Nolte/RDO EAW petition 2019

Pineland Sands Nolte/Offutt Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Heather Rutten	HEATHER Rutten	12315 130th LITTLE FALLS 56345
LARRY HAYES	Larry Hayes	19775 260th St Sebeka 56477
Dennis Gilgenbach / Jeanette Anderson	17242 260th St / 17242 260th St	Sebeka MN 56477 / Sebeka MN 56477
Vicki & DALE Hugget	19278 280th St.	Sebeka. MN 56477
Jonathan Harvey	Jonathan Harvey	2435 Acoma St. Roseville 55113
Kent / KENT SCHEER	Kent Scheer	850 Scheer Drive NE
Justin Kitzer		6386 Hwy 29
Ellie Miron		33154 Country Loop Wadena MN 56482
Jackie Miron		33154 Country Loop Wadena MN 56482
Richard Miron		33154 COUNTRY LOOP WADENA MN 56482
Stacy Miller	Wadena MN	33244 Country Loop Wadena MN 56482
Jay Mills	Wadena MN	33244 Country Loop Wadena MN 56482
Ronald Meyer	Pequot Lakes MN	6814 OLD Whitney Rd Pequot Lakes MN 56472
Diane Norlin	Diane Norlin	1739 10.5E NW Pine River MN 56474
Steve Norlin	Steven R Norlin	" " " "
JENNIE BUNCE	Jennifer Bunce	2133 14TH AVE NW BACKUS, MN 56435
Royce White	Royce White	1277 Hazleys Haven Rd NW Pine River MN 56474
PHILIP LILJA	Philip C Lilja	585 County 43 NW Backus MN 56435
Jon Lacho		2051 20TH AVE. NW. Backus, Mn. 56435

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Pineland Sands Nolte Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Joan Grindle	Joan Grindle	19775-260 Sebeka St 56477
KATHY CONNELL	Kathy Connell	18298 270th ST Sebeka, 56477
Steve Connell	Steve Connell	18298 270th St Sebeka 56477
Richard THEUSCH	Richard Theusch	27544 185th Ave Sebeka
Sharon Theusch	Sharon Theusch	27544 185th Ave Sebeka 56477
Carole J. makela	Carole J Makela	620 Aspen Ave SE Menahga 56464
Wes makela	Wes R. makela	" "
Deb Uliniemi	Debbie Uliniemi	526 Aspen Ave SE MENAHGA 56464
Debbie Uliniemi	Debbie Uliniemi	414 Aspen Ave SW MENAHGA 56464
Caroline Sola	Caroline Sola	17227 Alpine Law
	Scott Sagedahl	315A Aspen Ave Menahga 56464
Chris Basso	Chris Basso	321 Aspen Ave SW Menahga 56464
Shelby Pihlaja	Shelby Pihlaja	21641 Duck Lake Dr. Menahga 56464
Diana L. Pihlaja	Diana L Pihlaja	21641 Duck Lake Dr Menahga, MN 56464
Kim Lapinoja	Kim Lapinoja	21699 Co 30 Park Rapids MN 56470
Lindsay Kumpuk	Lindsay Kumpuk	132 W. Spruce St. Menahga, MN 56464
Tom T Gladys Murphy	Gladys Murphy	113 1st St SW - Menahga Minn 56464
Jacqueline Stewart	Jacqueline Stewart	125 Main St - Menahga
Marlin Stewart	Marlin Stewart	32583rd St NW Menahga MN 56464
Ac Clerd		224 MAIN ST. SW menahga 56464

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Pineland Sands Nolte Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Heidi Hillukka		226 Main St NW Nevada a
Mitchell Burdick		230 main Street SW Menahga
Sandy Schill		238 Main St SW 56464 MENAHGA
Virginia Bloomquist	Virginia Bloomquist	316 Main St 56464
Judy L. Garden		330 Eagle Dr. PR. Dr.
	ALEX WHEELER	320 Eagle Dr.
Becky Clark	BECKY CLARK	316 Eagle Dr. P.R. MN
Beverly Bethel	Beverly Bethel	22791 Green Pines Rd P.R.
Barbara Meckola	Barbara Meckola	22774 Duck Lk Rd
JoAnn Schauer	JoAnn Schauer	22772 Duck Lake Rd
Steve Schauer	Steve Schauer	22772 Duck Lake Rd
CARI CALISTRO		22702 Duck Lake Rd
Rosemary Simpson	Rosemary Simpson	" " "
Mark D. Munt		22601 Acorn Dr Menahga MN 56464
Trisha Janu	Trisha Janu	13611 283rd Ave. Zimmerman, 55398
Jason Janu	Jason Janu	"
Connie Pickar	19441 - 280th St Sebeka 56477	Connie Pickar
Kathy Pickar	25712 191st Ave Sebeka 56477	Kathy Pickar
Cheryl Mickunas	Cheryl Mickunas	17549 270th St Sebeka 56477
Robert Pickar	19441 260 ST 56477	Robert Pickar

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Pineland Sands Nolte/Offutt Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Robert Zimmer	Robert Zimmer	2911 Cty #41 N.W. Backus 56435
LELAND GREENINGER	Leland T Greeninger	3745 YELLOWSTONE LANE, PLYMOUTH MN 55446
~~SARAH COX~~	Sarah J. Cox	5688 FERNHURST DR NW HACKENSACK MN 56452
Ann Harris	Ann Harris	8505 Flying Cloud Dr Eden Prairie, MN 55344
Steve Helscher	Steve Helscher	5103 Boone Pt Rd NW Hackensack 56452
Barb Helscher	Barb Helscher	5103 Boone Pt Rd NW HACKENSACK 56452
Wendy Manley	Wendy Manley	3979 40th Ave. N.W. Hackensack 56452
Bill BURKE	Bill Burke	4962 Woodland Dr. 56452
Kim Burke	Kim Burke	4962 Woodland Dr HACKENSACK
Laurie Mclaughlin	Lori McLaughlin	4953 Woodland Dr 56452 HACKENSACK
Penny Swanum	Penny L Swanum	5237 Lower Ten Mile Lk Rd NW 56452
JAMES H WILLIAMS	James H Williams	2350 35th AVE NW Hackensack MN 56452
PAMELA S WILLIAMS	Pamela S Williams	2350 35th AVE NW Hackensack 56452
Charles W Helsde	CHARLES W HELSCHER	5147 BOONE PT Rd NW HACKENSACK MN 56452
Dawn Helscher	Dawn Helscher	5147 Boone Pt Rd NW Hackensack 56452
Gary Krueger	GARY KRUEGER	5145 BOONE PT RD NW HACK 56452
Karin Orsan	Karin Orsan	5145 BOONE PT RD NW HACKENSACK MN 56452
SHARON RHODES	Sharon Rhodes	4055 Forestman Pt Dr NW Hack MN 56452
H.W. Rhodes	H.W. Rhodes	4055 Forestman Pt Dr NW Hackensack 56452
Karlene Plante	Karlene Plante	5652 Bachelor Rd NW Hackensack MN 56452

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Print Name	Signature	MN address w/zip code
Julie Young	Julie Young	5417 Lower Ten Mile NW 56452
DAN DOKKEN	Dan Dokken	801 Sierra Ln NE Rochester, MN 55906
Marie Dokken	Marie Dokken	801 Sierra Ln NE Rochester, MN 55906
Burton Woock	BURTON WOOCK	5883 LOWER TEN MILE NW Hackensack, Mn. 56452
MARGARET M. BROWN	Margaret M. Brown	6411 JILLSTRAWBERRY LN NW HACKENSACK MN 56452
Gary W Pawlson	Gary W Pawlson	4962 Black Spruce Tr NW Hackensack, MN 56452
Andrew R Larson	[signature]	4940 Hiram Loop Rd NW Hackensack, MN 56452
Patricia A. Mitchell	Patricia A Mitchell	4934 Hiram Loop Rd NW Hackensack MN 56452
Cheris Garrison	Cheris L Garrison	4898 Hiram Loop Rd NW Hackensack MN 56452
Robert J. Garrison	[signature]	4898 Hiram Loop Rd NW Hackensack MN 56452
Stephen K. Erickson	Stephen K Erickson	4890 Hiram Loop Rd. NW. Hackensack, MN 56452
Marilee S. McKnight	Marilee S. McKnight	4890 Hiram Loop Rd NW Hackensack, MN 56452
Pat Abraham	PAT ABRAHAM	4886 HIRAM LOOP RD HACKENSACK, MN 56452
Barb Morris	Barb Morris	3880 63rd Ave. NW Hackensack, MN 56452
DAvid Morris	David Morris	3880 63rd Ave. NW Hackensack, MN 56452
William Jewell	W J Jewell	6254 Windsong Ln NW Hackensack, MN 56452
Kathy Jewell	Kathy Jewell	"
Geschwill, Edward	[signature]	2500 County 42 Backus MN 56435
Geschwill, Tracy	Tracy [signature]	" "
Geschwill, Maria	[signature]	7075 16th ST NW Backus, MN 56435

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Print Name	Signature	MN address w/zip code
Jim Etzel	Jim Etzel	5652 Bachelor Rd NW 56452 HACKENSACK
MIKE TAUBER	Mike Tauber	2540 CO 41 NW BACKUS MN 56435
Jennifer Tauber	Jennifer Tauber	"
Tim Mueller	Tim Mueller	588 CO 11 NW HACKENSACK 56452
JANETTE MUELLER	Janette Mueller	"
Deborah Monteka	Deborah Monteka	10094 Edgewood Loop Park Rapids, MN 56470
John Felton	J W Felton	5807 CO RD 40 NW HACKENSACK MN 56452
Ron Karow	Ron Karow	2768 Big Deep Hackensack
Kelvin Zaffke	KELVIN ZAFFKE	624 HWY 371 N HACKENSACK MN 229 FLETCHER AVE
Daniel M Hinger	Daniel M Hinger	HACKENSACK MN 56452
Christina Lewis	Christina Lewis	PO Box 231 Hackensack MN 56452
Curtis Lewis	Curtis Lewis	PO Box 231 Hackensack MN 56452
Ross Forsberg	Ross Forsberg	209 Minn Ave W Hackensack MN 56452
Tim Dahl	Tim Dahl	9820 Cargill Circle Bloomington MN 55438
James Ostlund	James Ostlund	5020 Normandale Court Edina MN 55436
Deb Hughes	Deb Hughes	3848 Sandy Beach Ln NW Hackensack, Mn. 56452
Sandy Tauber	Sandy Tauber	4156 23rd Ave NW Hackensack, MN 56452
Shannon Abraham	Shannon Abraham	1984 W. Ox Yoke Rd NW Backus, MN 56435
Luke Abraham	Luke Abraham	1984 W. Ox Yoke Rd NW Backus MN 56435
Troy Kreep	Troy Kreep	11641 7th st nw Backus, MN 56435

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Pineland Sands Nolte/Offutt Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Dan Ladehoff	Dan Ladehoff	2247 St Hwy 84 NW Longville, MN 56655
John Couchman	John G Couchman	620 Middleton Dr NW, Pine River 5647
TIM COUCHMAN	Tim Couch	620 Middleton Dr Pine River MN 56474
Peggy Couchman	Peggy M Couchman	620 Middleton Dr N.W. " "
BOB LADEHOFF	Bob Ladehoff	2247 ST. Hwy 84 NW Long ville 56655
RON Kitzmann		2835 Beeker Rd Maple Plain 55359
Mary Gabe		10610 - 48TH AVE. N. plymouth, MN 55442
Gary Gabe		" "
Dennis C Raymond	Dennis C Raymond	76 Glenview Loop St Cloud 56303
Naomi Raymond	Naomi Raymond	76 Glenview Loop St Cloud MN 5630
Anne McGill		4165 Cty 71 NW Hackensack 56452
BLAKE SHARON		12640 RESEDA RD. PLYMOUTH 55441
Donald Hoppe		4085 Forseman Pt HACKENSAK Dr NW 56452
Sue Eikenberry	Sue Eikenberry	5811 White Spruce LN Hackensack 56452
DAN Eikenberry	Dan Eikenberry	5811 White Spruce LN Hackensack 56452
JOHN HALLBERG	John E. Hallberg	3925 Plainview Dr 56452
Rob Iversen		534 Cty 71 NW 56452
Linda Schwartz		4850 Hiram Loop Rd, 56452
Justin Krueger		5228 Currant Trl NW, Hackensack 56452
Diane Power	Diane F Power	4417 Herg Trail NW Hackensack 56452

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Print Name	Signature	MN address w/zip code
Margaret Franklin	M. Franklin	5121 Boone Pt. Rd. Hackensack, MN 56452
James Franklin	James Franklin	5121 Boone Pt. Rd Hackensack, MN 56452
Sue Brandt	Sue Brandt	5143 Boone Point Rd Hackensack, MN 56452
Ned Miller	Ned Miller	2615 LAJARDA LN Hackensack 56452
Maggie McGill	Maggie McGill	2615 LAJARDA LN Hackensack 56452
Scott Gjevre	Scott Gjevre	4814 Hiram Loop NW Hackensack, MN 56452
Deb Massey	Rebecca Massey	P O Box 252 Menahga MN 56464
DAVID KANE	David Kane	854 EDGEWATER DR. NW HACKENSACK, MN
Tom Buss	Tom Buss	401 N. Bay Dr. N.W. Longville, MN 56655
Barbara Keinath	Barbara Keinath	1797 Sparkling Water Lane NE Longville, MN 56655
Richard Ohnesorge	Richard Ohnesorge	2146 STATE HWY 84 NW LONGVILLE MN 56655
Kathryn Wagner	Kathryn Wagner	1413 Walsedo Pass Rd NE Longville, MN 56655
KEN MATTSON	Ken D Mattson	31711 SUGAR CREEK RD OGEMA MN 56569
Linda Kruckenberg	Linda Kruckenberg	2590 Garden Ave. Waverly, IA 50677 6292 Jackpine Ln NW. Hackensack, MN
Jan Hosmann	Jan Hosmann	44483 Hwy #6 Box 247 Emily 56447
Larry Ellingsen	Larry Ellingsen	8875 Loon Call Lane Bemidji, MN 56601
Jim Shumate	Jim Shumate	33403 17th Line Canton of the MN 55008
Cecilia Riedman	C Riedman	51864 Becker Rd Bigfork, MN 56628
Stephen Long	S Long	" "
Sheila Boldt	Sheila Boldt	24966 old mill rd. merrifield MN 56465

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Pineland Sands Nolte/Offutt Petition for Environmental Assessment Worksheet

Print Name	Signature	MN address w/zip code
Barbara Courneya	Barbara Courneya	1388 Shadywood Shores Dr NW Pine River, Mn 56474
Terrence Cook	Terrence L. Cook	3918 63rd Av. NW Hackensack, MN 56452
Patricia Cook	Patricia Cook	" "
Judy Corriga	Judy Corriga	2509 Hayes DR Burnsville, MN 55337
Dave Sohn	Dave Sohn	569 Co 43 NW Backus, MN 56435
Mary Kowalski	MARY KOWALSKI	1407 Doctor A Mendota Hts, MN 55118
Carol Kwaas	Carol Kwaas	44401 Monument Beach L Veteran Rd 56572

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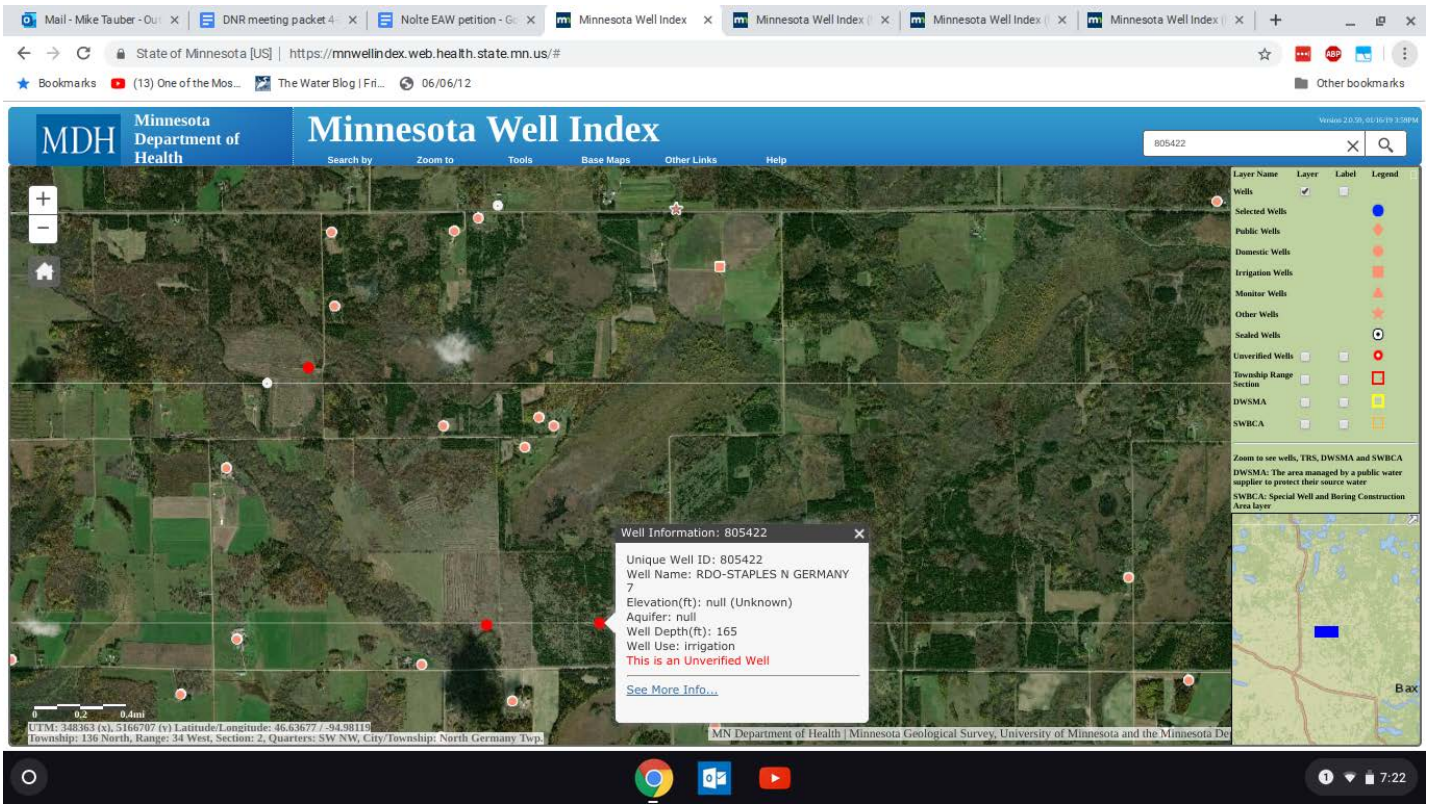
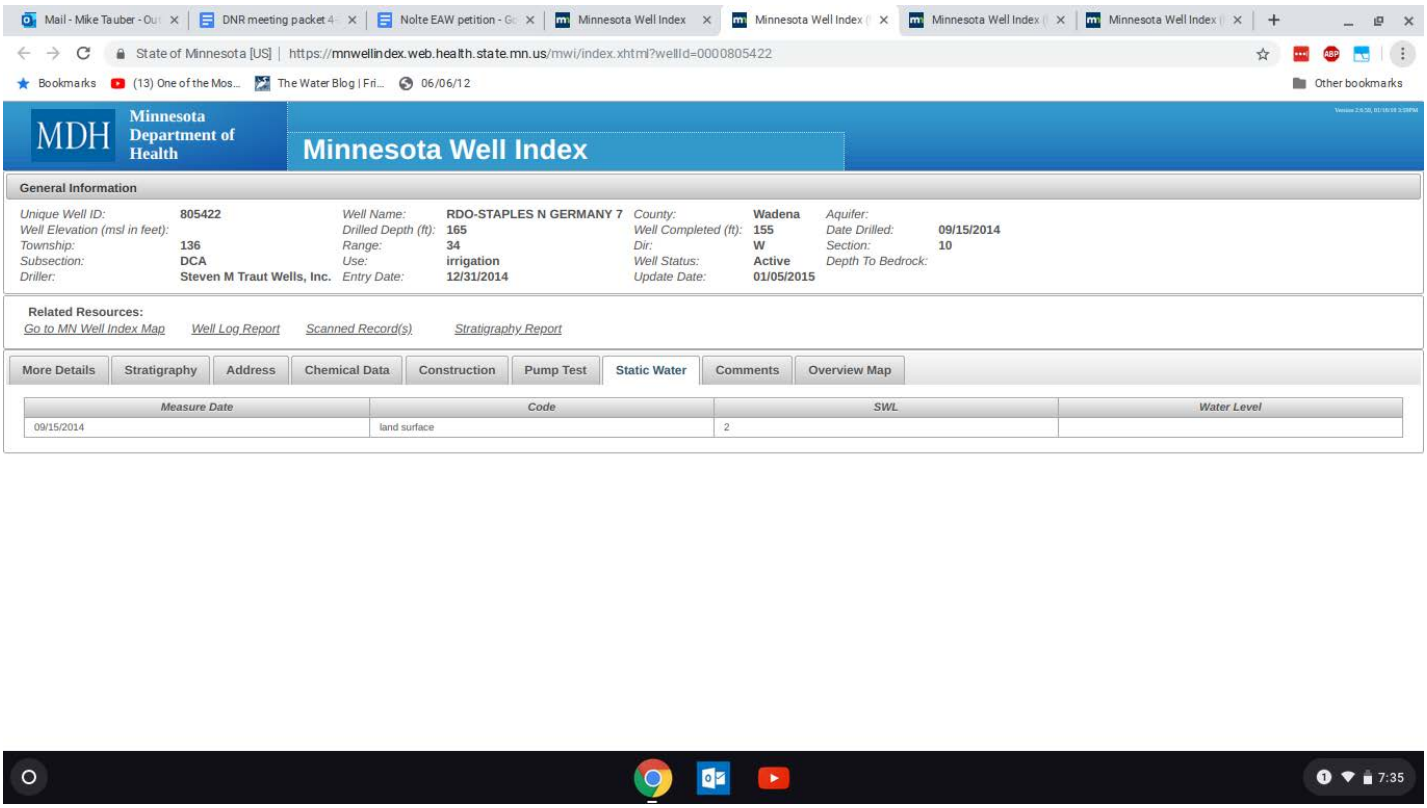

