adams County and Portage County, more than 92,000 acres of public land managed for wildlife and multi-use recreation exists within a 25 mile radius of the GSD Project Area (based on acreage figures listed on the WDNR web site).

WDNR State Natural Areas (SNAs) are lands identified by the WDNR that support habitat for rare and endangered flora or fauna or have unique geological or archeological significance. SNAs are utilized heavily for research and educational use and are important for the "preservation of genetic and biological diversity for providing benchmarks for determining the impact of use on managed lands[30]." Eight WDNR SNAs exist in Wood County encompassing 3,016 total acres. The nearest SNA to the GSD Project Area is Powers Bluff/Maple Woods State Natural Area which lies approximately 25 miles northwest of the GSD Production Area.

Conservation Areas are typically large geographic areas (thousands of acres) that may encompass portions of several counties which collectively support or have the ability to support a specific habitat type within an Ecological Landscape. Lands within Conservation Areas may be privately or publically owned and are identified as areas of significance for a broad range of flora and fauna. Conservation Areas often encompass several WDNR Wildlife Areas and/or SNAs and the WDNR is typically committed to protecting rare flora and fauna species through land acquisition or easements in these areas.

The nearest Conservation Area to the GSD Project Area is the Central Wisconsin Grassland Conservation Area (CWGCA). The CWGCA includes the Leola Marsh Wildlife Area (in Adams County), Buena Vista Marsh Wildlife Area, Paul J. Olson Wildlife Area and George W. Mead Wildlife Area. The southeastern extent of the CWGCA lies within 5 miles of the GSD Project Area. The CWGCA straddles the boundary between the Central Sand Plains and the Forest Transition ecological landscapes. The southeastern portion falls within the Central Sand Plains and is characterized by flat, sandy soils. Much of this area historically was a mix of marsh, prairie and savanna. In the early 1900s, draining and ditching transformed large areas into pasture, grass seed fields and cropland. The northern and western portions of the CWGCA have loamier soils, are slightly higher with more topography. As the name implies, the Forest Transition Ecological Landscape marks the beginning of the "northern forest" and historically this area was dominated by maple, hemlock, tamarack and pine. Following logging in the late 1800s, much of the uplands were converted to agriculture, initially in wheat and later in dairy farming (WDNR web site).

A description of State Wildlife and SNAs and County Parks that are located within Wood County are provided below.

Wood County State Wildlife Area

The Wood County Wildlife Area is a 21,000 acre property that lies within the bed of former Glacial Lake Wisconsin and is located 22 miles west of the GSD Production Area. The wildlife area is owned by Wood County and leased to the State of Wisconsin on a long-term basis. The area is characterized by large expanses of wetlands interspersed with forested uplands and

[30] WDNR web page. April, 2013; http://dnr.wi.gov/topic/lands/naturalareas/

islands. Aspen, oak lowland brush and sedges are the predominant vegetation types, and red, white and jack pine are also found on the area. The natural habitat diversity of the property is conducive to a wide variety of wildlife, including numerous protected species that are attracted to the area. Management of the area will continue to encourage a wide variety of wildlife species, and timber management practices will focus on maximizing habitat diversity for forest wildlife (2011 Wood County Parks and Recreation Plan – Page 39)

Sandhill Wildlife Area

The Sandhill Wildlife Area, 9,150 acres of state-owned land in southwest Wood County, features low, sandy upland of oak, aspen and jack pine forests, large marshes, and numerous flowages. The property is located approximately 21.6 miles west/northwest of the GSD Production Area in the bed of former Glacial Lake Wisconsin and is home to a diverse wildlife habitat and a small herd of American Bison. This area is intensively managed for wildlife habitat and a master plan is currently being developed for the property (Wood County Parks, Recreation, and Open Spaces Plan, 2011 Update – Page 39)

George W. Mead State Wildlife Area

George W. Mead Wildlife Area is located approximately 28 miles north of the GSD Production Area and encompasses over 33,000 acres of open marshes, hardwood and aspen forests, and grasslands. This area is one of the largest wildlife areas in Wisconsin, and is home to abundance of wildlife species and over 267 bird species have been documented on the property. The Mead Wildlife Area is an important resting, feeding, and nesting site for migrating waterfowl, shorebirds, and songbirds. Approximately 2,890 acres of George W. Mead Wildlife Area lie in Wood County (Wood County Parks, Recreation, and Open Spaces Plan, 2011 Update – Page 39)

Paul J. Olson State Wildlife Area

The Paul J. Olson Wildlife Area is a 2,995 acre property in western Portage and eastern Wood County with 1,065 acres in Wood County. This wildlife area is located approximately 17 miles north northwest of the GSD Production Area and is comprised of scattered, state-owned, parcels ranging in size from 40 to 860 contiguous acres. The property consists of non-native, cool-season grassland and shrub-carr and is managed as a habitat for Greater Prairie Chickens and other grassland dependent species (Wood County Parks, Recreation, and Open Spaces Plan, 2011 Update – Page 38)

Buena Vista State Wildlife Area

Buena Vista State Wildlife area is a 12,700 acre public wildlife and recreational area that is located in southwestern Portage County approximately 12.3 miles northeast of the proposed GSD Production Area. This wildlife area consists of scattered parcels 10 miles east of Wisconsin Rapids and 4 miles south of Plover. The area is predominately grassland with some woodland. This area is home to the largest concentration of greater prairie chickens in Wisconsin and represents one of the most extensive grasslands east of the Mississippi River. The property has a healthy population of other important grassland bird species including: Henslow sparrows (state threatened species), short-eared owls, upland sandpipers, northern harriers, bobolinks and eastern and western meadowlarks to name a few (WDNR web site)

Powers Bluff Maple Woods State Natural Area/Powers Bluff County Park

Powers Bluff Maple Woods is a 70-acre parcel owned by Wood County and was designated a SNA in 1976. This SNA is approximately 21.1 miles northwest of the GSD Production Area and features a mature southern mesic forest perched on a 300 foot high monadnock, an isolated remnant hill of erosion resistant quartzite. Dominant trees are sugar maple, yellow birch, and bitternut hickory with scattered red oak, white ash, and basswood. The understory is quite open and there is little herbaceous groundcover due to the low light levels. Some common species include plantain-leaved sedge, blue cohosh, maidenhair fern, and bloodroot (WDNR SNAs web page).

North Wood County Park

North Wood County Park is located 5 miles north of STH 13 and STH 80 on CTH A. The park is located on 172 acres on the banks of the Yellow River approximately 22.8 miles northwest of the GSD Production Area. Two small artificial lakes created by dams on the river and a small pine-wooded island provide scenic beauty for the entire area (Wood County official website).

South Wood County Park

South Wood County Park is located 5 1/4 miles east of Wisconsin Rapids on CTH W. The park is located on 332 acres around Lake Wazeecha, which is a Native American name that means "lake of the land of the pines." The lake is 148 acres (Wood County official website). This park is approximately 6.5 miles northeast of the GSD Production Area.

Nepco Lake County Park

Nepco Lake County Park was donated in 1977 by Nekoosa Papers, Inc., as a day use park. Nepco Lake County Park is located 1 mile south of Wisconsin Rapids. The park is 125 acres and is located on the 494 acre Nepco Lake. Nepco Lake County Park features a beach area, boat ramp, picnic area, playground, handicapped access boat docks and a small open shelter. An enclosed shelter is available for rent year round (Wood County official website). Nepco Lake County Park is approximately 4.5 miles north of the GSD Production Area.

Dexter County Park

Dexter Park is located 6 miles south of Pittsville at junction of STH 80 and STH 54 West. The park is located on 1,235 acres around Lake Dexter, which was developed in 1962. The lake is 298 acres. Dexter Park has over 1,000 acres of wild or undeveloped land with abundant wild life and game fish (Wood County official website). Dexter County Park is approximately 15.8 miles northwest of the GSD Production Area.

2.4.1.3 Rare Plants

The GSD Project lies within the “Central Sand Plains” Ecological Landscape. Within the Ecological Landscape of southern Wood County, three plant species are listed as “State Endangered”, nine plant species are listed as “State Threatened”, and twenty-seven plant species are listed as “State Special Concern” (Rapid Ecological Assessment for Central Wisconsin Wildlife Areas Property Group – page 14).

As a result of the Endangered Resources Review conducted by the WDNR for the GSD Project in October of 2012, within the GSD Project Area one plant species (Missouri Rock-cress) and six natural communities were listed as *"endangered resources recorded from within the project area and/or surrounding area"*. Natural communities are defined by the WDNR as "an assemblage of plant and animal species within a specific habitat". The Natural Heritage Inventory Program tracks examples of all types of Wisconsin's natural communities that are deemed significant because of their undisturbed condition, size, what occurs around them, or for other reasons. Natural communities may contain rare or declining species (ER Review Log # 12-662, Page 8).

2.4.1.3.1 Plants

Missouri Rock-cress (*Arabis missouriensis*),

A State Special Concern plant, Missouri Rock-cress is found in soil pockets on acidic cliffs, as well as in pine forests on sterile sand and gravel outwash plains. Blooming occurs late May through late June; fruiting occurs late June through late July. The optimal identification period for this species is late May through late June. Though not confirmed to be present in the GSD Project Area, Missouri rock-cress has been recorded in the vicinity.

Lupine (*Lupinus perennis*)

Though not listed as an endangered resource by state or federal regulatory agencies, lupine is worthy of mention due to its direct life-cycle association with the Karner blue butterfly, a Federally endangered butterfly species that is listed by the WDNR as an endangered resource. Wild lupine is a perennial plant in the pea family with pink to blue flowers. It is found primarily on dry, sandy soils in open to partially shaded habitats. Many of the areas with lupine are oak savanna and pine barren plant communities. In addition to the Karner blue butterfly, these communities support a diverse array of other rare plant and animal species such as the Blanding's turtle, dusted skipper and prairie fame flower. Lupines can occur in power line rights-of-ways and utility corridors, forest trails, and other open areas that are maintained as early successional landscapes. Without natural or artificial disturbance, savanna and barrens communities yield to shrubs or forests. Lupines in shaded habitats may survive, but usually with poor vigor and without flowering. When the canopy of trees and shrubs closes, minimal light hits the forest floor. At this point, the lupines are shaded out, making the site unsuitable for Karner blue butterflies (USFWS web site article "Wild Lupine and Karner blue butterfly, Kim Mitchell and Cathy Carnes, 1996).

Lupine has been observed within isolated portions of the GSD Project Area. See Section 2.5.1.4.2 for further discussion on lupine and Karner blue butterfly surveys.

2.4.1.3.2 Natural Communities

The Natural Communities summaries provided below are based on the WDNR Endangered Resources Review conducted by the WDNR for the GSD Project (Log # 12-662, Pages 5-6).

Northern Dry-Mesic Forest

In this forest community, mature stands are dominated by eastern white and red pines, sometimes mixed with northern red oak and red maple. Common understory shrubs are

hazelnuts, blueberries, wintergreen, and partridge-berry. Among the dominant herbs are wild sarsaparilla, Canada mayflower, and cow-wheat.

This community type does not exist in intact form in the GSD Project Area. Red pine is the only represented species (within this natural community type) that exists in any significance and is present only in plantation form. The lack of hardwood tree species and understory shrubs excludes this natural community from existing within the GSD Project Area.

Alder Thicket

The alder thicket community type exists within the GSD Project Area in very low densities along stream corridors and within floodplain wetlands. The alder thicket is a minerotrophic wetland community dominated by tall shrubs, especially speckled alder. Shrub associates may include red-osier dogwood, nannyberry, cranberry viburnum, wild currants, and willows. Among the characteristic herbaceous species are Canada bluejoint grass, orange jewelweed, asters, boneset, rough bedstraw, marsh fern, arrow-leaved tearthumb, and sensitive fern. This community type is sometimes an intermediate (seral) stage between northern sedge meadow and northern conifer swamp or northern hardwood swamp, but occurrences can be stable and persist at given locations for long periods of time. This community type is common and widespread in northern and central Wisconsin, but also occurs at isolated locales in the southern part of the state. Alder thicket often occurs as a relatively stable community along streams and around lakes, but can occupy large areas formerly covered by conifer swamps that were logged and/or where water tables were raised. Stands of alder that originated following logging and/or wildfire will usually revert to forest, although on heavy, poorly drained soils, forest re-growth can be problematic owing to "swamping" effects.

Northern Sedge Meadow

The northern sedge meadow community type exists within the GSD Project Area in very low densities along stream corridors and within floodplain wetlands. This open wetland community is dominated by sedges and grasses and occurs primarily in northern Wisconsin. There are several common, fairly distinctive, subtypes: Tussock meadow, dominated by tussock sedge and Canada bluejoint grass; Broad-leaved sedge meadow, dominated by the robust sedges (Carex lacustris and/or C. utriculata); and Wire-leaved sedge meadow, dominated by woolly sedge and/or few-seeded sedge. Frequent associates include blue flag, marsh fern, marsh bellwort, manna grasses, panicled aster, Joe-Pye weed, and the bulrushes (Schoenoplectus tabernaemontani and Scirpus cyperinus). Sphagnum mosses are either absent or occur in scattered, discontinuous patches. Sedge meadows occur on a variety of landforms and in several ecological settings that include depressions in outwash or ground moraine landforms in which there is groundwater movement and internal drainage, on the shores of some drainage lakes, and on the margins of streams and large rivers

Shrub-Carr

The shrub-carr community type exists within the GSD Project Area in low densities along stream corridors and within floodplain wetlands. This wetland community is dominated by tall shrubs such as red-osier dogwood, silky dogwood, meadowsweet, and various willows. Canada bluejoint grass is often very common. Associates are similar to those found in alder thickets and tussock-type sedge meadows. This community type occupies areas that are transitional between

open wetlands such as wet prairie, calcareous fen, or southern sedge meadow, and forested wetlands such as floodplain forest or southern hardwood swamp. Shrub-carr can persist at a given site for a very long time if natural hydrologic cycles are maintained. This community type often occurs in bands around lakes or ponds, on the margins of river floodplains, or, more extensively, in glacial lakebeds. It is common and widespread in southern Wisconsin but also occurs in the north. In the south, shrub-carr is often an integral part of prairie-savanna landscapes, though it also occurs in wetlands within more forested regions. In the north, the landscape matrix around the shrub-carr type is usually upland forest. Statewide, shrub-carr remains quite common, and has fared considerably better than many of the other native wetland types within Wisconsin.

Floodplain Forest

The floodplain forest community type exists in discontinuous and fragmented blocks within the GSD Project Area. This lowland hardwood forest community type occurs along large rivers, usually of Stream Order 3 or higher. Most of these rivers originate in northern Wisconsin and flow southward, growing in size as the volume of water they carry increases. As the stream gradients diminish, the floodplains become broader. Periodic floods, particularly in the spring, are the key natural disturbance event to which species of this community are adapted. Silt deposition and development of microtopography during flood events creates suitable sites for tree germination and establishment, and floods also carry seeds and propagules of plant species. The most extensive occurrences of floodplain forest are found along the large rivers of southern Wisconsin, but the community also occurs at scattered locations in the north. This community type was uncommon historically, occupying only about 3 percent of the Western Coulees and Ridges Ecological Landscape and even smaller percentages of other Ecological Landscapes (Finley, 1976). Canopy dominants vary, but may include silver maple, river birch, green and black ashes, hackberry, swamp white oak, and eastern cottonwood. Black willow, basswood, red oak, and red maple are associated tree species found in these forests. Historically, the elms were highly significant components of the floodplain forests, but Dutch elm disease has eliminated most large elm trees that formerly provided super canopy structure, snag and den sites, and large woody debris. Northern occurrences of this type tend to be less extensive, are often discontinuous, and are relatively species-poor compared to those in the south. Silver maple and green ash remain among the dominant species, with balsam-poplar, bur oak, and box elder replacing some of the many missing southern trees.

Stream – Slow, Hard, Cold

The stream-slow, hard, cold natural community type may exist on the GSD Project Area; however, the WDNR ER Review offers no description of this community type.

2.4.2 Potential Impacts

2.4.2.1 Plant Communities

Conversion of red pine plantation to forage and vegetable crops and/or a dairy production facility may lead to localized, short-term impacts to existing plant communities within the GSD Project Area. A rapid reduction (clear-cutting) of closed canopy red pine stands will shift the dominant vegetative type from mixed age class red pine stands to cultivated vegetable and forage

crops. Because of the nature of the red pine plantation, this conversion will not result in reductions in floristic diversity, and may actually increase diversity as the remaining pine stands will also be accompanied by perennial alfalfa and annual vegetable rotations, including peas, corn, and vegetables.

Invasive Species

Some potential does exist for invasive plant species redistribution into new locations within the GSD Project Area during conversion from red pine plantation to cultivated vegetable crops. The invasive plant species with the most potential for this type of re-introduction is Centaurea maculosa (spotted knapweed). Spotted knapweed has the highest potential for impacts for the following reasons:

1) Spotted knapweed already exists in the area in significant density so the potential for seed re-distribution (regardless of land use) is high.
2) Sandy soil conditions are prevalent in the GSD Project Area which is the preferred soil condition of spotted knapweed; and
3) There is a potential for soil surface disturbance during timber harvesting, site construction, and agricultural conversion. Spotted knapweed responds positively to soil surface disturbance.

Spotted knapweed prefers full sun and exists only on roadway right-of-ways and in patch clear-cuts, younger red pine stands that have been re-planted after harvest, and other forest openings. Some potential vectors for spreading this invasive species include vehicle and equipment tracks/tires and clothes/boots of workers. Spotted knapweed (and other invasive species) re-distribution can be minimized by adhering to guidelines established in the WDNR publication "Wisconsin's Forestry Best Management Practices for Invasive Species" (BMP 3.4 Plan Management Activities To Limit The Potential For The Introduction And Spread Of Invasive Species – page 23).

2.4.2.1.1 Forest

A net loss of total tree biomass will occur with the conversion of red pine plantation to cultivated vegetable and forage crops. Approximately 4,660 acres of red pine plantation will be converted to agricultural crops for the GSD Project. A potential impact of rapid loss of forest habitat may be a short-term increased concentration in wildlife density within remaining forest habitat in proximity to or within the GSD Project Area. Spatially focused increases in white-tailed deer density, for example, may result in over-browse of commercially important tree saplings within Saratoga Township. Over-browse is a non-sustainable level of vegetative consumption which may cause injury, stress or death to managed or preferred vegetation such as native trees, ornamental trees, and shrubs. Over-browse from ungulates and small mammals can also lead to a decline in species richness and diversity of native trees and shrubs within non-cropped areas within the GSD Project Area. An increase in forest-associated species densities (such as deer and raccoon) may result from a rapid loss of forest habitat. These temporarily displaced species may also lead to residential landscape tree and shrub over-browse, and to a decrease in commercial crop production due to increased short-term crop depredation, particularly in corn and soybean production areas.

2.4.2.1.2 Grasslands

Approximately 10 acres of grasslands will be converted to GSD Agricultural Crop Fields as part of the GSD Project in the gas pipeline utility corridor. Grasslands currently make up a very minor component of the GSD Project Area, so converting those areas to cultivated vegetable crops will not cause a significant impact. Opportunities exist to create a net gain in native grasses and forbs with the low level of native plants communities currently supported within the red pine plantations. Restoration of native grasslands within buffer areas, and other areas unsuitable for agricultural production may be utilized in the future to increase native grassland diversity.

2.4.2.1.3 Wetlands

Wetland hydrology is quite variable and can fluctuate widely during wet and dry periods, even seasonally, and is predominately controlled by stream levels which will be relatively unaffected by the GSD Project. Wetland plants are adapted in a relatively wide range of hydrologic conditions and persist even during periods of drought. Wetland soils maintain their hydric characteristics over a wide range of hydrologic conditions and take many decades to convert to, or from hydric conditions. Wetland plant communities may change from one type of hydrophytic plant community type to another but are not expected to be lost or converted to terrestrial plant community types.

Permanent reduction of groundwater levels may impact isolated wetlands that are fed by groundwater discharge and reduce their size or eliminate them completely; however groundwater fed non-riparian wetlands do not occur within the GSD Project Area (see Section 2.3.1.3.1 for the analysis of groundwater withdrawal and drawdown modeling).

Riparian wetland areas within the GSD Project Area will remain intact as native habitat and will not be disturbed for the GSD Project. Isolated wetlands adjacent to the GSD Agricultural Crop Fields converted from pine plantation will be managed as a SWQMA by maintaining a 25-foot buffer for all fields except those with alfalfa crops in rotation. For fields with alfalfa, GSD will manage SWQMAs by maintaining a 100 foot buffer. The reach of Spring Branch from Adams County Rd to County Road U was delineated as wetland on June 18, 2013 by Eco-Resource Consulting, LLC (**Appendix C**). The headwaters of this ephemeral, intermittent stream have been re-routed in Portage County, east of the GSD Project and much of the remaining stream channel is now a linear wetland that contains mainly facultative wet species with some obligate wetland species.

2.4.2.1.4 Aquatic

Aquatic plant communities generally consist of in-stream and adjacent submergent, emergent and floating-leaved species. However, very few submergent or emergent aquatic plants have been observed or identified in Sevenmile Creek, or Tenmile Creek, and Spring Branch contains no true aquatic plant communities. This lack of in-stream vegetation is due to the physical nature of these resources as relatively fast-moving creeks with sandy-sediment creek beds that do not have significant nutrient absorptive properties. A reduction of water level and flow in the aquatic habitat areas could alter the density and location of those plant communities that do exist. A significant riparian wetland exists upstream of Rangeline Road along both sides of Sevenmile Creek.

The in-stream aquatic bed plant communities are rare in Tenmile Creek and in select stretches of Sevenmile Creek. Aquatic bed plant communities were observed in Sevenmile Creek in the middle section of the stretch between Hollywood Road and CTH Z, upstream and downstream of the Hollywood Road crossing, and upstream of Rangeline Road. The greatest density of in-stream aquatic macrophytes was the middle section of the stretch downstream of the Nekoosa East Cranberry bog and the tributary that flows into Sevenmile Creek from the north (west of the Nekoosa East Cranberry operation). Aquatic macrophyte density was observed to be scarce in the remaining stretches of Sevenmile Creek on June 27, 2012.

The photographs below depict the Sevenmile Creek wetland and aquatic plant beds upstream and downstream of Rangeline Road, upstream and downstream of Hollywood Road, and downstream of Hollywood Road. The next two pairs of photographs are upstream and downstream of Tenmile Creek at STH 13, and Bell Road.

Sevenmile Creek upstream of Rangeline Road on 6/27/12.

Sevenmile Creek upstream of Hollywood Road above and downstream below on 6/27/12.

Aquatic plant beds in middle section of Sevenmile Creek downstream of Hollywood Road on 6/27/2012.

Tenmile Creek gaging Station upstream above and downstream below of STH 13 on 6/27/12.

Tenmile Creek downstream of Bell Road bridge and further downstream on 6/27/12.

Overall, negative impacts to streams may occur from the streambed substrate being either eroded away (degradation) or deposited (aggradation). Stream bank and bed erosion, which is the cause of most sediment in these creeks, occur primarily at high flow conditions. As a result, most sediment deposition also occurs during high flow events when sediment is available to settle out of the water column, and this deposition occurs mainly in backwater areas along the streams. Aquatic plant communities may convert to wet or sedge meadow plant communities if areas of stream wetted surface are reduced from water level reductions.

If groundwater quality is negatively impacted by the GSD Project due to an increase in available nutrients, an increase in rooted macrophytes and floating-leaved plants may occur. If increased sedimentation from the agricultural operations in the streams occurs, a change in stream geomorphology may result. Sediment aggradation may occur in the slack water areas and aquatic vegetation changes may occur that could include a change in aquatic plant community or a shift to an emergent wetland plant community. This shift in plant community currently occurs during drought years and reverts during high water periods.

2.4.2.2 Natural, Wildlife, and Conservation Areas

There are no SNAs, Wildlife Areas, or Conservation Areas within the GSD Project Area or within 5 miles of the GSD Project Area. No impacts are anticipated to plant communities within SNAs, Wildlife Areas, or Conservation Areas.

2.4.2.3 Rare Plants

Missouri rock-cress is a species of special concern in Wisconsin and has been recorded "within the vicinity" of the GSD Project Area (WDNR ER Review); however, the presence of this species has not been confirmed within the GSD Project Area. Although not listed as endangered or threatened, the WDNR recommends conducting presence/absence surveys for this species and recommends minimizing impacts.

Though not listed as an endangered resource by state or federal regulatory agencies, lupine is worthy of mention due to its direct life-cycle association with the Karner blue butterfly (KBB), a federally endangered butterfly species that is listed by the WDNR as an endangered resource. Based on surveys conducted by Plum Creek Timber Company, lupine has been recorded to exist in the GSD Project Area proposed for conversion from pine plantation to irrigated crop land. In accordance with the KBB Habitat Conservation Program (HCP) protocol, Level 1 and Level 2 surveys were conducted to determine the extent of lupine and KBB habitat throughout the GSD Project Area proposed for conversion. Additional information on the surveys conducted in 2012 and 2013 is included in Section 2.5.4.1.2. Small isolated lupine communities may be displaced during conversion of red pine plantation to vegetable agriculture; however, the majority of acreage where lupine is sufficient to support KBB habitat has been removed from the GSD Project to avoid impacts.

2.4.3 Significance of Potential Impacts

2.4.3.1 Plant Communities

Natural Community (Plant Community) types listed in the WDNR's ER Review document that exist on the GSD Project Area are wetland plant community types, so no impacts will occur to these communities as no disturbance will occur within riparian/wetland areas.

Conversion of red pine plantation to cultivated crop production will have a short-term impact related to the reduction of forest habitat, however the approximate 4,660 acres of forest conversion is a small percentage of available forest habitat in Saratoga Township and Wood County. This conversion will account for a 17 percent reduction of forest habitat in Saratoga Township and a 2 percent reduction in forest habitat in Wood County (based on figures derived from the Wood County web page).

Opportunities exist to increase native grassland or prairie habitat in the GSD Project Area by planting grassland buffers around field edges. Such an increase would benefit the overall plant community diversity in the Township. Plant diversity within agricultural field edges and "corners" of center-pivot irrigated fields would support more species diversity than existing monotypic red pine plantations.