Minnesota Well Index
Search by
Zoom to
Tools
Base Maps
Other Links
Help
805422
Well Information: 805422
Unique Well ID: 805422
Well Name: RDO-STAPLES N GERMANY 7
Elevation(ft): null (Unknown)
Aquifer: null
Well Depth(ft): 165
Well Use: irrigation
This is an Unverified Well
See More Info...
UTM: 348363 (x), 5166707 (y) Latitude/Longitude: 46.63677 / -94.98119
Township: 136 North, Range: 34 West, Section: 2, Quarters: SW NW, City/Township: North Germany Twp
MN Department of Health | Minnesota Geological Survey, University of Minnesota and the Minnesota De
7:22


https://mnwellindex.web.health.state.mn.us/mwi/index.xhtml?wellId=0000805422
Minnesota Well Index
General Information
Unique Well ID: 805422
Well Name: RDO-STAPLES N GERMANY 7
County: Wadena
Aquifer:
Well Elevation (msl in feet):
Drilled Depth (ft): 165
Well Completed (ft): 155
Date Drilled: 09/15/2014
Township: 136
Range: 34
Dir: W
Section: 10
Subsection: DCA
Use: irrigation
Well Status: Active
Depth To Bedrock:
Driller: Steven M Traut Wells, Inc.
Entry Date: 12/31/2014
Update Date: 01/05/2015
Related Resources:
Go to MN Well Index Map
Well Log Report
Scanned Record(s)
Stratigraphy Report
More Details
Stratigraphy
Address
Chemical Data
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Static Water
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Code
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Water Level
09/15/2014
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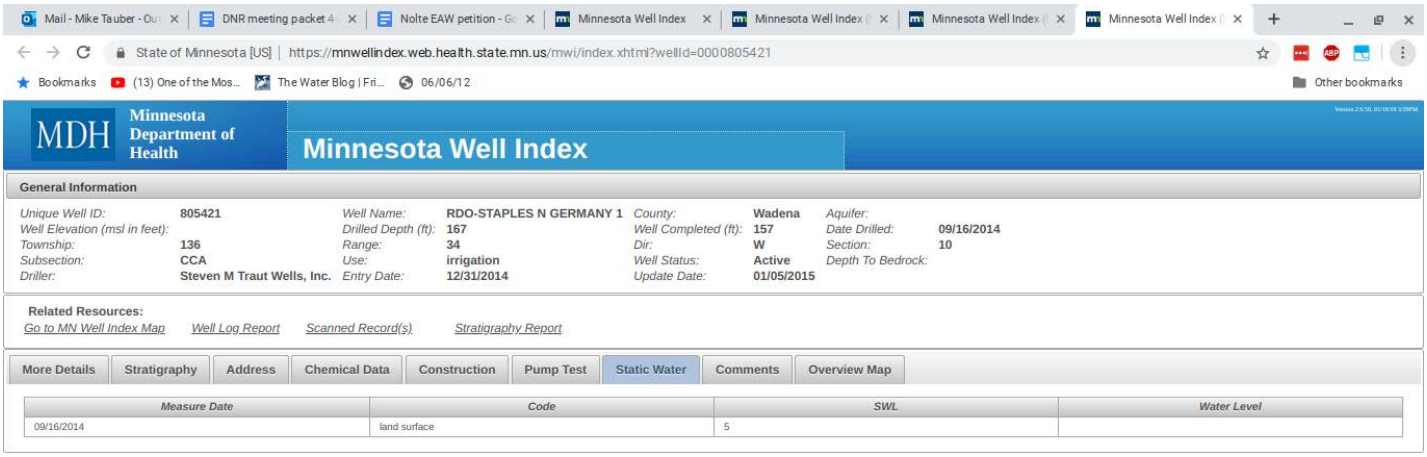
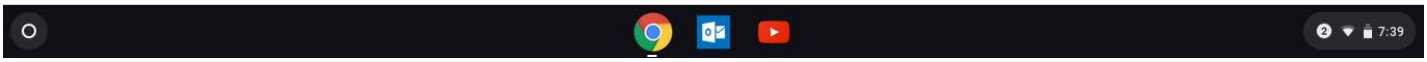
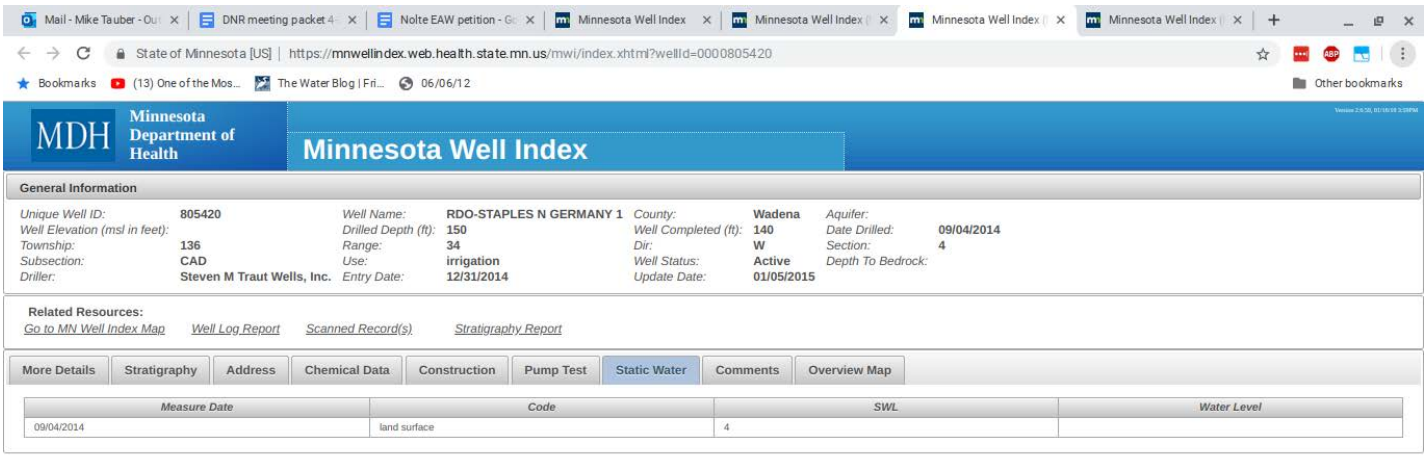
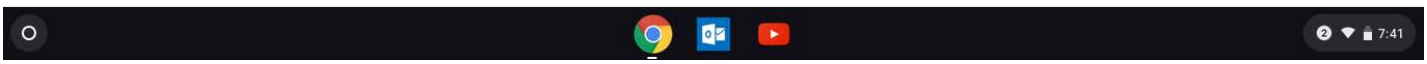








· 2013-0878 Amendment for 7.4 MGY increase

· 2013-0879 Amendment for 2.5 MGY increase

· 2013-0880 Amendment for 7.3 MGY increase

· 2013-0881 Amendment for 6.1 MGY increase

116B.01 PURPOSE.

The legislature finds and declares that each person is entitled by right to the protection, preservation, and enhancement of air, water, land, and other natural resources located within the state and that each person has the responsibility to contribute to the protection, preservation, and enhancement thereof. The legislature further declares its policy to create and maintain within the state conditions under which human beings and nature can exist in productive harmony in order that present and future generations may enjoy clean air and water, productive land, and other natural resources with which this state has been endowed. Accordingly, it is in the public interest to provide an adequate civil remedy to protect air, water, land and other natural resources located within the state from pollution, impairment, or destruction.

Pursuant to Mn Rules 4410.1100

subp. 1 Petitioner's signatures and mailing addresses , preceding

subp. 2

1. The proposed project is Mr. Tim Nolte's/RD Offutt Company's continued potato field expansions using DNR water appropriations (page 10), forest-to-field conversions and chemical applications in and around the Pineland Sands Area. Historically, there have been numerous government permits for these actions. Minnesota Valley Irrigation is also an agent associated with water appropriations in this project.
2. The proposer of the project is the RD Offutt Company, agents Mr. Tim Nolte and Mn Valley Irrigation.
3. The citizen petitioners' representative is Mike Tauber, 2540 Co 41 NW, Backus MN 56435 tel 218 675 5717
4. The following is a brief description of possible environmental effects which may result from the project.
5. Material evidence follows that shows, due to the nature and location of the project, there has been, and continues to be far more than just potential for significant environmental effects, the area is under direct ecological assault by corporate interests that leave residents with exorbitant natural and human consequences if permitted. The Pineland Sands now hosts over 50,000 acres of field watered by 444 irrigation wells permitted by Mn DNR to use over 19 billion gallons of water per year, with untold quantities of various hazardous chemicals applied. Multiple state studies have shown chemical intensive irrigated agriculture operations in sandy soils similar to those of the Pineland Sands Area contaminates groundwater.

Mn Rules 4410.1100 gives MN citizens the right to petition for environmental review. This petition is in regard to cumulative deforestation, surface and groundwater overuse and contamination, and chemical overspray of residences resulting from connected and phased installations of large scale chemical intensive irrigated agriculture in and around the Pineland Sands Area of north-central MN. The EAW process has been initiated in the Pineland Sands 4 times thus far; in 2012 by Cass County, called for but then rescinded by the MN DNR in 2015, and petitioned for by citizens in 2015 and 2018. This 2019 petition represents the fifth attempt at meaningful Environmental Review. This area includes and/or heavily affects Hubbard, Cass, Becker, Ottertail, Todd, Crow Wing, Morrison and Wadena counties, and also involves the 1855 Treaty (p.173) between the US Government and the Leech Lake Band of Ojibwe and the White Earth Band of Ojibwe.

The Pineland Sands Area in central MN has been a target area "developed" into center pivot row crop agriculture since the 1970's. This has accelerated greatly in recent years, propagating problems seen in other areas of the state and nation when allowed.

- The Jackpine forest type, once common in the area (DNR map showing existing vs. original stands attached, p.52), has been declared a rare forest type, home to numerous unique species, including the Blanding's Turtle and the Northern Goshawk, as stated by DNR Commissioner Tom Landwehr (Star Tribune Feb 5, 2015), referenced in the poorly executed Winnemucca Farms

EAW of 2012 (MPCA letter to Cass County ESD Jan 23,2013, p.58-59/DNR letter to Cass ESD, p.60-67), and the subject of Rep. Wagenius letter of August 29, 2013, (p.54-57). "Since 2006 the Upper Mississippi watershed has lost 275 square miles of forests and other natural land that has been converted to agriculture."(Star Tribune, Feb 5 2015, p.68-69) **We believe this deforestation has destroyed too much of the natural forest to sustain historic populations of flora and fauna, especially in and around the Pineland Sands and that reforestation efforts need to be undertaken to restore ecological balance.**

- The Pineland Sands Aquifer underlies this same region and was said to be a "very, very, very important" (Star Tribune Feb 5, 2015, p.68-69) aquifer by Tom Landwehr, DNR Commissioner. In 2016 the Pineland Sands Land and Water Study was proposed by the DNR, indicating willingness to further study issues of the area, but the study was not funded by the legislature. Again in 2018, as the DNR's preferred alternative to Environmental Review, a 1.85 million dollar Pineland Sands Special Study proposal was made (but not seen in public), and again it was not funded by the legislature. An EAW that was called for in the area in 2014 by the DNR, due to a high number of water appropriation applications that year by the RD Offutt Company, was eventually rescinded based on reduction of scope (Response and Record of Decision for RD Offutt Petition 12 Feb 2016, p.70-87). However, businesses involved in large scale forest-to-irrigated-field conversions continue as normal in the area by simply slowing the pace of requesting water appropriation permits (3 issued to RD Offutt Co in 2017 in Cass and Hubbard, 2017-0537, 2017-0538, 1996-3120), and having business partners file for DNR water appropriation applications. **We believe this shows the legislature will not address the issue, while at the same time the businesses involved expand by using the letter of the law to abuse the spirit of the law in Mn Statutes. This "very, very, very important aquifer" is apparently not important enough to have Environmental Review.**

- The Straight River Groundwater Management Area (excerpts attached, p.88-140) is one of three designated in the state of MN, which were created because water uses are suspected to be, or become, unsustainable. The SRGWMA study reports that over half of forested lands in the watershed have been converted to agriculture or residential use, and nitrate levels are rising in the river, groundwater and wells. Water temperatures in the Straight River (a designated trout stream) are rising enough to create "thermal stress" and "lethal conditions" for brown trout, and oxygen levels are falling at the same. The Straight River was listed as impaired by the MPCA in 2010 for dissolved oxygen (Northwoods Press Oct 1, 2014, p.141). In 2014 it was again listed as impaired for dissolved oxygen, with groundwater withdrawals indicated as a possible cause. (Crow Wing River Watershed Monitoring and Assessment Report, 2014, p.142-143). Jack Skrypek was adamant, before his retirement from the MN DNR, that the Straight River retain it's cold water status and this is a huge setback to that stated goal.

The fact that Farnham Creek in Byron Township is also a designated trout stream (list p.23) has not deterred forest-to-field conversion and installation of multiple irrigation wells in that area either. **We believe these problems have expanded and will continue to expand in correlation with deforestation, and that state agencies have turned a blind eye on the state designated trout streams affected in and around the Pineland Sands Aquifer.**

- MN Dept of Ag's Township Testing program (excerpts attached, p.144-151), developed in part to test the results of the Mn Nitrogen Fertilizer Management Plan, shows that more than 10% of the wells tested in Hubbard County had nitrate concentrations above the state limit of 10 ppm, while Hubbard township is approaching 20%. Wadena county data shows the same trend toward losing drinkable water even while excluding the very common, historically high quality (and most vulnerable) shallow wells. The townships in the study are considered most at risk for nitrate contamination because they are in the vicinity of center pivot irrigation operations. Water from intensive irrigation has inherently low residence time in the highly permeable soils of the Pineland Sands, promoting rapid downward travel of chemicals into groundwater once past the root zone. A very high water table is present in current project wells, many have less than 5 feet to static water (see table, p.29). This high water table in very porous soils must be taken into account while reviewing the Byron #1 Field Study - Groundwater Monitoring Report (p.30-38). The evidence leads to the inevitable conclusion that MnDNR water appropriation permitting is encouraging chemical contamination of groundwater. <u>We believe these items demonstrate a known and quantifiable relationship between center-pivot agriculture and nitrate pollution of groundwater, drinking water, and water leaving the watershed, and that the pollution is expanding at a frightening pace, creating an overt threat to public health.</u> A study done by MPCA in 2003 (Effects of Land Use on Ground Water Quality in the Anoka Sand Plain Aquifer of Minnesota- Trojan, Maloney, Stockinger, Eid, and Lahtinen, p.39-49) confirms this relationship has been known for years and demonstrated repeatedly. MDA's Central Sands Private Well Network (p.152-153) also demonstrates this. **More study as requested by DNR is completely redundant.**

- DNR assistant commissioner Barb Naramore said in 2015 of RD Offutt's 5 (modified from 54) Pineland Sands water appropriation applications "we don't see the potential for significant environmental effects from these 5 wells"(Northwoods Press Sep 16, 2015, p.154). All those who live next to a forest-to-field conversion watered through a DNR water appropriation permit see very significant environmental effects immediately, including overspray of carcinogenic and "fatal if inhaled" chemicals (hazardous materials data sheets, p.162-172) onto residential areas, dust storms from unprotected topsoil, loss of natural habitats, and the unavoidable groundwater issues. Air, land and water are all devalued for those in the area. Take for example a family residence in Hiram Township, Cass County, which is situated approximately 60' from one of the newest 160 acre forest-to-field conversions in Deerfield township (and the first in the Pine River Headwaters) that will be watered by DNR water appropriation permit 2017-0537. (MDH well index aerial photo, p.157) If standard industrial agricultural practices are continued on this new field, aerial chemical overspray is very likely, and the family's well, which is roughly ¼ mile from the center pivot well, may see a drop in static water level and an influx of nitrates and other undesirable nutrient at some point in the future; classic well interference. This is a dramatic departure from the family having a Potlatch owned timber lot as a neighbor that provided ample habitat for flora and fauna while protecting topsoil and groundwater. This is just one of hundreds of similar situations in the Pineland Sands area. DNR has failed to condition water appropriation permits to address chemical contamination or well interference though this is admittedly well within agency jurisdiction. **We believe that Mn authorities and RD Offutt Co have failed to fulfill their duties to protect public resources far too often and for far too long, and that now many of the residents of the Pineland Sands will**

pay dearly to cope with or rectify the problems created by the sacrifice of public waters for private profit.

- In 2014, thousands of acres of Potlatch timberland in Hubbard, Cass, Becker, and Wadena counties were purchased with the intent of converting them to center pivot row cropping. Much of this land has already been converted and doubtless much more is planned and even predicted as far back as the USGS Water Resources Investigations 77-102 report (which appears to have been a how-to manual for irrigation development of the Pineland Sands Aquifer, p.50-51). "The Freshwater Society, a Minnesota environmental group, found in a recent analysis that Offutt (RDO) is the largest single irrigator in the state, with rights to pump up to 12 billion gallons of water per year on 30,000 acres. Recently, it acquired 1,459 acres of cleared commercial forest land from Potlatch" (Blue Stem Prairie article excerpt Feb 5, 2015 referencing Star Tribune Oct 26, 2013, p.155-156).

The issue of surrogate permit holders is well illustrated by Mr. Nolte's and Mn Valley's involvement here. Numerous smaller businesses have spawned under the RDO corporate umbrella and data practices act requests are made fractionally effective as a result. We believe that many more acres are converted as a result of large business' smaller partners undertaking projects in portions, and this creates a convenient way for large businesses to appear to be bystanders. This occurs at the same as DNR's denial of need for Environmental Review that will necessarily take into account such connected and phased activity, and most importantly, cumulative effects in the environment.

- Hubbard County is home to the Badoura State Forest where aerial photos (supporting documents, p.158-160) show a group of ponds (57-317P, 57-318P and 57-319P) and Crystal Lake are experiencing water levels similar to the drought of the 1930's during non-drought conditions, likely due to multiple center pivot irrigation rigs within a mile of the ponds. MDH Well Index (p. 160) shows irrigation wells installed in 1990, 1991, 2012(3), 2013, and 2014, making a total of 7 that can legally pump 346.5 million gallons/year. Local DNR officials do not think that the water level drops in this case are due to intensive irrigation but could not rule this out as a contributing factor, as the Pineland Sands aquifers are known to be leaky and interconnected. We believe the wetland habitats in this and other areas of the Pineland Sands may be dying the death of a thousand wells, having been forgotten, and are in danger of being completely dewatered. White Bear Lake's problems seem to parallel the Pineland Sands' wherein DNR was found at fault in court (White Bear Lake Restoration Association v. Mn DNR and Thomas J. Landwehr) for allowing over-pumping of the Aquifer. Trout Unlimited has also been successful in showing the Mn court system (TROUT UNLIMITED, INC., et al., Appellants, v. The MINNESOTA DEPARTMENT OF AGRICULTURE, attached, p.24-28) understands the inherent risks of state agencies neglecting proper diligence in this situation. It should be noted that methods to measure water use on these wells are only required to be within 10% accuracy, and self-reporting by irrigators has obvious deficiencies. The USGS Water Resources Investigations 77-102 (excerpts attached, p.50-51) indicates that for long term pumping 295 cubic feet of water per second can be withdrawn from the Pineland Sands Aquifer without depleting storage capacity. 1 cubic foot of water is equal to 448 gallons per minute. Being that 444 irrigation wells have been permitted by DNR in the Pineland Sands Aquifer, and that these wells often use between 500 and 1000 gpm the water budget has been long ago surpassed according to this

study. Furthermore the drops in water tables were predicted, are locally observable, and are being ignored.

- The rate of growth in use of pesticides, fungicides, herbicides and the like in the state of MN has been exponential since 2002. The USGS studies of 2002 and 2012 show clear evidence of the increased use of chlorothalonil in the U.S. and MN (see included USGS estimate maps, p.161). Heavy use of synthetic chemicals is now taken for granted in agriculture and are assumed a necessity for profitable crop production. Many of these same chemicals stop the organic processes that break down hazardous substances and produce beneficial nutrients for plants (and therefore animals and people). Synthetic chemicals then become the stop gap measure prescribed by the petrochemical industry to avoid plant mortality. Chlorothalonil is a good case in point, as it is the most commonly used synthetic fungicide in the United States and popular brand names of Bravo® , Echo® , and Daconil® use the chemical as an active ingredient. In 1987, the EPA classified chlorothalonil as unsafe for home lawn use and likely carcinogenic, and the NJ Dept of Health Hazardous Substance Fact Sheet of 2005 listed the fungicide as a carcinogen. U.S. farmers and landscapers use the chemical for many different crops including potatoes, peanuts, tomatoes, and turf-grass for golf courses. In Minnesota, many residents express concern with the potato farm corporation R.D. Offutt Company, which uses chlorothalonil to grow more than 50,000 acres of potatoes. Pollinators may be affected by chlorothalonil also (as referenced in MPCA letter to Cass Co ESD Jan 23, 2013, p.58-59). We believe the exponential increase in the use of synthetic chemicals accompanies center pivot irrigation and is the genesis point for society-wide health complications.

- There are many more examples of endemic problems created by industrial agriculture, despite encouragement of Best Management Practices (MN Dept of Ag reports state that only about 1/3 of ag producers are employing BMPs). The people in and around the cities of Park Rapids and Perham can attest. Park Rapids, for example, has been forced to look for new sources for the municipal water supply because nitrate concentrations went above 10 ppm in the city's primary wells south and west of town, near fertilized farm fields. (Park Rapids Enterprise, April 23, 2011) A filtration system, to handle iron and manganese present in the deeper aquifer, has cost the city in excess of 3 million dollars. Even with these efforts, nitrates will eventually find their way through the leaky, interconnected Pineland Sands aquifers into the deeper wells (MN Dept of Health Mar 31, 2015 memo, p.174-176). This is evidenced by the sampling of tritium in the city's water, which is usually only present in surficial aquifers. (City of Park Rapids City Council Meeting February 23, 2016) Tritium was not present in the city's initial sampling (Leggett, Brashears and Graham, Inc Feb 28, 2013 Phase 2 Hydrogeologic Study, p.177-178). Park Rapids will soon be faced with the presence of nitrate in it's newest wells, forcing the city to install an additional $9-10 million dollars in filtration systems, even after creating a Drinking Water Supply Management Area (map attached, p.53). **We believe this bodes poorly for the often made claim that irrigation water appropriations in deeper aquifers of the Pineland Sands will not substantially affect residential wells, municipal wells or surface waters, and that, in fact, contamination is accelerated by these appropriations.**

In summary the Pineland Sands of north central MN is experiencing the poisonous cumulative effects of industrial agriculture permanently converting, through connected and phased actions, the prime forest habitats and sustainable, unimpaired public waters to an unsustainable row crop agriculture that

knowingly overuses, depletes and destroys natural resources to the point that the cumulative impacts approach being apocalyptic and irreversible.

In an effort to mitigate and eventually reverse the cumulative impacts previously listed we suggest the following:

1. An EAW for the Pineland Sands (a multi-county area) should be called for by MN DNR, MPCA, MDA, MDH or conceivably the EQB (since this is a multi-jurisdictional issue), necessarily followed by an EIS to show the true full scope of the conversions. The designated RGU could, as in the past, stop permitting water appropriations and put a halt to forest clearing and well drilling in the meantime. If deemed necessary, all water appropriation permits involved could be reviewed by the DNR, followed with adjustments made to volumes or outright revoking of unsustainable appropriations and those which will contaminate drinking water, ground water or surface water as allowed in MN Rules 103G. Local governments being designated the RGU has been problematic in the past, with due diligence wanting, likely caused by undue influence of industrial agriculture. As mandatory thresholds for conducting EAW have been crossed many times, without result, land conversion has been almost completely unregulated by local governments.

2. Common sense conditions need to be placed on all water appropriations permits stating that use of Mn waters for irrigation must not lead to chemical contamination or overuse of said waters.

3. The wording in 4410.4300 Subp.36.A. and B. should be modified to reflect the fact that installation of center pivot agriculture is a permanent conversion and should be considered the same as a golf course. The investment in such irrigation methods means converted land will stay that way until the profit motive is gone. This would give local government units better oversight of local impacts, in that an 80 acre threshold would trigger an EAW, instead of the often approached, but seldom crossed, square mile (640 acre) threshold that has done almost nothing to protect resources and ecology. Also agriculture, native prairie, forest, and naturally vegetated land designations were in the past considered one and the same in the state's eyes but this is no longer a tenable view, since one is overtaking the others to the detriment of all. Industrial agriculture, in particular, makes this very clear and creates the need to separate that designation from the others.

4. Connected actions and phased actions in the Pineland Sands area must be very seriously considered, since more forest clearing is very likely being planned soon, and years from now, and consolidation of existing small farms underneath a larger corporate umbrella is ongoing. In the past these actions have been universally ignored by authorities, but their cumulative impact is unavoidably obvious.

5. Promoting regenerative growing methods (see attached quick summary, p. 22, Forbes article p. 180-185) with redoubled intent will reduce and eventually eliminate chemical loading in the environment, and ease the strain on small farmers, as they are more intimate with the land and

better able to create and fill niches in the regenerative food marketplace than formula-farmed corporate agribusinesses. Regenerative methods will allow farmers to forego chemical inputs and build soil while producing high-value, nutrient dense food that the public has increasing demand for. Regenerative agriculture is predicted to claim the majority of carbon sequestration activity soon, and be the quickest way to bring ecological balance back to the landscape as more production is possible on fewer acres.

6. Reforesting converted land and retaining traditional forests in the Pineland Sands should be made a high priority for local and state government units through more purchase of parcels impacted or likely to be impacted by forest-to-field conversions. Encouraging current good stewards of forest (like Potlatch) via the tax code to remain in business in MN may be an option. The American Tree Farm System has some encouraging benefits for members and is supportive of FFO's (Family Forest Owners). Agriculture subsidies are an integral part of the formula that has put forests in jeopardy, especially those subsidies paid to mega-industrial agriculture. Conceivably a reduction in agriculture subsidies could be shifted toward FFO's, Potlatch, or other good stewards of forest. Forestry is a very sustainable industry, historically protecting resources well in the Pineland Sands and partnering marvelously with tourism, while industrial agriculture is proving to be quite the opposite.

7. Native American tribes like the Leech Lake Band of Ojibwe and White Earth Band of Ojibwe must be consulted regarding use of the area resources. The tribes did not cede the right to hunt, fish and gather in the 1855 treaty with the U.S. government (MN was still a territory). We believe it would be shameful travesty to have little left to hunt, fish and gather in these Pineland Sands when their treaty rights are affirmed in court, as they doubtless will be. Alanis Obomsawin spoke well when she said of Canada what also applies here; "*Canada, the most affluent of countries, operates on a depletion economy which leaves destruction in its wake. Your people are driven by a terrible sense of deficiency. When the last tree is cut, the last fish is caught, and the last river is polluted; when to breathe the air is sickening, you will realize, too late, that wealth is not in bank accounts and that you can't eat money."*

8. Protecting RGU personnel from industry influence is a part of the process of protecting the environment and resources, and without that protection little will be accomplished of value to the residents of Minnesota. Personnel that have stood in the way of this Pineland Sands forest-to-field conversions have often seen hardship as a result.

In closing we would ask the question "What kind of place do you want to live in? Do you want to be able to drink water without treating it, go outside without thinking about chemical exposure? Do you want to hunt, fish and gather; swim in a lake, pond or stream?

Do you want to have a forest to protect all these things?

On behalf of family, friends and neighbors, thank you for your consideration,

Mike Tauber mjtauber42@outlook.com 2540 Co 41 Nw 218 675 5717

Backus, MN 56435

Would you like to be contacted in the future if there are more land and water abuses in the area?

Have you, your family, animals or buildings ever been oversprayed by aerial applicators of chemicals?

Do you monitor your well for nitrates?

4410.1100 Subp. 2 e. Material evidence follows

DNR reports used in compiling this petition that are too lengthy to include:

https://www.lcc.leg.mn/lwc/Meetings/160426/DNR-RDO%20MOU.pdf

https://files.dnr.state.mn.us/input/environmentalreview/rdoffutt/rod-2019.pdf

https://www.dnr.state.mn.us/input/environmentalreview/rdoffutt/index.html

https://files.dnr.state.mn.us/input/environmentalreview/rdoffutt/rod-2019.pdf

Regenerative farming quick summary

The first step toward resolving chemical contamination of groundwater is simply to discontinue use of synthetic chemicals. This can be done when **regenerative agricultural methods** are employed, as many growers all across the nation can attest. See Forbes article (p.180-185)

A conventional grower might follow these steps to convert to regenerative growing which mimics nature and produces much more valuable, nutrient dense food without the high costs and risks entailed with chemical use.

- **Begin cover cropping**. Bare soil is not natural, and this eliminates most erosion problems while providing shelter for restarting soil life. Cover cropping helps retain soil moisture.
- **Employ no-till methods**. The microbial community does all the heavy lifting in the plant world, and when the soil remains undisturbed the network thrives, creating nutrients for plants and receiving reciprocal benefits in return.
- **Wean the land off chemical dependency**. Synthetic chemical inputs often have effects that make producers believe they need increasingly more inputs (an attractive feature to chemical salesmen). A producer may believe the chemical manufacturer's claims that more artificial input is scientifically proven to increase yields when in reality each chemical application kills a segment of the highly beneficial microbial community, ultimately resulting in soil sterility.
- **Diversify cropping**. Nature doesn't monocrop for good reasons, soil nutrients are depleted and pests accumulate. Polycultures encourage symbiotic relationships that balance nutrient distribution and production, thereby spreading pests amongst their predators.
- **Incorporate livestock.** Pasture management techniques like mob grazing and paddock fencing can be used to suppress undesired growth (weeds are just species whose usefulness is yet unknown) and push organic matter back into the soil, increasing soil fertility.

- **Become intimate with the land**. Knowing how to grow crops well comes from knowing what the land is capable of. Being on the land to observe, sample soil and crops, tend livestock and take advantage of weather conditions are all necessary to farm regeneratively. Smaller farmers will gain an advantage.

The overarching goal of regenerative farming is to promote soil health. With this focus organic matter is created, and plants are benefited along with animals and people who consume them. The ability for the soil to hold nutrient and water is greatly expanded, and smallest versions of biological life progressively attract the next higher level life form, to the extent that functional ecological pyramids are restored.

The most important feature of the restored functional ecology is a healthy root zone. A healthy root zone will house a robust, multi-species microbial community that has the ability to use up and/or degrade dangerous chemicals.

With the discontinuance of chemical use and the establishment of a healthy root zone the rehabilitation of contaminated waters becomes possible; irrigation equipment that helped bring the chemicals into the water table can now be employed to bring up contaminated water for a trip through a healthy root zone where soil microbes work as part of a larger ecological complex that naturally holds and filters water.

Area trout streams may be affected by these currently proposed projects, particularly Farnham Creek.

6264.0050 Subp. 4. Listing of designated trout streams.

I.	Cass County:			
(1)	Brittain Creek	138	31	35, 36
(2)	Cedar Creek	138	31	23, 26, 27, 28
(3)	Corey Brook	135	30	9, 16, 21, 22, 27
(4)	Dabill Creek	137	31	1, 2, 10, 11
		138	31	36
(5)	Farnham Creek	135	32	5, 6, 7
		136	32	3, 9, 10, 16, 20, 21, 29, 31, 32
(6)	Hay Creek	135	31	8, 9, 16, 17
(7)	Hoblin Creek	137	30	17, 18, 19
(8)	Olson Brook	136	30	12, 13, 14
(9)	Peterson Creek	134	30	29, 32
(10)	Pine River, South Fork	138	31	14, 23
(11)	Rogers Brook	134	30	29, 32
(12)	Spring Brook	139	26	3, 10, 11, 14
(13)	Stoney Brook	135	29	5, 8, 9
		136	29	30, 31, 32
		136	30	20, 21, 22, 25, 26, 27, 29, 30
		136	31	25, 26
(14)	Stoney Brook, N.Fk.	136	31	24, 25
(15)	unnamed creek	137	31	4, 5
(16)	unnamed creek	139	26	3, 10
(17)	unnamed stream	136	32	2, 3
(18)	unnamed stream	136	32	19, 30, 31
(19)	unnamed stream	135	30	15, 16, 21
SS.	Wadena County:			
(1)	Cat Creek	137	35	4, 9, 10, 11, 12, 13
(2)	Hay Creek	134	33	7, 8, 9, 10, 11, 16, 17, 18
(3)	Union Creek	134	35	4, 5, 7, 8, 18, 19, 30, 31

Trout Unlimited v. MINNESOTA DEPT. AGR.

Annotate this Case

528 N.W.2d 903 (1995)

TROUT UNLIMITED, INC., et al., Appellants, v. The MINNESOTA DEPARTMENT OF AGRICULTURE, Respondent.

No. C3-94-1900.

Court of Appeals of Minnesota.

March 7, 1995.

Review Denied April 27, 1995.

*905 Nicholas J. Spaeth, Steven M. Christenson, Dorsey & Whitney, Fargo, ND, for appellants.

Hubert H. Humphrey, III, Atty. Gen., Paul A. Strandberg, Asst. Atty. Gen., St. Paul, for respondent.

Considered and decided by DAVIES, P.J., and HUSPENI and FOLEY,[*] JJ.

OPINION

HUSPENI, Judge.

After reviewing an Environmental Assessment Worksheet (EAW) and comments responding thereto, the Commissioner of Agriculture (Commissioner) decided that an Environmental Impact Statement (EIS) was not required for a proposed irrigation project bordering Dead Horse Creek, a trout stream in Becker County.

Appellants Trout Unlimited, Inc. and the Osage Environmental Society filed an action in district court, seeking a declaratory judgment that an EIS was required for the irrigation project. The district court issued an order for summary judgment, concluding that the Commissioner had acted within his discretion when determining that there was no need for an EIS. Because we conclude that the Commissioner erred by failing to consider several comments received during the comment period, by failing to consider the potential cumulative effects of the project, and by relying on future permitting or monitoring efforts to control or redress potential problems, we reverse and remand to the Commissioner for preparation of an EIS.

FACTS

In early 1993, Triple J Farms applied for a water appropriation permit to irrigate approximately 140 acres of grass/brush land in Becker County, Minnesota. Triple J's proposed irrigation project is located on two sides of Dead Horse Creek, a trout stream. Regulations promulgated by the Minnesota Pollution Control Agency (PCA) provide that water taken from trout streams, if disinfected by approved methods such as simple chlorination, must meet the United States Health Department's drinking water standards.[1]

The land on both sides of Dead Horse Creek is very steep, particularly in portions of the ravine. Because of the steep slopes and coarse soil along the stream, a concern arose that the proposed irrigation could erode the stream banks, resulting in significant degradation. Interested citizens petitioned for environmental review of the irrigation project. The Minnesota Department of Natural Resources (DNR) and Minnesota Department of Agriculture (MDA) prepared an EAW for the proposed project. Initially, the DNR was designated as the responsible governmental unit for the environment review process, but in June 1993, the MDA was substituted as the responsible governmental unit.

The EAW raised several concerns, including "a significant potential for erosion," that would "not likely * * * be mitigable," and a "high potential for nitrate leaching under poorly-managed irrigated crops," requiring appropriate irrigation and nitrogen best management practices to reduce the potential impacts. The EAW also expressed a *906 concern that the clay layers separating the local aquifers could leak and allow movement of water between aquifer levels, which could result in the reduction of water flow in the trout stream during the late summer. The EAW also noted that future stages of Triple J's development were planned or likely. The EAW concluded that the current lack of information, the sensitive features of the site, and the high probability for adverse significant impacts to the trout stream required additional assessment and monitoring. The EAW also expressed a concern that any damages may not be mitigable, risking the state's prior investment in the stream as a trout habitat.

The EAW noted that the Becker County Soil and Water Conservation District (Conservation District) had approved a Conservation Plan for the proposed irrigation project, providing for a system of waterways, tillage residue requirements, and a 100-foot buffer strip between the crops and the stream. The EAW concluded, however, that the Conservation Plan required further modification, and that additional information was necessary to assess the level of projected erosion as a result of the irrigation project.

The EAW generated numerous comments from private citizens, organizations, and agencies. The DNR commented that insufficient information was currently available to make a recommendation on the need for an EIS. The DNR indicated that additional information was necessary concerning expected runoff of nutrients and pesticides to be applied during the irrigation process, the potential for erosion, future plans for farming and irrigation in the area, and plans for monitoring and enforcement.

The Department of Health expressed "serious concerns" with the proposed irrigation project, noting that it appeared to have "the potential for contamination of groundwater and surface water, with resultant negative impacts on drinking water and public health." Specifically, the Department of Health expressed concerns about erosion, fertilizer and pesticide leaching to groundwater, plans for future expansion or independent developments in the area, and a lack of monitoring plans.

The PCA also expressed concern about the lack of data in "several key areas," including nitrate runoff, erosion, and the possible existence of a subsurface connection between the source aquifer and the trout stream that could have "significant ramifications for creek water levels and temperatures." The PCA concluded that "the case for an EIS is compelling."

The comment period was extended[2] and the Conservation Plan was modified. The modified plan reduced the size of the project from 140 to 97 acres, and provided that, instead of a 100-foot buffer strip along the stream, as originally proposed, Triple J would keep 26 acres along the stream planted in alfalfa/hay, with small grain crops rotating every fourth year as a nurse crop for the alfalfa.

Nevertheless, the Department of Health, DNR, and PCA continued to express concern with the proposed irrigation project. The Department of Health stressed that additional information was necessary on the types and quantities of pesticides to be applied through irrigation and the plans of nearby landowners or Triple J for future similar projects.

The DNR recommended an EIS because the proposed irrigation project presented a "potential for significant environmental effects." The DNR indicated that there were risks of stream degradation that could occur before the DNR or MDA would have a chance to intercede. The DNR concluded that an EIS should address the potential for leachate discharge and migration, runoff impacts, and the potential for success of any proposed mitigation, including enforcement.

A memorandum from the PCA indicated a view that "significant environmental degradation would result" if the irrigation project were implemented. The PCA continued to recommend an EIS to explore further issues relating to thickness and permeability of the aquifers, potential ground water contamination from nitrate increases in the aquifers, *907 slope failure, sediment and nutrient erosion, and the effectiveness of the proposed buffer strips.

Despite the above concerns expressed by the DNR, PCA, and Department of Health, the Commissioner issued an order determining that the EAW had generated sufficient information to determine whether an EIS was necessary. The Commissioner concluded that an EIS was unnecessary because the proposed

irrigation project did not have a potential for significant environmental effects. The Commissioner specifically noted: "Areas where potential environmental effects have been identified have been addressed by appropriate mitigative measures incorporated into the project design or are subject to mitigation by ongoing public regulatory authority." Appellants brought a declaratory judgment action in district court. The court concluded that the MDA acted within its discretion in determining that there is no need for an EIS for the proposed irrigation project.

ISSUES

1. Did the Commissioner err by failing to consider all of the comments generated by the EAW?

2. Did the Commissioner err by failing to consider the potential cumulative effects of similar projects in the area?

3. Did the Commissioner err by failing to consider the potential impacts of chemigation and/or fertigation on the trout stream?

ANALYSIS Scope and standard of review

The district court limited its review to the record before the Commissioner, thereby functioning in an appellate, rather than a de novo, capacity. Accordingly, we must

make an independent examination of [the] administrative agency's record and decision and arrive at our own conclusions as to the propriety of that determination without according any special deference to the same review conducted by the trial court.

Reserve Mining Co. v. Herbst, 256 N.W.2d 808, 824 (Minn.1977).

We review the Commissioner's decision to determine whether it is unreasonable, arbitrary, or capricious. See Carl Bolander & Sons Co. v. City of Minneapolis, 502 N.W.2d 203, 207 (Minn.1993) (citing Swanson v. City of Bloomington, 421 N.W.2d 307, 313 (Minn.1988)). An agency's decision is arbitrary or capricious if "it represents the agency's will, rather than its judgment." Mammenga v. Department of Human Servs., 442 N.W.2d 786, 789 (Minn. 1989) (citing Markwardt v. State Water Resources Bd., 254 N.W.2d 371, 374 (Minn.1977)). A decision will be deemed arbitrary and capricious if the agency relied on factors which the legislature had not intended it to consider, if it entirely failed to consider an important aspect of the problem, if it offered an explanation for the decision that runs counter to the evidence, or if the decision is so implausible that it could not be ascribed to a difference in view or the product of agency expertise. Motor Vehicle Manufacturers Assoc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43, 103 S. Ct. 2856, 2867, 77 L. Ed. 2d 443 (1983).

I. Extent of the record

Appellants have appended to their brief certain documents obtained from the MDA's records. The Commissioner claims that he did not consider these documents, but based his decision solely upon the Conservation Plan, the EAW, and the comments specifically addressed in his order. The Commissioner admits, however, that the documents appended to appellants' brief were available to him when he was considering the need for an EIS.

A responsible governmental unit's decision on the need for an EIS must be based on "the environmental assessment worksheet and the comments received during the comment period." Minn.Stat. § 116D.04,

subd. 2a(b) (1992). The Commissioner argues that this language restricts the Commissioner to considering only the EAW and responses labeled "comments." We disagree, and decline *908 to read the statute as narrowly as the Commissioner urges. If the disputed documents were available and in the possession of the MDA, they are part of the record as defined by the statute, and should have been considered by the Commissioner when determining whether an EIS was necessary.

II. Cumulative effects of future projects

An EIS must be prepared for projects that have a "potential for significant environmental effects." Minn.Stat. § 116D.04, subd. 2a (1992). A responsible governmental unit should consider several criteria when deciding whether an EIS must be prepared. One of these factors is the "cumulative potential effects of related or anticipated future projects." Minn.R. 4410.1700, subp. 7B (1993). In addition, "[c]onnected actions and phased actions shall be considered a single project for purposes of the determination of need for an EIS." Id., subp. 9.

The Commissioner concluded:

Any potential impacts associated with possible future expansion of irrigation of cropland cannot be inferred from this project, nor can it be inferred that this project will significantly stimulate additional development of irrigated cropland. Since private decisions on whether to irrigate cropland involve individual financial, physical and environmental circumstances, one project is unlikely to have a significant effect on decisions on other projects in the area or the state.

In light of the record in this case, we conclude the above determination is arbitrary. The EAW itself stated that future stages of irrigation projects in the area were "planned or likely." A memorandum from the PCA stated that a nearby landowner had three or four parcels of land that he hoped to convert to irrigate and farm, pending the outcome of the Triple J permit. This land was approximately one mile upstream from Triple J and adjacent to Dead Horse Creek.

Letters from the DNR and Department of Health suggested that it would be impossible to determine the potential for significant environmental effects associated with the irrigation project without determining the extent of future plans for farming and irrigation in the area. In fact, the MDA itself stated in a letter to Triple J that the Department of Health believed additional information was necessary on "the plans of nearby landowners in terms of similar farming operations."

III. Potential impact of chemigation and fertigation

When considering whether to require an EIS, a responsible governmental unit must consider the "type, extent, and reversibility of environmental effects" and "the extent to which the environmental effects are subject to mitigation by ongoing public regulatory authority." Minn.R. 4410.1700, subp. 7A, C. "Mitigation" includes avoiding or limiting the size of a project, repairing or restoring the environment, working to preserve or maintain the environment during the life of the project, or replacing or substituting resources. Minn.R. 4410.0200, subp. 51 (1993).

The EAW noted that chemicals could impact Dead Horse Creek in several ways, including:

[i]ncreased movement of pesticides to surface water that stem from aerial or irrigation applied drift, increased pesticide application with the change in crops, pesticide adsorption to particles susceptible to

erosional transport, and pesticides leaching to ground water that then could be transported to the stream.

The DNR, Department of Health, and PCA also expressed grave concerns that chemicals applied through the irrigation project could result in a potential for significant environmental effects.

The DNR notified the Commissioner that the likely impacts of herbicides, insecticides, and fungicides on the stream required assessment, and that it was impossible to determine the potential for significant environmental effects without determining the extent of the expected chemical input. The Department of Health also informed the *909 Commissioner that information regarding the types and quantities of pesticides, herbicides, and fertilizers was needed before issuing a permit, and that such information could be part of an EIS. The PCA also expressed a concern with the potential for chemical movement into the stream.

The MDA itself noted in a letter to Triple J that several questions needed to be answered before a decision could be made on an EIS, including "What types and extent of chemical inputs are expected to be used in this farming operation?" and "What measures will be taken to protect Dead Horse Creek from chemical or nutrient inputs associated with the proposed farming activity?"

The Commissioner, having before him a record containing the concerns highlighted in the EAW and expressed by the DNR, Department of Health and the PCA, recognized that "the potential for nitrate leaching through the upper aquifers into Dead Horse Creek is a major concern with respect to the proposed project." The Commissioner also recognized that Triple J would need a chemigation permit to apply any pesticides through the irrigation system and a fertilizer chemigation permit to apply fertilizers through the irrigation system. The Commissioner ultimately concluded, however, that: "Monitoring and permit conditions can identify significant impacts and modify or terminate the project if necessary."

Our review of the record and the applicable statutes convinces us that this conclusion cannot be sustained. Under the Commissioner's analysis, the irrigation project would go forward without an EIS and in the event significant environmental effects did occur, the Commissioner would then rely on monitoring or restrictive permitting procedures to reduce or eliminate those deleterious effects. The very purpose of an EIS, however, is to determine the potential for significant environmental effects before they occur. By deferring this issue to later permitting and monitoring decisions, the Commissioner abandoned his duty to require an EIS where there exists a "potential for significant environmental effects." Minn.Stat. § 116D.04, subd. 2a. The potential impacts of chemicals should be analyzed during the EIS process, rather than waiting until Triple J has expended time and effort on its irrigation and farming operations only to face the risk of later restriction or withdrawal of its permits.

Finally, the Commissioner erred by confining the environmental review process to the EAW, in derogation of the more extensive analysis contemplated by an EIS. The EAW is only a "brief document which is designed to set out the basic facts necessary to determine whether an environmental impact statement is required for a proposed action." Minn.Stat. § 116D.04, subd. 1a(c) (1992). See Bolander, 502 N.W.2d at 207 (EAW process is designed to discover whether a project may harm the environment, while EIS is "more extensive"). When an EAW has indicated, as here, that a project may harm the environment, use of that indication to conclude that an EIS is unnecessary, "makes a mockery of the EAW as a decisionmaking tool." John H. Herman and Charles K. Dayton, Environmental Review: An Unfulfilled Promise Bench and Bar, July 1990 at 31, 36. The record in this case exemplifies the need for

careful evaluation of and differentiation between the purpose served by an EAW and that served by an EIS. The record also supports but one conclusion: in this case an EIS must be prepared.

DECISION

As the Environmental Assessment Worksheet revealed, Triple J's proposed irrigation project poses a potential for significant environmental effects. We therefore reverse and remand to the Commissioner for preparation of an Environmental Impact Statement.

Reversed and remanded.

NOTES

[*] Retired judge of the Minnesota Court of Appeals, serving by appointment pursuant to Minn. Const. art. VI, § 10.

[1] Minn.R. 7050.0420, 7050.0220, subp. 2B (1993).

[2] Minn.R. 4410.1700 (1993) authorizes a responsible governmental unit to postpone a decision on the need for an EIS for up to 30 days in order to obtain additional information.

List of Minnesota Unique Well and Boring Numbers for wells in North Germany Twp. of Wadena County and Byron Twp. of Cass County, along with reported static water levels and pumping levels after testing.

Well #	Static water level	Pumping level
805420	4’	29’1”
805421	5’	107
805422	2’	97’9”
791570	3’	36’
791571	2’	42’
791572	6’	77’
791573	2’	26’
791574	2’	30’
791575	3’	26’

791578	1’	26’

DEPARTMENT OF AGRICULTURE

Byron #1 Field Study

Groundwater Monitoring Report

January 2019

Minnesota Department of Agriculture
Pesticide and Fertilizer Management Division

CLEAN WATER LAND & LEGACY AMENDMENT

Introduction

Background and Partners

The Byron #1 Field Study began in 2014 and includes the monitoring of nitrate movement below an irrigated agricultural field recently transitioned from managed timberland. This field is located in Byron Township, Cass County, Minnesota. The project is supported by a core group of partners from both the private and public sectors (see box below).

The core project team members are:

- Central Lakes College, Staples (CLC)
- The Minnesota Department of Agriculture (MDA)
- University of Minnesota Extension (U of M)
- Northwest AqwaTek Solutions (NWATS)
- Sustainable Farming Association of Minnesota (SFA)
- The cooperating landowner

The property is managed cooperatively by CLC and the landowner with each raising crops throughout the rotation. The remaining partners fill supporting roles that help inform management decisions. The MDA monitors soil pore water and groundwater nitrate concentrations below and around the field, NWATS monitors groundwater quality, movement, and water levels and provides related consultation, the U of M has been involved in irrigation management, and SFA advises the group about soil health matters including cover crops.

Monitoring for nitrate concentrations in the soil and shallow groundwater of Byron #1 began in 2014, the first year of crop production. Nitrate in groundwater is of interest because it can be detrimental to the health of infants if consumed in water or formula at concentrations above 10 mg/L for nitrate as nitrogen. Nitrate is a common form of plant-available nitrogen and can come from nitrogen fertilizer, manure, or the breakdown of soil organic matter. If not utilized by plants or retained in soil organic material, nitrate can be moved by water through the soil profile and into the groundwater. Since water moves quickly through sandy soil, the potential for nitrate contamination of groundwater in shallow aquifers in Minnesota's Central Sands region is high.

Purpose and Objectives

The overall mission of the partnership is to "design and execute a land management plan that fosters soil health and provides adaptive management options that can be replicated to ultimately balance financial and environmental sustainability."

Specific to the study at Byron #1, the purpose of the work is to help researchers, the ag industry, and government better understand the potential for groundwater quality impacts from irrigated agriculture on loamy sands with shallow water tables. This is being accomplished by monitoring nitrate concentrations and movement under careful agronomic management over time and throughout the crop rotation. This directly ties in with the overall project objectives:

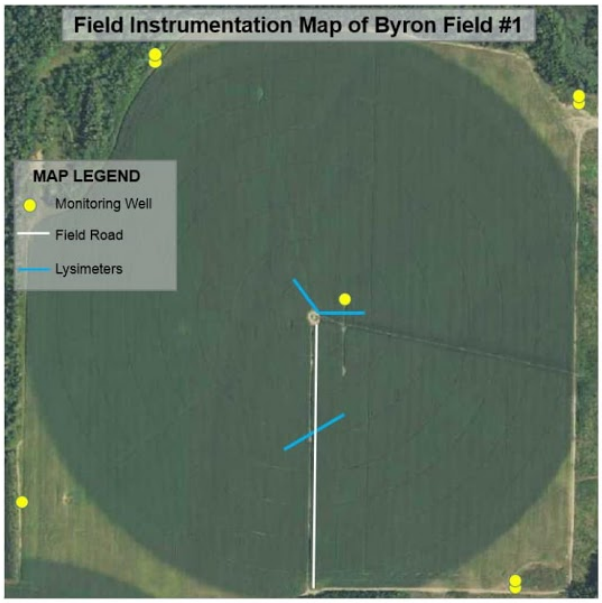
1. Maintain a healthy and balanced ecosystem.
2. Utilize agricultural best management practices.
3. Monitor groundwater flow and quality.
4. Study changes in quality of soil pore water under various cropping rotations.