There will be no adverse impact to plant communities in the 1,800 acres of existing irrigated crop land.

2.4.3.1.1 Invasive Species

Within the main areas of the GSD Project Area that will be converted from pine plantation, any spotted knapweed (or other invasive, non-native vegetation) will be contained through herbicide and tillage regimes – minimizing potential impact of invasive species re-distribution. Tillage and herbicide management in cropped areas will stop the spread of invasive species in areas that will be cropped. The only concern for invasive species is within the field edges that will be cleared to allow farming equipment to turn around when working within cropped fields. These areas will be mowed periodically to minimize the spread of invasive species.

2.4.3.1.2 Forest

Existing forestland within the GSD Project Area was planted with the intention of clear-cutting mature crop for use in the pulp and paper industry. Conversion of mixed age-class, monotypic stands of red pine to cultivated vegetable crops will lead to a rapid reduction in biomass of forest type; however, this result would likely occur with or without the GSD Project, as Plum Creek has made a business decision to divest these plantations because of low demand for pulp and wood products. In addition, because approximately 40,000 acres of forestland will remain in Wood County, impacts from the GSD Project forest conversion is considered insignificant. In fact, much of the remaining forestland in the County provides a far better forestland resource than that proposed for conversion because it is; 1) publicly owned, 2) not managed for commercial logging, and 3) supports a greater species richness and diversity of tree and shrub species. From a forestland diversity standpoint, the forests in Saratoga Township with the least amount of species richness and diversity will be converted to a vegetable crop rotation, resulting in a net average increase in the species richness and diversity of remaining forestland in

the township and county. Moreover, GSD will retain the field edges in their current state – creating connectivity of forest habitat communities for existing species through field buffers. Impacts to plant and animal communities would likely be greater, with more significant ecosystem fragmentation, if this land was converted from forest land to residential development.

2.4.3.1.3 Grasslands

Small impacts to grassland areas are expected as a result of the GSD Project due to agricultural cropping in select portions of existing utility corridors. The most significant grassland areas that exist in the GSD Project Area exist in areas that will not be disturbed such as riparian areas.

2.4.3.1.4 Wetlands

Riparian wetlands exist and persist through various hydrologic conditions ranging from spring flooding events to drought conditions. No riparian wetlands will be directly affected by farming activities, however the groundwater flow model indicates some reductions in groundwater discharges to wetlands may occur near the GSD Project Area. The modeled reduction of groundwater discharge to the local streams and groundwater level changes in the vicinity of streams is relatively small and is not expected to significantly impact vegetation in the riparian wetlands or the wetlands that exist in Portage County east of the proposed GSD Project Area. Any current stream bed areas that may be de-watered as a result of seasonal low flow conditions or groundwater inflow reduction may colonize with wetland plants.

Isolated wetlands in the GSD Project Area are limited by location and the high infiltration rates of the sandy soils. Reduction in groundwater levels is not expected to affect the existing isolated wetlands. The observed wetlands within the GSD Project Area in 2012, which was a drought year, were dry with no wetland hydrology during August. These wetlands contained hydrophytic vegetation that was in good health indicating that spring/early summer wetland hydrology was present, and adequate to sustain wetland conditions even during drought conditions. This condition of marginal wetland hydrology was observed during the wetland determination/delineation conducted on June 18, 2013 along Spring Branch. No impacts are expected in Spring Branch as a result of modeled groundwater reduction in this area. No impacts are expected to occur to prior farmed wetlands that may exist within the 1,800 acres of existing irrigated crop land.

2.4.3.1.5 Aquatic

Negative impacts to streams relating to the streambed substrate being either eroded away (degradation) or deposited (aggradation) are not expected to occur as a result of the GSD Project. Most sediment deposition occurs during high flow events, as this is when sediment is available to settle out of the water column, and this deposition occurs mainly in backwater areas along the streams. Stream bank and bed erosion, which is the cause of most sediment in these creeks, occurs primarily at high flow conditions. The changes in streamflow that will result from GSD Project groundwater withdraws are very small relative to the flows in Sevenmile and Tenmile Creeks as discussed in Section 2.3.1.3.2; therefore, no significant impacts from degradation or aggradation are expected to occur.

Erosion control measures and BMPs followed during conversion of the red pine plantation fields to cultivated agriculture will minimize sediment that may be transported to the nearby areas of aquatic habitat. The presence of riparian zones along the creeks will also minimize sedimentation in the aquatic habitats. Because no fields proposed for conversion to vegetable crops are located within 300 feet of any aquatic resource, there are no expected significant impacts as a result of conversion. Aquatic resources identified as SWQMAs in the 1,800 acres of existing crop land will be managed in accordance with chapter NR 243 requirements. Furthermore, sedimentation from agricultural practices is not anticipated to be significant given modern tillage and other conservation practices to be employed by GSD on these fields. Aquatic beds and wetlands undergo a dynamic flux based on periodic changes in hydrology that varies from wet to dry years. During dry years when the streams have lower water levels and modest reductions in wetted stream channel, aquatic plant communities may shift to wet/sedge meadow plant communities, and conversely during high water years, wet/sedge meadow plant communities may shift to aquatic bed plant communities. The modeled reduction in water levels is expected to reduce wetted stream channel in Sevenmile Creek by 0.010 feet and stream width in Tenmile Creek by about 0.04 feet. The modeled reduction in groundwater levels are very minimal (<0.01 foot) for Fourteenmile Creek and its tributaries, and Chester Creek, therefore wetted stream channel width should remain consistent with current conditions. As with current conditions, the modeled reduction of water level and flow in the aquatic habitat areas may alter the density and location of these plant communities but no significant adverse impacts are expected to plant communities in any stream or riparian wetlands.

Nutrient enrichment is another form of stream impairment that can affect the organisms living in a stream. Because GSD will be required to comply with its WDNR-approved NMP for all land applications of nutrients, over applications are not expected to occur and nutrient loading to surface water resources is not expected to occur. As described in section 2.3.2 above, the Nitrate Groundwater Model estimates a slight increase in nitrate concentrations in Sevenmile and Tenmile Creeks from nutrient applications to fields converted from pine plantation. Moreover, the lower reach of Sevenmile Creek is classified by WDNR as a Class 1 trout stream, and the lower reach of Tenmile Creek is classified as a Class 2 trout stream, and all observations conducted for this EIR indicate both creeks contain healthy ecosystems. The modeled slight increase in nitrate concentrations will not cause a significant impact on water quality or to aquatic flora. The 1,800 acres of existing irrigated crop land will not contribute any new or additional nutrients to the Sevenmile or Tenmile Creeks.

Sevenmile Creek

Sevenmile Creek is a small stream with aquatic in-stream habitat consisting of sand, gravel, undercut banks, overhead cover and a modest amount of aquatic vegetation. The aquatic plant communities are not expected to be negatively impacted based on the modeled groundwater flow reduction because the modeled change in wetted stream channel width is neglible. The sand, gravel, and overhead cover are not expected to be negatively impacted because the water levels are expected to be reduced by less than 0.01 foot. Nutrient modeling indicates that under the "most likely" scenario, nitrate concentrations in Sevenmile Creek may approach 1.6 mg/L as a result of the GSD Project but these levels are expected to take decades to develop. Due to the low concentrations and the long period of time it will take the creek to reach those

concentrations, nitrate impacts are not expected to have significant adverse effect on stream biota.

Tenmile Creek

Tenmile Creek is a larger stream with more streamflow than Sevenmile Creek and has similar in-stream habitat components. This stream has a much higher ratio of gravel to sand than Sevenmile Creek. In-stream aquatic vegetation was scarce in 1999 (WDNR) and 2012 (ERC) observations, and consisted mainly of emergent shoreline plants. The small modeled reduction in flow rate (<5 percent) and non-measureable reduction in streambed wetted surface is not expected to negatively impact substrate (sand and gravel), overhead cover, nor undercut banks. The aquatic plant communities are not expected to be impacted based on the non-measureable modeled groundwater flow, water level and wetted stream channel reduction. Nutrient modeling indicates that nitrate concentrations in Tenmile Creek may increase from 3.8 mg/L to 4.15 mg/L. Due to the low concentrations and the long period of time it will take the creek to reach those concentrations, nitrate impacts are not expected to have significant adverse effect on stream biota.

Spring Branch and Fourteenmile Creek

Spring Branch is an intermittent stream and a tributary of Fourteenmile Creek in the southeast portion of Wood County. This stream has been re-routed in southwest Portage County into a channelized ditch system that truncated the stream after re-routing to the south. This stream does not have persistent streamflow and is ephemeral in nature, meaning that it typically only flows during spring snow-melt or significant precipitation events. The stream bed for most of the year is dry and contains few true aquatic plant species, but does contain some wetland species in lower spots or stretches that are ponded for short periods of time before the surface water infiltrates into the sandy soils. Due to the wetland nature of Spring Branch and its lack of aquatic plant community, no impacts are expected.

The small modeled reduction in flow rate (<5 percent) and non-measureable reduction in streambed wetted surface is not expected to negatively impact substrate (sand and gravel), overhead cover, nor undercut banks in Fourteenmile Creek. The aquatic plant communities are not expected to be impacted based on the non-measureable modeled groundwater flow, water level and wetted stream channel reduction. These waterways are too far away from and are not located downgradient of the converted GSD Agricultural Crop Fields, so they will not be affected by nutrient applications conducted in accordance with the WDNR-approved GSD NMP. Although Fourteenmile Creek is near the existing 1,800 acres of existing irrigated crop fields, by bringing those acres into a WDNR-approved NMP, nutrient applications will now be regulated for the first time. As such, the rate, amount, frequency and location of nutrient applications will be monitored and managed in accordance with GSD's NMP, which will minimize future impacts to these resources, compared to the existing unregulated agricultural practices.

Chester Creek

Chester Creek is in the southwest portion of the GSD Project Area and streamflow is modeled to be reduced by 0.01 cfs which is neglible. This small amount of reduction in streamflow is not expected to negatively impact the stream substrate composition, overhead cover, aquatic vegetation or undercut banks because water levels and wetted stream channel will

not be changed. The aquatic plant communities are not expected to be impacted based on the modeled groundwater flow reduction because the water levels and wetted stream channel will not be changed. This waterway is too far away from and is not located downgradient of the converted GSD Agricultural Crop Fields, so it will not be affected by nutrient applications on these fields.

2.4.3.2 Natural and Conservation Areas

There are no SNAs, Wildlife Areas, or Conservation Areas within the GSD Project Area or within five miles of the GSD Project Area. No impacts are anticipated to plant communities within SNAs, Wildlife Areas, or Conservation Areas

2.4.3.3 Rare Plants

Missouri rock-cress has been recorded "within the vicinity" of the GSD Project Area (WDNR ER Review). The presence of this species has not been confirmed within the GSD Project Area, however suitable habitat does exist. Due to the fact that this species has not been confirmed to exist within the GSD Project Area, no significant impacts can be quantified.

Due to low density and total basal area of existing lupine plant communities within the GSD Project Area, a short term loss of lupine on the GSD Project Area will not result in significant impacts to Karner blue butterfly populations.

2.5 Fauna

2.5.1 Existing Conditions

2.5.1.1 Habitats

The four primary habitats found in the GSD Project Area are forest, grasslands, wetlands, and aquatic.

2.5.1.1.1 Forest

The majority of the GSD Project Area is currently being utilized primarily for commercial timber production. Commercial even-age class red pine plantations are managed for the singular purpose of maximizing timber production as quickly and efficiently as possible. This means site preparation, planting, stand densities, maintenance, timing of stand rotation, and harvesting is all conducted with methods and timing that does *not* prioritize wildlife habitat value. Due to a lack of vegetative structure (a variety of vertical and horizontal plant variety) and species diversity within monotypic red pine plantations, wildlife habitat is lacking scale, diversity and quality. Younger age class pine stands or older stands that have been thinned will support more plant structure and diversity due to an increase in sunlight that reaches the forest floor. As the pine stands age and canopy overstory closes, light infiltration to the forest floor is greatly reduced leading to a reduction in understory shrubs and herbs. This reduction in plant diversity leads to a reduction in food and cover available to wildlife. Ground level and understory vegetation can be diverse within red pine stands planted at non-commercial densities (8 feet x 10 feet spacing or greater), but most commercially planted red pine stands are planted at 6 feet x 8 feet spacing or less. (Ek, Katovich, Kilgore, Palik (2006)).

Overstory canopies in higher density red pine plantations (commercial sites) close within 20 to 25 years and significantly reduce the ability of understory vegetation to establish or thrive. Red pine stands at the 30 years age class are nearly completely lacking understory vegetation. (Pilon, 2006).The majority of the GSD Project Area currently contains red pine stands of several age classes, from the 0 to 15 year old range to 56 year old and older. Within the GSD Agricultural Crop Fields to be converted, approximately 2,142 acres are dominated by the 25 year or younger age class red pine (46%) (**Figure 2-33**) and the remaining acreage is dominated by red pine 26 years old or older.

Timber management practices including staggered stand thinning, support of mixed age class stands, patch clear cutting, the use of prescribed fire, and creation of smaller and more random mosaic tree planting units creates more edge effect and offers staggered harvesting periods. These timber management practices are currently absent or are implemented on a very limited scale in the GSD Project Area due to the increased costs compared to management of larger scale, even-age class timber stands.

Herbicide application to reduce herbaceous species and all deciduous (non-pine) species during re-planting and during timber production and other timber management activities also reduce the scale and quality of wildlife habitat by maintaining a single type and a single age class of trees.

The square or rectangular shape of cuts and planting units is designed to maximize mechanical efficiency of planting, maintenance, and harvesting of trees. Irregular shapes in commercial timber management units are rare, so edge effect as it pertains to wildlife habitat value is minimized.

Commercial timber stands also lack snags (standing dead trees available for wildlife habitat), deadfall trees and slash. Decay of deadfalls and slash on the forest floor supports fungi production which is an important food source for numerous wildlife species. The current timber stands are primarily harvested for pulp production. This means all tree species and most tree material and logging residue is harvested for pulp production. Mature and dense red pine stands provide thermal cover, protection and nesting/denning habitat for some wildlife species. Younger stands provide shelter to wildlife while older stands are more valuable for thermal cover. Birds of prey such as osprey and bald eagles utilize mature red pine trees for nesting sites within areas in close enough proximity to large bodies of water. As such, no osprey or eagle nests have been observed or confirmed within existing pine plantation area of the GSD Project Area. Mature red pines in the GSD Project Area are not in close proximity to large bodies of water.

Dense and mature stands typical of commercially planted red pine provide very low food value for wildlife due to the lack of vegetative structure and diversity in the understory. The value of wildlife habitat varies considerably with stand age, density, and mix of other tree species. Red pine plantations that are periodically managed with prescribed fire support a wider array of vegetation within the forest understory. Prescribed fire can also consume deep layers of pine duff in older red pine stands, leading to increased value for burrowing amphibians and reptiles. Prescribed fire is not a typical management tool utilized within commercial red pine plantations and has not been implemented within the GSD Project Area.

Windblown and downed red pine can provide cover for numerous mammal species; however windblown mature trees are often removed for processing within commercial red pine

plantations. A lack of wildlife-valued mast producing tree species is a limiting factor to wildlife habitat value within the existing GSD Project Area. Species such as oaks (particularly from the white oak family), and hickories comprise a very minor component of existing red pine plantation in the GSD Project Area. Red pine seeds can be an important food source for numerous mammals including rabbits, squirrels, voles, and mice. Red pine bark is also utilized as a food source by several small mammal species. Quality and quantity of pinecone (seed) production in red pine is not consistent and only offers high value wildlife forage every three to seven years. Red pines in closed stands do not even produce seed until they are 40 to 50 years old. (Wisconsin Department of Natural Resources Silviculture Handbook, Chapter 32, page 7).

2.5.1.1.2 Grasslands

Grassland habitat is rare within commercial red pine plantations. Perennial grasslands with early successional forb (broadleaf) components exist in small patches periodically along forest edges, in patch clear cut areas, in blowdown areas (as a result of wind damage), or within isolated wetlands or riparian areas. Existing grasslands in utility corridors are dominated by non-native cool season species such as brome, fescue, bluegrass, or reed canary grass. Native grasses such as little bluestem (in xeric and dry-mesic full sun areas) and Canada joint bluegrass (in wetlands) occupy a much less significant portion of the existing grasslands. Due to the lack of forbs present in cool season dominated grasslands, the wildlife habitat and forage value is limited. Forbs rely on insects for pollination, which provide the ecological foundation for all food webs. A reduced forb species richness and diversity leads to a reduced invertebrate (insect) component, leading to a reduction in wildlife forage value. The exception is the wild lupine present in the grasslands and other native forbs in full or filtered sunlight conditions within the GSD Project Area. Wild lupine is the host plant for the federally endangered Karner blue butterfly and is also associated with habitat suitable for two State Species of Special Concern; the persius dusky wing butterfly, and the dusted skipper butterfly. Significant surveys have been conducted of lupine and the KBB. The WDNR report indicated that the persius dusky wing butterfly and the dusted skipper butterfly have been identified “within the vicinity” of the GSD Project Area, but none have been observed or reported within the GSD Project Area.

2.5.1.1.3 Wetlands

Wetlands are part of the water cycle of all ecosystems, and their location in the landscape allows them to function as a buffer between upland areas and surface waters (Weller 1981). Wetlands perform a number of natural functions that benefit natural ecosystems and society. Water quality is often dependent upon wetlands because they serve to trap sediment, remove nutrients, protect shorelines and slow the effects of flood water. They also serve as both discharge and recharge areas for groundwater and provide habitat for many species of plants and animals (Stearns, 1978). In part due to these functions, wetlands exhibit higher biological productivity than most other community types, and support rare biota. In Wisconsin, 32 percent of the state's listed species are wetland dependent (Partners for Wildlife Program for Wisconsin, Department of Interior – Fish and Wildlife Service Programs). Riparian wetlands occur along all of the streams in the project area and are described in Section 2.3.1.2.5. These wetlands harbor numerous wildlife species including many of the species listed in Section 2.5.1.3 below.

2.5.1.1.4 Aquatic

Sevenmile Creek

Based on WDNR file review and fishing regulations, Sevenmile Creek is classified as a Class 1 trout water from the Wisconsin River upstream to Rangeline Road. Sevenmile Creek has been classified as a Class 1 trout water despite the existing conditions, which include very low flow in the upper portions of the designated Class 1 reach, wide and shallow pools that likely cause an increase water temperatures beyond those hospitable to spawning trout, and a complete diversion of the stream, at times within the Class 1 area, due to a cranberry operation. Upstream of Rangeline Road, Sevenmile Creek is seasonally intermittent and not classified as trout water.

According to WDNR files, Sevenmile Creek is considered to be a cool (cold) water headwater stream that contains a naturally reproducing brook trout population. Information from compiled surveys in the WDNR file indicate the following fish species have been observed in Sevenmile Creek: brook trout, green sunfish, blackside darter, common carp, northern creek chub, central mudminnow, burbot, American brook lamprey, pearl dace, northern pike, johnny darter, brook stickleback, walleye, red-bellied dace, largemouth bass, yellow perch, yellow bullhead, bluegill and white sucker. This fish assemblage contains cold, cool and warm water species which is likely at least partially due to the Wisconsin River fishes traveling upstream for spawning or to find suitable habitat conditions. The stream contains many invertebrate species including stonefly, mayfly, caddis and amphipods. With respect to Sevenmile Creek, deeper pools and in-stream cover are scarce (WDNR stream survey data, 1999).

Information from WDNR files indicates that Sevenmile Creek does not receive significant fishing pressure. WDNR fisheries data indicates that brook trout naturally reproduce and no stocking efforts are employed in Sevenmile Creek (WDNR Fisheries File). The carrying capacity of a stream is based on the amount of available habitat, food and space. Sevenmile Creek is a small stream with limited space (volume of water), and critical habitat (spawning, rearing, feeding, resting/refuge habitats). Adequate food sources are available for fishes based on stream surveys and are not likely a limiting factor.

Significant riparian wetland plant beds, are observable in Sevenmile Creek in the ponded area upstream of Rangeline Road and again immediately upstream and downstream of Hollywood Road. Just downstream of the Nekoosa East cranberry operation, significant rooted macrophyte growth indicating some nutrient impacts to this portion of the stream is present in the middle one-third of the stretch between Hollywood Road and CTH Z. The likely source of this nutrient impact is cranberry skins generated during Nekoosa East harvest and observed in October 2012. As the streamflow and gradient increases downstream of the cranberry operation, nutrient impacts are less noticeable and much less rooted macrophyte growth was observed. Observations made by the WDNR Fisheries staff on Sevenmile Creek on November 6, 1975 indicated that below the cranberry dam, “Water quality 300 feet below dam poor. Has a septic odor to it.” And similarly, on April 12, 1976 a WDNR stream survey noted that “Red sludge like growth (algae) covers the entire stream bed.” (WDNR Stream Survey Station Report, 1975 and 1976). These observed conditions are consistent with impacts from the diversion of flow and potential discharges from the cranberry operation, but are not consistent with the character of the entire Sevenmile Creek.

Tenmile Creek

Tenmile Creek is classified as Class 2 trout stream from the Wisconsin River upstream to Bell Road. From Bell Road upstream to CTH U it is classified as Class 3 trout stream. Information from compiled surveys in the WDNR files indicate the following fish species have been observed in Tenmile Creek: brown trout, brook trout, American brook lamprey, blackside darter, bluntnose minnow, brassy minnow, brook stickleback, burbot, central mudminnow, common carp, common shiner, fathead minnow, golden shiner, grass pickerel, johnny darter, largemouth bass, logperch, longnose dace, mottled sculpin, northern pike, redbelly dace, pearl dace, spotfin shiner, walleye, western blacknose dace, white sucker, yellow perch, black bullhead, brown bullhead, yellow bullhead, fantail darter, bigmouth shiner, quillback carpsucker, emerald shiner, and creek chub. This fish assemblage contains cold, cool and warm water species and is likely influenced by fish from the Wisconsin River traveling upstream for spawning or to find suitable habitat conditions. The stream contains many invertebrate species including stonefly, mayfly, caddis and amphipods (WDNR Fisheries File information).

WDNR stream fisheries survey data from 2012 for Tenmile Creek are listed on **Figures 2-34** and **2-35**. These data indicate that brown trout populations in 2012 were unusually low in the stretch from the Wisconsin River upstream to CTH Z, and unusually high in the stretch from the Enbridge pipeline to Rangeline Road. Given the severe drought conditions during 2012, it appears that brown trout migrated to the best available habitat conditions in the middle stretch of the stream. It is possible that during the 2012 drought conditions, water temperatures were too warm in the downstream stretch (from the Wisconsin River to CTH Z) and the fish moved into more favorable conditions upstream.

Historic sampling information indicates that brown trout do reproduce naturally but spawning habitat is limited, and stocking is needed to maintain the fishery as it does receive high fishing pressure. In 1994, WDNR established a Stream Bank Protection (SBP) program to improve and protect public access to the stream. The SBP boundary is 3,500 acres in size and to date, 521 acres have been purchased and 6 acres are under easements that have improved access and fishing opportunities. The SBP is not intended to improve stream or fish habitat.

Spring Branch and Fourteenmile Creek

Spring Branch is an intermittent stream in the southeast portion of Wood County and adjacent to the GSD Project Area. This stream has been re-routed in southwest Portage County into a channelized ditch system that truncated the stream after re-routing to the south. This stream does not have persistent streamflow and is ephemeral in nature, meaning that it typically only flows during spring snow-melt or significant precipitation events. The stream bed for most of the year is dry and does not support aquatic animal species. Due to the wetland nature of Spring Branch and its lack of aquatic animal community, no impacts are expected.

Downstream of Spring Branch, Fourteenmile Creek has been dammed to form Upper Lake Camelot, Lake Sherwood, and Lake Arrowhead. Thus, the natural stream no longer exists. No significant impacts are expected on these lacustrine environments.

Chester Creek

Chester Creek is a Class 1 trout stream in northwestern Adams County and flows into the Wisconsin River. The stream contains many invertebrate species including stonefly, mayfly, caddis and amphipods. This stream is impounded near the confluence of the Wisconsin River

and is more lacustrine or lake-like in nature but has a short section that contains brook trout and various other species similar to Sevenmile Creek (personal communication, Scott Provost, 2012).

2.5.1.2 Natural, Wildlife, and Conservation Areas

There are no SNAs, Wildlife Areas, or Conservation Areas within the GSD Project Area or within five miles of the GSD Project Area. No impacts are anticipated to faunal communities within SNAs, Wildlife Areas, or Conservation Areas.

2.5.1.3 Wildlife Species

Common wildlife species of Wood County and the Central Sands Region are listed below. This is a non-exhaustive lists of wildlife documented in Wood County and the Central Sands Region. Not all species listed are representative of Saratoga Township. Rare, Threatened, and Endangered Species documented to be in the region are not listed.

2.5.1.3.1 Mammals

Coyote	Little Brown Bat	Black Bear
Red Fox	Big Brown Bat	White Footed Mouse
Gray Fox	Raccoon	Snowshoe Hare
Bobcat	River Otter	Meadow Jumping Mouse
Wolf	Pine Marten	Eastern Cottontail Rabbit
White-tailed deer	Striped Skunk	Southern Bog Lemming
Muskrat	Opossum	Eastern Chipmunk
Beaver	Long-tailed Weasel	Eastern Prairie Mole
Woodchuck	Porcupine	Flying Squirrel
Badger	Meadow Vole	Woodland Vole
Gray Squirrel		

2.5.1.3.2 Birds

Ruffed Grouse	American Bittern	Downy Woodpecker
Eastern Wild Turkey	Green Heron	Northern Flicker
Mallard	Turkey Vulture	Pileated Woodpecker
Green-winged Teal	Osprey	Yellow-bellied Flycatcher
Ring-necked Duck	Bald Eagle	Eastern Phoebe
Red-breasted Merganser	Northern Harrier	Eastern Kingbird
Lesser Scaup	Red-tailed Hawk	Yellow-throated Vireo
Ring-necked Pheasant	Coopers Hawk	Warbling Vireo
Pied Billed Grebe	American Kestrel	Blue Jay

Gray Jay	Horned Lark	Purple Martin
Tree Swallow	Cliff Swallow	Barn Swallow
Black-capped chickadee	Tufted Titmouse	Red-breasted Nuthatch
Brown Creeper	House Wren	Marsh Wren
Eastern Bluebird	Hermit Thrush	Wood Thrush
American Robin	Northern Mockingbird	Gray Catbird
European Starling	Cedar Waxwing	Blue-winged Warbler
Golden-winged Warbler	Yellow Warbler	Pine Warbler
Double-breasted Cormorant	Sandhill Crane	Great Blue Heron
Great Horned Owl	Killdeer	Mourning Dove
Upland Sandpiper	Rock Pigeon	American Woodcock
Black Tern	Wilson's Snipe	Herring Gull
Wilson's Phalarope	Common Nighthawk	Eastern Screech Owl
Northern Saw-whet Owl	Barred Owl	Short-earned Owl
Whip-poor-will	Belted Kingfisher	Chimney Swift
Red-headed Woodpecker	Ruby-throated Hummingbird	Red-bellied Woodpecker
Common Yellowthroat	Scarlet Tanager	Eastern Towhee
Chipping Sparrow	Vesper Sparrow	House Sparrow
Song Sparrow	Dark-eyed Junco	Northern Cardinal
Indigo Bunting	Dickcissel	Bobolink
Red-winged blackbird	Eastern Meadowlark	Common Grackle
Purple Finch	House Finch	Pine Siskin
American Goldfinch	Evening Grosbeak	White-winged Crossbill

2.5.1.3.3 Reptiles and Amphibians

Blue-spotted Salamander	Spotted Salamander	Eastern Tiger Salamander
Redback Salamander	Eastern American Toad	Blanchard's Cricket Frog
Western Chorus Frog	Northern Spring Peeper	Gray Treefrog
Cope's Gray Treefrog	Green Frog	Bullfrog
Northern Leopard Frog	Wood Frog	Common Snapping Turtle
Wood Turtle	Blanding's Turtle	Western Painted Turtle
Five-lined Skink	Smooth Green snake	Western Fox Snake
Eastern Milk Snake	Eastern Garter Snake	Midland Brown Snake

Northern Redbelly Snake

2.5.1.3.4 Invertebrates

Water Strider Predaceous Diving Beetle

Flies (Order Diptera) – flies, midges, stoneflies, caddisflies, no-see-ums, mosquitoes, black flies, gnats

Butterflies - Skippers, Swallowtails, Sulphurs, Gossmer-Winged Butterflies, Silk Moths, Hawk Moths, Eribed Moth

Crayfish Dragonflies Terrestrial Butterflies

Mollusks Snails

Zooplankton - Scuds, Copepods, Rotifers, Cladocearans

Grasshoppers Honeybee Wasps/Hornets

Earthworms Centipedes

Spiders - Orb Spider, Wolf Spider, Sac Spider, Grass Spider, Jumping Spider, Brown Recluse Spider

Ticks - Deer Tick, Wood Tick

2.5.1.3.5 Fishes

Brook Trout	Rainbow Trout	Brown Trout
American Brook Lamprey	Redbelly Dace	Redfin Shiner
Gilt Darter	Least Darter	Minnows (several species)
Shiners (several species	Chubs (several species)	Carp
Buffalo	Mottled Sculpin	Sunfish
Pumpkineed	Bluegill	Black Crappie
White Crappie	Largemouth Bass	Smallmouth Bass
Rock Bass	White Bass	Northern Pike
Pickerel	Greater Redhorse	Bullhead
Catfish	Longnose Gar	Bowfin
Yellow Perch	Walleye	

2.5.1.4 Rare Animals

Rare animals occupying red pine forest are mostly found in young (1 to 10 years) and older (greater than 50 years) forests (Wisconsin Department of Natural Resources Silvicultural Handbook, Chapter 32, page 26). The 1 to 15 year old red pine age class represents only 15 percent (approximately 860 acres) of existing pine plantation in the GSD Project Area and the 46 year and older red pine age class represents less than 1 percent (approximately 17 acres) of existing pine plantation in the GSD Project Area (**Figure 2-33**). The majority of following

italicized headings in sections 2.5.1.4.1 through 2.5.1.4.3 was taken from Section B of the WDNR Endangered Resources Review (ERR Log # 12-662) for the GSD Project Area dated November, 2012.

2.5.1.4.1 Birds

Barn Owl *(Tyto alba),* a bird listed as Endangered in Wisconsin, but will be delisted as of January 2014. The barn owl inhabits open to partly open country, and prefers uncultivated field and wetland edges. It nests in buildings, caves and hollow trees. The recommended avoidance period is from April 16 through August 31. The GSD Project Area is currently in red pine plantations of varying ages, from recent clear cuts to mature red pine ready for harvest. These plantations have been planted on outwash sands that historically were oak and pine savannahs. These lands have been planted, harvested and replanted to red pines for many decades, and lack structural and species diversity that would be attractive to barn owls. The plantations individually are very monotypic with all the trees of the same age and size. There are almost no cavity trees for barn owls to nest in. There are no old farm buildings or houses on the footprint of the proposed farm. There are some understocked areas in the plantations which barn owls may find attractive for foraging, but there are no breeding sites within the pine plantations themselves. Large oaks and white pines can be found in the riparian forests along Sevenmile and Tenmile Creeks, some of which have large cavities that could be used by nesting owls.

Red-shouldered Hawk *(Buteo lineatus),* a bird listed as Threatened in Wisconsin. This species prefers larger stands of medium-aged to mature lowland deciduous forests, dry-mesic and mesic forest with small wetland pockets. The recommended avoidance period is from March 1 through- July 31. Areas proposed for clearing and farming are limited to red pine plantations growing on outwash sands. Plantations range from recent clear cuts to mature pine ready for harvest. Historically, these sites were comprised of pine and oak barrens. Red pine plantations are not considered suitable habitat for this species of raptor, which nests in mature-to- old growth deciduous forest types, typically interspersed with open wetlands or small meadows for foraging. Potential habitat for this hawk occurs in narrow linear bands along Sevenmile and Tenmile Creeks, in native riparian forest types, but the proposed farm does not contemplate altering these areas. These riparian forests are too steep and too wet to be used for irrigated agriculture, and thus will be buffered and left alone. Therefore, no take is expected to occur, even if logging and clearing is conducted during the red-shouldered hawks' breeding season, because no suitable habitat currently exists in the areas slated for agriculture.

No known detections or observations of this species exist within the GSD Project Area. Because WDNR expressed concern that there could be suitable habitat within the GSD Project Area, a habitat assessment was conducted as part of this EIR. No suitable habitat was identified within the GSD Project Area, or in close enough proximity to indicate the red-shouldered hawk could be affected by the GSD Project.

Greater Prairie Chicken *(Tympanuchus cupido),* a bird listed as Threatened in Wisconsin, prefers mixed grasslands and managed grasslands including wheatgrass, switchgrass, timothy, bromegrass, hoary alyssum, yarrow, blue vervain, daisy fleabane and goldenrods. The recommended avoidance period is from early March to late September. Dense mixed prairie or grassland habitat interspersed within oak woodlands and oak savannas suitable for the Greater Prairie Chicken does not exist within the GSD Project Area.

Bald Eagle *(Haliaeetus leucocephalus),* a bird listed as Special Concern in Wisconsin and Federally protected by the Bald & Golden Eagle Protection Act, prefers large trees in isolated areas in proximity to large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities. Large lakes and rivers with nearby tall pine trees are preferred for nesting. In southern Wisconsin, the recommended avoidance period extends from February 15 through July 1. In northern Wisconsin, the recommended avoidance period is from March 15 through August 1. Please see also the National bald eagle management guidelines. The GSD Project Area currently contains areas that may be suitable nesting habitat for bald eagles. Bald eagle nests have been observed within the vicinity of the GSD Project Area. Mature red pine trees can provide nesting habitat for bald eagles, however the limiting habitat element in the GSD Project Area is the "proximity to large areas of surface water". The core areas of mature red pine within the GSD Project Area are not in relative proximity to large open bodies of water.

Kirtland's Warbler *(Dendroica kirtlandii),* a bird listed as Special Concern in Wisconsin and Federally listed as Endangered, is found in areas at least 30 hectares in size, where scrubby jack pine (6 to 20 feet high) is interspersed with many small openings and minimal ground cover. The recommended avoidance period is from May 1 through August 30. Please note that this species has not been located in the immediate vicinity of the GSD Project Area and is being listed here only as a species recommended for surveys. Red pine stands with mixed densities of jack pine and pin oak are lacking in the GSD Project Area. This is the combination of woodland habitat type that typically supports the Kirtland's Warbler. Monotypic and even-class commercial red pine plantations do not typically support the ideal density or composition of species that is ideally suited for the Kirtland's Warbler. "Red pine is not a common breeding habitat for Kirtland's Warblers" (The Wilson Journal of Ornithology 123(2):199–205, 2011).

2.5.1.4.2 Invertebrates

Karner Blue *(Lycaeides melissa samuelis),* butterfly (KBB) listed as Federally Endangered and Special Concern in Wisconsin, has been found in pine barrens and oak savannas in close association with its larval host plant lupine (Lupinus perennis). In Wisconsin, KBB is also found along utility and road right-of-ways, abandoned agricultural fields, and managed forests. This butterfly has two flight periods: adults are present from late May through late June and again from late July through late August.

Although the KBB is a federally protected species, it is fairly widespread in the State of Wisconsin. Indeed, if the KBB was as common across its entire range as it is in Wisconsin, it would not qualify for protection as endangered or even threatened under the federal Endangered Species Act. However, due to the federal listing, WDNR has developed a Habitat Conservation Program for the KBB, the goal of which is to develop suitable habitat on specific dedicated recovery areas in Wisconsin. It is the intent of WDNR to accomplish full recovery of the KBB on these dedicated recovery areas. The KBB recovery goals for Wisconsin, as articulated in the Range-wide KBB Recovery Plan dated September 2003, do not require additional recovery or conservation on private lands outside the dedicated recovery areas in Wisconsin.

For conducting habitat and butterfly presence surveys, and determining, calculating and avoiding take, GSD is working with WDNR and although GSD is not a HCP Partner, it has largely followed the KBB HCP survey KBB protocols, as approved by the FWS. The HCP

protocols require a Level 1 and Level 2 survey to determine if habitat and KBB exist in a particular location. Level 1 surveys are a field-walk to identify the lupine plant. Lupine provides egg laying substrate and is the host plant for KBB in the caterpillar life stage. Level 2 surveys are additional field-walks conducted in the areas where Level 1 surveys documented adequate lupine to trigger a Level 2 survey. A level 2 survey is triggered when there are at least 25 plants or clumps of lupine at a density of 50 lupine plants per acre, or 25 lupine plants per every 200 meters for linear sites. Level 2 surveys also require observation and documentation of nectar-producing wildflowers that provide food for the adult life stage KBB.

Since 2003, Plum Creek has been enrolled as a HCP Partner and has conducted Protocol Surveys on a rolling five year basis. As such, the majority of the GSD Project Area has been subject to extensive survey work to determine the presence of KBB and habitat and WDNR has a longstanding record of the existence of KBB and supporting habitat in studied areas of the GSD Project Area.

In 2012, Plum Creek conducted Level 1 and Level 2 Surveys on more than 7000 acres in Saratoga Township, including all of the GSD Project Area proposed for conversion from pine plantation. Protocol Surveys are typically considered accurate and valid for a period of five years after they are conducted. However, due to the extreme drought in 2012, and because drought conditions can limit the development of lupine plants and therefore reduce the amount of area that qualifies for a Level 2 survey, WDNR expressed concerns that the 2012 surveys were not reflective of normal KBB habitat conditions.

At the request of WDNR and well beyond the requirements of the KBB HCP Program, in 2013 GSD worked with Plum Creek to undertake additional Level 1 and Level 2 surveys across the GSD Project Area proposed for conversion from pine plantation. More stringent than the Level 1 survey protocol described above, the 2013 efforts included Level 2 surveys for all areas where <u>any lupine plants at all</u> were observed, instead of those areas with a density of 50 lupine plants per acre, or 25 lupine plants per every 200 meters. This extra effort was mandated by GSD, not WDNR, to ensure that the GSD Project Area would be suitable for project development.

As a result of the 2013 surveys, GSD identified only one area where KBB exist that had not been identified in the 2012 surveys. The 2013 surveys reinforced the efficacy of the 2012 surveys, despite the 2012 drought conditions.

As a company, GSD is committed to avoiding and minimizing impacts to the KBB. Therefore, areas identified with KBB are not planned for development. Because those areas contain federally-protected species, they are not identified on any maps within this EIR. There are additional acres within the GSD Project Area that were identified with KBB habitat, but require additional surveys in the 2014 season. GSD does not anticipate any direct take, regardless of the result of subsequent surveys conducted in 2014 or beyond. In accordance with the HCP Protocol, any KBB observed as a result of subsequent surveys will be avoided or minimized to the maximum extent practicable. If isolated areas of KBB habitat are later identified, such that those areas are not contiguous with other habitat or sustainable for KBB, GSD will work closely with WDNR to determine how to manage those habitat areas.

GSD is committed to the conservation and recovery of the KBB; however, because GSD is not a HCP-Partner at this time, it is not obligated to implement HCP land use practices. If

WDNR and GSD develop land use protocols that are specific to agriculture, GSD may pursue HCP Partnership at that time, and will work to implement agriculture-specific HCP land use practices.

GSD has discussed extensively with WDNR and the U.S. Fish and Wildlife Service (FWS) the possibility of working to develop additional KBB habitat in areas within the GSD Project Area that will not be actively farmed. However, because the KBB is a federally-protected species, any take of the KBB requires a permit from WDNR or FWS. The development of additional KBB habitat may result in increased populations of KBB in the GSD Project Area, and therefore may increase the risk of impacts to KBB and take. As such, GSD cannot pursue habitat development activities without a Safe Harbor Agreement in place, developed by FWS. A Safe Harbor Agreement is a government permit, authorized under Section 10 of the federal Endangered Species Act. This permit is a negotiated recovery and conservation tool developed by the FWS to encourage landowners to develop, or allow natural development of, suitable habitat for rare species. Prior to issuing such a permit, FWS and the landowner agree to a baseline set of conditions present on the property that will be subject to the Safe Harbor Agreement. Baseline conditions are those that exist at the outset of the permit period (current conditions as to acres of habitat and number of individuals of a rare species on the land). Subsequently, for the duration of the permit term, any additional habitat developed and any increase in number of individuals present on the property can be "taken" by the landowner without fear of federal penalties because that "take" is simply returning the property to the baseline conditions, rather than further impacting the species.

GSD and FWS are in discussions regarding the development of a Safe Harbor Agreement. Although the timing is uncertain, GSD would like to have a Safe Harbor Agreement in place prior to logging and land clearing activities to maximize its ability to develop habitat improvement projects and procedures in the most cost-effective manner; however if there are delays in negotiating a Safe Harbor Agreement, land clearing activities will continue as scheduled and additional KBB habitat may be developed at a later date.

Sand Snaketail *(Ophiogomphus smithi*), a State Special Concern dragonfly, has been found in small to medium clean, fast-flowing sandy warm streams. The flight period extends from late May through mid-June. Suitable habitat for the Sand Snaketail may exist within portions of Sevenmile and Tenmile creeks, though areas of these streams with sandy substrate and warm water are rare. Although WDNR ER Review documents mentions this species is "known to occur within the vicinity of the project area" this species has not been identified or recorded within the GSD Project Area.

Dusted skipper *(Atrytonopsis hianna),* a State Special Concern butterfly, has been found in dry, open sandy areas, dry prairie, pine barrens. Its host plants are big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachryium scoparius*). This species is univoltine with adults in flight from late May to early June in Wisconsin when few other skippers are present. Fully grown caterpillars hibernate and pupate in a sealed case 1 to 3 inches above the ground at the base of the host plant. Native warm season grasses such as big bluestem and little bluestem are exceedingly rare within the GSD Project Area. Preferred nectar sources (pucoon, strawberry, phlox, and vervain) of the Dusted Skipper are also rare within the GSD Project Area, though blue vervain does exist in low levels within riparian areas.

***Persius Dusky Wing* (*Erynnis persius*),** a State Special Concern butterfly, has been found in pine/oak barrens and sand barrens. In the Midwest, its host plant is wild lupine (Lupinus perennis). This is a univoltine species, with the flight period from mid-May to early June. Eggs are laid singly under leaves. Larvae live and eventually hibernate in solitary nests on the plant. Pupation occurs in the spring following hibernation. Pine barrens, oak savannas, and appropriate open area habitat for the Persius dusty wing butterfly do not exist on the GSD Project Area. Native legumes such as Baptisia and Lupine which this species utilizes as host plants also exist in very low numbers.

2.5.1.4.3 Reptiles

Western Slender Glass Lizards *(Ophisaurus attenuatus)***,** listed as Endangered in Wisconsin, prefer sandy oak savannas, sand prairies, old fields with sandy soils, pine plantations with intact understory and woodland edges around and within all of these habitats. Glass lizards overwinter in burrows they create by forcing their bodies through lose sandy soils. This lizard is active from mid-April through September. Breeding occurs in May and eggs are deposited from late June to early July and hatch in August. Commercial red pine plantations that are not managed with prescribed fire result in the accumulation of pine duff on the forest floor that is too thick for this species to burrow through.

Any and all areas proposed for clearing and farming are currently comprised of red pine plantations of varying ages, from recently clear cut, to clear cut and planted to young red pine, to young plantations, to mature red pine ready for harvest. The proposed crop fields are on sandy outwash plains, and were historically pine and oak barrens. Access roads already exist throughout the property to enable forest management actions. Riparian areas along Tenmile Creek and Sevenmile Creek are not proposed for farming.

No known detections or observations of this species exist within the GSD Project Area. However, because WDNR informed GSD of general locations near the GSD Project Area where this species was observed in the past, a habitat assessment was conducted as part of this EIR. Very little potential suitable habitat was identified within the GSD Project Area, or in close enough proximity to indicate the slender glass lizard could be affected by the GSD Project. Specific avoidance practices will be implemented in GSD Project areas that contain potential suitable habitat.

Wood Turtles *(Clemmys insculpta),* a Threatened species in Wisconsin, prefer clean rivers and streams with moderate to fast flows and adjacent riparian wetlands and upland deciduous forests. This species often forages in open wet meadows or in shrub-carr habitats dominated by speckled alder. They overwinter in streams and rivers in deep holes or undercut banks where there is enough water flow to prevent freezing. This semi-terrestrial species tends to stay within about 300 meters of rivers and streams but exceptions can occur, especially within the driftless area of southwestern and western Wisconsin. This species becomes active in spring as soon as the ice is gone and air temperatures reach around 50 degrees in March or April. They can remain active into mid-October. Wood turtles can breed at any time of year, primarily during the spring or fall but have been observed breeding under the ice. Nesting usually begins in late May in northern Wisconsin and early June in southern Wisconsin and continues through June. This species nests in sand or gravel, usually very close to the water, although it is known to nest along sand and gravel roads or in abandoned gravel pits some distance from water. Hatching of eggs

occurs 55 to 75 days after egg laying (typically in August) depending on air temperatures. This species does not overwinter in nests, unlike other Wisconsin turtles.

Neither Sevenmile nor Tenmile Creeks are large enough rivers for this species to find the open sunny banks it needs to nest. Both creeks have nearly complete tree canopy over them, and lack open, unvegetated gravel bars, which are considered nesting habitat for the wood turtle. Therefore, we would not expect many wood turtles along these small creeks. However, in suitable habitat wood turtles spend much of their summer foraging along creeks, selecting open sunny areas with ample berries, slow-moving insects and succulent vegetation to feed upon. Such open sunny habitats cannot be found near Sevenmile and Tenmile creeks, so any wood turtles would need to travel some distance into the uplands to find these areas. Monitoring has found wood turtles can travel up to ¼ mile from the nearest creeks or rivers in summer.

No known detections or observations of this species exist within the GSD Project Area. However, because WDNR informed GSD of general locations near the GSD Project Area where this species was observed in the past, a habitat assessment was conducted as part of this EIR. No suitable habitat was identified within the GSD Project Area, or in close enough proximity to indicate the wood turtle could be affected by the GSD Project.

Blanding's Turtles (Emydoidea blandingii) have been delisted as a Threatened species in Wisconsin. They utilize a wide variety of aquatic habitats including deep and shallow marshes, shallow bays of lakes and impoundments where areas of dense emergent and submergent vegetation exists, sluggish streams, oxbows and other backwaters of rivers, drainage ditches (usually where wetlands have been drained), and sedge meadows and wet meadows adjacent to these habitats. This species is semi-terrestrial and individuals may spend a good deal of time on land. They often move between varieties of wetland types during the active season, which can extend from early March to mid-October. They overwinter in standing water that is typically more than 3 feet deep and with a deep organic substrate but will also use both warm and cold-water streams and rivers where they can avoid freezing. Blanding's turtles generally breed in spring, late summer or fall. Nesting occurs from about mid-May through early July depending on spring temperatures. They strongly prefer to nest in sandy soils and may travel up to 900 feet from a wetland or waterbody to find suitable soils. This species appears to display nest site fidelity, returning to its natal site and then nesting in a similar location annually. Hatching occurs from early August through mid-October. This species takes 17 to 20 years or more to reach maturity. Suitable habitat for Blanding's turtles may exist within riparian corridors though the emergent wetland, wet meadow, and emergent aquatic habitat types that are suitable for Blanding's turtle do not exist within the GSD Project Area, but were observed outside of the GSD Project Area in Tenmile Creek between CTH Z and the Wisconsin River.

2.5.1.4.4 Other

Wild Lupine *(Lupinus perennis)*

Though not listed as an endangered resource by state or federal regulatory agencies, wild lupine is worthy of mention due to its direct life-cycle association with the KBB - a federally endangered butterfly species that is also listed by the WDNR as an endangered resource, and the Persius dusky wing – a State Special Concern butterfly. Refer to the previous discussion on

Lupine in Section 2.4.1.3.1. Lupine has been observed and recorded infrequently and in low densities within isolated portions of the GSD Project Area.

2.5.2 Potential Impacts

2.5.2.1 Habitats

Wildlife habitat will be converted from a variant-age class red pine plantation to agricultural production, resulting in a short-term decline in available wildlife habitat in the GSD Project Area proposed for conversion from pine plantation. The highest degree of wildlife habitat diversity is supported in wetland and grassland habitat types which will largely remain undisturbed due to the GSD Project.

Opportunistic and generalist wildlife species (more common forested species such as deer, raccoon, opossum, skunk, etc.) which can utilize a wider range of habitat types will be impacted less than more specialized species that have specific habitat requirements and have a reduced capacity to seek new cover (less common species such as the previously listed invertebrates, and herpetofaunal species). Although none have been observed or documented, if they are living in the GSD Project Area, birds of prey such as the barn owl and red shouldered hawk could be temporarily displaced as habitat for prey base (small mammals) and cover (mature trees) is removed. These dislocations, if any, would be temporary as appropriate habitat exists within reasonable relocation distances for these species. These available habitats exist on private and public land adjacent to the boundaries of the GSD Project Area.

2.5.2.1.1 Forest

The low-quality forest habitat described in Section 2.5.1.1.1 will be impacted on a localized scale as red pine plantation habitat is harvested; however, only 15 percent of the existing red pine plantation is of the age class (1 to 15 years old) that is most beneficial to wildlife habitat (see Section 2.5.1.4). After harvest, the pine plantation will not be replanted, but the area will be converted to productive cultivated vegetable and dairy forage crops. Forested buffer areas between GSD Agricultural Crop Fields will be left intact.

The forested buffer areas will increase the amount of forest edge habitat, providing a benefit and allowing species to remain in place and providing travel corridors for transient species. The cessation of red pine plantation management will increase the quality of the remaining buffer areas.

Mobile and generalist species such as most birds and mammals associated with forest habitat will re-distribute into adjacent forested habitats. Specialized species that rely heavily on woodland plants to complete their life cycle (mainly invertebrates) will be impacted more significantly and directly in the short term.

2.5.2.1.2 Grasslands

Grasslands currently make up a very minor component within the red pine plantation so conversion of red pine plantation to row crops will not have potential impacts to grasslands. Opportunities will exist to create a net gain in native grasses and forbs with the low level of native plant communities currently supported within the red pine plantations.

2.5.2.1.3 Wetlands

Riparian wetlands may increase in size along stream banks and backwater areas if permanent reduction of groundwater discharge into the streams results in narrowing of the stream channel. Impacts to stream fauna may include reduction of invertebrates, minnow species, and trout.

Isolated wetland fauna may be negatively impacted if there is a permanent loss of wetland hydrology to sustain wetland conditions, mainly wetland plant communities that many wildlife species rely on for critical life stages. These wildlife species will be displaced if this permanent change in habitat from wetland to upland occurs.

2.5.2.1.4 Aquatic

The potential impacts to the aquatic wildlife in the streams in the GSD Project Area are related to reduced flow, increased temperatures and increased nutrient concentrations. Reduced streamflow in the streams could reduce available habitat for fishes and invertebrates. Stream temperature is one of the most important environmental factors affecting the physiology, life history and evolution of stream biota (Magnuson *et al*., 1979, Wehrly *et al*., 1998, Allan & Castillo, 2007). Increase in stream water temperatures could create stress and mortality on cold-water species such as trout. Stream temperature is a key factor limiting brook trout (charr) distribution and production (McCormick *et al*., 1972).

As discussed in further detail below, increased nutrients can cause shifts in invertebrate populations and impact fishes in the streams (Wang, *et al.,* 2007). High concentrations of ammonia is acutely toxic to aquatic organisms. High Biological Oxygen Demand (BOD) could cause depletion of dissolved oxygen in the water and could also result in asphyxia of aquatic organisms. High ammonia concentrations and oxygen depletion could be lethal to aquatic insects, snails and mussels, certain life stages of amphibians such as frogs, toads, and salamanders, fish, and possibly turtles. Excess sedimentation may also bury critical in-stream habitat areas such as gravel used for spawning beds and filling in of deeper holes that provide feeding and refuge. The downstream extent of acute impacts would depend on the volume of material, rate of flow, dilution, time of year, and water temperature.