Currently, the work at Byron #1 is focused on scientific monitoring, environmental sustainability, and less on economic profitability. However, the long-term goal is for the work to be both economically profitable and environmentally sustainable.

Factors in Nitrate Movement

Nitrate movement through the soil depends on several factors. Nitrate is highly soluble in water and moves with the water within the soil. Soil properties impacting water movement, such as soil texture, thus also impact nitrate movement. Water moves faster through coarser sandy soils compared to finer textured soils, and coarser sandy soils have comparatively lower water holding capacity, making precipitation intensity and irrigation management critical factors in evaluating potential nitrate loss. Irrigation management aims to provide adequate water to the crop without over application. However, precipitation timing and quantity can be difficult to predict and are highly variable; this variability is beyond a farm manager's control and can occasionally result in nitrate loss below the crop root zone.

Nitrate movement is also impacted by the crop being grown, such as the crop's nitrogen needs, its efficiency in nitrogen uptake, and the timing of its growth. Weather impacts crop growth and, therefore, impacts efficiency of nitrogen uptake. Weather also impacts mineralization, the breakdown of soil organic matter resulting in the release of nitrogen and other plant nutrients to the soil. Mineralization continues after the primary crop is no longer actively taking up nutrients, leaving unutilized nitrogen in the soil that can be lost as nitrate below the crop root zone. Cover crops can help manage nitrate movement by capturing and recycling nutrients present in the soil profile outside the growing season. Additionally, cover crops can utilize soil moisture when the primary crop is not actively growing—and potentially reduce the risk of nitrate loss.



Nitrate movement in Byron #1 is being monitored using suction tube lysimeters to collect water from soil pores at a four-foot depth and monitoring wells in the shallow aquifer around the field.

Materials and Methods

Site Characteristics

Byron #1 has been established on 160 acres that was previously managed for timber production and most recently harvested in 2012. After timber harvest, the land was purchased for irrigated agricultural production, and a drop-nozzle, center pivot irrigation system covering 129 acres was installed in the field in 2014. The irrigation system has telemetric control capabilities that allow operators to monitor, start, or stop its operation remotely from a computer or smart phone. The soil at the site is predominantly Friendship loamy sand and Menahga loamy sand. Groundwater is 10-20 feet below the field's surface. Meteorological information is available from a weather station from the Central Minnesota Agricultural Weather Network located at the CLC campus, within 15 miles of the site. Rainfall information is collected using manual rain gauges at the site.

Cropping History and Nitrogen Management

Because of the characteristics of Byron #1, farm operators maintain a crop rotation, nitrogen management and other agronomic management decisions focused on reducing nitrate loss beneath the field. The team is using an adaptive approach to management—actively using monitoring data to inform decisions in the crop rotation and to fine-tune nitrogen management.

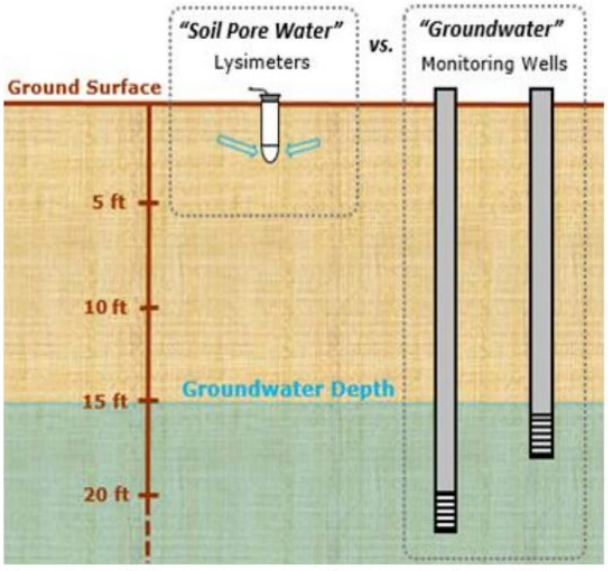
Crop rotation and environmental sustainability have been focal points for agronomic management. As the transition to row crop agriculture was finalized, the first crop was soybeans, grown in 2014, followed by corn in 2015, and soybeans in 2016. A rye cover crop was established in fall 2016 and was grown to maturity the following year. Grain lost during 2017 harvest was incorporated into the soil to establish a rye cover crop for fall and early spring; and peas were grown in 2018 and followed by a cover crop of oats and peas in the fall. Beginning in 2016, the management team decided to focus the crop rotation exclusively on crops with low nitrogen fertilizer requirements such as rye, seed potatoes, peas, barley, and soybeans.

In addition to a specialized crop rotation, agronomic management has included the use of nitrogen fertilizer Best Management Practices (BMPs): following U of M nitrogen rate guidelines, using split applications of nitrogen fertilizer, and incorporating nitrogen fertilizer into the soil with tillage or irrigation. The project includes cover crops to promote soil health and to capture and hold nitrogen for the following season.

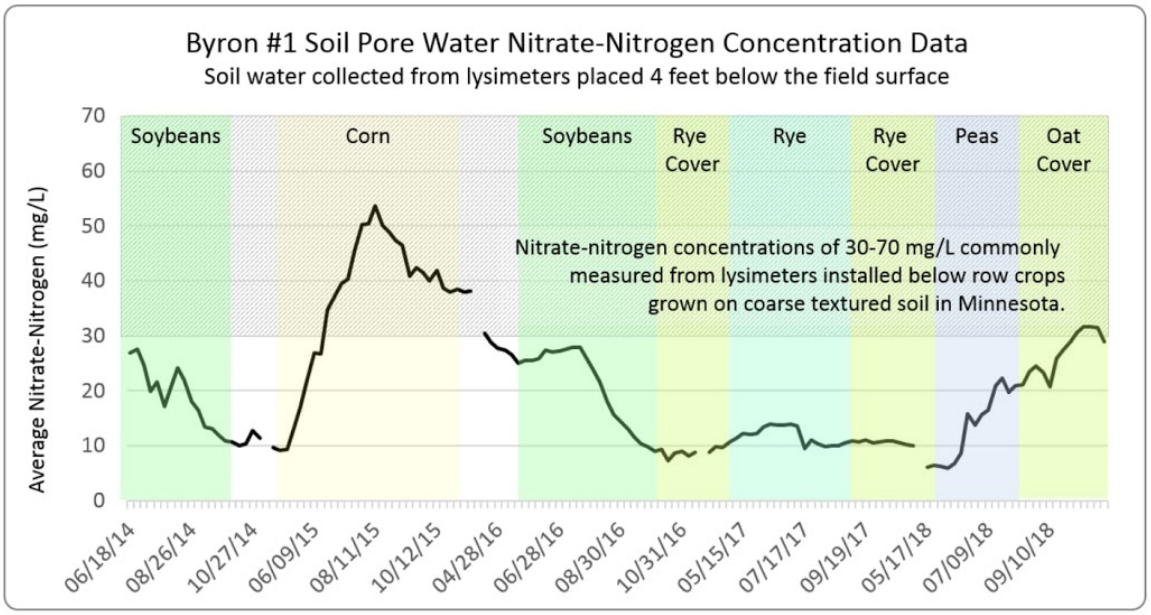
The work at Byron #1 has included irrigation management tools and has incorporated support from the University of Minnesota's irrigation specialist. Irrigation management has been done by experienced operators examining the soil to assess irrigation needs during the growing season. The project has also utilized soil moisture sensors and the irrigation checkbook method to help inform irrigation management decisions.

Soil Water Monitoring: Suction Tube Lysimeters

Suction tube lysimeters in Byron #1 are used to collect water from the soil's unsaturated zone beyond the reach of crop roots. Fifteen lysimeters were installed in 2014 at a depth of four feet. The tips of the lysimeters are made of a porous ceramic material. When vacuum is applied to lysimeters, water from the soil is drawn in through these ceramic tips. From April through November, water is collected from the lysimeters weekly and analyzed for nitrate concentration using an ultraviolet spectrophotometer. Results are averaged to account for variability and to gain more representative information. For quality assurance, 10% of the samples are tested by a certified lab in addition to being tested with the spectrophotometer.



This image illustrates the vertical difference between soil pore water collected in lysimeters versus groundwater collected in monitoring wells.

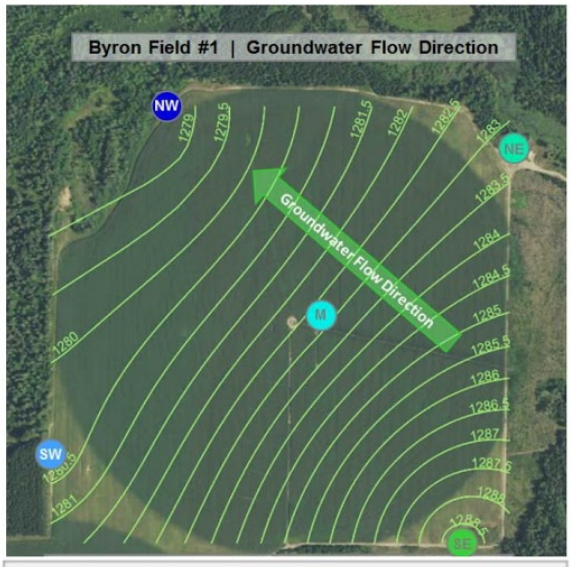


The black line in the graph above shows the average soil pore water nitrate-nitrogen concentrations observed at four feet below the field surface of Byron #1 from 2014 through 2018. Nitrate-nitrogen measured below other similar field demonstration sites throughout Central Minnesota have ranged from 30-70 mg/L throughout rotations that include corn, soybeans, potatoes, and edible beans.

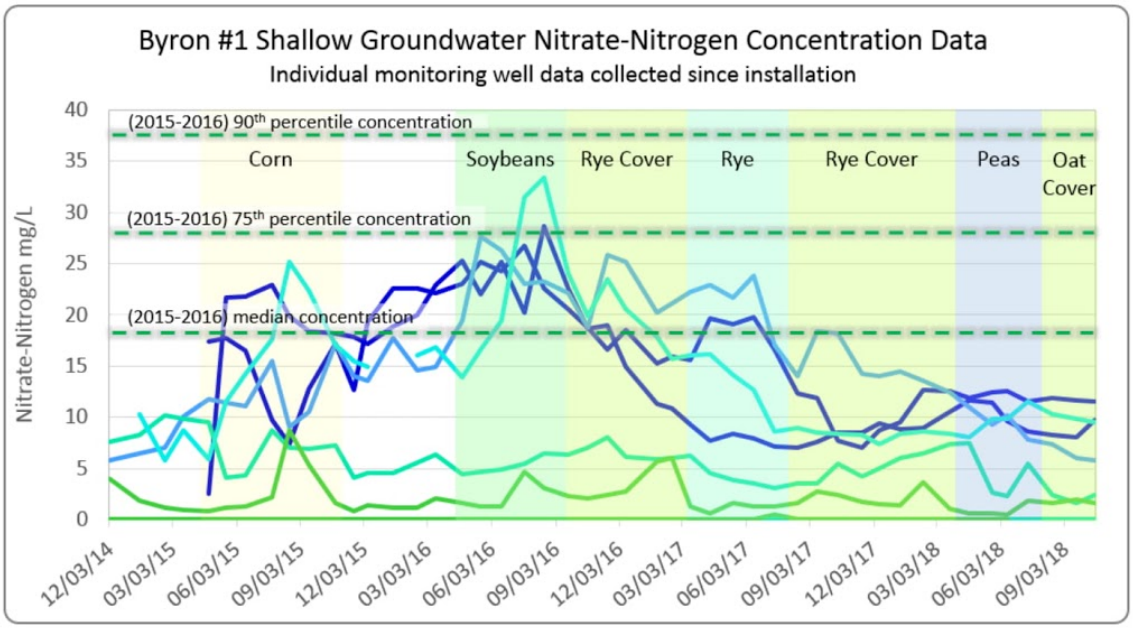
Groundwater Monitoring

The Minnesota Department of Agriculture installed seven shallow monitoring wells around the perimeter of Byron #1, and partners have provided access to an additional well near the center of the field. Depths of these wells range 8-22 feet. Wells are paired, where possible, with one positioned to collect water from near the water table and the other 4.5 feet deeper in the aquifer. Groundwater monitoring in the field began in December 2014 following the first year of crop production. Groundwater samples are collected each month and analyzed for nitrate concentrations.

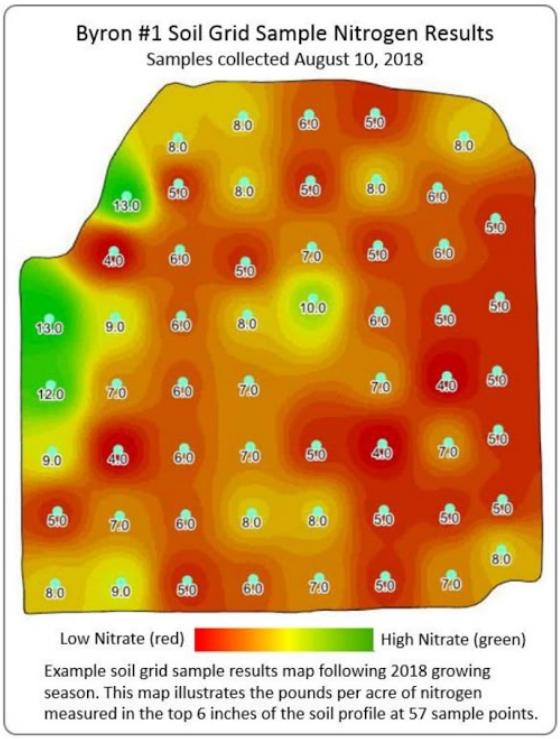
The location and depth of the eight monitoring wells used in this study are illustrated in the image and table shown on the right. The nitrate-nitrogen data collected from these wells is shown in graphic form on the following page.



Byron #1 monitoring well depth in feet				
Southeast (SE) Wells	Northeast (NE) Wells	Middle (M) Well	Southwest (SW) Well	Northwest (NW) Wells
11.4	17.7	22.0	16.2	8.1
16.2	22.2			12.7



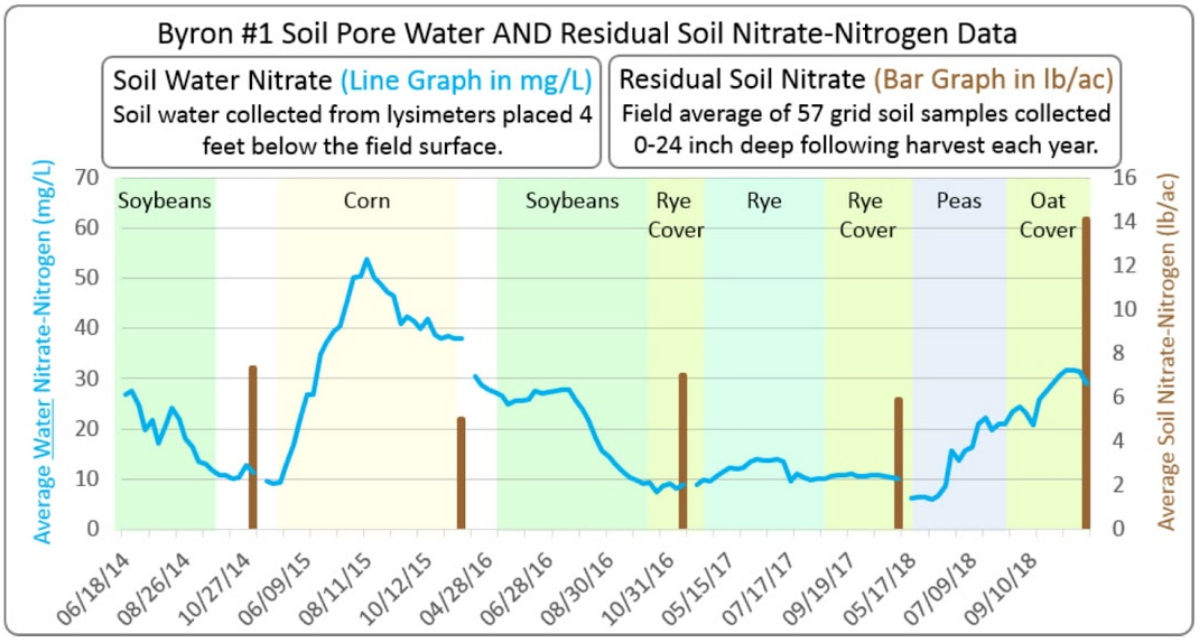
The solid lines in the graph above show the nitrate-nitrogen concentrations measured from individual monitoring wells placed around the perimeter of Byron #1. The dashed horizontal lines illustrate statistical benchmarks for comparable nitrate-nitrogen data collected from Minnesota Department of Agriculture monitoring wells in central Minnesota in 2015-2016. This monitoring network employs shallow wells at the edge of agricultural fields very similar to the wells placed near Byron #1. This comparable dataset includes information from 84 well sites and 174 samples collected throughout a 14-county area in central Minnesota that includes Cass County where the Byron #1 field is located. 75% of the groundwater nitrate-nitrogen samples collected at Byron #1 fall below the median concentration of samples collected from this central Minnesota monitoring network.



Example soil grid sample results map following 2018 growing season. This map illustrates the pounds per acre of nitrogen measured in the top 6 inches of the soil profile at 57 sample points.

Soil Grid Sampling

Byron #1 has had soil grid sampling done each year after harvest since 2014. For the sampling, the field is divided into 2.5 acre grids, and a composite sample is collected from each of the 57 grids. The soil is sent to a lab and analyzed for organic matter, nitrate-N, phosphorus, and potassium. This analysis provides useful information about nitrate concentration, transformation and movement in the soil and is used by farm operators to manage soil fertility.



The figure above illustrates the relative difference between nitrate-nitrogen concentrations in soil pore water during the season and in the soil following harvest. Soil pore water concentration (mg/L) is measured at a discrete point in the soil profile four feet below the soil surface. The soil nitrate concentration (lb/ac) is a composite of the top two feet of the soil profile. Because of the relationship between soil nitrate content and nitrate concentration in the water a relative comparison can be made. However, it should not be assumed that all of the soil nitrate measured at the end of the growing season will be lost to the groundwater during the late fall and early spring. Many factors including soil texture, organic matter, temperature, moisture, crop type and rooting system influence nitrate concentration and movement. The soil nitrate levels measured in this field following harvest are relatively low.

Byron #1 Post-harvest Soil Grid Sample Results
(Field average measured from 0-6 and 6-24 inch depth)

Year	Organic Matter		Nitrogen		
	%		lb/acre		
	0-6 inch	6-24 inch	0-6 inch	6-24 inch	0-24 inch
2014	1.7	0.5	3.5	3.8	7.3
2015	1.0	0.4	1.8	3.2	5.0
2016	1.0	0.6	3.3	3.7	7.0
2017	1.3	0.4	1.9	4.0	5.9
2018	1.2	0.6	6.7	7.4	14.1

Summary

The study underway at Byron #1 is intended to further our understanding about nitrogen fertilizer impacts to groundwater in this landscape. Researchers, the ag industry, government agencies, and the public need scientific data like this to inform their conversations on the topic. In the first few years of the study, the shallow groundwater monitoring data collected indicates some impact from row crop production on the land's surface. More recently, however, that same groundwater monitoring data has shown improvement in water quality that is associated with changes in the cropping and fertilizer management practices.

Careful cropping and nitrogen fertilizer management decisions that balance both economic and environmental considerations are critical to reducing the risk of nitrogen fertilizer loss to groundwater. Study data from Byron #1 shows that management efforts have reduced impacts to water quality, but financial data shows a negative net return in four out of the first five years (see Appendix). Considering economics, the unique approach to nitrogen management being used at Byron #1 isn't likely to generate wide-spread adoption at this point; and additional study is needed as the project team works to balance economic and environmental goals. The groundwater monitoring at this field is intended to be a long term effort lasting ten years or more. Ongoing monitoring of water quality data will allow future discussion and project conclusions following observation under varied weather patterns and repeated cropping rotations.

For questions related to the data summarized in this report you may contact:

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Byron #1 Field Study
Groundwater Monitoring Report
Financial Appendix

*Byron #1 Financial Data							
Year	Crop	Yield Bu/Acre	Total Direct Expenses	Total Overhead Expenses	Total Expenses	Total Gross Return	Net Return Per Acre
2014	Soybeans	22	$310.58	$154.44	$465.02	$230.00	-$235.02
2015	Corn	170	$658.49	$30.94	$689.43	$569.50	-$119.93
2016	Soybeans	50	$399.47	$45.33	$444.80	$501.00	$56.20
2017**	Rye	39	$145.98	$70.17	$216.15	$133.77	-$82.38
2018**	Peas	32.5	$184.08	$58.87	$242.95	$225.43	-$17.52
						△Net Return/Acre to Date:	-$398.65

*Provided by Central Lakes College Ag and Energy Center
**Based on area averages; CLC was not the operating entity
△**Agronomic practices have been performed with environmental sustainability as the primary consideration; financial return has been second**

The ***direct*** expenses entered in the crop budgets are expenses that are directly related to the number of acres on the farm. Direct expenses for Byron #1 include seed, fertilizer, chemicals, irrigation expenses, marketing, land rent, and crop insurance. In some cases, the term "Variable Expenses" is used as these type of expenses vary from year to year.

The ***overhead*** expenses, sometimes referred to as "Fixed Expenses," are those types of expenses for an enterprise that tend to occur annually. That is, they are more of a fixture to the farming operation as a whole and need to be allocated to an enterprise for payment. Fixed expenses for Byron #1 include depreciation on buildings and equipment, staff salaries, and other CLC Farm overhead costs such as maintenance.

The website www.finbin.umn.edu is where all the data collected on individual farms across the state of Minnesota and beyond is "binned." One can access an enterprise and query a search regarding many areas such as row width comparisons, impact of technologies employed, tillage methods and so on. The data is thoroughly reviewed annually for accuracy and comes from the producers themselves that are enrolled in the Farm Business Management program.

ground water

Effects of Land Use on Ground Water Quality in the Anoka Sand Plain Aquifer of Minnesota

by Michael D. Trojan[1,2], Jennifer S. Maloney[1], James M. Stockinger[1], Erin P. Eid[1], and Mark J. Lahtinen[1]

Abstract

We began a study, in 1996, to compare ground water quality under irrigated and nonirrigated agriculture, sewered and nonsewered residential developments, industrial, and nondeveloped land uses. Twenty-three monitoring wells were completed in the upper meter of an unconfined sand aquifer. Between 1997 and 2000, sampling occurred quarterly for major ions, trace inorganic chemicals, volatile organic compounds (VOCs), herbicides, and herbicide degradates. On single occasions, we collected samples for polynuclear aromatic hydrocarbons (PAHs), perchlorate, and coliform bacteria. We observed significant differences in water chemistry beneath different land uses. Concentrations of several trace inorganic chemicals were greatest under sewered urban areas. VOC detection frequencies were 100% in commercial areas, 52% in sewered residential areas, and <10% for other land uses. Median nitrate concentrations were greatest under irrigated agriculture (15,350 µg/L) and nonsewered residential areas (6080 µg/L). Herbicides and degradates of acetanilide and triazine herbicides were detected in 86% of samples from irrigated agricultural areas, 68% of samples from nonirrigated areas, and <10% of samples from other land uses. Degradates accounted for 96% of the reported herbicide mass. We did not observe seasonal differences in water chemistry, but observed trends in water chemistry when land use changes occurred. Our results show land use is the dominant factor affecting shallow ground water quality. Trend monitoring programs should focus on areas where land use is changing, while resource managers and planners must consider potential impacts of land use changes on ground water quality.

Introduction

The Anoka Sand Plain Aquifer in east central Minnesota (Figure 1) is a large surficial aquifer consisting predominantly of outwash sands and gravel. Most of the approximately half-million people living on the Anoka Sand Plain derive their drinking water from the Anoka Sand Plain Aquifer. The aquifer is considered sensitive to contamination from chemicals that may leach through the vadose zone (Minnesota Department of Natural Resources 1998). Areas overlying the Anoka Sand Plain have among the fastest growing populations in Minnesota, with 1990s growth rates ranging from 10% to 50%, compared to the statewide average of 6% (Figure 1). Changes in population correspond with changes in land use, including expansion of urban areas, changes in agricultural practices, and increasing numbers of nonsewered communities that are not linked to metropolitan areas.