2.5.2.1.4.1 Flow Rates

Lower flow rates may affect the available habitat for instream species. Lower flow rates may also affect the wetted surface of in-stream spawning habitat for fishes and substrate for invertebrates. Decreases in groundwater discharge to streams can cause decreased water velocity, water depth and wetted channel width; increased sedimentation; and changes in thermal regime and water chemistry. Invertebrate abundance increases or decreases may occur in response to decreased flow, whereas invertebrate richness can decrease because habitat diversity decreases (Zoe, *et al.,* 2007). The breakdown of average annual flow reductions in each stream are listed on Tables 2-6 and 2-7.

2.5.2.1.4.2 Temperature

Temperature ranges in the streams is another factor in assessing impacts. Reductions of streamflow can cause warmer water temperatures in the summer and colder temperatures in the

winter. Warmer water temperatures in the summer can preclude fish from spawning or reaching spawning areas. Overall warmer water temperatures can also preclude some species from inhabiting historically warmer stream reaches. Colder water temperatures in the winter can cause the stream to freeze over entirely, reducing the ability of fish and other macroinvertibrates to survive during cold winter months. The thermal regime of these streams is largely a function of groundwater inputs that provide the ideal conditions for brook trout (charr) growth, survival, and high production throughout the year by providing seasonal protection from elevated summer temperatures and cooler stream temperatures incurred throughout the winter months (Waco & Taylor, 2010).

Temperature variance during the summer period when water temperatures are at their highest was modeled to address this issue. Modeling calculations of temperature changes in Sevenmile Creek under dry conditions in August 2012 were performed. The calculated temperature change at Hollywood Road is a change of less than 0.1 ºC.

On Tenmile Creek, simulated temperature changes under dry conditions in August of 2012 were calculated. The calculated temperature in Tenmile Creek at Rangeline Road would increase less than 0.1°C, with increases upstream of Rangeline Road being smaller. This modeled increase in water temperature would maintain conditions sufficient to sustain cold-water fish species.

2.5.2.1.4.3 Nutrient Concentrations

Nutrient enrichment from human actions has been studied and can have significant negative impacts to aquatic ecosystems. A 1996 EPA national water quality inventory report to Congress identified that excessive nutrients are the leading cause of impairment in lakes, and the second leading cause of impairment in streams and rivers (EPA, 1998). Excess nutrients from human activities can result in the overgrowth of benthic algae in shallow, faster current areas and the overabundance of phytoplankton and macrophytes in deeper and slower current areas of rivers and streams.

Nutrient enrichment may adversely affect stream animal communities. Nutrient enriched streams can have increased invertebrate biomass and altered invertebrate communities (Bourassa and Cattaneo 1998). Community structure has been correlated directly with phosphorus concentration (Miltner and Rankin 1998). Potential phosphorus impacts are observable in Sevenmile Creek in the ponded area upstream of Rangeline Road and again immediately upstream and downstream of Hollywood Road where fine-grained sediments have accumulated likely due to infrequent yet potentially large surface water run-off events along existing roadways. Further downstream of the Nekoosa East cranberry operation, significant rooted macrophyte growth is present for about one-third of the stretch between Hollywood Road and CTH Z. As the streamflow and gradient increases downstream of the cranberry operation, nutrient impacts are less noticeable and much less rooted macrophyte growth was observed.

The nutrients of concern related to the GSD Project are phosphorus and nitrogen/nitrate. In 2010, WDNR concluded its study of phosphorus impacts on surface waters in Wisconsin and finalized an administrative rule package that established numeric criteria for phosphorus. EPA has approved that numeric criteria and the statewide implementation effort is ongoing. Although EPA has directed states within the Mississippi River Basin to develop nitrogen reduction

strategies, WDNR has not developed any statewide numeric criteria for nitrogen. Indeed, no state has yet developed a statewide numeric water quality standard for nitrogen. Although there is an increasing body of evidence that nutrients directly affect the productivity and assemblage of primary producers and are indirectly linked to primary and secondary consumers in controlled nutrient enrichment experiments, only limited studies have demonstrated observational linkages between nutrients and the health of macroinvertebrate or fish assemblages in natural streams.

A 2005 research paper summarized a large body of research on nitrate toxicity to aquatic invertebrates, fish and amphibians (Camargo et al, 2005). Although the purpose of the paper was to establish a "safe level" of nitrate for aquatic species, the paper itself identifies a significant range of nitrate concentrations that could be considered toxic to aquatic animals (0.226 – 5050 mg NO3-N/L [mg/L nitrate as nitrogen]). Despite this range, the paper concludes that, "Because a nitrate concentration of 10 mg/L (USA federal maximum level for drinking water) can adversely affect, at least during long term exposures, freshwater invertebrates…, safe levels below this nitrate concentration are therefore recommended to protect these sensitive freshwater animals from nitrate pollution." (Camargo et al, 2005). The paper then states that, following a recommendation from a 1979 study, the authors consider a concentration limit of 2 mg/L nitrate to protect "the most sensitive freshwater species."

Wang and others (2006) sampled 240 wadeable streams in Wisconsin for nitrogen and phosphorus to identify how nutrients influence macroinvertebate and fish communities. Their evaluations identified threshold levels of nitrogen and phosphorous below which nutrient concentrations have no effect on macroinvertebrate and fish communities and above which nutrient concentrations are one of many factors that affect macroinvertebrate and fish communities. The thresholds identified by Wang and others were all less than 0.1 mg/L for total phosphorus and 2 mg/L for total nitrogen. In other words, if phosphorus and nitrogen concentrations in streams are below 0.1 mg/L and 2 mg/L respectively, nutrients have little or no impact on the macroinvertebrate and fish communities; if nitrogen and phosphorus concentrations are above those thresholds, nutrients become one of many factors that can affect macroinvertibrate and fish communities. (Wang, *et al.,* 2006, EPA, 1998, Welch, *et al.,* 1992, Miltner and Rankin, 1998, Dodds and Welch, 2000). Wang and others identified many macroinvertebrate and fish measures that were positively correlated with phosphorus and nitrogen concentrations, implying that nutrients have direct or indirect links with these biological assemblages in Wisconsin's wadeable streams. However, selected environmental factors explained only 54 percent of the variation in fish assemblages from the control. Of this explained variance, 46 percent was attributed to catchment and instream habitat, 15 percent to nutrients, 3 percent to other water quality measures and 36 percent to the interactions among all environmental variables (Wang, 2006). In summary, 46 percent of the variations in the fish assemblages were left unexplained, and only a small percentage of the explained variations could be attributed to nutrients.

Robertson and others (2006) found that the nutrient relationships were much weaker in smaller wadeable streams due to the influence of other confounding environmental factors, with nutrients alone explaining only a small portion of the response. Most of the biological measures exhibited a wedge-shaped response to increases in nutrient concentrations. At relatively low nutrient concentrations, the biotic indices ranged widely, but at relatively high concentrations, the indices generally were poor. The wedge-shaped distribution indicates that at low nutrient

concentrations, factors other than nutrients often limit the health of biotic communities, whereas, at high nutrient concentrations, nutrients and factors correlated with high nutrient concentrations are the predominant factors. Simply stated, it is difficult to find a healthy population at a nutrient enriched site, but common to find a poor population at low nutrient sites due to the influence of other factors (Robertson, et al. 2006).

Due to the confounding effects of these other factors, the macroinvertebrate response to nutrients was statistically weak and could be depicted by a wedge-shaped relationship as described previously. With the exception of un-ionized ammonia, elevated nutrient levels are not acutely toxic in the aquatic environment; instead, their effects are chronic and cumulative over time. Nutrient concentrations are typically variable over time and exhibit a log-normal distribution in the aquatic environment. Therefore, instantaneous criteria are not generally considered practical or appropriate for nutrients, and are better expressed as an average over a longer period of time. Additionally, the geometric mean, rather than an arithmetic mean, is often used to provide a more accurate representation of the central tendency of positively skewed data (e.g., log-normal), such as nutrient concentrations. The use of the annual geometric mean mutes the short-term variability in sampling quality data to provide a more reliable, long-term value for assessing the nutrient status in aquatic environments (Robertson, et al. 2006).

The difficulty in linking nutrient concentrations in streams and macroinvertebrate or fish assemblages is reflected in the fact that to date, no state has developed or implemented a statewide numeric surface water quality standard for nitrogen in streams. In 2010, EPA attempted to implement a numeric nitrogen standard in the State of Florida, but that standard was challenged in court and has not been implemented as designed. In 2012, the Florida Department of Environmental Protection (DEP) issued technical documentation of its research and efforts to establish numeric nutrient criteria. This document notes, "the statistical relationships between the biological response variables and nutrient levels are weak, and DEP could not identify specific thresholds for establishing numeric nutrient criteria from the analyses…This may be because the biological responses can be confounded by numerous other factors (including low residence time for uptake) and confounding variables under real world conditions found in natural streams." The Florida DEP also evaluated existing research, including Robertson and others (2006) and noted that the relationships between nutrient enrichment and various adverse biological responses "were much weaker in smaller wadeable streams [in Wisconsin] due to the influence of other confounding environmental factors, with nutrients alone explaining only a small portion of the response."

After much research and consideration, the Florida DEP (2013) concluded, "Despite an exhaustive effort to develop stressor-response relationships between nutrients and biological responses in streams, insufficient responses were observed to develop numeric nutrient criteria." The Florida DEP went on to note, "Because of the complexity associated with nutrient enrichment effects, no single assessment tool is adequate to evaluate all potential impacts…" The Florida DEP (2013) submitted its implementation report to EPA in support of its proposed regulatory approach, which does not rely on numeric criteria alone to determine if a stream is meeting water nutrient quality standards. According to the implementation report, the State of Florida will require multiple lines of evidence to be evaluated and, even if numeric thresholds are exceeded, "if floral and faunal measures are met, the streams are found to be healthy and well balanced."

Although the technical and implementation reports cited above document research efforts by the Florida DEP, the agency's ultimate conclusions are instructive in that a simple numeric water quality standard is likely inappropriate for nutrients. In fact, it may be even more difficult to isolate a specific numeric nutrient concentration that negatively affects Wisconsin streams because the colder Wisconsin climate results in a shorter warm weather/warm water season, and less time for algae and other indicators of nitrate impacts to appear in surface waters.

In summary, the overall health of a stream's flora and fauna will be indicative of the potential for nutrients to negatively affect aquatic fauna. Sevenmile and Tenmile Creeks have been identified by WDNR as high quality resources, portions of which near the GSD Project Area are Class 1 and Class 2 trout streams, respectively, and nothing in the WDNR files indicates these creeks are impaired due to nutrients. If nutrient discharges to these creeks occur in sufficient quantity, the creeks may experience a change in the quantity or quality of aquatic fauna.

2.5.2.2 Natural and Conservation Areas

As there are no SNAs or Conservation Areas within the proposed GSD Project Area, no potential impacts to SNAs or Conservation Areas are anticipated as a result of the GSD Project.

2.5.2.3 Wildlife Species

Some wildlife species may be temporarily displaced during red pine plantation conversion but sufficient similar habitat remains in the local area to provide suitable habitat requirements for all native species.

Potential for impacts to wildlife from manure-related pathogens do exist. Several types of microbial pathogens to wildlife can exist in cow manure (refer to Section 2.3.2.3). Containment breeches of manure lagoons during flooding leading to wildlife mortality have also been documented.

2.5.2.4 Rare Animals

2.5.2.4.1 Birds

The habitat preferred by various rare birds (small areas of bottomland hardwoods and mixed mesic/dry-mesic mixed deciduous/conifer forest areas) does exist in the GSD Project Area proposed for conversion from pine plantation. These areas lie mainly along riparian zones and small pockets of floodplain forest along Tenmile and Sevenmile Creeks and may offer suitable habitat for the red-shouldered hawk. However, as noted above, habitat assessments confirmed there is no suitable habitat for red-shouldered hawk within the GSD Project Area. Since these areas will remain intact as buffers between agricultural production areas and riparian areas, even if the red-shouldered hawk or the barn owl exist within the GSD Project Area, minimal impacts are anticipated.

Although some elements of other rare bird habitat may exist within the GSD Project Area, ideal habitat conditions do not exist and the following species have not been observed within the GSD Project Area, so no impacts to these species are anticipated: barn owl, greater prairie chicken, bald eagle, Kirtland's warblers. The barn owl has been delisted and is no longer considered threatened or endangered in Wisconsin.

2.5.2.4.2 Invertebrates

The KBB is the most prominent invertebrate that could be impacted by the GSD Project. If WDNR and GSD develop agriculture-specific HCP protocols, GSD may have a future opportunity to support KBB habitat as a HCP-Partner. Similarly, if FWS and GSD are able to negotiate and develop a Safe Harbor Agreement, GSD would have a future opportunity to develop additional KBB habitat and potentially increase the population of KBB in the State of Wisconsin. Any increase in KBB population would be a significant benefit to Federal and State conservation efforts, the HCP program and the listed species.

As with most environmental conservation programs, many industries and businesses, including farmers and crop growers, are hesitant to lose the full use and control of private property. However, if GSD can ultimately be successful in supporting KBB habitat and engaging in conservation efforts, its example could generate interest across the agricultural sector and could create more opportunity for agricultural partnerships in conservation in the Central Sands area of Wisconsin.

Despite GSD's commitment to avoid and minimize impacts to KBB, normal farming activities could impact KBB if they exist within an irrigated crop circle. The loss of KBB as a result of normal farming activities could reduce the local population of KBB in Saratoga Township, but any such losses would be minor and not hinder the state and federal conservation efforts in the Central Sands.

Red pine plantation now covers the majority of the GSD Project Area. Because the red pine plantations are harvested for the production of paper, stands are clear-cut when red pines are ideal for paper pulp. When red pine stands are clear-cut, the logged area can develop into viable KBB habitat for a period of time. However, because those clear-cut areas have historically been replanted for new pine plantation, when the trees start to grow the logged areas eventually fill in. After 20 or so years the pines begin to grow together and the canopy closes and the KBB habitat is shaded out and ultimately disappears. One impact of the GSD Project is that the temporary KBB habitat opportunities created upon clear-cutting will no longer occur.

Although some elements of other rare invertebrate habitat may exist within the GSD Project Area, ideal habitat conditions do not exist and the following species have not been observed or documented within the GSD Project Area, so no impacts to these species are anticipated: Sand Snaketails, Dusted Skippers, Persius Dusty Wings, Western Slender Glass Lizard, Wood Turtle, Blanding's Turtle.

2.5.3 Significance of Impacts

2.5.3.1 Habitats

Wildlife habitat will be converted from predominately red pine plantation to irrigated vegetable and crop production, resulting in a short-term decline in available wildlife habitat. Impacts to overall faunal habitat diversity will not be significant on a landscape scale because land use changes from a long-term harvested monotypic type to a short-term harvested monotypic type will be beneficial to diversity. Because diversity and quality of wildlife habitat within the existing red pine plantations is low, the landscape scale habitat impacts to the GSD Project will not be significant.

2.5.3.1.1 Forest

Forest habitat will be impacted on a localized scale as forest habitat is replaced with annual agricultural crops. However, due to low quality and diversity of the existing forest, and remaining forest habitat within the township and county, regional impacts will not be significant.

2.5.3.1.2 Grasslands

Due to the fact that grasslands currently represent such an insignificant portion of the GSD Project Area, no significant negative impacts to grassland areas are expected as a result of the proposed action.

2.5.3.1.3 Wetlands

If modeled groundwater flow, water level, wetted stream channel width, nutrient, pathogen and temperature calculations are accurate, and all NMP and BMPs are followed, expected impacts to wetlands are not significant.

2.5.3.1.4 Aquatic

Due in part to existing aquatic resource conditions, the modeled reduction in streamflow due to the GSD Project is unlikely to cause a significant adverse impact. The implementation and compliance with a WDNR-approved NMP and implementation of anaerobic digestion technology will minimize the risk of significant impacts to water resources from nutrient and pathogen loading.

Sevenmile Creek

Streamflow reductions – Undercut banks are unlikely to be reduced in size, depth, and shape based on average annual flow reduction of less than one percent and index flow reductions of less than four percent, and are unlikely to result in reduction of trout habitat (**Table 2-6**). Modeled stream depth is expected to be reduced by about 0.01 foot and stream wetted channel width is expected to be reduced by 0.01 foot. These minimal reductions may slightly reduce available in-stream habitat but are not expected to significantly impact the in-stream fauna.

Nutrient Concentration

Water samples were collected from Sevenmile Creek on October 10, 2012 at CTH Z and Rangeline Road, and the results are included in **Table 2-9.** These data indicate that the current concentrations of nutrients are quite low in Sevenmile Creek. The implementation and compliance with a WDNR-approved NMP will minimize the risk of additional nutrient loading to Sevenmile Creek from surface runoff events. As described in section 2.3.2 above, the Nitrate Groundwater Model estimates a slight increase in nitrate concentrations in Sevenmile Creek, from its current level of 0.3 mg/L to 1.6 mg/L. The modeled concentration in Sevenmile Creek is below the 2 mg/L threshold described in Wang (2006) at which nitrate concentrations are one of the factors that influence aquatic populations. Moreover, Sevenmile Creek is classified by WDNR as a Class 1 trout stream, and observations conducted for this EIR indicate the creek is a healthy ecosystem. The slight increase in nitrate concentrations in Sevenmile Creek will not cause a significant adverse impact on water quality or to aquatic fauna.

Temperature

Modeled temperature changes during the warmest part of the growing season indicate that at the modeled reduction in flow rates, water temperature changes are expected to be insignificant.

Tenmile Creek

Streamflow reductions

Modeled stream depth is expected to be reduced by less than 0.05 foot and stream wetted channel width is expected to be non-measureable due to Tenmile Creek's larger watershed and groundwater discharge characteristics. Tenmile Creek is a larger stream than all of the other streams in the GSD Project Area and will realize less impact from the groundwater reduction. These minimal reductions may slightly reduce available in-stream habitat but are not expected to significantly impact the in-stream fauna.

Nutrient Concentration

The existing water quality in Tenmile Creek has been impacted by upstream agricultural and residential activities. Average nitrate-nitrogen concentration between November 2009 and May 2012 was 3.8 mg/L. Average total phosphorus concentration in the same period was 0.50 mg/L, which exceeds the total phosphorus standard for small rivers about 13 percent of the time. Water quality data from Tenmile Creek from November 2009 to May 2012 for total nitrogen and total phosphorus are shown in **Figures 2-28** and **2-29**.

The implementation and compliance with a WDNR-approved NMP will minimize the risk of additional nutrient loading to Tenmile Creek from surface runoff events. As described in Section 2.3.2 above, the Nitrate Groundwater Model estimates a slight increase in nitrate concentrations in Tenmile Creek, from its current level of 3.8 mg/L to 4.5 mg/L. Although the modeled concentration in Tenmile Creek is above the 2 mg/L threshold described in Wang (2006) at which nitrate concentrations are one of the factors that influence aquatic populations, the modeled contribution by the GSD Project of 0.2 mg/L is minimal, and will not result in any observable changes in existing water quality or to aquatic fauna. Moreover, Tenmile Creek is classified by WDNR as a Class 2 trout stream in the lower reach and a Class 3 trout stream in the reach between Bell Road and County Road U, and observations conducted for this EIR indicate the creek is a healthy ecosystem. The minimal increase in nitrate concentrations in Tenmile Creek will not cause a significant impact on water quality or to aquatic fauna.

Wisconsin River

The Wisconsin River did not show any modeled reduction in habitat space or temperature as a result of the GSD Project so no adverse habitat impacts are expected due to groundwater pumping associated with the GSD Project. The minimal increase in nitrate concentrations in Sevenmile and Tenmile Creeks will not cause a significant impact on water quality or to aquatic fauna in the Wisconsin River.

Chester Creek

Changes in stream depth and stream wetted channel width is expected to be non-measurable. These minimal reductions may slightly reduce available in-stream habitat but are not expected to significantly impact the in-stream fauna. Groundwater from areas underlying the GSD Agricultural Crop Fields is not expected to discharge at Chester Creek, therefore, water quality impacts are not expected to occur in Chester Creek as a result of the GSD Project.

Tri-Lakes Impoundments

Impacts to Tri-Lakes impoundments include impacts to Spring Branch and Fourteenmile Creek. Spring Branch is intermittent near the GSD Project Area and south into Adams County and thus no adverse water-quantity or water-quality impacts are expected. Groundwater flow from areas underlying the converted GSD Agricultural Crop Fields is not expected to discharge at Fourteenmile Creek or Spring Branch, thus water quality concerns are not expected and adverse impacts to the in-stream fauna are not expected. These waters may currently receive discharge from groundwater beneath the existing 1,800 acres of irrigated crop fields, however any such discharges will be minimized due to the implementation of a WDNR-approved NMP on these acres.

2.5.3.2 Natural and Conservation Areas

As there are no SNAs or Conservation Areas within the proposed GSD Project Area, no potential impacts to SNAs or Conservation Areas are anticipated as a result of the GSD Project.

2.5.3.3 Wildlife Species

The potential exists for the transmission of pathogens to wildlife species. Pathogen transmission from the wildlife to cattle interface can occur through direct and indirect pathways. Some pathogens require an intermediate arthropod (tick) host to transfer to a new species while other pathogens can be directly introduced from wildlife to bovine (cattle) species and from cattle to wildlife species (Miller, 2012). Pathogen transmission can occur when wild animals share food and water sources and during exposure to untreated manure. Wildlife (particularly birds) in direct contact with untreated manure in concentrated areas prior to or during the treatment process could lead to pathogen transmission. Manure generated by the GSD Project will be treated in an anaerobic digester, which will significantly reduce pathogen survival and transmission potential. The addition of an anaerobic digester to the project sufficiently minimizes the occurrence of pathogens so as to render the likelihood of this risk to be insignificant.

2.5.3.4 Rare Animals

GSD has worked very closely with WDNR to ensure that none of the rare animals identified in this EIR are impacted by the GSD Project.

As described throughout this report, GSD is committed to avoiding and minimizing impacts to the KBB. Because GSD engaged in significant and redundant surveying efforts in 2013, it can proceed with project development in areas where surveys documented no KBB with confidence that project development will not result in take. In areas that require additional surveys, GSD will not proceed with development until surveys are conducted and demonstrate, with agreement by WDNR, that no KBB will be impacted by development activities or that appropriate mitigation strategies are implemented. As such, the potential for negative impacts to KBB as a result of the GSD Project is minimal.

In the worst case scenario, given the abundance of KBB in Wisconsin, even if all the documented KBB are impacted or eliminated from the GSD Project Area, it would only result in

a *de minimis* loss of the State-wide KBB population, and have no effect upon any KBB populations within any dedicated recovery area.

If a Safe Harbor Agreement is negotiated and developed by FWS, GSD's contribution to the KBB population in the Central Sands could be significant and beneficial to Federal and State conservation efforts.

2.6 Air quality

2.6.1 Regulatory Framework

The regulatory framework for protecting air quality is characterized as "cooperative federalism" whereby the federal government has enacted legislation (the Clean Air Act (the Act or CAA)) and the federal administrative agency (EPA) has promulgated rules to implement the Act. Each state is also provided an opportunity to develop its own State Implementation Plan (SIP). Upon EPA approval, the state is delegated the authority to implement and enforce those portions of the SIP approved by EPA. A state with delegated CAA authority is considered the primary implementation and enforcement authority; however, if a state fails to comply with or appropriately enforce the CAA or its SIP, EPA has authority to initiate its own enforcement actions against the state and/or a facility regulated by or permitted pursuant to the SIP.

No standards, emission limits or other requirements have been established by EPA or WDNR specifically for dairy farms or irrigated agricultural operations.

2.6.1.1 Federal Regulations

Under the federal CAA, new and existing major stationary sources of federally regulated criteria air pollutant emissions are subject to federal air permit requirements, including the federal "Prevention of Significant Deterioration (PSD)" and "Non-Attainment Area" New Source Review programs, along with the applicable requirements for "Best Available Control Technology", and "Lowest Achievable Emission Rate" technology and offsets, respectively.

Under Section 112(b) of the federal Clean Air Act, hazardous air pollutants (HAPs) are regulated through National Emission Standards for Hazardous Air Pollutants (NESHAPs) established by industry sector. No NESHAPs have been established specifically for CAFOs or irrigated agricultural operations. Ammonia and hydrogen sulfide (H_2S), two air pollutants associated with CAFOs, are not regulated as federal HAPs under section 112(b).

The CAA lists ammonia in section 112(r)(3) and the Emergency Planning and Community Right-to-Know Act (EPCRA) and both statutes have reporting requirements that are triggered when 100 pounds per day of ammonia (18.3 tons per year), are "released" without proper authorization. EPCRA does not require reporting of the release of any substance used in routine agricultural operations. CERCLA excludes from the definition of release the normal application of fertilizer.

The CAA lists hydrogen sulfide in section 112(r)(3), and both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the EPCRA have reporting requirements that are triggered when 100 pounds per day of H_2S (18.3 tons per year),

are "released" without proper authorization. EPCRA does not require reporting of the release of any substance used in routine agricultural operations. CERCLA excludes from the definition of release the normal application of fertilizer.

2.6.1.2 State Regulations

2.6.1.2.1 Air Emissions

The federal air permit requirements described above are incorporated into state air permit rules in Wis. Admin. Code Chs. NR 405, 406, and 407. In addition, Wis. Admin. Code Chs. NR 406 and 407 include air permit requirements for minor sources.

Wis. Admin. Code Ch. NR 445, addresses the control of state hazardous air contaminants. This rule establishes standards for specific contaminants in the ambient air, including ammonia and hydrogen sulfide. The acceptable 24-hour average ambient concentrations for ammonia and hydrogen sulfide, the two primary contaminants associated with agricultural waste, are 418 and 335 micrograms per cubic meter, respectively.

On March 7, 2012 the Wisconsin legislature enacted Wisconsin Act 122 (creating § 285.28, Wis. Stats.), which exempts hazardous air contaminants associated with "agricultural waste" from requirements of Wis. Admin. Code Ch. NR 445. Specifically, the law states that the Department "...may not regulate the emission of hazardous air contaminants associated with agricultural waste except to the extent required by federal law." This permanent exemption also pertains to portions of Wis. Admin. Code Chs. NR 406 and 407 which directly relate to Wis. Admin. Code NR 445.