Similar trends exist in the United States. The U.S. population grew by ~13% between 1990 and 2000, with much of this growth occurring in areas of urban expansion (U.S. Census Bureau). Total hectares in agricultural production decreased by nearly 3.2 million between 1987 and 1992 (Census of Agriculture 1992). During the same period, however, irrigated hectares increased by more than 7 million.

Land use changes are likely to result in changes in ground water quality. Land use impacts on ground water quality include increased concentrations of major ions, changes in oxidation-reduction conditions, and increased concentrations of minor elements in developed land use settings compared to nondeveloped settings (Cain et al. 1989; Anderson 1993; Eckhardt and Stackelberg 1995). Cain et al. (1989) observed greater detection frequency of

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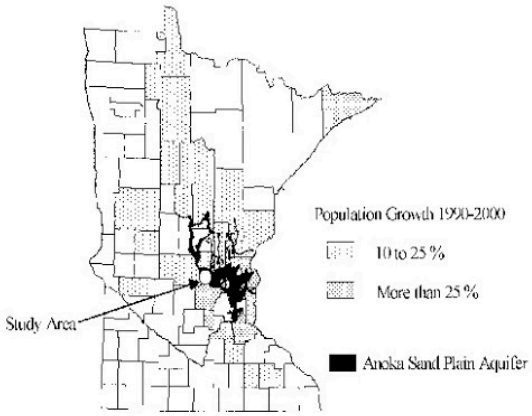

Figure 1. Location of the study area, shown as an open circle, with respect to the Anoka Sand Plain Aquifer. Areas with population growths of 10% to 25% or exceeding 25% are highlighted.

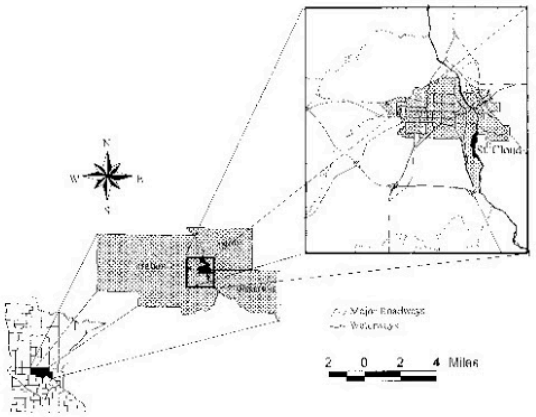

Figure 2. Detailed location of the St. Cloud study area.

volatile organic compounds (VOCs) under urban and commercial areas and greater detection frequency of pesticides under agricultural areas compared to nondeveloped areas. Factors within land use settings also affect the quality of ground water. For example, in areas not serviced by municipal sewers, age and density of septic systems affect ground water quality (Yates 1985; Flipse et al. 1984; Gold et al. 1990; Katz et al. 1980). Miller (1975) observed median nitrate concentrations of 2.0 and 13.0 mg/L in ground water under 0.2 ha lot developments that were two and 15 years old, respectively. In residential areas, turfgrass management practices affect water quality (Morton et al. 1988; Petrovic 1990). Geron et al. (1993) observed lower nitrate loss on seeded turfgrass plots compared to sodded plots, although nitrate concentrations were greater on seeded plots during the first year of the study, reflecting a disturbed soil condition. Morton et al. (1988) observed a factor of 10 increase in nitrogen loss under home lawns overwatered with 3.75 cm/week of water. Within agricultural areas, cropping practices affect ground water quality (Kitchen et. al 1997). Landon et al. (1993), for example, observed greater concentrations of nitrate in shallow ground water under potatoes than under sweet corn.

Effects of human activity on ground water quality will be greatest in sensitive hydrologic settings. These settings are not unique to east central Minnesota. Strong correlations between ground water quality and land use have been observed elsewhere when sensitive aquifers underlie areas where land use is rapidly changing (Ayers et al. 2001; Domagalski et al. 2000; Bruce and McMahon 1996).

The combination of land use change and a sensitive hydrologic setting make east central Minnesota an excellent location to study impacts of land use on ground water quality. Although there is considerable information in the literature relating ground water quality to land use, there are difficulties with these types of studies (Eckhardt and Stackelberg 1995; Barringer et al. 1990). These difficulties include ensuring that a sample represents the intended land use, avoiding spatial correlation, working with non-normal distributions of data, and sampling for chemicals with a low detection frequency. In this study, we tested the hypothesis that ground water quality is not affected by land use. We attempted to overcome the aforementioned limitations by establishing a monitoring network that represented discrete land uses and would be sampled quarterly over a period of four years. We applied nonparametric analysis methods to determine the effect of land use, sampling season, and time on ground water quality.

Methods and Materials

Physical Setting

The study area is located on the Anoka Sand Plain near St. Cloud, Minnesota, and encompasses ~50 km^2 (Figures 1 and 2). The St. Cloud metropolitan area has a population of ~100,000 and is undergoing rapid urbanization. In selecting St. Cloud, we felt that information gathered from this study could be used for land use interpretations in similar hydrogeologic settings.

The surficial geology consists primarily of outwash deposits of sand and gravelly sand associated with the Des Moines Lobe (Minnesota Geological Survey 1995). Localized alluvium consisting of <2 m of silt loam and loamy sand occurs along the Sauk River, which dissects the study area before discharging to the Mississippi River. Isolated peat deposits, bedrock outcrops, and till lenses typically comprise areas <1.0 km^2. Peat deposits, where they are mapped, are associated with organic deposits >1 m in thickness and are found in marshes located in the southern portion of the study area. Till deposits are associated with the Wadena Lobe and are sandy loam, unsorted, and become very dense with depth. A schematic cross-section through the study area is shown in Figure 3.

Average annual precipitation at the National Weather Service St. Cloud Airport Station from 1948 to 1996 was 697 mm, with 457 mm occurring from May through September. Average annual ground water runoff to the Sauk River for the period 1934 to 1971 was 95 mm (Helgeson et al. 1975). This value represents average recharge over a watershed of 1489 km^2. Although the value for recharge was computed using data only through 1971, much of the watershed has remained in row crop agriculture and the

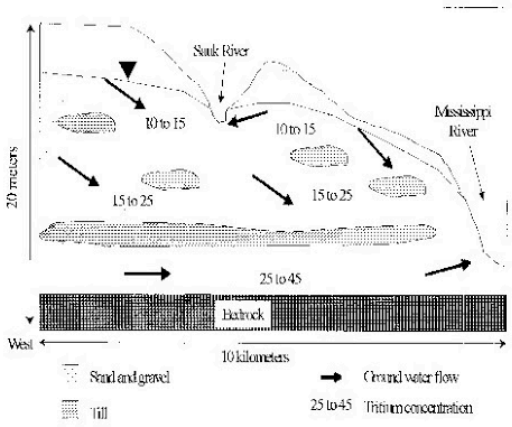

Figure 3. West to east schematic cross-section through the center of the study area.

recharge value for the watershed has probably changed little. Recharge in areas near St. Cloud, however, is likely to have changed since 1971 because land use has changed significantly. Recharge is greatest in areas where coarse textured soils occur and typically occurs in spring after snow melts and the soil thaws.

Soils in the study area consist of the Hubbard-Dickman and Estherville-Hawick associations (U.S. Department of Agriculture 1985). The Estherville-Hawick association occurs along the Sauk River and consists of nearly level to steep, excessively drained, moderately coarse- and coarse-textured deposits occurring on outwash plains and stream terraces. The Hubbard-Dickman association occurs over the remainder of the area and consists of nearly level to gently sloping, excessively and well-drained, moderately coarse- and coarse-textured deposits occurring on outwash plains and stream terraces. Minor soils make up ~35% of each association and are typically associated with more poorly drained soils in till or organic deposits.

The surficial aquifer is within 3 to 8 m of the land surface. Thickness of the surficial aquifer varies from 1 to 15 m. Ground water flows in a general eastern direction, discharging locally to the Sauk and Mississippi rivers. Till, ranging in thickness from 1 m to >10 m, separates the water table aquifer from a buried sand aquifer. The average thickness of the till is ~3 m but the till is not continuous across the study area. There is, therefore, hydraulic interaction between the surficial and confined aquifers in those areas where the till is thin or absent. Locally, ground water flow may be affected by discharge to the Sauk River, pumping for irrigation, and dewatering of sand and gravel quarries. General ground water hydrology is illustrated in Figure 3.

Establishing a Monitoring Network

We established a ground water monitoring network in 1996. The network included 23 wells completed in the upper meter of the aquifer. Well screens, 1.6 m in length, were set 1 m into the aquifer at the time of drilling. All wells were fully developed within two weeks of drilling.

At least three wells were completed in each of the following land uses:

1. Nonirrigated row crop agriculture (corn and soybeans)
2. Irrigated row crop agriculture (corn and soybeans)
3. Nonsewered residential (homes serviced by Individual Sewage Treatment Systems)
4. Sewered residential (homes serviced by municipal sewers)
5. Commercial and industrial
6. Nondeveloped

At the time of drilling, for a minimum of 100 m in the upgradient flow direction from the well, > 90% of the area consisted of a discrete land use. Each well thus discretely represented one of the six land uses. Nondeveloped areas included forested land and a field that had been in the Conservation Reserve Program for nine years. In addition to the six noted land uses, three of the shallow monitoring wells were completed in areas of transitional land use. These transitional wells occurred where land use changed in the second year of the study. Transitional wells included one well in an area that converted from light commercial to intensive commercial land use, one well in an area that converted from nonirrigated agriculture to sewered residential land use, and one well in an area that converted from fallow fields to sewered residential land use. One of the areas classified as nonsewered residential changed to sewered residential land use after two years. The well in this area therefore represented nonsewered residential land use for the first two years of the study and a transitional land use the second two years. We installed continuous water level recorders in four monitoring wells and recorded hourly changes in water level.

The initial monitoring network included 12 additional private wells completed deeper in the surficial aquifer and nine wells completed in the buried aquifer. Information from these wells helped us identify ground water flow patterns in the study area and the relative age of water in the aquifer. Two surface water sampling points were located on the Sauk River. One of these was at the upgradient edge of the monitoring network and the second was located at a point just before the Sauk River enters the Mississippi River. Figure 4 illustrates the location of monitoring points.

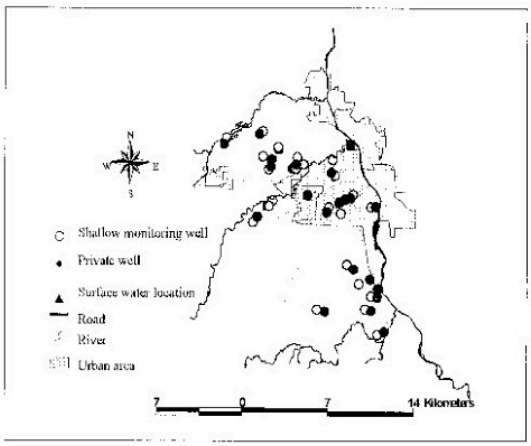

Figure 4. Location of wells and surface water sampling points.

Sample Collection

We collected samples in March, May, August, and October of each year from 1997 to 2000. Samples were pumped using a peristaltic pump. Water passed through a YSI 600 XL multiparameter probe and measurements of oxidation-reduction potential (mV), temperature (°C), pH, specific conductance (μmhos/cm), and dissolved oxygen (mg/L) were taken at approximately five-minute intervals. Samples were collected once temperature, specific conductance, and pH stabilized to 0.1°C, 10%, and 0.1 pH unit, respectively, for three successive readings. Sample collection included 250 mL clear HDPE bottles with 5 mL concentrated sulfuric acid for anions; 250 mL clear HDPE bottles with 5 mL of nitric acid for cations; 20 mL glass vials with 8 drops of phosphoric acid for total organic carbon; 40 mL glass vials with two drops of hydrochloric acid and no headspace for volatile organic compounds; 500 mL HDPE bottles for dissolved solids, sulfate, perchlorate, and tritium; 1000 mL amber glass bottles for polynuclear aromatic hydrocarbons (PAHs) and acid herbicides; 60 mL amber glass bottles for base neutral herbicides; and 100 mL plastic bottles for bacteria. Samples for inorganic chemicals were analyzed at the University of Minnesota Research Analytical Laboratory in St. Paul. Samples for VOCs, PAHs, bacteria, and perchlorate were analyzed at the Minnesota Department of Health Laboratory in Minneapolis. Samples for base neutral herbicides were analyzed at the U.S. Geological Survey Laboratory in Lawrence, Kansas. Samples for acid herbicides were analyzed at the Minnesota Valley Testing Laboratory in New Ulm, Minnesota. Samples for tritium were analyzed at the Environmental Isotope Lab in Waterloo, Ontario, Canada. All samples for laboratory analysis were packed in coolers at 4°C and delivered to laboratories within required holding times. Table 1 summarizes laboratory methods and reporting limits. Field and laboratory duplicates were performed at a rate of 10%.

Data Analysis

We established the following null hypotheses:

- Concentrations of individual chemicals do not differ between land uses.
- Concentrations of individual chemicals do not differ between sampling seasons.
- Concentrations of chemicals did not change over the four-year sampling period (i.e., as a function of sampling event).

To test the null hypotheses for land use and sampling season, we applied the Kruskal-Wallis test. A test significance of 0.05 was used to identify land uses or sampling seasons in which chemical concentrations differed. To test for changes in chemical concentration over the four-year sampling period, we applied linear regression analysis to ranked data. Data were ranked because there were differences in chemical concentrations between wells within the same land use. Lumping this data would potentially mask concentration trends within land uses. To further explore relationships between chemical concentrations and either land use, sampling season, or sampling event, we conducted correlation analysis between different chemicals using the Spearmann rank method. A test significance of 0.05 was used to identify significant correlations.

Table 1
Analysis Method and Reporting Limits for Sampled Chemicals

Parameter	Method	Reporting Limits (μg/L)
NO_3-N	Cadmium reduction	20
Co[a], Li, total sulfur, total phosphorus, Ca, Mg, Na, K, Fe, Al[a], Mn, Si, Zn, Cu, Ni, Cd[a], As[a], B, Cr[a], V[a], Ti[a], Pb[a], Ag[a], Be[a], Sr, Rb, Mo, Ba	ICP or ICP-MS	0.002, 5.3, 19, 10, 55, 20, 60, 118, 2.1, 0.06, 0.9, 17, 2.7, 4.6, 5.4, 0.02, 0.06, 13.0, 0.05, 4.7, 0.0035, 0.030, 0.0090, 0.010, 0.60, 555, 4.2, 1.4
Cl, F, SO_4, Br	Ion chromatography	100, 200, 100, 100
Dissolved oxygen	Field meter	100
Alkalinity	Titration	1000
Oxidation-reduction potential	Field meter	1 mV
Volatile organic compounds	MN Dept. Health 465A	Varies from 0.1 to 10
Total organic carbon	Dohrman carbon analyzer	100
Electrical conductivity	Field meter	0.1 mmho/cm
Kjeldahl-nitrogen	Digestion/colorimetric	200
Ammonia	Colorimetric	20
Base neutral herbicides	GCMS	0.050
Acid herbicides	MDA List 2	0.20
Polynuclear aromatic hydrocarbons	EPA Method 8270	0.010

[a]ICP-MS

Table 2
Median Chemical Concentrations for Different Land Uses

Chemical	Nonirrigated	Irrigated	Sewered	Nonsewered	Commercial	Nondeveloped
Alkalinity	19900 c	238750 ab	263168 b	238167 b	322000 a	236500 b
Aluminum	6.82	9.26	7.87	8.29	8.51	7.84
Ammonia-N	50	40	40	35	55	40
Antimony	0.055 b	0.049 b	0.098 b	0.040 b	0.089 a	0.060 b
Arsenic	0.67	0.73	0.70	0.70	0.49	0.68
Barium	63 bc	76 b	62 b	53 cd	204 a	28 d
Beryllium	0.030	0.030	0.040	0.039	0.030	0.029
Boron	21 b	39 a	41 a	71 a	57 a	17 b
Cadmium	0.040	0.040	0.090	0.041	0.070	0.100
Calcium	74000 c	91650 b	105021 b	73448 c	123010 a	62571 c
Chloride	15540 b	40920 b	78775 a	82695 a	59020 a	1765 c
Chromium	0.59	0.86	1.15	1.06	0.81	1.11
Cobalt	0.296 b	0.375 b	0.381 b	0.366 b	0.504 a	0.283 a
Copper	< 5.40	5.40	< 5.40	< 5.40	< 5.40	< 5.40
Dissolved organic carbon	2250	1400	1900	1350	2850	1300
Dissolved oxygen	5090 b	6180 ab	4280 b	8397 a	3600 b	4845 b
Eh	323	352	322	306	319	322
Fluoride	< 100 b	< 100 ab	200 ab	< 100 ab	200 a	140 ab
Iron	3.60 b	4.90 b	5.60 b	< 3.10 b	9.30 a	10.00 b
Lead	< 0.030	0.027	0.070	0.050	0.060	0.040
Lithium	< 4.40 b	< 4.40 b	5.24 a	< 4.40 b	< 4.40 b	< 4.40 b
Magnesium	21801 b	22907 a	29211 a	18702 b	28423 a	22080 ab
Manganese	2.55 c	0.50 c	7.95 b	0.45 c	19.80 a	0.60 bc
Molybdenum	< 4.1 b	< 4.1 b	< 4.1 a	< 4.1 b	< 4.1 b	< 4.1 b
Nickel	< 6.0	< 6.0	< 6.0	< 6.0	6.00	< 6.0
Nitrate-N	3100 c	15350 a	2350 cd	6080 b	2000 c	600 d
pH	7.24 a	7.10 a	7.19 a	7.29 a	6.92 b	7.24 a
Phosphorus (total)	33 a	34 ab	27 a	35 ab	20 ab	10 b
Potassium	2007 c	1267 ab	2878 a	1028 cd	3205 b	1080 d
Sulfur (total)	6725 ab	7727 bc	19863 a	7794 d	13041 ab	3266 cd
Silica	6366 d	10380 a	9125 b	9023 b	9327 b	7416 c
Silver	< 0.009	0.010	0.015	< 0.009	0.013	0.011
Sulfate-S	6335 ab	7580 bc	17630 a	7095 c	11305 ab	2950 bc
Sodium	4269 c	7789 bc	26067 b	62692 a	24290 b	5598 c
Specific conductance	524 c	700 b	808 a	804 b	870 a	442 c
Strontium	68 b	126 b	130 b	85 c	167 a	66 c
Temperature	9.22 c	9.74 c	12.29 a	11.18 ab	11.73 a	9.93 bc
Thallium	< 0.0050	0.011	0.015	< 0.0050	0.015	0.008
Titanium	< 0.0034	< 0.0034	< 0.0034	< 0.0034	< 0.0034	< 0.0034
Total dissolved solids	350000 b	488000 c	537000 a	492000 b	564000 a	268000 c
Total Kjeldahl nitrogen	240 ab	< 200 c	220 a	< 200 c	210 bc	< 200 c
Total organic carbon	2000 a	1400 bc	1700 b	1300 c	2000 bc	1300 bc
Total suspended solids	6000	6000	13000	5000	4000	4000
Vanadium	< 4.70	< 4.70	4.70	< 4.70	< 4.70	< 4.70
Zinc	6.00 abc	7.05 ab	9.05 a	5.05 c	7.90 abc	5.90 bc

Concentrations are in µg/L, except conductance (µmhos/cm), temperature (°C), pH, and Eh (mV). Different letters within a row indicate concentrations that differ at a 0.05 significance level.

Results and Discussion

Hydrology and Age of Ground Water

To validate our experimental design and assumptions about the source of water in each well, we determined recharge rates, ground water flow direction, and approximate age of ground water. Water levels in wells with water level recorders were recorded at 15-minute intervals. We computed a daily average water level and estimated recharge by summing positive changes in daily water level measurements, assuming a porosity of 0.30. The median annual recharge between 1997 and 2000 was 207 mm in nondeveloped areas, compared to 82 mm in sewered residential areas. The most dramatic difference in recharge occurred in 1999, when the amount of rainfall was low. Recharge in the nondeveloped area was 161 mm in 1999 and 48 to 74 mm in wells from urban areas. Recharge was always greatest in spring when rainfall occurred after soil thaw. Recharge occurred on a few occasions in summer and fall, but only after extended periods of rainfall, which led to

Table 3
Summary of Detections for VOCs, by Land Use

Land Use	Detections	Chemicals Detected
Nonirrigated	3	Toluene, Benzene, Acetone
Irrigated	4	Chloroform, Toluene
Sewered	32	Acetone, Benzene, Chloroform, Dichlorodifluoromethane, PCE, TCE
Nonsewered	1	Toluene
Commercial	63	Chloroform, 1, 1-Dichloroethane, PCE, TCE, Toluene, Dichlorodifluoromethane
Nondeveloped	2	Benzene, Toluene

soil wetting. Assuming sewers and water mains were not leaking in the urban areas, differences in recharge reflect differences in percent of impermeable surface, with urban areas having 50% to 70% impervious surface.

Tritium concentrations provide an indication of the relative age of water. Tritium was detected in all samples. Tritium concentrations increased with depth to ~25 m. The tritium distribution suggests increasing ground water age with depth. Water at 25 m appeared to have originated in the late 1950s and early 1960s, when tritium concentrations in the atmosphere were at their highest. The results validate the general flow model illustrated in Figure 3.

Since recharge occurred annually and downward hydraulic gradients existed in shallow ground water throughout the study area, samples collected at each monitoring well reflected water that passed through the vadose zone directly above the well. Water chemistry thus reflects the overlying land use. Results therefore indicate that each well was properly located with respect to the assumed overlying land use and water throughout the aquifer was less than 50 years old.

Land Use Effects: Inorganic Chemicals

Inorganic chemicals occur naturally in ground water but may occur at higher concentrations under certain land uses. We sampled for inorganic chemicals to determine water chemistry under nondeveloped areas and to allow comparison with areas overlain by other land uses.

Table 2 summarizes median concentrations of inorganic chemicals for each of the six land uses. Perchlorate was not detected in any sample and is not included in Table 2, which provides information about concentrations for specific chemicals in specific land use settings. The data are useful when considering water chemistry associated with a particular land use. Data for the nondeveloped land use are assumed to represent background concentrations.

Median concentrations that differed between land uses for an individual chemical are indicated by different letters in Table 2. Concentrations of antimony, bicarbonate, barium, calcium, cobalt, iron, manganese, and strontium were highest in commercial/industrial areas. There are many sources for these chemicals, including alloys, road salt, automobile fluids, and human septage. High concentrations in these areas may reflect annual inputs from some of these sources, but may also be due to accumulation of these elements in ground water, or to past disposal and management practices.

Table 4
Summary of Detections for Herbicides and Herbicide Degradates

Chemical Parent Compounds	No. Detections
Atrazine	18
Dicamba	6
Prometon	9
Pesticide Degradates	
Acetochlor ESA	26
Acetochlor oxanilic acid	5
Alachlor ESA	40
Alachlor oxanilic acid	4
Cyanazine-amide	7
Deethylatrazine	33
Deisopropylatrazine	32
Hydroxy-atrazine	3
Metolachlor ESA	34
Metolachlor oxanilic acid	21

Concentrations of magnesium, potassium, sulfate, total sulfur, and total dissolved solids were higher in sewered residential and commercial/industrial areas compared to other land uses. In addition to the chemicals discussed previously, chloride and boron were higher under urban land use than under agricultural land use. Road salt is an important source of dissolved solids, as indicated by elevated concentrations of chloride, calcium, and potassium. Boron concentrations are typically higher under urban land use compared to agricultural land use (Rivers et al. 1996; Sloto 1989). In addition to road salt, sources for these chemicals include leakage from sewer lines and discharge from individual sewage treatment systems.

The median temperature of ground water was about 9.7°C under agricultural areas, 11.6°C under urban areas, and 9.9°C under nondeveloped areas. The higher temperature under urban areas was significant at the 0.001 level compared to agricultural areas. Reasons for the temperature difference are unclear. Rainfall that percolates through the soil may be warmed more in urban areas, since soil tends to warm more quickly in urban areas.

Nonsewered residential areas generally had lower concentrations of most dissolved solids compared to other urban areas, with the exception of boron (71 µg/L), chloride (82,695 µg/L), nitrate (6080 µg/L), and sodium (62,692 µg/L). Concentrations of these chemicals were correlated with each other ($R^2 > 0.690$). We did not observe significant correlations between these chemicals in sewered residential or commercial/industrial areas. Septic systems appear to be an important source for these chemicals. A factor affecting nitrate concentration appeared to be density of septic systems, with the highest chemical concentrations occurring in areas with smaller lot size, and thus, higher density of septic systems. Researchers have shown that lot size is an important factor affecting the distribution of

nitrate in ground water (Hantzsche and Finnemore 1992; Anderson et al. 1987; Baumann and Schafer 1984).