Similar to federal reporting requirements, state reporting rules include the air spill reporting requirements in Wis. Admin. Code Ch. NR 445 and the annual air emission reporting requirements of Wis. Admin. Code Ch. NR 438. Air emissions from animal feeding operations are not categorically exempt from these reporting requirements.

Wis. Admin. Code § NR 415.04 regulates fugitive dust and requires that precautions be taken when handling materials or using a road to prevent particulate matter from becoming airborne.

2.6.1.2.2 Odors

Malodorous emissions are regulated under NR 429 and odor control practices contained in Wis. Admin. Code Ch. ATCP 51 (Livestock Facility Siting) are included in the design of the proposed project. The Livestock Facility Siting Law consists of a state statute (§93.90, Wis. Stats.) and rule (Wisconsin Administrative Code Ch. ATCP 51) that establish state standards and procedures that local governments must follow if they choose to require conditional use or other permits for siting new and expanded livestock operations. Facilities covered by the Livestock Facility Siting Law must comply with an odor standard that uses a predictive model to determine acceptable odor levels from the farm areas, including manure storage, animal housing and open lots. The Livestock Facility Siting Law does not provide authority to monitor or regulate air emissions.

The predictive model used with ATCP 51:

- Requires additional BMPs if a proposed facility does not have adequate separation distance from neighbors
- Provides a range of practices to choose from to reduce odors (including low cost options to manage odor), and
- Fixes the closest neighbor at the time of the original application.

The GSD Production Area is located in Wood County where the Livestock Facility Siting Law has been adopted. The Livestock Facility Siting permit application submitted by GSD demonstrates that the facility will comply with all odor requirements. The addition of the anaerobic digester at the GSD Production Area will have significant odor-reduction benefits. See Wilkie et al (1995) for a summary of odor control benefits of anaerobic digestion.

2.6.2 Existing Conditions

Wood County is in compliance with federal standards for ozone, PM, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead. The nearest multi-parameter monitoring site applicable to the GSD Production Area is the "Lake DuBay" site located in the township of Bergen in Marathon County, approximately 30 miles north of the proposed GSD Production Area. Ozone is the only compound tested at this location along with the collection of various meteorological data.

The Lake DuBay monitoring site is located in a rural area with land use designated for agriculture. The air shed in this location is substantially similar to that near the proposed GSD; however, because of the distance away from the proposed GSD Production Area, the data are of limited use in evaluating existing air quality conditions near the proposed facility. A summary of ozone concentrations at Lake DuBay is presented in the table below.

	1-Hour Average *(ppm)*	**8-Hour Average** *(ppm)*
Highest Recorded Ozone Concentration	0.082	0.078
NAAQS Ozone Standard	0.12*	0.075

*No longer a NAAQS standard, however some areas have continued obligations under that standard.

2.6.3 Pollutants of Interest and Potential Impacts

All animal agricultural operations generate odors and air pollutants. How animals and wastes are managed determine the potential air quality impacts on human health and the environment.

Odors are produced by a number of different air pollutants associated with animal agriculture. Some of the compounds produced that are odiferous include: organic acids including acetic acid, butyric acids, valeric acids, caproic acids, and propanoic acid; sulfur

containing compounds such as hydrogen sulfide and dimethyl sulfide; and nitrogen-containing compounds including ammonia, methyl amines, methyl pyrazines, skatole and indoles.

Airborne contaminant emissions from CAFOs, and other types of animal agricultural operations include gases and particles. Air quality concerns are focused primarily on ammonia (NH_3), hydrogen sulfide (H_2S), odors, PM, VOCs, and greenhouse gases (GHGs). Storage and handling of grain, as well as diesel combustion from semi-trucks, manure spreaders, and other miscellaneous farm equipment produce PM emissions. Emergency generators, other stationary diesel or biogas engines and other combustion sources also emit pollutants. The combustion of diesel, biogas or other fuels emits and can form pollutants such as oxides of nitrogen (NOx); carbon monoxide (CO); sulfur dioxide (SO_2) and other products of incomplete combustion.

In addition to primary emissions, some air pollutants are formed through chemical processes in the atmosphere known as secondary formation processes. For example, ammonia can react with SO_2 and NOx to form particles with a diameter of 2.5 micrometers or less (PM2.5), and VOC and NOx can react to form ozone.

Emissions from CAFOs come from animal housing, waste storage and the application of nutrients to the land. Air emissions from these types of activities are challenging to accurately estimate which has made it difficult to predict off-site impacts. There is a potential that emissions from the GSD Production Area could cause odors that are unpleasant to some people and contribute to elevated off-site, background concentrations of pollutants that are subject to the ambient air quality standards. These intermittently elevated concentrations could be attributable to a multitude of variables, including the quantity and concentration of emissions from area, stationary and mobile sources in the region. Emissions associated with land application activities may cause the same potential impacts. Manure applications via center pivot equipment, if conducted during times of high wind speed or without implementing appropriate BMPs, may result in the airborne transport of nutrients and pathogens. Offsite drift of pollutants or pathogens from the GSD Production Area or Agricultural Fields could negatively affect nearby neighbors if the BMPs described in Section 2.6.7 are not followed. Human health effects are discussed below.

2.6.3.1 Overview of Air Emission Health Effects

Air emissions, including hydrogen sulfide, ammonia and dust, can have a detrimental effect on respiratory health. Even when using beneficial management systems and mitigation techniques, some airborne contaminants may be generated. Concentrations of airborne contaminants may build up inside livestock buildings resulting in animal and human health concerns. Most concerns are associated with chronic or long-term exposure. However, some human and animal health concerns or safety hazards can result from acute or short-term exposures.

Pollutant	Sources	Health Effects
Particulate Matter, PM of 2.5 and 10 micrometers (PM, $PM_{2.5}$, PM_{10})	Grain & Feed storage and handling; animals; windblown dust	Larger particles of PM are mostly associated with physical soiling and considered a nuisance while PM_{10} and $PM_{2.5}$ are associated with increased respiratory symptoms such as exacerbation of bronchitis and asthma.
Hydrogen Sulfide and other sulfur compounds	Animal manures	Odor at low concentrations. High concentrations cause nervous system depression including temporary respiratory paralysis which may lead to loss of consciousness and death. Intensity of odor is not a good indicator of danger, due to rapid olfactory fatigue.
Ammonia	Animal manures and urine	Ammonia may be associated with increased respiratory symptoms. Ammonia can contribute to $PM_{2.5}$ concentrations and resulting health effects of fine-particle pollution.
Volatile Organic Compounds (VOCs)	Animals, feeds and waste treatment	This is a general class of chemicals, many of which have odors and some of which may have effects on the respiratory system. No single chemical has been strongly associated with symptoms as a result of actual off-property exposures. Compounds include volatile fatty acids (butyric and caproic acid), that have a distinct and offensive odor. In addition to health effects of individual compounds, VOCs participate in atmospheric reactions to create ozone, which is a respiratory irritant.

Pollutant	Sources	Health Effects
Greenhouse Gases (GHGs)	Animal manures	The major GHGs emissions associated with dairy farming are methane and nitrous oxide. The main impact from GHG emissions is on the environment as increases in these compounds may contribute to change global temperatures.

2.6.3.1.1 Ammonia

Ammonia is an atmospheric pollutant of concern that reacts with acids and precursor pollutants in the atmosphere to form particulate ammonium sulfates (NH_4HSO_4 and $(NH_4)_2SO_4$), and ammonium nitrate (NH_4NO_3). These are contributors to ambient fine particulates ($PM_{2.5}$), regional haze, and soil and water acidification.

Ammonia is primarily generated from animal waste and is released from buildings, infrastructure or other areas where animal waste is transported, processed, stored or land-applied. Most ammonia is produced when the urea contained in urine comes in contact with the urease enzyme contained in feces (or e.g., on barn floors and in soil). Smaller amounts of ammonia are produced during the decomposition of feces. Nitrogen occurs as unabsorbed nutrients in animal feces and in urea in urine from cows. The potential for ammonia emissions exists wherever manure is present and will be emitted from confinement buildings, open lots, stockpiles, manure handling and storage facilities, and land application with both wet and dry manure handling systems.

The volatilization of ammonia from manure management operation is highly variable depending on total ammonia concentration, temperature, pH, and storage time. Ammonia is highly soluble in water, but can also readily volatilize from water solution to enter the air. However, when the pH of an ammonia solution is acidic, ammonia exists in the form of ammonium ions (NH_4^+), which are much less volatile than ammonia (NH_3). High pH and high temperature favor higher concentrations of ammonia and, thus, greater ammonia emissions. The pH of manures handled as solids can be in the range of 7.5 to 8.5, which results in fairly rapid ammonia volatilization.

Ammonia emissions from CAFOs are not constant throughout the year as emissions vary seasonally and daily. The degree of seasonal variation depends on the geographic region, animal sector, and type of animal production practices used. For example, high temperature increases ammonia volatilization. Precipitation and humidity can increase or decrease emissions depending on how manure is managed. High wind speeds can increase emissions from open manure storage facilities and land application. The population of animals on a farm also may vary throughout the year, thereby changing ammonia emissions from housing and manure storage facilities.

Ammonia is a State HAP under Wis. Admin. Code Ch. NR 445. Wisconsin has an ambient air quality standard for ammonia of 418 $\mu g/m^3$ averaged over a 24-hour period. Agricultural wastes are exempt from the requirements of Wis. Admin. Code Ch. NR 445. Wis. Admin. Code Ch. NR 438 contains reporting requirements when ammonia emissions exceed 2,097 lb/yr. The CAA lists ammonia in section 112(r)(3). The EPCRA includes reporting requirements that are triggered when 100 pounds per day of ammonia are "released" without authorization. EPCRA does not require reporting of the release of any substance used in routine agricultural operations.

Ammonia is listed as a hazardous air contaminant in Wis. Admin. Code Ch. NR 445 because it can cause adverse health effects at elevated concentrations. Ammonia's toxicity is based upon its caustic properties. At low concentrations, ammonia is irritating to wet tissues of the lungs, airways, and eyes. At sufficiently high concentrations, ammonia begins to dissolve those tissues, causing more severe damage.

Ammonia Toxicity Progression

Property	Concentration in Air (ppm)
Detectable Odor	0.04-53
Eye, Nose Irritation	50-100
Strong Cough	50-100
Airway Dysfunction	150
Lethal in 30 Minutes	2,500-4,500
Lethal Immediately	5,000-10,000

2.6.3.1.2 Hydrogen Sulfide

Hydrogen sulfide is a product of the anaerobic decomposition of sulfur-containing organic matter (primarily manure). It is a colorless gas that is heavier than air, highly soluble in water, with odor and health implications. Liquid manure storage pits are the primary sources of hydrogen sulfide in animal production. Significant quantities of hydrogen sulfide can be released during agitation of stored liquid manure.

There are limited studies in Wisconsin on the levels of hydrogen sulfide considered unhealthy beyond the property boundary of animal agricultural operations. These studies have not documented any health hazard associated with hydrogen sulfide concentrations from dairy CAFO operations in Wisconsin. Hydrogen sulfide is a state hazardous air contaminant under Wis. Admin. Code Ch. NR 445. Wisconsin's ambient air quality standard for H_2S is 335 $\mu g/m^3$ averaged over a 24-hour period. Agricultural wastes are exempt from the requirements of Wis. Admin. Code Ch. NR 445.

Of the several ways in which hydrogen sulfide can affect human health, the most dangerous is when H_2S is concentrated enough to cause respiratory paralysis through the nervous system, leading to collapse and loss of consciousness. Concentrated H_2S can occur in confined air environments such as a sewer or enclosed manure pit. Manure gas safety is outlined in an interagency report (Wisconsin Department of Agriculture, Trade & Consumer Protection [DATCP], Natural Resources Conservation Service [NRCS], and Department of Health and Family Services [DHFS]) dated November 2008, "Manure Gas Safety; Review of Practices and Recommendations for Wisconsin Livestock Farms".

Hydrogen Sulfide Toxicity Progression

Property	Concentration in Air (ppm)
Offensive odor, headache (chronic exposure)	0.3
Very Offensive (chronic)	3-5
Asthmatics affected (acute)	2
Olfactory paralysis (acute)	150
Central Nervous System Depression/Loss of Consciousness	>500
Lung Paralysis, Collapse, Death	600-1,000

2.6.3.1.3 Particulate Matter and Fugitive Dust Emissions

Wisconsin defines particles, particulates or PM as any airborne finely divided solid or liquid material with an aerodynamic diameter smaller than 100 µm (micrometers). In general, particles are identified according to their aerodynamic diameter with PM_{10} being particles with an aerodynamic diameter smaller than 10 µm.

Particles classified as $PM_{2.5}$ (particles with an aerodynamic diameter smaller than 2.5 µm) are primarily formed by reactions in the atmosphere, or may be emitted directly to the atmosphere during combustion.

Known precursor pollutants for $PM_{2.5}$ include ammonia, SO_2, NOx and organic carbon. The nature and sources of organic carbon vary widely and include combustion as well as secondary formation. Together, ammonium nitrate and ammonium sulfate represent about 60% of the total mass of $PM_{2.5}$.

On average, organic carbon represents about 30% of the mass of $PM_{2.5}$. Black carbon and crustal material together are about 10% of the mass of $PM_{2.5}$.

Bioaerosols are a component of the PM from CAFOs. Bioaerosols are particles of biological origin that are suspended in air and include bacteria, fungi, fungal and bacterial spores, viruses, mammalian cell debris, microorganisms, pollens, and aeroallergens.

2.6.3.1.4 Greenhouse Gases

Agriculture, in general, and livestock operations in particular, are sources of GHG emissions. The primary GHGs associated with animal agriculture include methane (CH_4) and nitrous oxide (N_2O). The July 2008 report of the Wisconsin Governor's Task Force on Global Warming includes several recommended policies for the animal agriculture sector to reduce GHG emissions. Among the recommendations to reduce emissions are: nutrient and manure management changes (i.e., to reduce nitrous oxides and methane); and the production, capture and combustion of animal methane through a digester. While enteric (intestine related) emissions are typically the majority of GHGs emitted by livestock, GHGs associated with manure management can be significant.

U.S. EPA has finalized a rule (40 CFR part 98, subpart JJ) which contains reporting requirements for GHGs (for animal agricultural sources emitting over 25,000 metric tons annually of carbon dioxide equivalents from manure management activities). However, since the rule was finalized, Congress has annually prohibited the expenditure of funds to implement subpart JJ, rendering ineffective EPA's GHG reporting requirements for animal agriculture. In addition, Wis. Admin. Code§ NR 405.07 (9) incorporates federal rules and includes a GHG PSD major source permitting threshold of 100,000 tons/year of carbon dioxide equivalent (or 75,000 tons/year carbon dioxide equivalent if a new major stationary source for any other regulated NSR contaminant).

2.6.3.1.5 Volatile Organic Compounds & Other Hazardous Air Contaminants

VOCs at CAFOs are associated with fermented feeds, enteric fermentation, and with fresh and stored manure. VOCs are defined in s. NR 400.02(162), Wis. Adm. Code as "any organic compound which participate in atmospheric photochemical reactions" excluding a number of compounds determined to have negligible photochemical reactivity, such as methane. VOCs are a criteria pollutant, and have permitting thresholds and general control requirements in Wis. Admin. Code Chs. NR 405, 406, 407, 408, 419 and 424.

On a mass basis, ethanol, methanol, acetic acid, acetaldehyde, and acetone are the major VOC compounds generated during daily animal agricultural operations (from silage and manure sources). Both methanol and acetaldehyde are federal HAPs under Sec. 112 (b). To our knowledge, no state has made a regulatory decision at animal agricultural operations based on methanol or acetaldehyde emissions, nor has the U.S. EPA published or cited information to suggest these pollutants could individually exceed 10 tons/year or together exceed 25 tons/year (the trigger for developing a maximum achievable control technology under s. 112(d), or determining a case-by-case maximum achievable control technology under s. 112(g)(2) of the Clean Air Act).

2.6.3.1.6 Odors

Odor is an issue for farmers, neighbors and local government in terms of health risks, both perceived and real, and the underpinning of nuisance law suits. Air emissions and odors are discussed as being the same issue. However, it is important to note that not all air emissions have odors, just as not all odor-causing agents are regulated air pollutants. Differentiating between air pollutant emissions and odors is important, both in terms of mitigation practices and the effectiveness of those practices. Odors from CAFOs are primarily generated from the

breakdown of feed in the gut of animals and in the excreted manure. Feed, particularly silage under certain conditions, can also be a significant odor source. While there are numerous odorous compounds associated with manure, odors can also result from a combination of dozens, if not hundreds, of airborne compounds. These combinations of compounds can act synergistically to produce an odor that is actually more intense than would be expected from the sum of the individual compounds present.

A combination of gases or particulates in sufficient concentration and chemical composition may be perceived as an irritant odor downwind of a CAFO. The generation rate of these gases, organisms and particulates varies depending on time of year and day, species, type of housing, manure handling system, feed type and management system. Odor emissions can vary widely throughout the day. Once these odors are generated they can be emitted through the barn by natural ventilation. After these materials become airborne they can be transported downwind. Travel distances can vary greatly depending on the size of particles, weather conditions and the surrounding topography and vegetation.

Most of the odorous compounds that are emitted from animal production operations are byproducts of anaerobic decomposition/transformation of livestock wastes by microorganisms. Animal wastes include manure (feces and urine), spilled feed and water, bedding materials (i.e., straw, sunflower hulls, wood shavings), wash water, and other wastes. The technical standards developed by Natural Resource Conservation Service and incorporated into rules by DATCP and WDNR define manure as containing all these things (feces, urine, bedding, process wastewater, etc.). This organic rich mixture includes carbohydrates, fats, proteins, and other nutrients that are readily degradable by microorganisms under a wide variety of suitable environments. The by-products of microbial transformations depend, in major part, on whether it is done aerobically (i.e., with oxygen) or anaerobically (i.e., without oxygen). Microbial transformations done under aerobic conditions generally produce fewer odorous by-products than those done under anaerobic conditions. Moisture content and temperature affect the rate of microbial decomposition.

A large number of volatile compounds have been identified as by-products of animal waste decomposition. The compounds are often listed in groups based on their chemical structure. Some of the principal odorous compounds and compound groups are: ammonia, amines, hydrogen sulfide, volatile fatty acids, indoles, skatoles, phenols, mercaptans, alcohols, and carbonyls. Carbon dioxide and methane are odorless. Wisconsin Administrative Code §NR 429.03 conditionally prohibits the emission into ambient air of substances in such quantities that an objectionable odor is determined to result unless preventative measures satisfactory to WDNR are taken to abate or control such emissions. This rule establishes general limitations on objectionable odor, defines the tests for what constitutes objectionable odor, and sets abatement or control requirements. Wis. Admin. Code Ch. NR 429 includes a procedure for determining objectionable odors based on conditions at the facility once it has been constructed and is operating.

2.6.3.1.7 Pathogens

Dairy waste contains many different microorganisms including bacteria, viruses, and protozoa. Some of these microorganisms are pathogenic, that is capable of causing disease in animals and/or humans. The amount and variety of pathogens present in dairy waste is dependent

on the health status of the animals and characteristics of the manure and manure storage facilities (Spiehs and Goyal, 2007). While most environmental effects of manure containing pathogens involve surface water contamination, there is potential for these pathogens to become airborne during the process of land application of manure via center pivot. Incorporation of an anaerobic digester into GSD's manure management process will eliminate 95-98% or more of pathogens found in manure (Saunders and Harrison, 2012).

2.6.4 Quantifying Air Pollutants

After contaminants are generated, they are emitted through animal housing or emitted from other sources including animal holding and production areas, feed preparation and storage, manure management/storage facilities, mortality management, and land application sites. From these sources, air pollutants are dispersed by atmospheric processes. The travel distance of airborne contaminants varies due to size of particles, air contaminant reactivity, weather conditions, surrounding topography, and vegetation. These variations make it challenging to form a clear picture of the expected emissions and emission-related effects from animal agricultural operations. This is especially true for air pollutant concentrations (indoor or outdoor ambient air quality measurements) as opposed to an average annualized emissions flux. Both the quantity and the types of air contaminant emissions from animal agricultural operations are challenging to estimate, making off-site air quality impacts difficult to predict. This is due to hourly, daily, and seasonal temperature variation; the varying number and type of animals present (which may change over time); the type of housing and manure handling system; the feed type; and the chosen management practices.

As part of this EIR, the applicant conducted an extensive review of existing air emission research to determine appropriate emission factors for estimating the emissions from the GSD Project. Emission estimates were calculated for the digester engine, the emergency generator, and the corn silage pad based on readily available U.S.EPA AP-42 Air Pollutant Emission Factors. These are well documented emission factors and are considered reliable and appropriate. Emission estimates for the remaining elements of the GSD Project are discussed below. The following is a summary of the air emission research conducted and the most applicable sources of emission factors for estimating the process emissions (housing and lagoon storage) of contaminants originating from the GSD Project.

2.6.4.1 National Air Emissions Monitoring Study – Production Area

There is a general lack of good quality emission factors available for the estimation of emissions from agricultural operations. Many estimated emission factors produced are based on very small data sets and farm sizes that are not representative of CAFOs. Indeed, many scientists have agreed that there are many factors that can influence the emissions. For these reasons, air emissions from CAFOs have not been regulated by emission thresholds or ground level concentrations.

In the late 1990s, the EPA realized that it did not have sufficient air emissions data to implement federal Clean Air Act requirements for animal feeding operations. An Animal Feeding Operations Air Quality Compliance Agreement was developed in December 2001 by the

EPA to encourage CAFOs to facilitate collection of CAFO emissions data and to promote a national consensus on methodologies for estimating CAFO emissions. On January 31, 2005 EPA issued a Federal Register notice offering individual animal feeding operations an opportunity to voluntarily sign a consent agreement committing them to participate in a nationwide air emission monitoring study and establishing a timeline for them to achieve compliance with federal air permit, air emission control, and air emission reporting requirements. In return, EPA provided limited amnesty from enforcement action during the term of the agreement.

Data collection was completed in mid-2009 with final data reported to the EPA during the summer of 2010. On January 13, 2011, the EPA made National Air Emissions Monitoring Study (NAEMS) data available to the public. The EPA is presently evaluating these and other data and intends to publish air emissions estimating methods for animal feeding operations in the future. The two draft Federal emissions estimating methodologies for animal agricultural operations -- one for "broiler operations" and the other for "lagoon emissions" from dairy (and swine) operations, based on NAEMS-derived data have been published (USEPA 2012b, 2012c).

NAEMS carried out four separate dairy facility case studies across the country with a variety of manure management and ventilation conditions. An anticipated advantage of using the four studies to estimate emissions was the wide geographical distribution of the sampling locations. Averaging the emission factors developed over the four dairy case studies produces results that are representative of a broad range of dairy facilities. The downfall of this approach is that a broad range of facilities may be regulated using emission factors developed from small data sets developed on farms with different operational and management protocols and of different sizes.

The NAEMS main focus has been on the emissions of ammonia, hydrogen sulfide, PM, and VOCs from animal housing as well as ammonia, and hydrogen sulfide from waste storage facilities (lagoons). This covers the major sources of pollutant generation for most of these contaminants.

However, due to the complex nature of dairy facilities, many processes contain sources that emit various types of VOCs. For instance, waste storage facilities have also been found to emit VOCs; yet the NAEMS only monitored ammonia and hydrogen sulfide from waste storage facilities. Therefore the results of this study are not considered a reliable approach for determining VOC emissions from waste storage facilities.

2.6.4.2 San Joaquin Valley – Production Area

A study was performed by the San Joaquin Valley Unified Air Pollution Control District to determine appropriate emission factors for VOCs emitted from diary facilities (Crow, 2005[31]). This study has become the benchmark for VOC emissions factors from dairy facilities. In 2012, the San Joaquin Valley Unified Air Pollution Control District published a revised version of the

[31] Crow, David L. (2005). *Air Pollution Control Officer's Determination of VOC Emission Factors for Dairies*. San Joaquin Valley Unified Air Pollution Control District.

previous study (Sheraz & Ramon, 2012[32]) that reevaluates the previously available dairy VOC emission factors. The results of the 2012 study are considered to provide the most representative data with the addition of improved emission research techniques. As well, the study followed strict principles in evaluating research studies to ensure the selection of appropriate data for emission factor estimation.

Historically, there has been little data available that could be used to quantify VOC emissions from dairy facilities. Due to this lack of available information regarding VOC emissions, the San Joaquin data emerges as one of the most thoroughly analyzed reports in VOC emission factor development.

The San Joaquin emission factors are developed from a wide variety of emission sources at a dairy production facility. Emission factors were determined for each of the specific processes or constituents based on a combination of various studies from reputable sources. The San Joaquin study is currently being used by the state of California as a basis for air emissions permitting. The San Joaquin emission factors provide nine potential process emission sources of VOC generation at dairy facilities – many more than previous studies provided.

The San Joaquin emission factors have been thoroughly analyzed and determined to present a more representative profile for VOC emissions anticipated from the GSD Production Area than the NAEMS emission factors. For these reasons, the emissions of VOCs emitted from the GSD Production Area were estimated using the San Joaquin emission factors as provided in **Table 2-10**.

2.6.4.3 Land Application Emission Estimation

All liquid manure will be applied by traditional method of incorporation into soil, direct injection or potentially in the future by center pivot irrigation. All land application activities are regulated pursuant to the WDNR-approved NMP. Typically the greatest concern with respect to air emissions from the land spreading of animal manure on cropland is the volatilization of ammonia.

Solid manure will be stored on the solids pad after the anaerobic digestion process and then land applied when deemed appropriate based on the NMP. The amount of solid and liquid manure that would be generated per year, type of land application, as well as the total nitrogen content of that manure are driving factors in the release of ammonia to the atmosphere through land spreading. All of this information will be included in the NMP and in annual NMP updates that will be submitted to WDNR pursuant to Wis. Admin. Code Ch. NR 243 and the WPDES permit.