Within agricultural areas, concentrations of bicarbonate, arsenic, barium, boron, calcium, chloride, nitrate, sulfur, silica, sulfate, sodium, and total dissolved solids were lower in nonirrigated areas compared to irrigated areas. The high concentrations of chloride (40,920 µg/L) and nitrate (15,350 µg/L) under irrigated agriculture are most likely related to higher fertilizer application rates. Median nitrate concentrations in each well from irrigated agriculture exceeded 13,000 µg/L. Nitrate concentrations were not correlated with concentrations of other chemicals.

Concentrations of many chemicals were low in nondeveloped areas. Chloride appears to be an excellent indicator of human impacts. The median concentration of chloride in nondeveloped areas (1765 µg/L) was only ~13% of the next lowest median concentration (15,540 µg/L under nonirrigated agriculture). The median nitrate concentration under nondeveloped land use was 600 µg/L. Since samples were well oxygenated (dissolved oxygen = 4845 µg/L and Eh = 322 mV), nitrate would not be denitrified. The value of 600 µg/L thus represents a background value for nitrate in shallow ground water. The results indicate that concentrations of many chemicals are greater under all land uses than concentrations under nondeveloped land use.

Results clearly indicate differences between land uses. We, therefore, reject the null hypothesis that there are no differences in water chemistry beneath different land uses. Compared to nondeveloped areas, agricultural and nonsewered areas are characterized by high concentrations of nitrate, commercial areas by high concentrations of several trace inorganic chemicals, and residential areas by high concentrations of chloride.

Land Use Effects: Organic Chemicals

Most volatile organic compounds (VOCs) and pesticides do not occur naturally in ground water. We sampled for VOCs and pesticides because they are widely used in industrial, commercial, transportation, agricultural, and household activities, and their presence in ground water thus provides an indication of human impacts.

VOCs were detected at least once in 21 of the 23 shallow monitoring wells. VOCs were detected in all 62 samples collected from commercial/industrial areas and in 32 of 62 samples collected from sewered residential areas. Concentrations of VOCs were significantly greater in samples from commercial and sewered residential areas compared to the remaining land uses ($p = 0.016$).

Chlorinated hydrocarbons accounted for 79% of the VOC detections. Chloroform accounted for 27% of the VOC detections, 1,1,2,2-tetrachloroethene (PCE) for 23%, 1,1,2-trichloroethene (TCE) for 15%, and 1,1-dichloroethane for 6%. Chloroform is either naturally occurring or associated with industrial activity, since these wells were not disinfected.

Table 3 summarizes VOC detections by land use. Except for a single detection of chloroform in an irrigated agricultural well, halogenated chemicals were not detected outside of sewered areas. There were four or fewer detections in each of the nonsewered land uses. Many of these detections were of toluene, which was detected in equipment blanks during one of the sampling events.

There were 238 herbicide detections, but only 33 of these were of the parent compound (Table 4). Atrazine accounted for 18 of the 33 detections for parent compounds. Herbicide degradates accounted for ~96% of the cumulative herbicide mass detected in monitoring wells. Sulfonic acid (ESA) degradates of the acetanilide herbicides (alachlor, metolochlor, and acetochlor) accounted for ~69% of the cumulative herbicide mass and 100 of the 238 herbicide detections. These results compare favorably with those of Kolpin et al. (1996), who observed the widespread occurrence of these pesticide metabolites in shallow ground water in the midwestern United States. The ESA form is favored in soil, while the oxanilic acid (OA) form of acetanilide herbicides is favored in ground water. Both degradates are mobile and persistent in aerobic environments (Philips et al. 1999; Graham et al. 1999). The parent compound appeared to largely be degraded in soil and then was transported to ground water during recharge.

Ratios of deethylatrazine to atrazine (DAR) provide information on the relationship between herbicide concentrations in surface water and ground water. Thurman and Fallon (1996) observed a decreasing DAR in surface water for spring storms following herbicide application. A decreasing DAR indicates increasing contributions from the parent compound, atrazine. Deethylatrazine accounts for only 6% of the degradation of atrazine, but it is selectively removed from soil and transported to ground water and surface water. We observed the highest DAR from surface water in spring, suggesting large ground water contributions to surface water. The DAR decreased between spring and summer sampling events. Our DAR were much higher than those of Thurman and Fallon, indicating degradation of atrazine in soil prior to transport of degradates to ground water.

Deisopropylatrazine is another degradate of atrazine, but is less mobile than deethylatrazine. Thurman et al. (1994) suggest the ratio of deisopropylatrazine to deethyla-

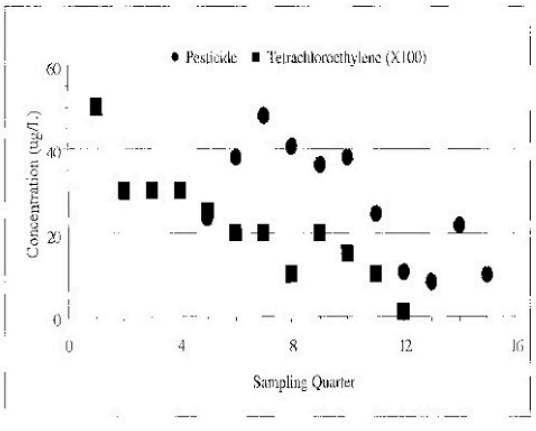

Figure 5. Cumulative pesticide concentrations in all wells, and concentration of tetrachloroethylene in Well 588392 for the 16 sampling quarters between 1997 and 2000. The first sampling quarter was winter 1997. Quarterly samples were collected in March, May, August, and October of each year.

trazine (D2R) should increase during the growing season, thus reflecting the time lag in movement of deisopropylatrazine to ground water. The D2R was lowest in spring, reflecting inputs of deethylatrazine to ground water. The D2R increased through the growing season, as predicted by Thurman et al. (1998).

Eighty-six percent of samples collected from irrigated agricultural areas had a detectable herbicide, compared to 68% in nonirrigated agriculture and 10% or less in the remaining land uses. A detectable herbicide was present in 86% of surface water samples. Triazine and acetanilide herbicides and their degradates accounted for all herbicide detections under agricultural land use. The median cumulative pesticide concentration of 2.91 µg/L from wells in agricultural areas was higher than under other land uses. Dicamba and Prometon were detected in sewered residential areas during the summer sampling event. Dicamba is a common herbicide for lawn use, while Prometon is widely used in road right-of-ways. Dicamba was detected on two occasions at a concentration of <5µg/L, while Prometon was found at concentrations >0.10 µg/L. Alachlor ESA, metolochlor ESA, and Prometon were detected in commercial areas. The source of the agricultural herbicides in samples from commercial areas and in the single sample from a nondeveloped area is unclear.

Concentrations of polynuclear aromatic hydrocarbons (PAHs) were below the reporting limit of 0.010 µg/L in all but one well. Benzo(g,h,i)pyrelene and Indeno(1,2,3,-c,d)pyrene were detected at concentrations of 0.013 and 0.012 µg/L, respectively, in one monitoring well located in a commercial/industrial area.

The data show differences in occurrence of organic chemicals in shallow ground water beneath different land uses. We, therefore, reject the null hypothesis that there are no differences in water chemistry beneath different land uses. Compared to nondeveloped areas, agricultural areas are characterized by high detection frequencies for herbicides, and commercial areas by high detection frequencies for VOCs.

Land Use Effects: Bacteria

Coliform bacteria may indicate impacts from animal or human waste. We detected coliform bacteria in eight of the 17 monitoring wells that we sampled. Coliform bacteria were detected under all land uses. The highest concentrations were found under nonsewered residential areas, with concentrations ranging from 200 most probable number (MPN)/100 mL to >1700 MPN/100 mL. Concentrations under other land uses were <39 MPN/100 mL. The high concentrations in nonsewered areas may be due to inputs from septic systems. The data support the null hypothesis that land use differences do not exist for bacteria, but additional sampling is recommended. Bacteria may not be a good indicator for the occurrence of pathogens, and there appears to be a tendency for higher concentrations under nonsewered residential areas.

Effect of Sampling Season

We tested for seasonal (quarterly) differences in chemical concentrations within individual wells, between wells within a land use, and between land uses. The only differences between sampling season were for temperature and ammonia. Temperature, as expected, was highest in summer (10.3°C) and lowest (8.2°C) in winter. Ammonia concentrations were higher in winter (median = 70 µg/L) compared to the remaining seasons (median ranged from 30 to 40 µg/L). This may be due to decreased biological activity, and lower nitrification rates, in winter.

We accept the null hypothesis that there were no seasonal differences in water chemistry. Seasonal sampling, however, allows only general comparisons of water chemistry. Impacts of individual recharge events cannot be determined from seasonal data. Our data indicate that effects from individual events are either small in magnitude, have short duration, or are perhaps limited to the uppermost part of the aquifer. Aquifer mixing or pumping from the top few feet of the aquifer can mask these effects.

Although there were no seasonal differences in water chemistry, we advocate quarterly sampling in the beginning phases of a monitoring program, particularly when hydrogeologic conditions differ from those presented in this study. Long-term quarterly sampling should be abandoned, however, if four years of sampling reveal no effect of sampling season.

Table 5
Summary of Regression Analysis for Chloride, Nitrate, Pesticides, and VOCs in Wells with Significant Regressions ($p < 0.05$)

Well No.	Well Type	p-Value	R^2	Slope (µg/L/ Sampling Event)
Chloride				
507503	Monitoring	0.001	0.610	207
561094	Monitoring	< 0.001	0.740	1737
588380	Monitoring	< 0.001	0.770	2895
588381	Monitoring	0.005	0.494	2155
591783	Monitoring	0.001	0.744	1404
594121	Monitoring	< 0.001	0.715	405
594125	Monitoring	< 0.001	0.783	755
Nitrate				
517210	Monitoring	< 0.001	0.736	16
588378	Monitoring	0.001	0.725	−1496
588381	Monitoring	< 0.001	0.662	118
591783	Monitoring	< 0.001	0.928	865
594117	Monitoring	< 0.001	0.842	527
594125	Monitoring	0.01	0.408	563
Pesticides				
588380	Monitoring	0.006	0.684	−0.566
594112	Monitoring	0.028	0.474	−0.101
111111	Surface water	0.021	0.557	−0.098
222222	Surface water	0.014	0.735	−0.082
588378	Monitoring	0.007	0.573	−0.069
591783	Monitoring	0.002	0.724	−0.048
594126	Monitoring	0.003	0.786	0.037
VOCs				
588392	Monitoring	0.003	0.728	−0.040
594111	Monitoring	0.037	0.439	−0.011

The regression model was concentration = a + b (sampling event), where a is the intercept of the regression line and b is the slope (mg/L/sampling event). Sample type identifies the sample as being collected from a monitoring well or from surface water. P-value refers to the probability that concentrations did not change with sampling event. R^2 represents the correlation coefficient for the regression.

Trend Effects

We performed regression analysis of chloride, nitrate, VOC, and herbicide concentration on sampling events for individual wells. Because there were no seasonal differences in these chemicals, we did not have to deseasonalize the data. Table 5 indicates there were seven significant regressions for chloride, six for nitrate, seven for pesticides, and two for VOCs. Chloride concentration increased with sampling event in six wells and decreased in one well. Wells 588381, 594121, and 594125 occurred in transitional areas where land use changed during the study. In the transitional wells, chloride concentrations increased as land use changed from nondeveloped to sewered residential. Nitrate increased during the sampling period in four wells and decreased in two wells. Nitrate concentrations decreased dramatically in Well 588378 (agricultural land use), with a slope of 1496 µg/L/year. These may reflect buildup of soil nitrate and reduced leaching following successive dry years in 1999 and 2000. Nitrate concentrations increased with sampling event in two wells in which land use changed from nondeveloped to sewered residential. In Well 594125, the nitrate concentration was 12,000 µg/L for the last sampling event in the year 2000. This concentration greatly exceeds concentrations we observed in other sewered residential areas. This well was located in an area where land use changed from pasture to sewered residential. The increase in concentration may be due to release of nitrate from the soil during construction and inputs from fertilizer applied to sod that was not well established.

Pesticide concentrations decreased with sampling event in five wells and at the two surface water sampling locations. The decreases in wells occurred in agricultural settings. Figure 5 shows the decrease in cumulative pesticide concentrations with sampling event. The decreases in concentration may reflect decreased recharge in 1999 and 2000. The peak for sampling event 14 coincides with recharge that occurred during early May 2000.

Concentrations of VOCs decreased in two wells. Tetrachloroethylene concentrations in Well 588392 decreased at a rate of 0.04 µg/L per sampling event, while concentrations of trichloroethylene in Well 594111 decreased at a rate of 0.011 µg/L per sampling event. Each of these wells occurred in older residential and commercial areas of St. Cloud. Assuming sources for these VOCs have been removed, the decreases may reflect long-term decreases in concentrations in these wells. Figure 5 shows that the decrease in tetrachloroethylene concentration in Well 588392 was relatively steady over the sampling period.

Because samples were collected quarterly, short-term impacts from individual recharge events cannot be discerned. We therefore cannot conduct trend analysis during individual seasons or years. Although analysis of the data over longer times may have eventually indicated additional trends, there is sufficient evidence to reject the null hypothesis that there were no changes in water quality during the four-year study. In particular, our data indicate two important results: First, when land use change is dramatic (e.g., nonsewered to sewered; nondeveloped to residential), water chemistry changes in shallow ground water are rapid. Second, although we probably captured only a small window of a longer trend, water quality in older commercial and residential areas may be slowly improving as a result of cleanup and prevention programs. Unfortunately, there are few long-term monitoring efforts to test the effectiveness of these programs.

Summary

We established a ground water monitoring system in a shallow sand aquifer overlain by six different land uses (nonirrigated agriculture, irrigated agriculture, nonsewered residential, sewered residential, commercial/industrial, and nondeveloped). We tested three hypotheses

- Water chemistry did not differ between land uses.
- Water chemistry did not differ between sampling season.
- Water chemistry did not change during the four year sampling period.

We observed significant differences in water chemistry beneath different land uses and therefore rejected the null hypothesis. Sewered residential and commercial/industrial areas were characterized by higher concentrations of total dissolved solids, including calcium, potassium, sulfate, and magnesium, compared to other land uses. Concentrations of several trace elements, including barium, iron, and manganese, were greater under commercial/industrial land use. Nonsewered residential areas had lower concentrations of most chemicals compared to sewered areas, with the exception of boron, chloride, and nitrate. These chemicals were present in higher concentrations and appear to be associated with septic systems. Irrigated agricultural areas had very high concentrations of nitrate, with median concentrations of ~13,000 µg/L. Concentrations of most chemicals were lowest in nondeveloped areas. Chloride appears to be a good indicator of human impacts, with chloride concentrations under nondeveloped land use being 13% or less of concentrations under the remaining five land uses. VOCs were detected in all samples from commercial/industrial areas and in about half the samples under sewered residential land use. Chlorinated chemicals, particularly chloroform, 1,1,2,2-tetrachloroethene, and 1,1,2-trichloroethene, were the most commonly detected VOCs. Herbicides were commonly detected in agricultural samples, but degradates accounted for ~96% of the total herbicide mass detected. The sulfonic and oxanilic acid degradates of the acetanilide herbicides accounted for the majority of herbicide detections. Polynuclear aromatic hydrocarbons were detected in only one well and perchlorate was not detected in any sample. Coliform bacteria were detected in eight of 17 wells.

We observed seasonal differences in water chemistry only for ammonia and temperature and therefore accept the null hypothesis that sampling season had no effect on water chemistry. Although seasonal sampling may mask individual recharge events, results indicate land use is the dominant factor affecting water chemistry of shallow ground water.

Although we sampled for only four years, we observed significant trends in water chemistry when land use changes were dramatic, such as nonsewered to sewered res-

idential land use or nondeveloped to residential land use. We also observed a trend of gradually improving water quality in commercial areas, probably due to efforts of cleanup and prevention programs.

Our data indicate land use is the dominant factor affecting water quality in shallow ground water. Changes in water chemistry and water quality are likely if land use changes. This includes implementation of activities designed to improve water quality, such as best management practices.

Ground water quality assessment and monitoring activities should focus on land use. Trend monitoring programs will be most effective in areas where land use is changing. Similarly, water resource managers and planners need to understand how land use decisions could potentially impact ground water quality.

Additional monitoring is needed to understand rates of change and final water quality in areas of land use change. More information is needed for certain land uses that may impact drinking water receptors. These include irrigated agriculture and nonsewered residential development for nitrate, sewered areas for VOCs, and agricultural areas for pesticides. The results also indicate the potential importance of new chemicals that have not been extensively studied, such as pesticide degradates.

Acknowledgments

The authors would like to thank John Chilton of the British Geological Survey for his careful review of the paper, and Michael E. Thurman of the U.S. Geological Survey for his assistance with collection, analysis, and interpretation of pesticide data.

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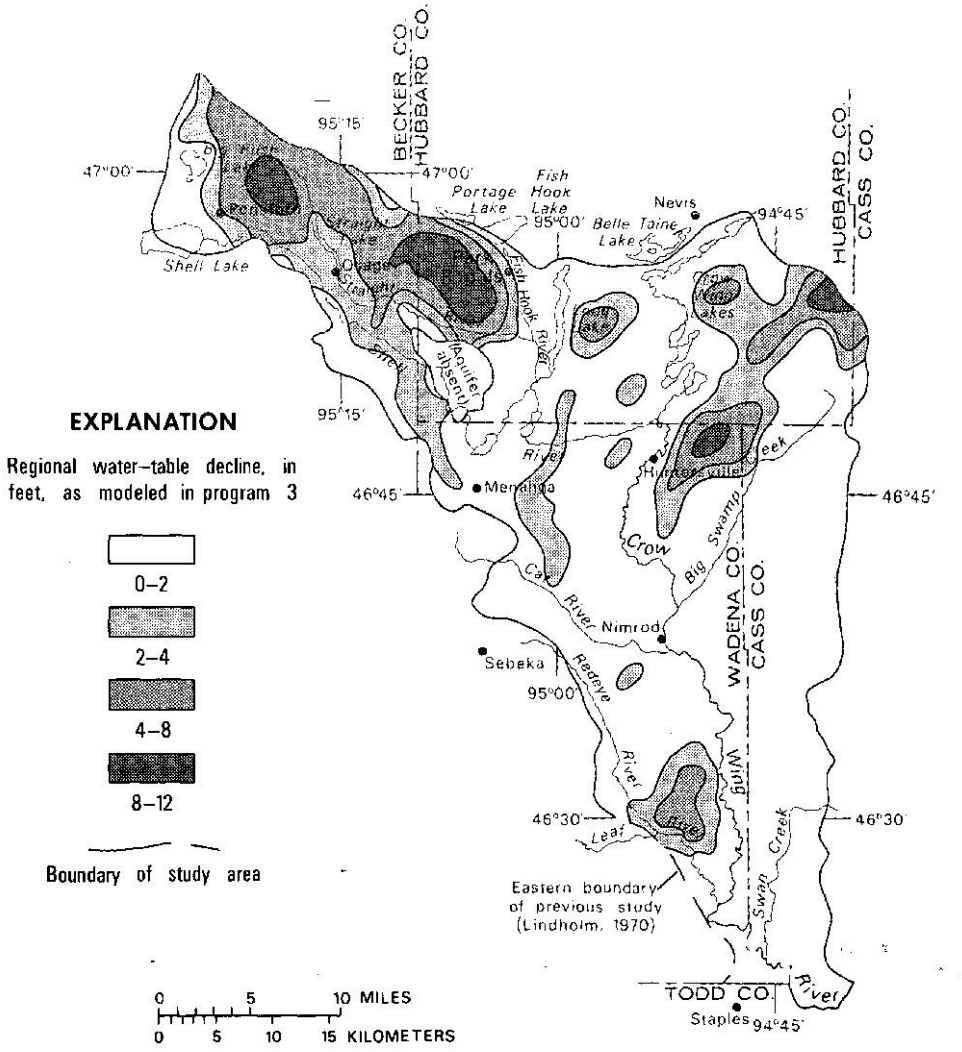


Figure 18.--Simulated water-table declines resulting from 20 years of pumping, as modeled in program 3.

In programs 2 and 3, the percentages of water from each source at any given time are nearly the same and therefore are shown as a single graph.

Base flow to streams is reduced to 78 percent of its natural steady-state value in program 2 and to 56 percent in program 3. (Refer to table 4 for steady-state values.) In both simulations, only a few scattered nodes (part of Shell River southeast of Ponsford and parts of two small tributaries to the east side of Crow Wing River) were indicated to have more than their entire base flow (contributed within that particular node) intercepted. This suggests that, although ground-water pumping will reduce streamflow, it will probably not induce enough infiltration directly from streams to cause significant reaches of stream to go dry.

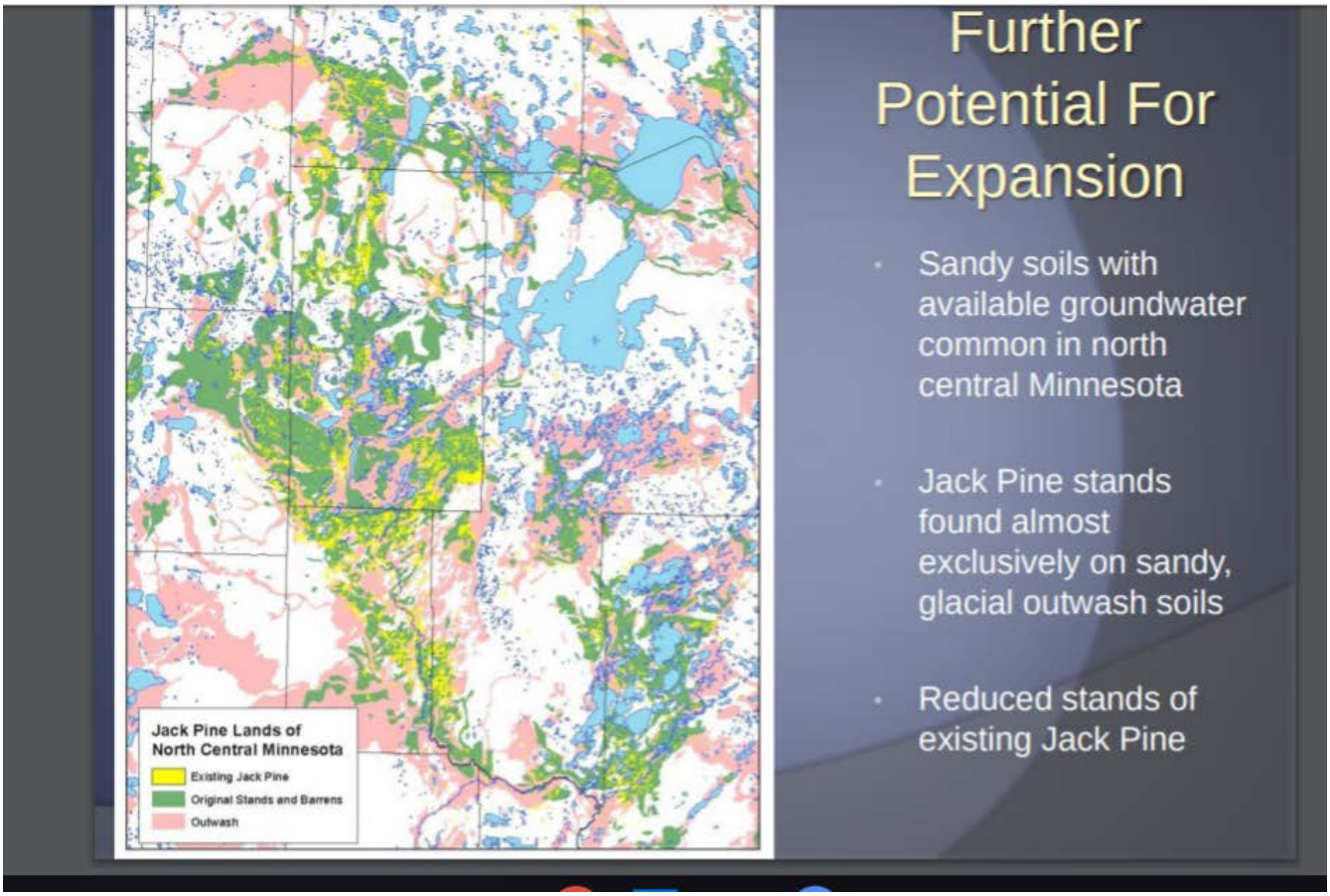
Ground-water discharge to lakes is reduced to 86 percent of its natural value in program 2 and to 72 percent in program 3. The effect on a specified lake depends on the relative importance of ground water in maintaining the lake level. Most large lakes have sufficient stream inflow, along with nonintercepted ground-water inflow, to maintain levels. Possible exceptions are as follows: (1) Big Rush Lake could be seriously depleted by development, as modeled in programs 2 and 3, (2) the levels of Twin Lakes (northeast of Menahga) and Shell Lake could decline slightly in response to pumping, as modeled in programs 2 and 3, and (3) the level of Blueberry Lake (north of Menahga) could decline in response to pumping, as modeled in program 3. Lakes and ponds that rely mostly on ground water for inflow might decline appreciably, particularly in areas of substantial water-table declines. (See figs. 17 and 18.)