Ammonia losses from dairy manure, with respect to the application to land are a common concern due to the high concentration of ammonia and ammonium in dairy manure. The method of application has an effect on the amount of time that it takes for the total volatilization of

[32] Sheraz, Gill; and Ramon, Norman. (2012). *Air Pollution Control Officer's Revision of the Dairy VOC Emission factors.* San Joaquin Valley Unified Air Pollution Control District.

ammonia to occur. Along with the application method and ammonia concentrations, factors such as solids content and wind speed can affect ammonia loss.

The current methods available for estimating the volatilization of ammonia from land application activities were reviewed and an ammonia emission model was identified. This model calculates ammonia volatilization from multiple methods of application, with varying manure types. This model was used to estimate the losses from both the liquid and solid applications of manure from the GSD Project. Using the same model for both application methods maintains consistency when comparing and summing the emission results.

The equation for ammonia loss following the application of animal manure was developed at Clemson University in South Carolina (Chastain, 2005). The equation below describes the total ammonia lost following application expressed as a percentage of total ammoniacal nitrogen content (sum of ammonia and ammonium, TAN applied:

$$AL(t) = f_S f_A AL_{max}(1 - e^{-Kt})$$

where:
AL(t) = ammonia lost following application expressed as a percentage of TAN applied
f_S = soil factor based on the total solids content of the manure
f_A = application method factor that depends on the style of manure application
AL_{max} = the maximum ammonia loss possible expressed as a percentage of TAN applied, and
K = rate constant that is a function of manure type and wind speed (h-1)

Using the total amount of ammonia lost (volatilized) from the manure as a percentage of TAN applied, the total amount of ammonia lost can be solved for by using the percentage of TAN in total nitrogen of the type of manure (i.e. lagoon supernatant, or solid dairy manure). This information, with the known total nitrogen to be produced from the facility in a given year, will produce a total amount of ammonia lost to the atmosphere in that year. The most conservative parameters (i.e. highest solids content) were used in the model for lagoon water given by Chastain, 2005. The amount of liquid manure that would be generated per year as well as the total nitrogen content that would be produced is summarized in **Table 2-11**.

The volatilization model for ammonia during land application developed at Clemson University accounts for variation in field application types as well as manure (solid/liquid) being applied. Considering that GSD will be land spreading both liquid and solid manure with different application methods, the Clemson University model is the most appropriate technique for estimating ammonia emissions.

2.6.4.3.1 Traditional Manure Application – Land Application

Utilizing the injection and incorporation of manure application methods decreases the time in which volatilization can occur. All parameters input into the Chastain equation for liquid manure injection are summarized in **Table 2-12**.

Based on the method and assumptions described above, injection and incorporation of manure generated by GSD in a single year yields an ammonia volatilization emission of 14.16 tons/year. GSD may apply by “top dressing” method approximately 4,000 gallons of liquid

manure per acre on approximately 1631 acres of alfalfa crops, four times per year; and approximately 559 acres may be top dressed once per year. If these applications occur, they would add approximately 5.36 tons/year and 0.46 tons/year, respectively, of additional volatized ammonia emissions, increasing the total potential ammonia emissions from traditional manure application to 19.98 tons/year.

Anaerobic digestion will significantly reduce the amount of pathogens being released into the environment. GSD is intending to implement a mesophillic (~100°F) anaerobic digester which can reduce the pathogen content in manure by 95-98% (Saunders and Harrison, 2012). It is anticipated that the pathogen reduction associated with the digester will eliminate the occurrence of negative impacts caused by the introduction of airborne pathogens.

2.6.4.3.2 Center Pivot Manure Irrigation – Land Application

GSD has planned to apply manure via center pivots; however, such applications will not be made upon startup of the dairy farm. Indeed, the use of center pivot irrigation equipment for the land application of manure has been met with a fair amount of controversy and when this method of application will be approved for the GSD is unclear. When manure application via center pivot occurs, GSD will follow BMPs and regulatory restrictions that exist at that time and pursue an evaluation and approval of the irrigation and transfer equipment pursuant to NR 243.16, Wis. Admin. Code.

The application of manure by center pivot allows the application of nutrients to be timed such that crops receive nutrients when they are needed most during the growing season. This method of nutrient applications during the growing season minimizes the potential for nutrient leaching to groundwater. The public and WDNR have raised concerns that this application method creates a greater risk of airborne pathogen transport than traditional manure application methods.

The center pivot equipment GSD would likely use will apply manure through drop tubes, approximately 8 feet off the ground, using a nelson rotator and trash buster nozzle at around 45 pounds per square inch of pressure. All parameters input into the Chastain equation for liquid manure irrigation are summarized in **Table 2-13**.

Based on the method and assumptions described above, center pivot irrigation of the total manure generated by GSD in a single year would increase the potential amount of ammonia volatilization from 14.16 tons/year with traditional application methods (or 19.98 tons/year with top dressing) to 25.44 tons/year. This increase would occur due to the increased opportunity for aerosol volatilization during the spraying process. This increase in ammonia emission due to land application technique represents only an 8.8 % increase of the total ammonia emissions from the GSD Agricultural Crop Fields, does not trigger any regulatory threshold limits and is not considered significant.

Although the release from the center pivot irrigation system will cause some droplets to become entrained in the air (depending on temperature and wind speed), the use of the anaerobic digester is a proven way of significantly reducing the pathogenic content of liquid manure. As described above, treatment through anaerobic digestion will significantly reduce the amount of pathogens potentially released into the environment. GSD intends to implement a mesophillic (~100°F) anaerobic digester which can reduce the pathogen content in manure by 95-98%

(Saunders and Harrison, 2012). During land application pathogens that may have survived the digestion process also have the potential to be further reduced as bacteria are highly susceptible to UV light and drying that naturally occurs following surface application of manure to cropland (Spiehs and Goyal, 2007). It is anticipated that the pathogen reduction associated with the digester and UV exposure will eliminate the occurrence of negative impacts caused by the introduction of airborne pathogens.

2.6.4.4 Housing and Lagoon Emission Factor Selection

The housing and lagoon emissions for ammonia, hydrogen sulfide, and PM_{10} (housing only) were estimated from emission factors provided by the NAEMS study. For these contaminants and the potential sources of their emission the NAEMS study provides the most appropriate emission factors that are currently available.

The NAEMS study did not provide estimates for VOC emissions from the lagoons for dairy facilities, but only provided those emissions for housing emissions. Emission factors for the lagoon were taken from the San Joaquin Valley study, described in Section 2.6.4.2.

2.6.5 Production Area Dispersion Modeling

The emission rates of contaminants obtained from the emission factor review were evaluated using air dispersion modeling software to compare the estimated maximum ground level concentrations (GLCs) against applicable regulatory criteria. This dispersion modeling was completed on a voluntary basis by GSD as part of the EIR.

Air dispersion modeling for ammonia, hydrogen sulfide, particulate matter (PM_{10}), and nitrogen oxides emitted from the GSD Production Area was performed using the EPA multi-source dispersion model AERMOD. AERMOD is an advanced steady-state plume model that has the ability to incorporate building cavity downwash, actual source parameters, emission rates, terrain, and historical meteorological information to predict GLCs at specified locations.

The air dispersion modeling was completed to include the following potential sources of emissions:

- Dairy housing
- Manure storage lagoon[33]
- Silage pad
- Digester engine
- Emergency generator[34]

[33] The manure storage lagoon and silage pad are considered fugitive emission sources. WDNR does not require the modeling of fugitive emissions from any source. All dispersion modeling completed for this EIR was done voluntarily by GSD.

[34] On March 6, 2012, WDNR issued a memo announcing a policy of not modeling intermittent sources of air pollutants, including emergency generators that operate fewer than 200 hours per year. All dispersion modeling completed for this EIR was done voluntarily by GSD.

The emissions from the dairy housing (comprised of two freestall barns, parlor, special needs barn, and dry cow barn) were divided equally throughout the buildings to estimate an area flux rate (g/s/m^2) due to the constant fluctuations in the animal configuration within the barns.

A summary of the AERMOD input parameters for all sources is provided in **Table 2-14**. Stack parameters for the digester engine and emergency generator were estimated based on CRA's experience. The locations of the modeled sources are shown on **Figure 2-36**. The GSD Production Area property boundary used for the modeling assessment is provided in **Figure 2-37**.

2.6.5.1 Model Executables

The following EPA computer models were used in the assessment:

- AERMOD meteorological pre-processor (AERMET), version 11059;
- AERMOD digital terrain pre-processor (AERMAP), version 11103;
- AERMOD air dispersion model (AERMOD), version 12345;
- Building Profile Input Program (BPIP), version 04274.

2.6.5.2 Meteorological and Land Use Data

Meteorological data for the site was retrieved from www.webmet.com for the years 1986 to 1990. Surface data was taken from Madison Dane County Airport in SAMSON format. Upper-air data was taken from the Green Bay Austin Straubel International Airport in TD6201 format.

The AERMET pre-processor was used to process the meteorological data for use in AERMOD. Meteorological data was processed on a monthly basis for 12 wind sectors. Land use surface parameters (albedo, surface roughness, Bowen ratio) were calculated using the AERSURFACE pre-processor using USGS NLCD92 land cover data.

2.6.5.3 Receptors

The receptors in the model for the GSD Production Area are based on the property line and adjacent contiguous land spreading locations. No receptors were placed inside the GSD Production Area. A 300 meter property boundary grid with 25 meter spacing was used to evaluate the maximum property boundary concentration.

2.6.5.4 Coordinate System

The UTM NAD83 coordinate system was used to specify source locations, model object sources, and buildings.

All source coordinates are provided in **Table 2-14**.

2.6.5.5 Area Source Facility Emission Configuration

The housing area of the GSD Production Area is modeled as an area source due to the naturally occurring ventilation. Area source modeling is based on the assumption that the barn roofs will not be tightly sealed and that emissions occur at the top of the barn. The barns were combined to act as a single area source since they are connected and the animals will be reconfigured within the barns based on their specific needs and maturity.

The lagoon is also modeled as an area source based on the assumption that the lagoon will have a flat surface open to the atmosphere. Only ammonia and hydrogen sulfide emissions are of concern for the lagoon storage as the manure is in liquid form and fairly stagnant which will reduce the opportunity for particulate emissions.

The corn silage will be stored on a large pad. During delivery there is potential for particulate emissions. The silage pad is modeled as an area source, assuming uniform distribution of the feed as it is being dropped off by trucks.

2.6.5.6 Point Source Facility Emission Configuration

Both generators (digester and emergency) are considered point sources for the dispersion modeling. The pollutants concerned with the generators are products of combustion (NO_X and PM). The engine and emergency generator locations used in the model are shown on **Figure 2-36**.

2.6.5.7 Dispersion Modeling Results

As previously identified the State of Wisconsin does not currently have applicable regulatory criteria for ammonia or hydrogen sulfide for agricultural waste emissions. In an effort to quantify and compare potential ammonia and hydrogen sulfide emissions to recognized criteria, WDNR Ambient Air Criteria (AAC) were selected. These criteria were selected to assess to the potential short-term and long-term exposure impact to human health from GSD's emissions.

The other pollutants of interest are compared to the US EPA's National Ambient Air Quality Standards (NAAQS).

Compound	**Calculated Maximum Ground Level Concentration**		**Regulatory Criteria**		**Percent of Criteria**	
	24-hour	Annual	24-hour	Annual	24-hour	Annual
	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(%)	(%)
Ammonia	218.65	34.34	418	100	52.13	34.34
Hydrogen Sulfide	12.6	-	335	-	3.76	-
PM_{10}	25.45	-	150	-	16.97	-
$PM_{2.5}$	2.87	0.40	35	12	8.21	3.33
Nitrogen (2) Oxides	95.10 (1)	3.38	188 (1)	100	50.54	3.39

Note:

(1) Nitrogen oxides are based on a 1-hour averaging period.

(2) Regulatory criteria based on the nitrogen dioxide as nitrogen oxide criterion is not available.

Based on the modeling results, the pollutants of interest that will be emitted from the proposed GSD Production Area are well below the WDNR AAC and NAAQS criteria for all averaging periods. Therefore, based on the above emission estimates, dispersion modeling, and a review of the applicable criteria, adverse health impacts due to ammonia, hydrogen sulfide, PM_{10}, $PM_{2.5}$ and nitrogen oxides emissions from the GSD Production Area are not expected to occur.

2.6.6 Land Application Dispersion Modeling

The ammonia loss from land application of manure was modeled separately from the emissions of the GSD Production Area. The model was performed separately as the land application process is a mobile single source that will operate occasionally throughout the year, whereas the GSD Production Area will be operating 24 hours a day, 7 days a week.

Air dispersion modeling for the concentration of ammonia emitted from the land application was performed using the EPA SCREEN3 (SCREEN3) model. The SCREEN3 model utilizes area sources and only one source may be modeled at a time. During any 1-hour period, it is possible that worst-case atmospheric dispersion conditions could occur for the entire period. The SCREEN3 model was therefore used to determine the worst-case atmospheric conditions that would produce the maximum ground level concentrations. The receptor heights were set at 0 m, with flat terrain along with the full meteorology option. The model was run using a dispersion coefficient for a 'rural' landscape for distances between 10 and 1,000 meters to determine the potential maximum ground level concentration.

The land spreading was modeled in SCREEN3 as an emission generated from an area source assuming that the manure was applied evenly across the field. The dimensions of the field were estimated based on averaging the areas of the parcels of land shown in **Figure 2-38**.

SCREEN3 modeling was performed using the emission rate of the total annual emission of ammonia from land spreading divided over an estimated 100 days of land spreading events. The emission rate of ammonia from the center pivot irrigation was used in the modeling to provide a worst-case scenario for the land application process.

The maximum ground level ammonia concentration for the 24-hour and annual averaging period was modeled to be 267 $\mu g/m^3$ and 54 $\mu g/m^3$, respectively. The modeled 24-hour ammonia concentration produced by land spreading represents 64% of the WDNR AAC of 418 $\mu g/m^3$. The annual ammonia ground level concentration represents 54% of the WDNR AAC of 100 $\mu g/m^3$.

The ground level concentrations for the worst-case 24-hour and annual averaging periods are well below the AAC set by the WDNR, and there are not expected to be any environmental or human health impacts associated with traditional manure applications. The air dispersion modeling results are summarized in **Table 2-15**.

2.6.7 Significance of Impacts from Air Emissions

Based on the significant BMPs that are proposed for implementation at the GSD Production Area and during nutrient applications, air emissions from the GSD Project are not considered significant.

There are ways to minimize, but not eliminate, air pollutant emissions from animal agricultural operations, including dairy operations. Various BMPs such as production methods, technologies and waste management practices are used to prevent or control air emissions from livestock facilities. See Beneficial Management Preactices for Mitigating Hazardous Air Emissions from Animal Waste in Wisconsin, (WDNR, 2010).

The WDNR in coordination with an advisory group which included animal agriculture producers, academia, NRCS and DATCP, published a report in December 2010 (WDNR, 2010) which included a list of BMPs that reduce ammonia and hydrogen sulfide air emissions.

The BMP report includes the following general concepts:

- Not every BMP will be appropriate for every animal agricultural operation, nor will every BMP be technically or economically feasible for a given farm. Animal agricultural operations generally choose a number of individual, or a combination of, practices based on farm-specific features and other factors.
- In some cases, a specific BMP focusing on one air pollutant may actually contribute to an increase in other air emissions or to environmental problems in other media (e.g. groundwater or surface water).
- In general, practices which reduce odor tend to reduce ammonia and/or hydrogen sulfide, but not always.
- Different production methods, animal types, and manure management systems have the potential to create different types and quantities of air emissions. In order to successfully mitigate emissions, different, or a combination of practices and technologies may be required.
- Many of the BMPs that prevent or mitigate air emissions often make common sense. For example, mixed operations that integrate optimal cropping systems with animal production typically retain nitrogen for crops (minimizing ammonia losses), resulting in decreased need for fertilizer nitrogen.
- Successful reduction of ammonia and hydrogen sulfide losses from animal agriculture requires an integrative, whole-farm emissions approach for effective evaluation and selection of practices or technologies.
- While certain practices or technologies may be quite effective for controlling emissions from one part of a farm, it is important to understand the fate of those controlled emissions elsewhere. For example, while an impermeable cover is one of the most effective ways of controlling emissions from manure storage facilities, liquid manure still has potential to release contaminants during subsequent land application activity.

There are practices and technologies which prevent or reduce the formation of ammonia or hydrogen sulfide. For example, one benefit of not over-feeding nitrogen to animals through dietary and nutrition practices is a reduction in nitrogen excretion (and, hence, ammonia) which will be realized throughout all farm components (e.g., animal housing, manure management

systems including manure storage, and land application). For daily operations, an excellent measure of feed protein efficiency is MUN (milk urea nitrogen). MUN can also be used to measure the extent of ammonia emissions that escape into the environment from daily production facilities. Reductions in MUN show a proportional reduction in ammonia emissions.

Technologies which capture and treat air (e.g., biofilters) can also significantly reduce air emissions (for ammonia, hydrogen sulfide, VOCs) from any mechanically ventilated space. Production methods and practices which keep manure in an aerobic state will greatly reduce the emissions of hydrogen sulfide.

Proposed odor reduction measures to be implemented by GSD include frequent cleaning of the housing facilities, conserving water, covering feed piles, injection or incorporation during land application, paving driveway surfaces, and manure solid/liquid separation.

2.6.7.1 Feed Management BMPs

Feed mixing will be done within the commodity shed to minimize windblown dust.

2.6.7.2 Manure Processing BMPs

While manure solids separation is not automatically considered an air quality BMP, manure solids separation at the GSD Production Area will be performed inside the manure processing building, a 170-foot by 376-foot building. This building will house mechanical equipment, tanks, and recycled sand prior to being moved to an outside drainage/storage area. Housing manure solid separation activity inside a building (compared to open sand channels exposed to wind and the outside environment) will likely reduce ammonia and hydrogen sulfide emissions. Agitation or processing of manure in enclosed buildings could pose indoor air quality issues and appropriate guidelines and safety standards will be followed.

The addition of an anaerobic digester installed at the GSD Production Area will provide energy production as well as significantly reduce odor and emissions associated with manure and process wastewater. Anaerobic digestion is defined as the biological oxidation of organic matter by microbes in an environment in which there is no molecular oxygen. The organic matter is a food source for the microbes, which convert it into oxidized materials, new cells, energy for their life processes, and gaseous end products, such as methane and carbon dioxide. Biogas, one of the products of anaerobic digestion, is typically made up of 55% to 65% methane (CH_4); 35% to 45% carbon dioxide (CO_2); and traces of ammonia (NH_3) and hydrogen sulfide (H_2S). Biogas can be burned in boilers to produce hot water, in engines to power electrical generators, and in absorption coolers to produce refrigeration. Biosolids, the other product of anaerobic digestion, can be thickened, dewatered, and dried for use as animal bedding or combined with other organic materials for use as a soil amendment. Specific details of the anaerobic digester plans at GSD have not yet been finalized because technology continues to advance and GSD will prefer to construct and install the most advanced technology on the market at the time the facility is built, and ensure the digester is properly sized to allow for optimal methane combustion.

An anaerobic digester will capture and burn methane and therefore reduce the GHG emissions from the GSD Production Area in two ways: first, through capturing and burning methane (methane destruction) and second, by displacing the use of fossil fuels for electricity use at the farm. The potential for anaerobic digesters as a GHG mitigation strategy was identified as

one recommendation of the Final Report of the 2008 Wisconsin Governor's Task Force on Global Warming, and subsequent research by researchers at the Nelson Institute for Environmental Studies at UW Madison underscores the magnitude of the GHG mitigation of anaerobic digesters for livestock (Zaks and others, 2011). This study uses predictive models to study the effects of climate policy on the market for anaerobic digesters and find that these systems have the potential to generate 5.5% of U.S. electricity in 2025. The use of an anaerobic digester will significantly reduce air emissions and odor.

The overall significance of the GSD Project on GHG emissions can also be viewed from the perspective of the food produced by the GSD Project. The UW – Extension's Green Cheese project is an effort to identify the GHG emissions and energy intensity in the dairy sector. Data from the UW work[35] indicates that globally, GHG emissions from milk range from 0.4 to 1.81 kg CO2-eq/kg milk. Results from Green Cheese study for Wisconsin "ranged from 0.43 to 0.89 kg CO2-eq/kg of milk at the farm gate, depending on the dairy diet and manure handling methods." The lowest values were for milk produced in systems that account for biofuels and biogas. In addition, the use of biogas as a fuel on the dairy (as proposed by the GSD Project) results in negative average energy intensity due to the positive energy output from the system through the renewable electricity generation from biogas. Thus, the GSD Project will represent a dairy production system with some of the lowest GHG emissions studied and will be a net producer of renewable electricity.

2.6.7.3 Estimated Potential Air Emissions

The estimated potential air emissions (total mass on an annualized basis) from GSD Production Area and GSD Agricultural Crop Fields process are listed below.

	Potential Emissions from Golden Sands Dairy (3400 Milk Cows, 600 Dry, 300 Heifers, & 1000 Calves)
PM_{10}	6.93 tons/year 1. Housing – 1.47 tons/year[36] 2. Silage – 0.43 tons/year[37] 3. Digester Generator – 0.18 tons/year[38] 4. Emergency Generator – 4.85 tons/year[39]
$PM_{2.5}$	5.55 tons/year 1. Housing – 0.46 tons/year[40]

[35] http://fyi.uwex.edu/greencheese/greenhouse-gas-emissions-and-energy-intensity-in-the-dairy-sector/

[36] Emission factor used was the average of PM_{10} emissions from all dairy facilities in the National Air Emission Monitoring Study (NAEMS).

[37] All Silage calculations based on lb/ton rating under US EPA AP-42 emission factors for grain receiving.

[38] All Digester Generator calculations based on US EPA AP-42 emission factors for uncontrolled digester gas-fired turbines.

[39] All Emergency Generator calculations based on US EPA AP-42 emission factors for uncontrolled diesel industrial engines. The emergency generator is an intermittent source of air pollutants and is planned to operate fewer than 200 hours per year.

[40] Emission factor used was the average of $PM_{2.5}$ emissions from all dairy facilities in the National Air Emission Monitoring Study (NAEMS).

	2. Silage – 0.07 tons/year 3. Digester Generator 0.18 tons/year 4. Emergency Generator 4.85 tons/year[41]
VOCs (volatile organic compounds)	56.28 tons/year[42] 1. Enteric Emissions – 11.40 tons/year 2. Milking Parlor – 0.11 tons/year 3. Freestall Barns – 5.04 tons/year 4. Corrals/Pens – 26.50 tons/year 5. Liquid Manure Handling (lagoons) – 1.86 tons/year 6. Liquid manure Land Application – 4.24 tons/year 7. Solid Manure Land Application – 1.03 tons/year 8. Separated Solids Piles – 0.16 tons/year 9. Solid Manure Storage – 0.42 tons/year 10. Digester Generator – 0.09 tons/year 11. Emergency Generator – 5.44 tons/year
H_2S (hydrogen sulfide)	7.26 tons/year[43] 1. Housing – 3.62 tons/year 2. Lagoon Storage – 3.64 tons/year
NH_3 (ammonia)	139.61 tons/year[44] 1. Housing – 69.37 tons/year[45] 2. Lagoon Storage – 44.88 tons/year 3. Landspreading – 25.44 tons/year[46]

2.6.7.4 Significance of Estimated Air Emissions

Particulate and VOC emissions are below the major source permitting thresholds for both federal and state CAA permit requirements. The GSD Project is exempt from the Wis. Admin. Code Ch. NR 445 requirements. Regardless, hydrogen sulfide and ammonia emissions in dispersion modeling show that GSD will be below Wis. Admin. Code Ch. NR 445 HAP permitting thresholds. The federal and state permitting thresholds were developed based on the

[41] This analysis conservatively assumes that all PM is $PM_{2.5}$.

[42] Emissions 1-9 for VOCs calculated from: Gill, Sheraz; Norman, Ramon. 2012. Air Pollution Control officer's Revision of the Dairy VOC Emission Factors. San Joaquin Valley Unified Air Pollution Control District.

[43] Emission factors used for housing and lagoon storage for H_2S was averaged over all dairy facilities in the NAEMS study.

[44] This total reflects nonfugitive sources (housing) and fugitive sources (lagoon storage and landspreading). The potential estimated tons of ammonia per year attributed to fugitive sources are not counted toward the 100 tons/year major source threshold. See §NR 407.02(4).

[45] Emission factors used for housing and lagoon storage for NH_3 were averaged over all dairy facilities in the NAEMS study.

[46] Based on emission model for ammonia loss following the application of manure developed at Clemson University in South Carolina: Chastain, John P. 2005. Manure Nitrogen Management Issues in Conservation Tillage. 2005 Southern Conservation Tillage Systems Conference Clemson University. This estimate assumes all manure generated by GSD is applied via center pivot, as that is the worst-case scenario for ammonia volitization. As described on page 150 of this document, the total ammonia emisions from traditional applications, including the top dressing of 1631 acres four times per year and 559 acres once per year is 19.98 tons/year.

known potential for impacts to human health and the environment; because GSD's emissions will be well below federal and state permitting thresholds, GSD will not have known potential for impacts to human health and the environment.

The emission estimates and dispersion modeling results provided in Section 2.6.5.7 and 2.6.6 for the GSD Project are all well below their appropriate criteria. The emission estimates and air dispersion modeling were completed using a conservative approach that does not underestimate the emissions of the expected ground level concentrations. Emissions and associated ground level concentration of compounds from the GSD Project will not cause or contribute to human health or environmental impacts.

3 SOCIOECONOMIC CONDITIONS AND POTENTIAL IMPACTS

3.1 Neighbors

3.1.1 Existing Conditions

3.1.1.1 Residents

The population density in Saratoga, Wisconsin is 103 people per square mile (City-Data.com, Saratoga, Wisconsin). The locations of nearby residences within one mile of the GSD Project are shown on **Figure 2-5.** There is one residence located within 1/2 mile of the GSD Production Area with the closest residence located 2,350 feet from the GSD Production Area. There are approximately 440 residences located within 1/2 mile of the irrigated areas of the GSD Agricultural Crop Fields proposed for conversion from pine plantation as shown on **Figure 2-5**.