The simulations show that diverted evapotranspiration forms a relatively small part of pumpage, because most expected development is not in areas of shallow water table.

Most increased underflow resulting from pumping would occur across the boundary of the northwestern part of the aquifer. In this area, modeled underflow increased about 20 percent in program 2 and 50 percent in program 3. Slight increases in underflow were indicated in the Belle Taine Lake area.

Qualifications of Results

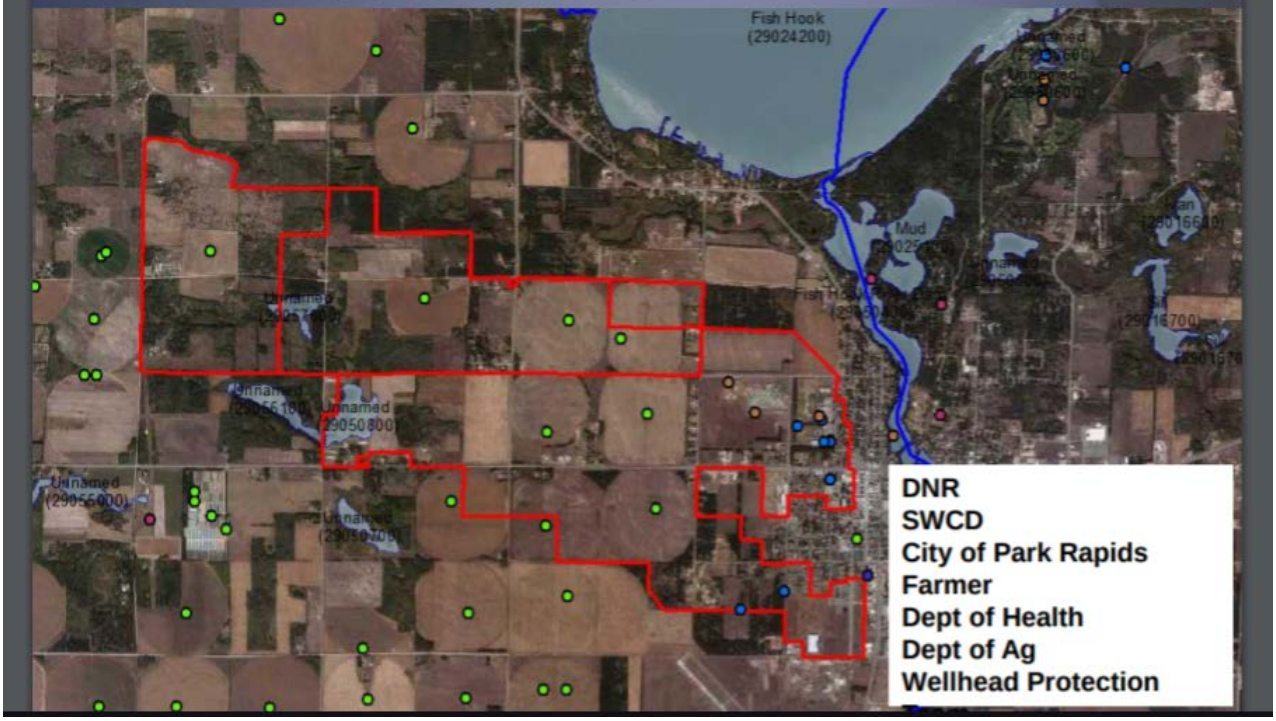
The model identifies the capability of different parts of the surficial aquifer to support large-scale development.



Further Potential For Expansion

- Sandy soils with available groundwater common in north central Minnesota
- Jack Pine stands found almost exclusively on sandy, glacial outwash soils
- Reduced stands of existing Jack Pine

New Irrigation in Park Rapids Drinking Water Supply Management Area



Jean Wagenius
State Representative

District 63B
Hennepin County

Minnesota House of Representatives

COMMITTEES: CHAIR, ENVIRONMENT, NATURAL RESOURCES AND AGRICULTURE FINANCE
AGRICULTURE POLICY
ENVIRONMENT AND NATURAL RESOURCES POLICY
LEGACY
WAYS AND MEANS

August 29, 2013

President Don Thompson
P.O. Box 4953
Oak Brook, IL 60522-4953

President Thompson:

The Legislative-Citizen Commission on Minnesota Resources recently visited Byron Township in Cass County in northern Minnesota, where your potato supplier, Ronald Offutt and Son Inc. (Winnemucca Farms), has clear cut part of the 1,459 acres of forested land that it purchased from the Potlatch Real Estate Investment Trust with the intention of converting it to agriculturally intensive potato production. The conversion of quality forest habitat into high intensity agricultural land is absolutely contrary to your stated commitment to sustainable land use practices.

On the "Values in Action" section of your website you state that you work with suppliers for "(l)and managed in a way that does not damage ecological processes, reduce biological diversity or waste natural resources." The Ronald Offutt and Son Inc. method of growing potatoes that includes heavy irrigation and substantial nitrogen and pesticide inputs cannot avoid contaminating the groundwater or wasting natural resources on this particular converted forest land.

The forested lands purchased from the Potlatch Real Estate Investment Trust to establish Winnemucca Farms sit on top of what is known as the Pinelands Sands Aquifer, a glacial outwash area characterized by fine to course grained sands and gravels which are well drained. The area is underlain by an extensive surficial sand and gravel aquifer (the water table) along

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with buried sand and gravel aquifers. (Converting Forests to Annual Crops, Minnesota Department of Natural Resources, July 2013)

The Minnesota DNR also reports that "(t)he water table aquifer and surface water bodies in this area are interconnected and dependent on one another. Withdrawals in the water table aquifer can cause lower water levels in the nearby wetland, lakes and streams. Some of the streams are designated trout streams and highly dependent on a cold groundwater supply. The deeper buried sand and gravel aquifers also have some connectivity to the shallower water table aquifer in different locations throughout this area and withdrawals from these deeper aquifers can also impact surface water bodies." (Converting Forests to Annual Crops, Minnesota DNR, July 2013) Given the sensitive geology of this area, the problems that can arise from Ronald Offutt and Son Inc. intensively raising potatoes on these lands become clear.

Currently streams in western Cass County have very low natural nitrate levels. But because the soils are well drained, chemicals applied to the surface can infiltrate quickly into the soil. This is especially true of water-soluble chemicals like nitrate. Much of the resulting groundwater contamination will end up in streams. This is especially true because of the interconnectivity noted above.

These types of impacts have the potential to reverberate throughout the ecological system and beyond the immediate geographical area. Consider that The Minnesota Pollution Control Agency reports that biological monitoring in Swan Creek, Byron Township, 2.25 miles southwest of the newly deforested land, shows "excellent" fish and invertebrate communities. (Minnesota Pollution Control Agency, Biological Monitoring Results, 2010) The creek is a tributary of the Crow Wing River, a tributary of the Mississippi River. Crow Wing watershed streams receive significant groundwater inputs because of the high water table in the area and consequently are at risk if ground water levels are altered. (Minnesota Pollution Control Agency, Byron Township Stop: LCCMR Tour, July 2013)

In June 2013, the Minnesota PCA reported that statewide, in an average precipitation year, 30% of total nitrogen contribution to surface waters came from cropland groundwater. (Nitrogen in Minnesota Surface Waters, June 2013, p. 9) "Groundwater baseflow is a major pathway in non-tiled cropland, and its effects are particularly important in areas with more highly permeable soils such as karst geology and sandy soils."(page E3-8)

An August 2013, PCA report pinpointed the specific regions. "The shallow sand and gravel aquifers contained the highest median nitrate concentrations compared to all of the other aquifers assessed in this report. The highest nitrate concentrations occurred in the aquifers in Central and Southwestern Minnesota. In Central Minnesota, about 40 percent of the shallow sand and gravel aquifer wells contained water with nitrate concentrations that were greater than the Maximum

Contaminant Level (MCL) of 10 milligrams per liter (mg/L) set by the U. S. Environmental Protection Agency (USEPA) for drinking water." (The Condition of Minnesota's Groundwater, 2007 – 2011, p. 1) Ronald Offutt and Son Inc. currently raises potatoes for you in this central sands region.

Efforts are underway to reduce the nitrogen load to Minnesota's waters. Minnesota takes its responsibility seriously. The cumulative nitrogen and phosphorus contributions from several states are largely the cause of the hypoxic zone in the Gulf of Mexico. Minnesota contributes the sixth highest nitrogen load to the Gulf. (Nitrogen in Minnesota Surface Waters, June 2013, p 1)

The excessive application of nitrogen fertilizer is not just a burden on our neighbors to the south. It is a public health issue and financial burden on Minnesotans whose drinking water is contaminated. Seventy five percent of all Minnesotans use groundwater for drinking water. The highest nitrate concentrations are in the shallow groundwater underlying agricultural lands with the highest concentrations of all occurring where Winnemucca Farms currently operates-- in the central sands region of Minnesota where 40% of the wells are contaminated. (See above.) Of necessity our citizens have had to incur significant financial costs that have included abandoning wells, drilling deeper wells, and installing specialized municipal treatment facilities.

One example is Park Rapids, Minnesota, a community in the central sands region. Park Rapids had to abandon several wells because they exceeded the nitrate drinking water standard. In 2009, Park Rapids' City Administrator Bill Smith stated that the blame for unsafe nitrate levels includes Ronald Offutt and Son Inc. (Minnesota Public Radio, Farm runoff blamed for town's contaminated water, June 2009) In total these costs have reached nearly $3 million and are projected to grow as drilling and facilities are constructed. (Minnesota Department of Health, Conversion of Forested Land to Irrigated Potatoes, July 2013)

On the "Values in Action" section of your website, you highlight your commitment to respect forests with sustainable land management practices. Clear cutting forests with the resulting elimination of wildlife habitat is not a sustainable land management practice.

In addition to the loss of habitat, species that are threatened or of special concern are put at further risk. The Winnemucca Farms Environmental Assessment Worksheet (EAW) acknowledges that an aquatic plant of special concern, Vasey's Pondweed, is found on site. The Minnesota Department of Natural Resources states that one of the threats to Vasey's Pondweed is water quality degradation from chemical contamination. In the EAW, Ronald Offutt and Son Inc. states it will use strategies to "reduce the potential for degradation" but, with its intensive use of herbicides, reducing the potential is highly unlikely to protect this species.

The Blanding's turtle, a state threatened species, has been found on lands in the area. The DNR lists the causes of the Blanding's turtle's decline, with the "loss of upland habitat through development or conversion to agriculture" at the top. The DNR states that "wetland complexes and adjacent sandy uplands are necessary to support viable populations of Blanding's turtles." (Minnesota DNR, Rare Species Guide: Blanding's turtle)

Minnesota recently added 180 species of plants and animals to the list of endangered and threatened species. (Minneapolis Star Tribune, August 20, 2013) A quote in the Star Tribune sums up the problem:

> *'We've got to learn how to manage at a larger scale,' said Richard Baker, endangered species coordinator for the DNR. The strategy of trying to save one species at a time will no longer work, Baker said. The new list shows that bigger solutions, such as maintaining broad swaths of forest and grassland, will be critical for the survival of not only those on the list but many others, he said.*

McDonald's stated principles of sustainability are the right ones. It is time to let Ronald Offutt and Son Inc. know that you cannot continue to use it as a supplier if its operation does not meet your standards.

This is especially important now since DNR reports that the Potlach Corporation and the Potlach Real Estate Investment Trust have 60,000 acres of timberland in Cass and adjoining Wadena and Hubbard Counties. The current expectation is that many of the forest acres will also be deforested and converted to intense potato agriculture. If that is the case, the implications for biodiversity and water quantity and quality are grim.

Your website states an "ultimate goal of credible third-party certification." Minnesota will be offering that opportunity soon. Legislation passed this last session establishes a water quality certification program. We will let you know once the rule making has been completed.

We will be having hearings on October 7 and 8, 2013, that will include the reports from the Pollution Control Agency on nitrogen and groundwater. On October 8 at 8:30 AM in Room Five of the Minnesota State Office Building, one of the topics will be the deforestation in Cass County and the conversion to agricultural land. You can find more information at the following website: http://www.house.leg.state.mn.us.comm/committee.asp?comm=88011 We would welcome your participation.

Jean Wagenius

Representative Jean Wagenius
Chair, Environment, Natural Resources and Agriculture Finance Committee

Minnesota Pollution Control Agency

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January 23, 2013

Mr. John P. Ringle
ESD Director
PO Box 3000, Cass County Courthouse
Walker, MN 56484

Re: Winnemucca Farms Cass County Potato Farm Environmental Assessment Worksheet

Dear Mr. Ringle:

Thank you for the opportunity to review and comment on the Environmental Assessment Worksheet (EAW) for the Winnemucca Farms Cass County Potato Farm project (Project) located in Cass County, Minnesota. The Project consists of the conversion of 1,459 acres of commercial forest to irrigated agricultural land. Based on this review by Minnesota Pollution Control Agency (MPCA) staff, we believe that the information provided in the EAW is insufficient to fully identify and assess the environmental effects of the Project. Consequently, we respectfully recommend that Cass County either withdraw the EAW and re-notice an augmented version, or issue a positive declaration to prepare an Environmental Impact Statement (EIS) to provide more information and analysis. Nevertheless, in the interest of informing the ongoing environmental review of the Project, the following comments are provided for your consideration.

Water Use (Item 13)

- This section of the EAW states that irrigation wells have already been installed. According to Minn. R. 4410.3100, subp. 1, if an EAW is required, a project may not be started until completion of the environmental review process. It appears that the installation of the irrigation wells may not be consistent with the Environmental Quality Board rules.
- Information related to the potential impacts and mitigation to be afforded by the permitting of the irrigation wells appears to be generally lacking. If such information is available at this time it should have been summarized and presented in the EAW. If information is not currently available, it should be developed and incorporated into the environmental review.

Geologic Hazards and Soil Conditions (Item 19)

The EAW does not identify or discuss the use of pesticides or fungicides, or potential environmental effects resulting from pesticide or fungicide use, in potato production. In particular, the high likelihood of fungicide use for as long as this land is in potato production should be discussed at some level in several parts of this document in order for the EAW to be complete. The majority of all Minnesota potato farms use applications of fungicide and a high majority of these use chlorothalonil specifically. The application of chorothalonil, presumably via crop dusting, should be a consideration when discussing, at a minimum, items 11, 17, 20, 23, or 30. Chlorothalonil is classified by the Environmental Protection Agency (EPA) as "very highly toxic" or "highly toxic" to aquatic invertebrates. The EPA Reregistration Eligibility Decision (RED) fact sheet also states that "Chorothalonil can contaminate surface water via spray drift or through runoff and erosion. Chlorothalonil can be dissolved in runoff and adsorbed to sediment in the runoff." As this proposed agricultural site has both wetlands and a stream that drains to the Crow Wing River, the potential for surface and groundwater contamination resulting from the use of pesticides and fungicides should be addressed in this environmental review.

In addition, recent reports by numerous sources, including the University of Minnesota Extension Service, indicate that the combination of chlorothalonil and some of the chemicals that beekeepers use as miticides in their apiaries can dramatically increase the toxicity of both products, and contribute to the death of the hive: (http://www.extension.org/pages/61004/miticide-and-fungicide-interactions).

This possible connection has been observed by members of the North Central Beekeepers Association in Brainerd, Minnesota, where hive death occurred repeatedly in hives with comb that had elevated levels of chlorothalonil and chlorpyriphos. We believe that information and analysis regarding all possible fungicides and pesticides that are likely to be used as a result of this project, and potential environmental and human health hazards of each, must be addressed in the environmental review of this Project in order for it to meet the intended purpose of adequately informing future decision making and the public.

The failure to have addressed this very significant environmental impact potential renders this EAW ineffective as an assessment tool, and considerations should be given to either retracting and reissuing the document with this issue being more adequately addressed, or making a positive declaration requiring an Environmental Impact Statement for this proposal.

Cumulative Potential Effects (Item 29)
A cumulative potential effects analysis is applicable and must be conducted for the environmental review to be complete. This requires an analysis of specific projects that may interact with the proposed project in such a way as to cause cumulative impacts. The responsible governmental unit must inquire whether a proposed project, which may or may not individually have the potential to cause significant environmental effects, could have a significant effect when considered along with other projects that (1) are already in existence or planned for the future; (2) are located in the surrounding area; and (3) might reasonably be expected to affect the same natural resource(s). The cumulative potential effects assessment should:

- Consider *past projects, existing projects*, as well as anticipated *future projects* that have been planned or for which a 'basis of expectation has been laid' (future projects for which permit applications or EAWs have been submitted either at the state or local level, or projects for which plats have been approved on the local level may be considered to demonstrate the required basis of expectation).
- Consider a limited geographic area surrounding the project in which facilities may reasonably be expected to affect the same natural resource – for instance, a nearby lake – as the proposed project.

In completing this analysis, the responsible governmental unit must identify: a) the limited geographical area considered; b) any other projects as outlined above, (and explain how they were identified); c) the cumulative impacts that may occur as a result of interaction of the other project(s) with the proposed project; and d) the natural resource(s) affected and how it may be affected.

We appreciate the opportunity to review this project. If you have any questions concerning our review of this EAW, please contact me at 651-757-2508.

Sincerely,

Karen Kromar

Karen Kromar
Planner Principal
Environmental Review Unit
Resource Management and Assistance Division

KK:bt

cc: Craig Affeldt, MPCA, St. Paul
Reed Larson, MPCA, Brainerd
Scott Lucas, MPCA, Brainerd

Minnesota Department of Natural Resources
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January 22, 2013

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john.ringle@co.cass.mn.us

Re: Winnemucca Farms Cass County Potato Farm Environmental Assessment Worksheet (EAW)
Department of Natural Resources (DNR) Comments

Dear Mr. Ringle,

The Department of Natural Resources (DNR) has reviewed the EAW for the Winnemucca Farms Cass County Potato Farm. We appreciate the opportunity to review this project and offer the following comments for your consideration.

We have reviewed the EAW and do not believe the project's potential environmental impacts are adequately disclosed. Our comments indicate the potential for significant impact having to do with both potential water table drawdown effects on wetlands and surface waters, and the potential for nutrient contamination of the drinking water aquifer. If the Responsible Government Unit (RGU)/the County share this conclusion, they have two choices for moving forward: (1) make a positive declaration on the need for an environmental impact statement (EIS), or (2) postpone the decision on the need for any EIS for 30 days or other such period of time agreed upon by the RGU and the proposer. In some cases, a proposer also voluntarily withdraws an EAW to modify a project or otherwise address concerns.

While these potential impacts are subject to mitigation by ongoing regulatory authority (a consideration in determining the need for an EIS), the project triggers an EAW of which the purpose is to disclose information about potential environmental impacts. Likewise, we recommend that all potential impacts and measures to offset those impacts be disclosed in the EAW. If required by the RGU, this information would serve a dual purpose of public disclosure and meeting permit requirements.

Sincerely,

Peter Buesseler, Regional Manager
DNR Division of Ecological and Water Resources

Enc: DNR Specific Comments and Winnemucca.PDF

Winnemucca Farms Environmental Assessment Worksheet (EAW)

DNR Specific Comments

Question 8. Permits and Approvals Required

If the project involves any proposed work in *Public Water Wetland 11-0654W*, a permit to work in public waters may be necessary. Exemptions provided by the Wetland Conservation Act (WCA) for wheeled booms on irrigation devises do not apply to public waters. Also, proposals with the purpose of creating upland or for the construction of roadways or pathways through public waters are explicitly prohibited (see MN Rules 6115.0190 Subp. 3). In order to permit a wheeled irrigation crossing, it will be necessary to look at non-filling crossing alternatives (bridges, boardwalks) and still meet other goals and requirements contained in MN Statutes 103G and MN Rules Chapter 6115.

Question10. Cover Types

The answer to this question indicates that wetland acreage will remain unchanged, yet the answer to Question #12 indicates that wetland filling activities will occur to accommodate movement of the center pivot irrigation systems.

DNR recommendation:
The EAW should provide estimates of wetland fill and update the answer to Question #10 accordingly.

Question 11.a. Fish, Wildlife and Ecologically Sensitive Resources

This question asks for the identification of fish and wildlife resources and habitats on or near the site, and to describe how they will be affected by the project. While the answer to this question provides some data on existing resources, impacts and methods to minimize and avoid impacts, it falls short in adequately describing all. By not including this information, potential impacts and information about necessary mitigation measures are not disclosed (a main purpose of an EAW). DNR is providing the following supplemental information to assist the County in providing this information.

General Ecological Setting
Every state recently completed a "state wildlife action plan (SWAP)" which identifies conservation needs, actions and priorities for species of concern, including threatened and endangered wildlife and other important wildlife species. Minnesota's SWAP titled, "*Tomorrow's Habitat for the Wild and Rare*" describes conservation concerns for species of greatest conservation need (*SGCN*) and their *key habitats* within various landscape settings (characterized using the Ecological Classification System [ECS]).

SGCN are defined as species whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure long-term health and stability (includes threatened and endangered species). Much of the species documentation within Minnesota's SWAP is provided by the Minnesota County Biological Survey (MCBS). Key habitats are defined as the habitats most important to the greatest number of SGCN. Key habitats are specific to individual *ecological subsection* and are not found everywhere in the state. Minnesota's SWAP identifies 292 SGCN's in the state. Each of the species was evaluated to determine the factors influencing their rarity, vulnerability, or decline (SWAP, Page 60). The

results of the species analysis indicated that habitat loss and degradation are the most significant challenges facing Minnesota's SGCN. A copy of Minnesota's SWAP is available online at http://www.dnr.minnesota.gov/cwcs/wild_action_plan.html.

The proposed project is within the Pine Moraines and Outwash Plains Subsection (212Nc) of the Laurentian Mixed Forest Province (212). A full profile of the Pine Moraines and Outwash Plains Subsection (which includes *key habitats*, *SGCN*, and subsection conservation actions and priorities) is available at http://www.dnr.state.mn.us/ecs/212Nc/index.html

Identified *key habitats* within the Pine Moraines and Outwash Plains Subsection include upland forests (Red-white Pine), shrub/woodland-uplands (Jack pine woodland), non-forested wetlands, and rivers.

89 Species of Greatest Conservation Need (SGCN) are known or predicted to occur within the Pine Moraines and Outwash Plains Subsection. These SGCN's include 29 species that are federal or state endangered, threatened, or of special concern. This is an important transition zone interspersed with lakes and wetlands valuable for wildlife. Featured wildlife includes bald eagles, gray wolves, sharp-tailed grouse, sandhill cranes, upland sandpipers, common terns, yellow rails, red-necked grebes, trumpeter swans, common loons, least darters, and eastern hognose snakes. In addition to all key habitats, other areas important for SGCN include Camp Ripley Military Reservation; Chippewa National Forest; Deep Portage Conservation Reserve; Smoky Hills, Two Inlets, Badoura, Huntersville, Foot Hills, Pillsbury, and Crow Wing State Forests; Greenwater Lake Scientific & Natural Area; *Itasca State Park; and several WMAs (remove italics).*

DNR recommendation:
DNR recommends that the soil and water conservation plan identify how soil and water conservation actions and key habitats intersect on the property, then incorporate on-ground tasks that will preserve and enhance remaining key habitats (likely non-forested wetland areas).

Fish and Wildlife Habitats on and Near the Site and Potential Impacts

Fish Habitats
As indicated in the EAW, no substantial fish habitats are found on the property; however, in Section 5, immediately north of the project area, Tower Creek is a Designated Trout Stream Tributary identified or classified as a tributary to a Designated Trout Stream – Farnham Creek which flows to the southwest less than one mile from the project. Because surface water and the shallow groundwater are related in this area, pumping from future wells could impact this stream (existing wells on south end of project site less likely to impact the trout stream tributary). Per MN Statute 103G.285, pumping from a trout stream is not allowed unless temporary, and this protection may extend to protected tributaries if impacts to the tributary impact the designated trout stream.