Between the years 1970 and 2000, the population of the Town of Saratoga has increased by 81 percent, compared to 16 percent increase for the County. Since 2000, the population of the Town has declined by 5.2 percent to 5,102 people in July, 2009 (City-Data.com, Saratoga, Wisconsin). Most residents within the Town are within 20 miles of the City of Nekoosa, Wisconsin Rapids, and the Village of Port Edwards. The largest age group is those 35 to 44 years old (19.3 percent). The median age is 38.5, which is higher than the County and State median age. Approximately 14.6 percent of the population is at or near retirement age (60 years and older). (Source: Town of Saratoga Comprehensive Plan, p. 41).

The estimated median household income in Saratoga in 2009 was $52,364 per year, compared to the Wisconsin median household income of $49,993 (City-Data.com, Saratoga, Wisconsin).

Conditions related to employment are discussed in Section 3.3.1.

3.1.1.2 Businesses

Businesses in Saratoga Township generally consist of retail shops, restaurants, manufacturing facilities and health care sectors. The locations of nearby cranberry fields/operations are shown on **Figure 3-1**. The nearest cranberry operation is the Nekoosa East operation, located on about 80 acres one mile northwest of the GSD Project.

3.1.1.3 Private/Public Wells

Nearby private and public water supply wells are discussed in Section 2.3

3.1.1.4 Property Values

The estimated median house or condo value in Saratoga in 2009 was $136,405 (City-Data.com, Saratoga, Wisconsin).

3.1.2 Potential Impacts

3.1.2.1 Residents

The increased economic activity from the GSD Project and the increase in irrigated agriculture will likely create additional economic opportunity and may increase the current population. During facility operation there may be impacts due to an increase in odor from the GSD Project, as well as increased traffic from milk trucks, manure hauling and harvesting crops. Although some existing trees along field edges will remain as buffers, residents will notice a change in the landscape, as forested land within the GSD Project Area will be converted to cultivated vegetable and dairy forage crops. Residents will also be affected by manure nutrient applications. Residents will also have increased employment opportunities at the GSD Production Area, as well as new potential sources for local purchasing of goods and services through the GSD Project development. Economic impacts on property values are discussed in Section 3.1.2.4.

3.1.2.2 Businesses

The GSD Production Area and GSD Agricultural Crop Fields will require materials and supplies to sustain effective operations. The new agricultural presence may create opportunities for local development of agricultural input businesses.

The public has expressed concerns about impacts to tourism businesses due to an increase in odor from the GSD Project; however, such impacts will be minimal due to odor control BMPs planned for the GSD Project, including a digester at the GSD Production Area.

3.1.2.3 Private/Public Wells

Water quantity and water quality impacts are discussed in Section 2.3.

3.1.2.4 Property Values

Property values within the GSD Project Area will go up due to the physical improvements to the site, and should hold that value as long as the GSD Project is in operation and is maintained.

Property values on adjacent residential parcels could decrease due to proximity to the GSD Production Area and associated concerns about odor, noise, traffic, groundwater degradation, viewscape, etc. However, if the GSD Project is properly managed and uses the best available technologies for dealing with manure and odor any drop in property value would be short-term. Moreover, because newly built operations employ the best available technologies for dealing with waste and odor, new larger operations are not necessarily more harmful than smaller operations (Community Impacts of CAFOs: Property Values, Purdue Extension, 2008).

The value of land needed for raising crops, and perhaps more importantly, acreage needed for manure spreading may increase due to the demand for suitable sites close to GSD.

The tax base in the area will likely go up in response to the increase in property values and improvements at the production site. Property values may also go up for parcels used for growing crops and application of manure.

3.1.3 Significance of Impacts

3.1.3.1 Residents

Operation of the GSD Production Area and GSD Agricultural Crop Fields is not expected to significantly impact population density or conditions in the nearby area. Increases in jobs may result in an influx of residents to the vicinity, but that increase is unlikely to put pressure on existing infrastructure.

3.1.3.2 Businesses

Potential negative impacts to local businesses are not anticipated due to construction or operation of the GSD Project. Impacts to tourism businesses due to an increase in odor from the GSD Project are expected to be minimal due to odor control BMPs planned for the farm, including a digester at the GSD Production Area. If negative business impacts are experienced, they are unlikely to be significant. The GSD Project will not have a material impact on the water resources relied upon by the Nekoosa East cranberry operation, so negative economic impacts to that business are not expected to occur. Potential water quality and water quantity impacts on this cranberry farm operation are discussed in Section 2

Positive impacts to businesses are expected to be significant due to an increase in the number of job opportunities, the potential for some inflow of new residents to fill these jobs, and the resulting increased demand for services and supplies by these residents. The number of new residents is not expected to put significant pressure on existing infrastructure.

3.1.3.3 Private/Public Wells

The impacts to water resources are discussed in Section 2.3.

3.1.3.4 Property Values

The changes – positive or negative – in property values in and around the GSD Project Area are not expected to be significant. If the farm is properly managed and uses the best available technologies for dealing with manure and odor any drop in property value for nearby parcels is expected to be short-term and minimal. We are aware of no documented negative impacts on property values in Wisconsin caused by the existence of CAFOs. Indeed, the property values for land near CAFOs has increased as a general trend since the recent development of CAFOs in Wisconsin as increasing competition for productive land and housing has supported and elevated land values generally. The residential properties located in closest proximity to the GSD Production Area will be the most affected by the farm's activities.

3.2 Health, Education and Emergency Services

3.2.1 Existing Conditions

The location of hospitals, clinics and schools are presented in the charts below, along with the distance of each from the GSD Production Area[47]. All but one of these facilities is located more than five miles from the GSD Production Area and should not realize any adverse impacts from the GSD Production Area or the conversion of pine plantation to irrigated agriculture.

3.2.1.1 Nearby Hospitals and Clinics

There are no health care facilities located in the Town of Saratoga (Town of Saratoga Comprehensive Plan). The nearest hospital is Riverview, in the City of Wisconsin Rapids (410 Dewey Street). Riverview Hospital is licensed for 99 beds and provides a wide range of outpatient services. In addition, the Riverview Hospital Association maintains two clinics in the City of Nekoosa, Riverview Family Clinic and the Lake Area Medical Clinic. Medical Facilities near the GSD Project are summarized in **Table 3-1**.

3.2.1.2 Nearby Schools

There are thirty-five schools within 10 miles of the GSD Project as shown in **Table 3-2**, including public and private schools and preschools. Most of these schools are located in Wisconsin Rapids. The nearest school is a private elementary school located 0.81 miles north of the project area at the Good Shepherd Lutheran Church and School-Wels. According to the Town of Saratoga Comprehensive Plan there are no licensed childcare facilities in the Town of Saratoga; however, there are several within the Nekoosa, Port Edwards, and Wisconsin Rapids.

3.2.1.3 Emergency Services

The Wood County Sheriff Department provides police service to Saratoga residents (Town of Saratoga Comprehensive Plan). Three fire districts (Nekoosa, Rome, Grand Rapids) provide fire protection. Rescue services are provided by Saratoga First Responders, and Nekoosa EMS.

3.2.2 Potential Impacts

Nearby hospitals and schools face the same potential impacts as nearby residents. These risks are identified in Section 3.1.2.1 above. With the exception of potential new students that move to the area if their parents become employed by GSD, the development of the GSD Project will not result in any additional demand on schools. There should be no additional demand on local hospitals due to the GSD Project, other than occupational injuries that could potentially occur during GSD construction and operation.

3.2.3 Significance of Impacts

Nearby hospitals and schools face the same potential impacts as nearby residents. The significance of these risks is identified in Section 3.1.3.1 above.

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[47] All locations are measured in miles from Tower Road near the GSD Production Area.

3.3 Population, Land Use and Economy

3.3.1 Employment

3.3.1.1 Current Conditions

The Wood County labor force is approximately 54,500, with an unemployment rate of 8.2 percent in July 2012 (U.S. Bureau of Labor Statistics). The existing economy in Wood County is dominated by the manufacturing, retail trade and health care sectors. In 2005, the UW Extension estimated that there were 3761 jobs in Wood County that were related to agriculture, including farm owners, on-farm employees, veterinarians, crop and livestock consultants, feed and fuel suppliers, food processors, farm machinery dealers, barn builders and agricultural lenders. Farming and related activities generated $537.8 million in economic activity. Every dollar of sales of agricultural products spurs an additional $0.41 in other parts of the county economy. Further, the UW-Extension estimated in 2004 that agriculture accounts for $114.9 million in income — 4.2 percent of Wood County's total income, including wages, salaries, benefits and profits of farmers and workers in agriculture-related businesses. Every dollar of agricultural income generates an additional $1.02 of county income.

By 2011, the UW Extension reported that agriculture provides jobs for 4,616 Wood County residents; of this number, 2,401 jobs are for on-farm milk production and dairy processing; and that every job in agriculture generates an additional 0.77 jobs in the county. In 2011, Wood County agriculture had generated $1.02 billion, or 12.3% of the county's total business sales, and that every dollar of sales from agricultural products generates an additional $0.38 of business sales in other parts of the county economy. In 2011, Agriculture contributed $253 million to the county's total income and paid almost $22 million in taxes, not including property taxes paid to support local schools. In 2011, at the county level every dairy cow generated $3,432 in on-farm sales, and at the state level every dairy cow generated about $21,000 in total sales. "Wood County Agriculture: Value and Economic Impact", available at http://www.uwex.edu/ces/ag/wisag/documents/agimpactbrochWoodCoFINAL.pdf.

3.3.1.2 Potential Impacts

The community will benefit from the GSD Project, which will have a local payroll of $1,500,000 and a local services procurement of $6,000,000 annually. Due to the conversion of managed forest land to cultivated vegetable crops, the Town of Saratoga will receive a significant MFL tax payment from GSD. The percentage of jobs and income associated with agriculture will increase due to the development of the GSD Project.

Construction of the GSD Project is estimated to provide 100 new jobs for about six months and 50 jobs for an additional six months. The dairy itself will provide approximately 40 new permanent full time jobs, including veterinarians and assistants, herdsmen, milkers, feed attendants, heavy equipment operators, animal breeders, forage harvesters, transport drivers and office staff. The Wysocki Produce Farm also will require an additional 5-10 people for farm operations and land clearing in support of the GSD Project.

3.3.1.3 Significance of Impacts

The economic growth associated with the GSD Project will be a significant positive impact on the local region. The GSD Project will positively add to the existing growth of the dairy and agricultural sectors in Wood County.

3.3.2 Agricultural and Rural

3.3.2.1 Current Conditions

Dairy was the top agricultural commodity for Wood County in 2002, with $39.0 million in sales. Economic activity associated with agriculture in Wood County accounted for nearly $10 million in property, sales and other taxes[48]. According to a 2011 UW Extension report titled "Wood County Agriculture: Value and Economic Impact", dairy farming is the major agricultural industry in Wood County. In 2011, on farm milk production generated $85.7 million in sales while milk processing accounted for another $ 615.4 million. Also reported in 2011, agriculture provided jobs for 4,616 Wood County residents; of this number, 2,401 jobs are for on-farm milk production and dairy processing. In 2011, at the county level, each dairy cow generates $ 3,432 in on-farm sales to producers; at the state level, each dairy cow generates about $21,000 in total sales. In 2011, agriculture contributed $253 million to the county's total income and paid almost $22 million in taxes (this figure does not include all property taxes paid to local schools). Wood County is home to fourteen plants that process dairy products.

As of 2007, the number of farms in Wood County had increased since 2000.

3.3.2.2 Potential Impacts

The GSD Production Area will operate on what used to be a red pine plantation in an existing agricultural area. The area surrounding the GSD Project is managed red pine plantation and will continue being farmed, but the crops will be vegetables and forage instead of red pine plantation.

This project involves construction of a new farm in an existing agricultural area. The majority of land in the township is farmed for pulp and paper. With the development of the GSD Project, new crops will be grown to provide vegetables for canning and feed for animals. The farm animals being brought onto this site will generate a large volume of manure. Utilization of this manure as a soil conditioner and valuable nutrient source will provide an alternative to purchasing commercial fertilizers to enhance the soil and grow crops. The NMP will require numerous stringent conditions be met for land application of that manure. The NMP requirements are summarized in Section 1.2.1.4; the NMP is attached to this document as **Appendix A**.

There is currently one WPDES permitted CAFO in Wood County. There are also a few smaller farms scattered throughout the area, including one larger tree nursery and vegetable crop production farm and a few small (5-10 head) farmettes. The presence of the GSD Project will

[48] http://wood.uwex.edu/files/2010/05/04ageconimpacts.pdf.

not have an effect on the existing farms as no lands to be used by GSD are currently in use by the other farming operations.

3.3.2.3 Significance of Impacts

Overall, the development of the GSD Project will have a positive impact on the agricultural industry in Wood County and the Town of Saratoga. The GSD Project will positively add to the existing growth of the dairy and agricultural sectors in Wood County.

3.3.3 Service industries

3.3.3.1 Potential Impacts

The location of the GSD Project will enhance the need for local service industries, including veterinarian and animal care specialists, feed processing, transportation and trucking services, implement dealers, construction, tree harvesting, land clearing and root pulling.

3.3.4 Tourism and Recreation

3.3.4.1 Parks and Public Lands

3.3.4.1.1 Current Conditions

See Section 2.4.1.2 for a list of all Wood County conservation areas and parks.

There are no available parks in the Town of Saratoga. According to the Town of Saratoga Comprehensive Plan:

A small boat landing provides access to the Wisconsin River from CTH Z. The Plan Committee indicated that this landing was in poor condition and was not appropriate for many trucks and trailers. The Plan Committee indicated that a new park and landing was something the Town should consider adding in the future. In a survey of Town residents, respondents indicated that a local park was the second most needed facility in the Town (compost area was number one). When asked what types of parks, public lands, or recreational facilities are needed most, respondents listed multiuse trails, natural areas, and community parks in that order. Additional park and river access is available through the City of Nekoosa.

3.3.4.1.2 Potential Impacts

Because there are no parks in the Town of Saratoga, there will be no impacts from the GSD Project.

3.3.4.1.3 Significance of Impacts

Because there are no parks in the Town of Saratoga, there will be no impacts from the GSD Project.

3.3.4.2 Trails and Scenic Roads

3.3.4.2.1 Current Conditions

The current Wood County bicycle routes and trails near the GSD Project Area are on CTH "Z", STH 73, Rangeline Road, South Hollywood Road and Hillcrest Road. Bicycle traffic in the Town of Saratoga primarily utilizes public roadways (Town of Saratoga Comprehensive Plan).

Currently, the Wood County snowmobile trail system routes runs through the proposed GSD Production Area and GSD Agricultural Crop Fields located west of the GSD Production Area.

3.3.4.2.2 Potential Impacts

Increased traffic from the GSD Production Area may affect bicycle safety on public roadways. After the development of the GSD Project, the existing snowmobile trails will no longer be heavily forested, but will continue to have forested areas as buffers between agricultural fields and roadways.

3.3.4.2.3 Significance of Impacts

It is unknown if the presence of the GSD Project will have a significant effect on the use of bike paths or roads. Increased traffic may result in a reluctance of bicycle use on the roads, but such a condition cannot be predicted since bicycle use is popular in populous cities with heavy traffic, such as Madison. The change in snowmobile trail use will not be significant, except there will be fewer trees and therefore a reduction in risk of collision. Snowmobiles will be permitted on the perimeter of GSD's Agricultural Crop Fields.

3.3.4.3 Hospitality and Recreational Businesses

3.3.4.3.1 Current Conditions

Various hospitality and recreational businesses such as campgrounds, sporting goods stores, and motels are located within the town of Saratoga.

3.3.4.3.2 Potential Impacts

The discussion below on hunting addresses the potential impact for local sporting goods stores. Hospitality businesses may be negatively impacted by odors from the GSD Production Area, but there may also be an increase in business due to the increased economic activity for the town, and any lodging needs required by GSD's out of town guests.

3.3.4.3.3 Significance of Impacts

The significance of impacts to local hospitality and recreational businesses as a result of the GSD Project is likely to be a positive in the near-term, during construction, and insignificant overall. Construction will bring more demand for hospitality services in the near and short term. Longer term, the GSD Project is not likely to pose a significant adverse effect given its distance from hospitality and recreational businesses in the area.

Odors from the GSD Project will be significantly reduced by the operation of an anaerobic digester at the GSD Production Area. The digester will reduce by 95-98% pathogens from manure generated at the GSD Production Area (Saunders and Harrison, 2012).

3.3.4.4 Hunting and Trapping

The open MFL land status of most of the current GSD Project Area allows for year-round public access and provides hunting and trapping opportunities. Trapping opportunities are less prevalent as most legal trapping in Wisconsin occurs in or near wetlands and the wetland habitat type comprises a very small portion of the GSD Project Area.

3.3.4.4.1 Current Conditions

Deer hunting is the most common type of hunting that occurs within the proposed GSD Project Area. The WDNR uses Deer Management Units (DMUs) to delineate boundaries to maintain harvest and population data. Six DMUs converge in Wood County. The GSD Project Area falls within two DMUs (53 and 57C)[49].

DMU 53 lies in southeast Wood County with STH 13 and 73 serving as the eastern boundary, and northern Adams and Juneau Counties. The unit encompasses 599 square miles and about 50 percent of the unit is open to public hunting. The WDNR considers 73 percent of this DMU to be viable deer range. DMU 53 represents 191,680 acres of land available for hunting and 279,852 acres of viable deer range. The estimated over-winter deer population in the DMU for 2011/2012 was 11,900 deer and the fall population density was estimated at 24 deer per square mile in 2011. The total number of deer harvested in this unit has steadily declined every year since 2006 to a record low of 2,965 in 2011.

DMU 57C lies in eastern Portage and southeastern Wood County and encompasses 440 square miles. The WDNR considers 60 percent of this unit to be viable deer range. DMU 53 represents 168,960 acres of viable deer range. The estimated over-winter deer population in the DMU for 2011/2012 was 10,100 deer and the fall population density was estimated at 33 deer per square mile in 2011. Total deer harvested from this unit historically fluctuates but harvest numbers have been increasing slightly every year since 2009. Hunters harvested 3,826 deer in 2011. Limited small game hunting opportunities (rabbit, squirrel, and ruffed grouse) exist within the current open red pine plantations. Hunters using dogs to hunt bear and coyote rarely utilize the open red pine plantations.

Trapping opportunities are minimal within the monotypic commercial red pine plantation. Fur-bearing harvest data is collected by surveying licensed Wisconsin fur trappers and fur buyers. The five most commonly trapped species statewide in 2011 were muskrat, raccoon, beaver, coyote, and red fox. Of these species, muskrat and beaver are associated with streams and wetlands and raccoon, coyote, and red fox may be found within the proposed GSD Project Area.

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[49] All DMU, harvest, and population data was taken from the WDNR web page: (*http://dnr.wi.gov/topic/wildlifeHabitat/reports.html*) titled "Wisconsin Wildlife Reports". Deer management areas are available at http://dnr.wi.gov/topic/hunt/dmu.html

3.3.4.4.2 Potential Impacts

Conversion of red pine plantation to vegetable and forage agricultural production will eliminate hunting and trapping opportunities on approximately 4,460 acres of open MFL lands in Saratoga Township. Currently Saratoga Township contains 8,367 acres of open MFL land (WDNR Forestry Division). This loss will represent an approximate 55 percent reduction in MFL land available for public hunting in Saratoga Township.

Wood County currently contains 11,000 acres of open MFL land (WDNR Forestry Division). The removal of 4,660 acres from this program will equate to a 42 percent reduction in MFL land available for public hunting.

Despite these reductions, the overall available acreage for hunting and trapping near the GSD Project Area will remain significant. As noted above, more than 1,000 square miles of land exists in nearby DMUs, which amounts to nearly 200,000 acres of land for hunting and nearly 450,000 acres of viable deer range.

The conversion resulting from the GSD Project could cause the displacement of approximately 175 deer as well as raccoon, coyote and red fox, if they are currently habituating the GSD Project Area. The displaced deer and other animals could concentrate on the remaining open MFL land in Saratoga Township, Rome Township, Wood County and Adams County, and on neighboring private land. However, given the significant nearby acreage in DMUs, the concentration is unlikely to result in long term impacts or permanent loss of hunting lands for hunters in these areas. The addition of 4,660 acres of vegetable and forage crop fields will provide feeding areas for deer, a healthier deer herd, and may increase the opportunities for sport and subsistence hunters in the surrounding areas. Muskrat and beaver are associated with streams and wetlands and may be impacted if significant riparian wetland or stream depth and channel reductions occur within the proposed GSD Project Area.

3.3.4.4.3 Significance of Impacts

Due to the abundance of public hunting and trapping access that will remain in Saratoga Township and Wood County, no significant long term impacts to these activities are expected as a result of the proposed action. Muskrat and beaver are associated with streams and wetlands and would not be significantly impacted within the proposed GSD Project Area based on the modeled stream width and depth calculations.

3.3.4.5 Fishing

3.3.4.5.1 Current Conditions

Fishing opportunities in the GSD Project Area include trout fishing in Sevenmile Creek, and Tenmile Creek in Wood County, and Chester Creek in northwestern Adams County. Tenmile Creek is the most popular of these streams for trout fishing. Tenmile Creek offers both a brook and brown trout fishery and numerous public access points. Tenmile Creek has greater depth, width and flow than Sevenmile and Chester Creeks, which provide scouring for spawning locations, undercut bank habitat, and adequate macroinvertebrate habitat. Tenmile Creek is classified as Class 2 trout water from the Wisconsin River upstream to Bell Road. From Bell Road upstream it is classified as Class 3 trout water (**Figure 3-2**). The stream contains

predominantly brown trout and some brook trout. Historic sampling information indicates that brown trout do reproduce naturally but spawning habitat is limited, and stocking is needed to maintain the fishery as it does receive high fishing pressure.

In 1994, WDNR established a SBP program to improve and protect Tenmile Creek. The SBP boundary is 3,500 acres in size, and to date 521 acres have been purchased and 6 acres are under easements that have improved access and fishing opportunities.

Sevenmile Creek has a relatively short stretch of fishable trout water as well as limited access and smaller size classes of trout. Sevenmile Creek is classified as a Class I trout stream from the Wisconsin River upstream to Rangeline Road; however the current condition of the resource indicates it should be reclassified as Class 2 or Class 3. Upstream of Rangeline Road, Sevenmile Creek is seasonally intermittent and not classified as trout water.

Chester Creek is a Class 1 trout water in northwestern Adams County and flows into the Wisconsin River. This stream is relatively small in size and is impounded at the confluence with the Wisconsin River and it is more of a small lake than a creek. Near CTH Z it has brook trout, but transitions to a lacustrine environment quickly downstream of there (WDNR staff, personal communication, 2012).

3.3.4.5.2 Potential Impacts

Potential impacts from the GSD Project include a reduction in trout habitat due to the reduction in baseflow of Tenmile, Sevenmile and Chester Creeks. The reduction in baseflow may cause a reduction in habitat space, a change in sediment transport and an increase in temperature. These changes could reduce the ability of trout to spawn and propagate in these streams and ultimately reduce the fishable trout population.

3.3.4.5.3 Significance of Impacts

See Section 2.5 above for an analysis of the significance of potential habitat reduction in Tenmile, Sevenmile and Chester Creeks. Potential impacts to the fishing resources are not expected to be significant for any of the creeks in the GSD Project Area. Sevenmile Creek is not a well-used fishery due to its small size, thick riparian zone and small fish size. Tenmile Creek is the most popular trout stream in the GSD Project Area and will continue to be after the GSD Project is developed. Chester Creek is not a popular trout fishery but has a small lacustrine setting that harbors warm water species and receives modest fishing pressure. Fourteenmile Creek and its tributaries are not popular trout fishing destinations and are not expected to change if the GSD Project proceeds.

3.3.4.6 Wild plant harvesting

Wild ginseng is the most commonly harvested wild plant in Wisconsin. Other common species include various berries, mushrooms, and succulent herbaceous plants.

3.3.4.6.1 Current Conditions

Due to a lack of understory or shrub layer vegetation in most of the commercial red pine plantation, wild edible plants are rare or non-existent. Sandy soil conditions are not conducive

for harvestable ginseng plants. Xeric (dry) soil conditions are not conducive for mushrooms or other succulent herbaceous edible plants which require more mesic soil conditions.

3.3.4.6.2 Potential Impacts

Because current wild plant harvesting conditions will not change, no significant impacts to wild plant harvesting are expected as a result of the GSD Project.

3.3.4.6.3 Significance of Impacts

Because current wild plant harvesting conditions will not change, no significant impacts to wild plant harvesting are expected as a result of the GSD Project.

3.3.5 Taxes

3.3.5.1 Current Conditions

The state, county and town currently receive a MFL tax payment. The Town of Saratoga has minimal existing businesses, so the Town's basis for business tax income is limited. In addition, there is minimal employment opportunity in the Town, so there is minimal payroll tax income generated within the Town.

3.3.5.2 Potential Impacts

The GSD Project will provide an increase to the tax basis of the Town of Saratoga, with a total investment of $20- 30 million, including the dairy, digester and cropped acreage.

MFL withdrawal tax is assessed on any acres withdrawn from the MFL program. All acreage must be withdrawn on complete 40 acre parcels. MFL withdrawal payment is initially made to the state, and the state distributes approximately 10 percent to the state, 70 percent to the town and 20 percent to the county. The payment amount is based on the current property tax assessment and mill rate, carried back for the number of years the land was in MFL, with interest added. For example, if all of the land was removed from MFL at the end of 2014, the MFL payment calculation, with interest added, is estimated to exceed $600,000.

Currently Wood County is eligible for the Resource Aid Payment (RAP) because the MFL and FCL enrollment exceeds 40,000 acres. Wood County has 46,247 acres of MFL and FCL lands. Wood County's RAP is approximately $20,000 per year. The annual rate of increase for MFL acreage in Wood County has been between 3 percent and -1.5 percent the past 6 years. It is possible that the annual rate of increase will not make up the potential withdrawal of acreage by GSD. If this happens, then the acreage of MFL and FCL would fall below the 40,000 acre threshold and Wood County would be ineligible for RAP. However, Wood County will receive significant annual revenue from taxation of new buildings, structures and land, as well as an upfront payment for its portion of the MFL withdrawal payment.

3.3.5.3 Significance of Impacts

The GSD Project will provide a significant increase to the tax basis of the Town of Saratoga. The increase in tax basis could be used by the Town to develop and maintain public common areas such as parks, or to improve existing infrastructure such as boat landings and roads. The increase in tax basis could also be used to provide services to Town residences, such as improved

waste collection or to develop a fund to assist residents with replacing old and non-compliant septic systems or private water supply wells. The increase in tax basis to the Town will provide a significant benefit to the Town and its residents.

The conversion of 4,660 acres of MFL to irrigated crop fields is not expected to prevent Wood County from RAP eligibility, as the county is expected to continue to exceed the 40,000 acre enrollment requirement. Wood County will also receive significant new revenue from the development of the GSD Project.

3.4 Transportation

3.4.1 Roads and Truck Traffic

3.4.1.1 GSD Production Area

3.4.1.1.1 Current Conditions

The GSD Production Area is currently undeveloped with no roads or paved or gravel surfaces. Public roadways in proximity to the GSD Project Area include STH 13, STH 73, Tower Road, Evergreen Avenue, Blue Ridge Lane, and Rangeline Road. STH 13 and STH 73 are 2-lane roadways and are a combination of paved with gravel shoulders and stormwater ditches. Tower Road, Evergreen Ave, Blue Ridge Lane and Rangeline Road are asphalt 2-lane roadways with gravel shoulders and ditches for stormwater. The current condition of each road is described in **Appendix F.**

A 24-hour traffic count was conducted on STH 13 just south of Tower Road. Based on traffic count, peak travel hours on nearby roadways are as follows:

Morning Peak Hour – 7:45 AM to 8:45AM

Midday Peak Hour – 12:15 PM to 1:15 PM

Evening Peak Hour – 4:45 PM to 5:45 PM

The traffic classification count concluded that at this location approximately 65 percent of current daily traffic is cars, 28% is single unit trucks and 7 percent of all daily traffic is semi- or similar sized trucks.

3.4.1.1.2 Potential Impacts

During construction, traffic will increase due to the delivery of building materials and construction workers to the site for work each day. Due to the variable nature of construction work, it is difficult to estimate the likely increase in vehicle numbers while the facility is being constructed. Once construction is completed and the GSD Production Area is populated with animals, normal operations will be conducted around the clock.

A summary of projected average daily traffic counts is provided in **Table 3-3**. On an average day, the GSD Production Area will operate with approximately 15 people on site at a time (with 35 total employees). Shift changes throughout the day do not coincide with peak traffic times. On an average day there will be approximately 5 truckloads of milk leaving the

GSD Production Area, 15 to 20 feed loads and an additional 5-10 varied deliveries. The estimate for the average day traffic would be 60 vehicles made up of 35 cars and 25 semi-trucks.

During the forage and alfalfa harvest, which will occur over about a week four times per year between Memorial Day and Labor Day, the average additional traffic is projected to be an additional 20-25 trucks per day. An estimate of the traffic to be expected during corn harvest, which will occur once per year in the fall, was developed based on a traffic count that was conducted during the 2012 corn harvest at the CSD, located in Juneau County. Because the CSD operates the same way the GSD Project is expected to operate, CSD traffic data is used to project the traffic that will occur during corn harvest for the GSD Project. The 2012 corn harvest at CSD added 92 trucks and 64 cars to the average day. Because the increased traffic was distributed throughout the day, the increase did not create any detrimental traffic impacts to the roadways.

Solid manure will be hauled by semi- truck periodically throughout the year. Manure hauling may consist of 3 loads per hours along the routes varying by field location.

The majority of liquid manure will be applied via drag hose, not semi-truck, and will result in no additional truck traffic. Some liquid manure hauling may consist of 3 loads per hour along routes varying by field location.

As an additional result of increased traffic, increased dust may be generated during periods of high traffic. During the construction phase, gravel driveways and roads will be sprayed with water for dust suppression.

3.4.1.1.3 Significance of Impacts

Because the additional traffic will either be new employees commuting to the GSD Production Area or additional truck traffic distributed throughout the day, impacts of increased traffic are not considered significant. Even during the greatest increase in traffic during corn harvest season, the GSD Project will generate fewer than 100 additional vehicles during peak traffic hours, and less than a 1% increase in truck traffic. This increase is not considered significant and no Traffic Impact Analysis is required.

During the construction phase, gravel driveways and roads will be sprayed with water for dust suppression.

All hired vendors will be instructed to follow standards related to truck routes and engine braking. Courtesy to neighbors signage will be installed at property exits to remind drivers to adhere to the posted speed limits and to drive courteously.

3.4.1.2 Agricultural Crop Fields

3.4.1.2.1 Current Conditions

Fire lanes and forest management access lanes currently exist through the GSD Project Area. Existing fire lanes are used to transport harvested red pine and related biomass products from the plantation to state highways.

3.4.1.2.2 Potential Impacts

During conversion of red pine plantation to crop fields, an increase in traffic will occur due to bringing harvest and chipping equipment to the area, and removing logs and biomass material. When the conversion is complete, approximately 40 to 45 percent of the planted crops will come from the western portion of the GSD Project Area. A portion of the existing access lanes may be used by GSD for planting and harvesting crops from the western portion of the GSD Project Area; additional lanes will be located between and around irrigated fields. Field road traffic may cross Rangeline Road, but travel on Rangeline Road will be limited.

3.4.1.2.3 Significance of Impacts

Although vehicle traffic on access lanes will increase overall, the increased traffic will not present any new significant safety concerns. The existing agricultural field roads will continue to be used to transport manure and feed to and from the GSD Agricultural Crop Fields. All hired vendors will be instructed to follow standards related to truck routes and engine braking. Courtesy to neighbors signage will be installed at property exits to remind drivers to adhere to the posted speed limits and to drive courteously.

Because the access roads are and will be located on private property, the new use of transporting farming equipment is not considered a significant impact.

3.4.2 Railroads

There are no anticipated impacts to railroad traffic from the GSD Project.

3.4.3 Airports

There are no anticipated impacts to airport traffic from the GSD Project.

3.5 Utilities

3.5.1 Public Utilities

3.5.1.1 Current Conditions

There are two major utilities near the GSD Project Area. The first is a natural gas pipeline, owned and operated by Enbridge. The natural gas pipe line travels from northwest to the southeast over a distance of about 3000 feet and crosses the very southwest corner of the GSD Project Area and covers an area of about 10 acres. The natural gas pipeline effectively impacts one field within the NMP. The natural gas pipe line is buried below the frostline and deeper than any agricultural activities will occur on these fields. Enbridge has an easement from the prior owner to construct and operate the underground natural gas pipe line area. GSD intends to farm some portion of the surface area of the easement. In the event the natural gas pipe line requires maintenance, Enbridge has full rights to enter the easement area property to conduct maintenance or repairs on the pipeline.

The second major utility is electricity transmission lines. The transmission lines are owned by American Transmission Company (ATC) and are located west of STH 13, and intersecting the natural gas pipe line in the southwest corner of the GSD Project Area. The electricity

transmission line is located on northeast to southwest directional. ATC has an easement from the prior owner to construct and operate the transmission lines.

3.5.1.2 Potential Impacts

The clear cutting of the forest, subsequent stump removal, and farming activities may impede the transmission of electricity or natural gas through the utilities on the property if equipment strikes one of the utility lines. The rupture of a natural gas line may cause an explosion and injure workers. Such an event would likely delay utility service to the public.

3.5.1.3 Significance of Impacts

The potential impacts are not significant because the natural gas pipe line is constructed at a depth below any agricultural activities or stump removal activities that may occur on the site and the operation is well aware of the pipeline and its layout. Enbridge has full access to the pipeline to maintain the pipeline and prevent any accident from occurring as a result of the GSD Project. The potential impacts for the electricity transmission line are not significant because normal agricultural activity will not interrupt the transmission of electricity, and the operation has not committed to farming the area surrounding the transmission line. Potential impacts of the project on electrical distribution in the area are likely to be positive based on the type of renewable electricity that will be produced from the manure digester system. Biogas from the digester is produced continuously and burned in electrical generators to provide heat and electricity. The EPA identifies the rural electrical benefits of biogas electrical generation to include green power, distributed generation, and voltage support (http://www.epa.gov/agstar/anaerobic/faq.html).

3.5.2 Town Utilities

3.5.2.1 Current Conditions

3.5.2.1.1 Water and Septic

According to the Town of Saratoga Comprehensive Plan, Town residences rely on private septic systems for sanitary needs. Most of these systems are in proper working condition; however, the Town of Saratoga Plan Committee did indicate that there is concern over aging systems that are on lots too small to locate a second system. The Plan Committee is also concerned about increased development in areas that have high water tables (northeastern portion of the Town).

The Wood County Sanitary Ordinance regulates the location, design, construction, alteration, and maintenance of all private waste disposal systems in the county. The County requires approval for a sanitary system be obtained prior to issuance of a Building Permit and installation or modification of any sewage disposal system.

Town of Saratoga businesses and residences rely on private wells for water needs. A map of nearby water supply wells is shown on **Figure 2-5**. Wells are safe, dependable sources of water if sited wisely and built correctly. Wisconsin has had well regulations since 1936 and Wis. Admin. Code Ch. NR 812 (formerly NR 112) for Well Construction and Pump Installation, is administered by the WDNR. The Well Code is based on the premise that if a well and water

system is properly located, constructed, installed, and maintained, the well should provide safe water continuously without a need for treatment.

3.5.2.1.2 Solid Waste Disposal and Recycling Facilities

According to the Town of Saratoga Comprehensive Plan, curbside pickup for solid waste and recycling facilities are available in the Town. These services are contracted with a private company (Onyx). In a survey of Town residents, 86 percent of respondents indicated that current levels of service are "good." However, some concern was raised over spills during pickup and the failure to cleanup. Survey respondents also indicated that a compost area was the number one service or facility needed in the Town.

3.5.2.1.3 Telecommunications

According to the Town of Saratoga Comprehensive Plan, there are two telecommunication towers located with the Town of Saratoga. One behind the Town Hall and another one located along STH 13 on the Town's southern border. Cellular coverage appears to be adequate in most parts of the Town.

3.5.2.1.4 Power Plants and Transmission Lines

There are no power plants in the Town of Saratoga. Existing transmission lines are discussed above in Section 3.5.1.1.

3.5.2.1.5 Cemeteries

According to the Town of Saratoga Comprehensive Plan, there are two cemeteries located in the Town of Saratoga.

3.5.2.2 Potential Impacts

3.5.2.2.1 Water

See Section 2.3 for a discussion on the potential impacts to groundwater.

3.5.2.2.2 Solid Waste Disposal and Recycling Facilities

There are no anticipated potential impacts to the solid waste disposal and recycling facilities in the Town of Saratoga.

3.5.2.2.3 Telecommunications

There are no anticipated potential impacts to telecommunications as a result of the GSD project.

3.5.2.2.4 Power Plants and Transmission Lines

Because there are no power plants in the Town of Saratoga, there are no potential impacts from the GSD Project. The potential impacts on transmission lines are discussed above in Section 3.5.1.2.

3.5.2.2.5 Cemeteries

There are no anticipated potential impacts to cemeteries as a result of the GSD Project.

3.5.2.3 Significance of Impacts

3.5.2.3.1 Water

See Section 2.3 for a discussion on the significance of impacts to groundwater.

3.5.2.3.2 Solid Waste Disposal and Recycling Facilities

As there are no anticipated impacts, there are no significant impacts to solid waste disposal and recycling facilities as a result of the GSD Project.

3.5.2.3.3 Telecommunications

As there are no anticipated impacts, there are no significant impacts to telecommunications as a result of the GSD project.

3.5.2.3.4 Power Plants and Transmission Lines

Because there are no power plants in the Town of Saratoga, there are no significant impacts from the GSD Project. The significance of any impacts on transmission lines are discussed above in Section 3.5.1.3.

3.5.2.3.5 Cemeteries

As there are no anticipated impacts, there are no significant impacts to cemeteries as a result of the GSD Project.

3.6 Historic and Archaeological Resources

The Wisconsin Historical Society (WHS) is the state agency and private membership organization responsible for collecting and managing information regarding significant historic structures, archaeological sites and burial locations within Wisconsin. Within the WHS, The Division of Historic Preservation is the official state clearinghouse and repository for records pertaining to all such historic information. This information is accessed through the Wisconsin Historical Preservation Database (WHPD) and is available within three distinct database inventories. These inventories are the Archeological Sites Inventory (ASI), the Architectural History Inventory (AHI), and the Bibliography of Archeological Report (BAR).

The ASI database is a list, established and maintained by the office of the State Archeologist of archeological sites, burial mounds, unmarked and marked cemeteries, and cultural sites.

The AHI database is a collection of information on historic buildings, structures, sites, objects, and historic districts throughout Wisconsin. This database is comprised of written text and photographs of each property, which document the property's architecture and history.

The BAR database is a summary of archeological projects, site surveys, and reports of findings. The BAR records consist of survey methods, site investigation information, and legal descriptions of surveyed areas. The BAR is not a database of physical "sites" as are the ASI and

AHI databases but rather are descriptions of surveys that have been conducted to determine if sites exist in a given area.

3.6.1 Existing Conditions

An official request for a WHPD GIS data review resulted in historical data from all three WHPD inventories applicable to the general area of the GSD Project site. As illustrated on **Figure 3-3** none of the archeological sites inventory (ASI) or architectural history inventory (AHI) locations are applicable to the specific geographic footprint of the GSD Project Area. Three ASI sites (28807, 7506, and 81684), and one AHI site (55807) are located near the GSD Project but are outside of the area proposed for development. Eight separate archeological areas have been surveyed and documented in the Bibliography of Archaeological Reports (BAR) within or adjacent to the GSD Project; these locations are shown on **Figure 3-4** (the first numbers of each survey report code indicate the year the survey was conducted).

3.6.2 Potential Impacts

Due to the fact that all archeological (ASI) and architectural (AHI) locations are outside of the GSD Project Area footprint, no potential impacts to these sites are anticipated. The BAR areas are simply locations of prior surveys, and the GSD Project will not cause any impacts.

3.6.3 Significance of Impacts

Due to the fact that all archeological (ASI) and architectural (AHI) locations are outside of the GSD Project Area footprint, no potential or significant impacts to these sites are anticipated. The BAR areas are simply locations of prior surveys, and the GSD Project will not cause any impacts.

3.7 Aesthetics

3.7.1 Existing Conditions

3.7.1.1 GSD Production Area

3.7.1.1.1 Visual

The GSD Production Area is currently MFL planted with red pine trees approximately 20 to 40 feet high.

3.7.1.1.2 Noise

Noise under the current conditions of MFL is due to vehicles movement and operation during seasonal crop harvesting, wood chipping, and logging.

3.7.1.1.3 Lighting

The MFL is currently unlit, except for lights on harvest or maintenance equipment that may work after dusk.

3.7.1.1.4 Odor

No odor is associated with the current MFL, except for vehicles and machines operated during harvest or maintenance.

3.7.1.2 Agricultural Crop Fields

3.7.1.2.1 Visual

The GSD Agricultural Crop Fields are currently MFL planted with red pine trees approximately 20 to 40 feet high.

3.7.1.2.2 Noise

Noise under the current conditions of MFL is due to vehicles movement and operation during seasonal crop harvesting, wood chipping, and logging.

3.7.1.2.3 Lighting

The area proposed for GSD Agricultural Crop Fields is currently unlit.

3.7.1.2.4 Odor

No odor is associated with the current MFL, except for vehicles and machines operated during seasonal crop harvest.

3.7.2 Potential Impacts

3.7.2.1 GSD Production Area

3.7.2.1.1 Visual

The physical changes at the site due to converting MFL to animal housing, manure storage and process wastewater storage, and feed storage represent a change from the current red pine plantation landscape. Additional visual changes include paving driveways and roads on the site.

The 98-acre GSD Production Area will be converted from red pine plantation to the proposed barns, buildings, storage pads and storage basins. The GSD Production Area will be screened by existing pine trees to the east of the facility along State STH 13. The site will have limited views from the north and south across the GSD Agricultural Crop Fields depending on the height of crops. The view from the north will be of the north freestall barn, the separation building and stockpiled separated solids and hay storage. The view from the south will be of the special needs barn, the parlor, the dry cow barn, the silage feed pile, and the embankment of the manure storage basin.

3.7.2.1.2 Noise

Dairy construction and general farm equipment will be generating noise as well as the trucks and other equipment performing services in the normal course of this facility's operations. Construction operations likely will be limited to business hours, Monday through Friday. Once the dairy is constructed normal operations will be conducted seven days a week. Whenever

possible, transportation will occur during daylight hours, unless unavoidable due to weather, the needs of the animals or crops or in an emergency.

3.7.2.1.3 Lighting

The conversion from MFL red pine plantation to the 98-acre GSD Production Area will result in more lighting at the GSD Production Area than is currently present. GSD Production Area lighting will be primarily inside buildings with minimal building entrance exterior lighting. Minimal exterior lighting will be installed to provide for safe operation during non-daylight times and such lighting will not be directed upward.

Travis Longcore and Catherine Rich, in their article "Ecological Light Pollution" http://www.urbanwildlands.org/Resources/LongcoreRich2004.pdf) make a distinction between "astronomical light pollution", which is defined to obscure the view of the night sky, and "ecological light pollution", which is defined as that which alters natural light regimes in terrestrial and aquatic ecosystems. Regarding the "astronomical light pollution" effect of the GSD Project, there is no data available to indicate the degree of change in lighting due to the GSD Project, so it is uncertain if it will have any impact on the area's night sky. In the realm of "ecological light pollution", one of the documented consequences of night lighting is the deaths of migratory birds around tall lighted structures. Since birds migrate at altitudes of several hundred to several thousand feet and the facilities at this site are not this tall, lighting at this site is not expected to have any impact on migratory birds. The effect of artificial night lighting on the behavior and ecology of other species is not as thoroughly studied so it is unknown if there might be any effect on other species from night lighting at this site.

3.7.2.1.4 Odor

See Section 2.6 above for discussion on air pollutants and odor.

3.7.2.2 Agricultural Fields

3.7.2.2.1 Visual

The visual condition of the landscape will change from red pine plantation to irrigated crop fields. Some of the lands will continue to have trees as buffers.

3.7.2.2.2 Noise

There will be additional noise associated with the transportation of livestock, feed, and manure to land application sites. There will be equipment used to till the land, to spread fertilizers, and to harvest. The size and scope of the projects proposed harvest and manure spreading activities will increase truck traffic and corresponding noise and decibel levels above current conditions.

3.7.2.2.3 Lighting

The size and scope of manure spreading or harvesting activities may require an increase in artificial lighting above current conditions from farm machinery operated during non-daylight hours. This increase in lighting will be minimal and variable, and be restricted to agricultural fields.

3.7.2.2.4 Odor

See Section 2.6 above for discussion on air pollutants and odor.

3.7.3 Significance of Impacts

3.7.3.1 GSD Production Area

3.7.3.1.1 Visual

The visual impacts of the buildings and structures in the GSD Production Area will be a significant change from the existing MFL; however, pine tree screening along the eastern boundary of the GSD Production Area and the GSD Agricultural Crop Fields surrounding the GSD Production Area on the other three sides of the property will minimize the visual impacts of the building and structures and help to maintain the agricultural aesthetics of Wood County. As a result of the use of tree and grassland buffers, the impact of the visual change will be mitigated.

3.7.3.1.2 Noise

Noise associated with the GSD Production Area will increase as compared to MFL, but will likely be similar to noise in the areas during MFL harvest. Operations in the GSD Production Area are not expected to generate a significant level of noise.

3.7.3.1.3 Lighting

Lighting in the GSD Production Area will be moderate as compared to MFL, with most of the lighting as exterior entrance lighting on buildings; however the impacts of lighting in the GSD Production Area are not expected to be a significant disturbance to nearby residents and businesses.

3.7.3.1.4 Odor

See Section 2.6 above for discussion on air pollutants and odor.

3.7.3.2 Agricultural Fields

3.7.3.2.1 Visual

The visual impacts of conversion from MFL to irrigated crop agriculture are not expected to be significant and the irrigated agriculture fields will be consistent with the agricultural aesthetics of Wood County.

3.7.3.2.2 Noise

Noise associated with the GSD Agricultural Crop Fields will be moderate as compared to MFL, with most of the noise the result of vehicle and farm equipment traffic. Operations in the GSD Agricultural Crop Fields are not expected to generate a significant level of noise, with the majority of the truck traffic-related noise occurring on weekdays during daylight hours.

3.7.3.2.3 Lighting

Lighting in the GSD Agricultural Crop Fields due to vehicle operation and farm equipment lights will be minimal and not expected to be a significant issue for nearby residents and businesses.

3.7.3.2.4 Odor

See Section 2.6 above for discussion on air pollutants and odor.

3.8 Lifestyle

3.8.1 Rural

3.8.1.1 Current Conditions

A rural lifestyle can be described as one that takes place in an agricultural or remote area. A "town" in a rural lifestyle has a small population, limited commercial activity, and a general sense of open space. The area surrounding the GSD Project is predominately rural. More than half of the town's land is used by some form of agriculture or forested agriculture. The character and economy of the area is connected to the rural lifestyle. Many residents are farmers, while other residents work for businesses that are essential to a rural lifestyle, like the small diners that dot the side of a highway.

3.8.1.2 Potential Impacts

The GSD Project will take large areas of forest plantation agriculture and convert it to vegetable and dairy forage agriculture. This is a general trend in the area brought about by the changing economics of paper production and demand as society moves to a more electronic-based economy and some concerns have been raised locally concerning the changes in land use. The Town of Saratoga places value on the large swaths of forested land that surround the town.

3.8.1.3 Significance of Impacts

There will be no significant impact on the rural lifestyle of the area as a result of the GSD Project. In fact, the GSD Project will promote a rural lifestyle by allowing thousands of acres to remain in agriculture instead of being converted to residential use or other nonagricultural development. The horizons of trees that are of high rural value to the people of Saratoga will remain along the edges of fields to retain a visual similarity to current land use on the property. The GSD Project will also create jobs that help foster a stable rural economy for the town.

3.8.2 Urban / suburban

3.8.2.1 Current Conditions

The area surrounding the GSD Project is characterized as rural, but the Town of Saratoga is feeling the pressure of a growing population and the growing nearby Cities of Nekoosa and Wisconsin Rapids. Suburban elements like commercial strip development and traffic congesting are occurring along STH 13 and 73.

3.8.2.2 Potential Impacts

The GSD Project may create more of a demand for housing and commercial activity in the area because it will foster jobs that attract people to the community. The population of the area is already expected to grow in the future and the GSD Project may add to that growth.

3.8.2.3 Significance of Impacts

The GSD Project will not significantly affect the urban and suburban lifestyle of the surrounding area. Great attention to detail has gone into the planning of the GSD Project to preserve a rural aesthetic and provide jobs for local residents that drive the rural lifestyle of the surrounding area.

4 ALTERNATIVES

4.1 Project Alternatives

The Wysocki Family considered three options prior to deciding to pursue the GSD Project at the proposed GSD Production Area. These options and a no action alternative are discussed in below.

4.1.1 Option I – No Action

Under a no-action alternative, the current red pine plantations would be harvested by Plum Creek Timber, with no replanting of red pines and the land would remain fallow or the land would be sold for other nonagricultural development. A no action alternative would not provide the economic and environmental advantages of the GSD Project in terms of providing crop and dairy commodities and soil carrying capacity improvements, and the addition of local jobs and the significant increase in tax basis for the local community. A no-action alternative would not provide additional meat or milk supply to Wisconsin's processing infrastructure. No additional groundwater pumping would occur and there would be no reduction in stream flow and no lowering of the groundwater table. There would be no change in odor or air emissions from the current conditions; however, there would likely be a significant increase in PM and dust due to wind erosion from the thousands of acres of harvested fallow land with sandy soils. The harvested fallow land would not be pleasing to a community that values a forested aesthetic. The no action option would have more significant negative impacts on hunting and trapping opportunities near the GSD Project Area, as no forest buffers would be left in place and no fringe habitat elements would exist to allow species to remain in the area. Additionally, the no-action alternative which would result in other development on the harvested pine plantation would carry with it other impacts depending on the nature of the development. The no-action alternative does not allow a status quo given Plum Creek's decision to divest of the pine plantation.

4.1.2 Option II – Utilize Four Small Dairies

Option II involves the construction of four small dairies, which would be operated independently and below the WPDES CAFO permit threshold of 1,000 animal units. The advantages to this option were significantly less regulation of everyday business practices, no review and approval of construction design or practices, no public hearings for the WPDES permit process, no requirement for a NMP, no recordkeeping or obligations to report manure generation or application amounts to WDNR, and closer hauls for feed and manure. This plan would not include the construction of an anaerobic digester and would thus also allow for direct spreading of untreated manure. This plan was rejected because it would locate dairies closer to residences which would create more dispersed odor impacts that would affect more local residents, result in unregulated manure handling practices, and create multiple traffic concentrations. This option provides fewer environmental controls and management efficiencies gained by an operation of more concentrated scale. This option would have included the same number of high capacity wells as are proposed for the GSD Project and result in a less vigorous

environmental review of those high capacity wells. This option remains viable if the GSD Project, the preferred option, does not proceed.

4.1.3 Option III – Location West of Proposed Location

Option III involves locating the proposed dairy on a parcel of land located 1.5 miles west of the current site. This proposal would site the dairy further from residential buildings while still being central to the GSD Agricultural Crop Fields and an acceptable distance from power lines (to avoid stray voltage). Although this site may have resulted in less noticeable impacts to nearby residents, it was rejected because it is closer to Sevenmile Creek, Tenmile Creek and the Wisconsin River. This option would have included the same number of high capacity wells as are proposed for the GSD Project.

4.1.4 Option IV – Location SW Quarter of Section 34

Option IV involves locating the facility in the SW quarter of Section 34. This option is south of most of the residential neighborhoods so the northwest prevailing winds would have less impact on them. This site is also located further from Sevenmile Creek. This option was not chosen because of its close proximity to Tenmile Creek and the increased risk of impacts to Tenmile Creek from activities at the dairy farm. This site is also a smaller contiguous block of land which means that more of the forage crop harvest and more of the manure spreading would need to be trucked over town and county roads, likely resulting in greater traffic concerns. This option would have included the same number of high capacity wells as are proposed for the GSD Project.

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