Also, the Crow Wing River, a significant high quality resource, is located about 0.3 miles from the southwest corner of the project area with a backwater oxbow located closer. East of the project area is Swan Creek, which is as close as 0.3 miles from the east side of the project site.

DNR recommendation:
DNR recommends that the EAW included assessment of potential impacts to Tower Creek and other nearby surface waters. Testing will be required for wells located in close proximity to the trout

stream tributary and other surface waters as part of the Appropriation of Waters application process.

Wetlands and Surface Water Habitats

The EAW correctly indicates that an open water shallow water wetland community exists adjacent to the center of the property and makes mention of other wetland on the property, including shrub cars and shallow marshes, both as isolated basins and as flow-through wetland complexes.

The EAW does not describe potential hydrologic impacts to onsite and nearby wetlands and surface waters (many of which are *key habitats*) that may occur as a result of pumping and irrigation, or from construction of wheel paths. The exiting documentation of onsite *key habitats*, listed species presence, and high species diversity (DNR Heritage Review, October 10, 2012) increase the importance for thorough assessment, disclosure of potential impacts, and identification of adequate mitigation measures.

It is widely accepted that small changes in hydrology can significantly affect wetland and surface water ecological processes, species composition and ecological function. Such impacts include but are not limited to declines in vegetation diversity, shifts to tolerant species (including invasives), and declines in overall wildlife species richness. The impacts of changes in water level dynamics are further summarized in a online document titled, Working Paper No. 1 – An Overview of the Impacts of Water Level Dynamics ("Bounce") on Wetlands.

Impacts to Hydrology Caused by Pumping and Irrigation - The well logs submitted with the EAW show that all the proposed wells are located in the water table aquifer and are generally shallow. We've estimated the land surface elevation at each well and the nearby lake and wetlands using the USGS topographic map (the best available elevation data at this location). The results show static water elevations just below land surface and similar in elevation to the nearby surface water bodies (wetlands and shallow lakes). This data indicates that the shallow water table aquifer is directly connected to the nearby surface water bodies. This is expected in an outwash area such as what. Based on the pumping levels provided in the well logs, pumping levels are significantly below the nearby surface water bodies at the tested rates (see attached map Winnemucca.pdf). Pumping elevations are estimated to be between 1192 to 1248 ft mean sea level, while nearby wetlands and lakes range from 1260 to 1274 ft. The sandy soils (Figure 9 in EAW and Well Logs), in addition to pumping elevations provided, indicates that pumping these wells may impact nearby surface water bodies and wetlands by reducing water table elevations below the landsurface or otherwise affecting water level dynamics.

As acknowledged in answering Question #17, runoff will be increased from the site as a result of the project. The EAW indicates that changes in runoff will be insignificant within the watershed context. It is unclear what watershed if being referenced, but based on information described above in addition to the changes in runoff; we believe impacts resulting from changes in runoff may be significant within the watersheds of the onsite and nearby wetland habitats.

Impacts to Hydrology Caused by Wheel Boom Paths – The project will result in direct habitat loss through filling and potential indirect habitat impacts through changes in water level dynamics (i.e. "bounce").

DNR recommendations:

The EAW should describe, through quantifiable means, the changes in hydrology that could occur (due to pumping, irrigation/changes in runoff, and construction of wheel paths through wetlands), and the effects on onsite and nearby wetlands and surface water level dynamics.

Specifically, the potential changes in water level dynamics should be informed by water pump testing and modeling. Prior to continuous pumping, all wells should be evaluated with resource aquifer tests (multiple pumping wells and longer duration), in conjunction with installation of water level observation wells at several locations. In addition, staff gages (or piezometers if no standing water is present) should be installed in the wetlands to determine the sustainability of this pumping. Once the area of potential affect is identified, operational controls and maximum use thresholds that would avoid impacts should be described.

Basic hydraulic analysis/modeling should be provided to explain and describe culvert size and placement location recommendations associated with the irrigation wheel boom pathways. Similar analysis should be provided for changes in surface water run-off and potential impacts resulting from changes in "bounce".

While DNR Appropriation of Waters applications require this testing to inform appropriate permit actions, the EAW process should disclose all potential project related impacts. Since the project has the potential for impacts to extend offsite into public use areas, this is especially important.

Existing onsite wetlands should be described by type (Circular 39 Classification) and amount of direct impact caused by filling (per type within the project area). Measures to avoid and minimize impacts should also be described (as asked by EAW Question #11).

Public Lands

It is the DNR's responsibility to avoid, when possible, all potential adverse impacts to DNR administered lands. Farnham Lake Wildlife Management Area (WMA) is located directly adjacent to the west. It was created in 2010 to secure and protect long-standing public use of Farnham Lake for waterfowl hunting, trapping, and wild rice harvesting. Farnham Lake is classified as a shallow/wildlife lake due to its mean depth of 1.7', maximum depth of 2.0', and 80% wild rice coverage (DNR wildlife lake survey, June 20, 2007). If adequate control mechanisms are not identified, the impacts described above could potentially extend into the WMA and significantly impact and degrade habitats and public use of the WMA.

DNR recommendation:

The impacts assessment described above (pump testing, operational controls, etc.) should include potential impacts and avoidance measure to protect habitats and public use of Farnham Lake WMA.

Terrestrial Habitats

Clearing for agriculture will result in permanent loss of forest areas. Replacement of forested areas with agricultural field will eliminate these areas' habitat functions. The EAW indicates that wildlife movement will be altered - we agree. The removal and fragmentation of plant communities leaves fewer habitats

for wildlife, as they are pushed into other habitats which many times are already at their carrying capacity. As limiting factors come into play, an overall net decrease in species abundance and diversity can result, leaving the residual areas populated by species that thrive in the presence of disturbance and human activity. These are often species viewed as nuisance species.

Since onsite forested areas appear to have been harvested and intensively managed in the past, their habitat value would not be the same as native plant communities and other on-site key habitats (intensively managed forests typically lack the structural diversity and habitat value of stands originating from fire).

Question 13. Water Use

There are no permitted appropriators within one mile of this EAW boundary. There are no location-verified groundwater users per MN Department of Health County Well Index (CWI) near this property. There is a domestic well located within ½ or one-half mile east of the eastern boundary of Section 18 of this EAW (see attached map Winnemucca.pdf). This domestic well is located in a deep confined aquifer (131 ft deep) and will not to be impacted by the shallower proposed production wells based on the information we have to date. There are other shallow domestic wells > ½ or less than one-half mile to the west and east, and appear to be in the same aquifer as the proposed production wells. However, impacts to these wells would most likely occur after impacts to the nearby wetlands.

Nutrient contamination from agriculture has been demonstrated in sand and gravel outwash plains in similar areas to this area (Straight River area). The soils in this area are moderately to excessively well-drained (per SSURGO soils information and well logs), with the exception of very poorly drained mucks in the wetlands. Soil textures indicate a high potential for nutrient contamination in the shallow water table if nutrient application rates are not strictly managed. This can pose a health risk if there are nearby receptors. The EAW indicates that University of MN has developed best management practices (BMP's) for sandy soils which are used to develop nutrient recommendations for individual fields; however, it is unclear from the EAW whether the BMP's are effective in preventing exceedance of minimum water quality standards or whether they will be used.

At the time of this review, there was limited use of the groundwater in and in close proximity to the project area for drinking water and, therefore, limited risk to human health. However, if additional wells are installed in this area and nutrient concentration is above MN Department of Health's Risk Limits, it is likely that the water table aquifer may be of limited use for domestic drinking water.

DNR recommendation:
DNR recommends that the EAW described effectiveness of the University of MN's BMP's and describe plans for incorporation of measures to prevent agricultural chemical contamination. Such plans should be described in context of well pump test findings.

Question 19. Geologic Hazards and Soil Conditions

Soils survey information indicates that the majority of the site contains soils classified as excessively drained to moderately well drained soils. This creates much higher potential for pumping associated with irrigation to adversely impact other uses and resources.

The testing, mentioned above, will be necessary to further define the relationship between pumping draw downs and effects on other uses and resources. With projects that trigger mandatory

environmental review, it is important that potential use conflicts be fully disclosed through the process provided by the EAW.

Question 25. Nearby Resources.

The Crow Wing River provides excellent angling opportunities, particularly for smallmouth bass and walleye, and is a popular canoe route.

DNR recommendation:

The Crow Wing River is a State Water Trail and should be included as a nearby trail resource.

Question 29. Cumulative Potential Effects

Records indicates that in Wadena County alone, 676 acres of Potlatch lands were sold to Winnemucca Farms or RD Offutt between the publications of the 1999 and 2012 plat books, and an additional 868 acres of Potlatch lands were sold since the publication of the 2012 plat book and today.

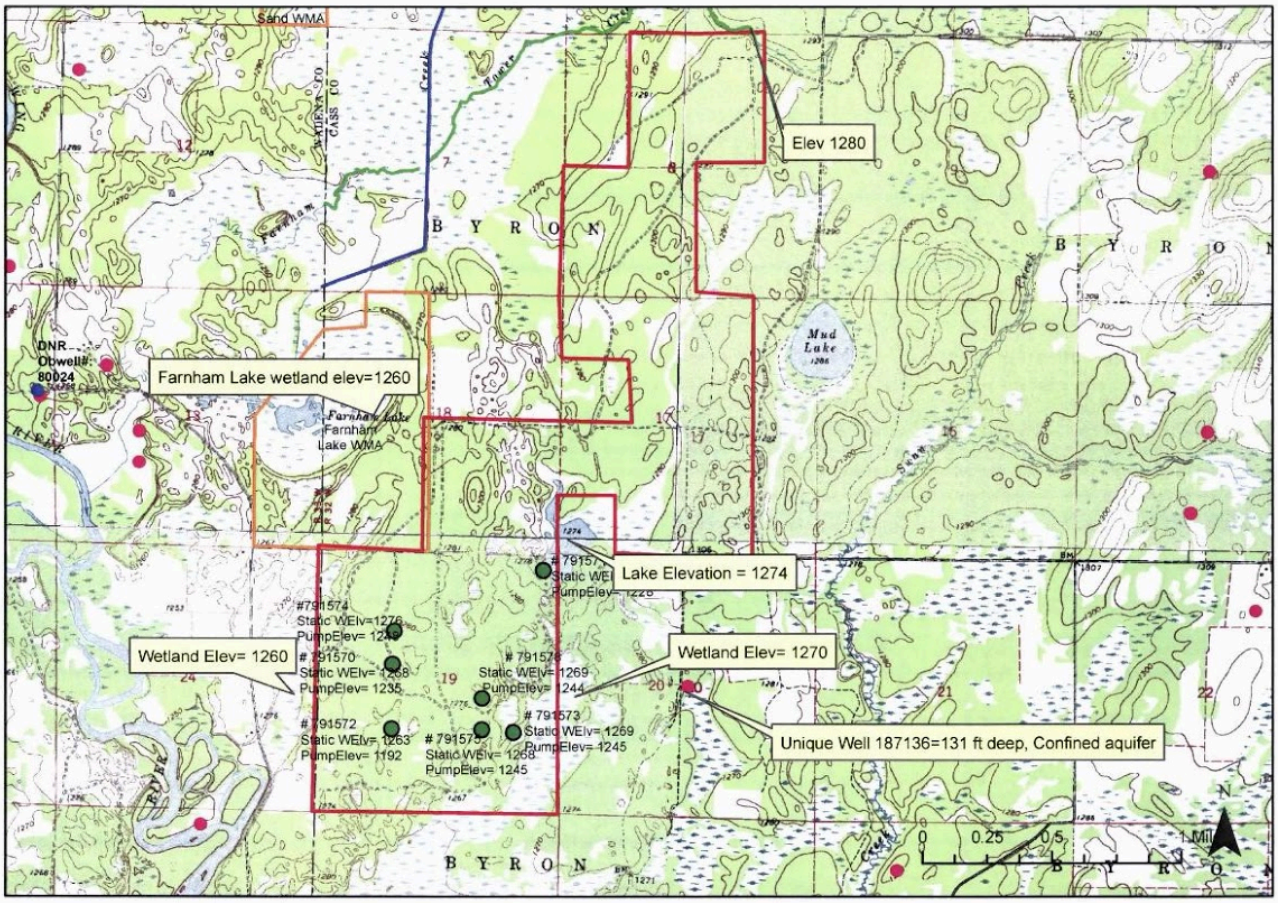
DNR recommendation:

In order to determine whether the additional holdings represent reasonably expected projects that could interact with the current proposal, DNR recommends that the EAW describe other landholdings in the area and their potential for interactions with the proposed project. At a minimum, the distance of the other projects and potential for those projects to affect the sustainability of overlapping resources (e.g. habitats, aquifers, surface waters within the same watershed) should be described.

Thank you for the opportunity to review and comment on this project. Please call Nathan Kestner, Regional Environmental Assessment Ecologist, at 218-308-2672, with general questions about this review. For specific direction about the scope and methods of the water resource testing and monitoring, it will be necessary to work directly with Michele Walker, NW Regional Groundwater Specialist, at 218-308-2664.

Winnemucca Land Conversion EAW Assessment

1/4/2013



LOCAL

DNR halts pines-to-potatoes conversion in central Minnesota

Study could take up to a year and will look at potential threats to groundwater

By Tony Kennedy (http://www.startribune.com/tony-kennedy/10645191/) Star Tribune

FEBRUARY 5, 2015 — 10:52PM

Alarmed by rapid deforestation in an ecologically sensitive swath of central Minnesota, state regulators have ordered a broad environmental review that will temporarily halt conversion of the region's jackpine stands to potato fields.

Natural Resources Commissioner Tom Landwehr said Thursday he's ordering the study of water and wildlife impacts because the bulldozing of trees and plowing of soil is happening over a permeable aquifer that could be polluted by fertilizers and depleted by crop irrigation.

Until the study's completion, which could take nine months to a year, the state won't consider dozens of permit applications for high-capacity groundwater wells submitted by potato processor R.D. Offutt Co. as it expands its already formidable footprint in the region.

Even then, the DNR could block further conversions if the review finds there are already severe threats to natural resources associated with the pristine Pineland Sands Aquifer and its overlying woods, Landwehr said. The area of concern touches Becker, Cass, Hubbard and Wadena counties.

"We simply have to get a better handle on what's happening with overall water use and water quality in this very, very, very important aquifer," Landwehr said.

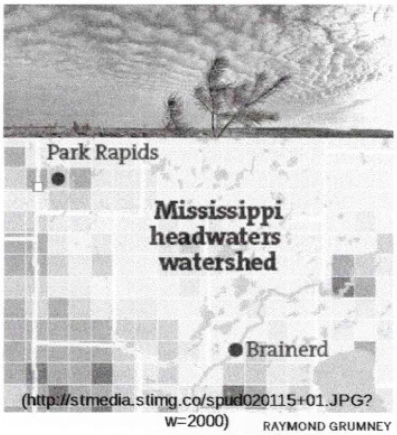
Offutt declined to comment Thursday on Landwehr's announcement, but General Counsel Paul Noah said the company is acquiring land in an effort to reduce the environmental impact of potato cultivation.

"Our intention in acquiring land is to allow for increased crop rotation as part of our ongoing commitment to sustainable farming practices," Noah said. He said Offutt, the nation's largest potato grower, is committed to preserving groundwater and surface water quality in the communities where it farms. In Minnesota, Noah said, the company is participating in a Byron Township water quality study in partnership with the DNR and other agencies. The first-of-its-kind study was launched last fall and will benefit communities and farmers statewide and elsewhere, he said.

The Star Tribune reported Sunday that the pines-to-potatoes conversion is part of a bigger, mostly invisible transformation in the watershed that drains into the Upper Mississippi River, a basin that supplies drinking water for 1.7 million people in the Twin Cities. Since 2006, about 275 square miles of natural land in the Upper Mississippi watershed has been converted to row-crop agriculture, according to a University of Minnesota analysis — much of it sandy soils and forests where no one ever expected to see farming.

The DNR estimates that North Dakota-based Offutt already has purchased about 12,000 acres of pine forests in northern Minnesota for conversion to irrigated cropland. A third of that land already has been converted and won't be affected by the DNR review. Observers say the forest loss in the four counties could expand to include 42 square miles depending on how much more land Potlatch, the giant wood products manufacturer, sells to agriculture-minded buyers.

The DNR controls permitting of high-capacity groundwater wells that Offutt and other farmers need for irrigation of the sandy soils in the region. The agency notified Offutt by letter Thursday that the review, known as an Environmental Assessment Worksheet, will



(http://stmedia.stimg.co/spud020115+01.JPG?w=2000) RAYMOND GRUMNEY BRIAN PETERSON – STAR TRIBUNE

Graphic: Losing natural land to farming

Gallery: A lone pine tree survived the plowing of this field south of Park Rapids.

preclude construction of any projects that depend on groundwater well approvals.

To date, the DNR has issued 32 irrigation permits to Offutt, and the company has proposed an additional 54.

The DNR's letter defined "construction" as "any activity that directly alters the environment, including the preparation of land."

On Thursday, Landwehr applauded Offutt for adopting techniques that produced "amazing" decreases in nutrient and pesticide use. But he said the magnitude of the company's land conversions in Minnesota demanded an examination of the cumulative effects.

The DNR said nitrate contamination in water, from fertilizer, is difficult to avoid when growing potatoes in sandy soils and that contamination could hurt groundwater, connected surface waters, fish, and other aquatic species. The cumulative volume of water being consumed also is a concern, as some municipalities in the region have already had to invest in deeper wells.

Landwehr also said the environmental worksheet will consider impacts of deforestation on the area's wildlife. He said jackpine stands are a rare forest type in Minnesota, home to a number of unique species, including the goshawk and Blanding's turtle.

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Minnesota Department of Natural Resources
500 Lafayette Road Saint Paul, Minnesota 55155-4037
Office of the Commissioner
651-259-5555

MNDNR

February 12, 2016

Ms. Amy Mondloch
Toxic Taters Coordinator
PO Box 25
Callaway, MN 56521

VIA E-MAIL AND U.S. MAIL

Mr. Keith McGovern
CEO R.D. Offutt Co.
15357 US 71
Park Rapids, MN 56470

Mr. William Seuffert
Executive Director
Minnesota Environmental Quality Board
520 Lafayette Rd. N.
St. Paul, MN 55155

Re: Petition for EAW: RD Offutt Expansion in the Pineland Sands Aquifer
DNR Determination on Need for an EAW

Dear Ms. Mondloch, Mr. McGovern and Executive Director Seuffert:

This letter serves to notify you that the Minnesota Department of Natural Resources (DNR) has determined that the proposed "RD Offutt Expansion in the Pineland Sands Aquifer Area" does not have the potential for significant environmental effect and that, therefore, an Environmental Assessment Worksheet is not required for the proposed Project.

Enclosed please find the Department of Natural Resources (DNR's) Finding of Fact and Record of Decision for this matter.

Very truly yours,

Sherry A. Enzler
General Counsel

cc: Randall Doneen, Environmental Review Supervisor
Kate Frantz, Environmental Review Project Manager

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

RECORD OF DECISION

In the Matter of the Determination
of Need for an Environmental
Assessment Worksheet for the RD Offutt Expansion
In the Pineland Sands Aquifer Area in
Wadena, Hubbard, Becker and Cass
Counties, Minnesota

FINDINGS OF FACT, CONCLUSIONS, AND ORDER

PROCEDURAL BACKGROUND

1. On February 5, 2015 the Commissioner of the Department of Natural Resources (DNR) issued an Order for a discretionary EAW to RD Offutt Company (RD Offutt) for a project that consisted of applications for 21 groundwater appropriation permits and a request for 33 preliminary well assessments. If granted, the permits would have resulted in the conversion of approximately 7,000 acres of pine forest, historically managed for timber production, to irrigated agriculture.

2. RD Offutt appealed the DNR's February 5, 2015 Order to the Minnesota Court of Appeals and requested that the Court vacate the DNR's February 5, 2015 Order.

3. While the appeal was pending, RD Offutt submitted two letters to the DNR, dated April 7, 2015 and April 22, 2015, withdrawing all of the preliminary well assessments and some of the permit applications.

4. On May 12, 2015, the DNR filed a motion to dismiss RD Offutt's appeal as moot because RD Offutt's Project changes were substantial changes requiring the DNR to determine whether RD Offutt's Project, as modified, required the preparation of an EAW.

5. On June 2, 2015, the Minnesota Court of Appeals found RD Offutt's appeal to be moot because RD Offutt had so modified its project that DNR was required to make a new determination on the need for an EAW. The Court of Appeals dismissed RD Offutt's appeal.

6. Due to the withdrawal of all but 18 permit applications (Modified Project), the DNR vacated the February 5, 2015 order for the discretionary EAW on June 19, 2015.

7. On June 19, 2015, the DNR ordered a discretionary EAW for the remaining 18 permit applications associated with the Modified Project.

8. RD Offutt withdrew an additional 13 permit applications on or about June 19, 2015, and confirmed this withdrawal of permit applications on September 8, 2015, leaving 5 water appropriation permits pending.

9. On September 10, 2015, the DNR vacated the June 19, 2015 order for a discretionary EAW.

10. On September 10, 2015, the DNR entered into a Memorandum of Understanding with RD Offutt in which the scope of a Pineland Sands Special Study was developed, the intent of which was to study land and water impacts from the conversion of forested land to irrigated agriculture in the Pineland Sands Area.

11. DNR issued permit number 2014-0678 (Menahga 6W) on November 17, 2015.

12. On or about November 19, 2015, the Minnesota Environmental Quality Board (EQB) received a petition requesting the preparation of an Environmental Assessment Worksheet (EAW) for the proposed RD Offutt Expansion in the Pineland Sands Aquifer Area, located in Wadena, Hubbard, Becker and Cass Counties, Minnesota (Project).

13. The EQB determined that the petition met the threshold requirements set forth in Minn. R. 4410.1100, subp. 1 and 2.

14. The EQB designated the Minnesota Department of Natural Resources (DNR) as Responsible Governmental Unit (RGU) to make the decision on the need for an EAW. Minn. Stat. § 116D.04, subd, 2a(c) and Minn. R. 4410.0500, subp. 1. Pursuant to the requirements of Minn. R. 5510.1100, subp. 5, the petition was transmitted to the DNR for a determination of the need for an EAW. Notice of the assignment of the petition to the DNR was published in the EQB Monitor on December 7, 2015.

15. The DNR received the petition from the EQB on November 24, 2015.

16. On January 11, 2016, the Petitioners and the DNR agreed to stay the DNR's determination on the petition for thirty (30) days pending discussions regarding whether the concerns raised in the petition by the Petitioners could be addressed in a separate study covering the broader Pineland Sands aquifer outside of any environmental review. The stay expired on February 11, 2016.

17. On February 10, 2016, RD Offutt withdrew two of the remaining four water appropriations permit applications pending before the DNR. The remaining water appropriation applications pending before the DNR are: 2014-2074 (Huntersville #6) and 2014-1028 (Jacobson). Neither of the fields to which these permit applications pertain are currently forested. The Jacobson field was not previously owned by Potlatch nor was it forested. The Jacobson field is currently planted with a cover crop.

18. Pursuant to Minn. R. 4410.1100, subp. 2, a petition must contain the following information:

    a. a description of the proposed project;
    b. the proposer of the project;

c. the name, address, and telephone number of the representative of the petitioners;
d. a brief description of the potential environmental effects which may result from the project; and
e. material evidence indicating that, because of the nature and location of the project, there may be potential for significant environmental effects.

19. The petition submitted on the RD Offutt Expansion in the Pineland Sands Aquifer Area Project contained the required elements prescribed in Minn. R. 4410.1100, subp. 2.

20. The petition alleges the DNR's decision to authorize five pending water appropriations permits for the RD Offutt Expansion in the Pineland Sands Aquifer area may have/has the potential for the following environmental effects:

a. The RD Offutt Expansion Project will deplete the water resources contained in the Pineland Sands Aquifer, impacting area water resources.
b. The RD Offutt Expansion Project will contaminate the aquifer, due to the application of synthetic fertilizers, potato insecticides, fungicides, herbicides, and fumigants.
c. The RD Offutt Expansion Project will increase the health impacts to area residents of pesticide drift.
d. The RD Offutt Expansion Project will result in significant deforestation.
e. The RD Offutt Expansion Project will result in negative socioeconomic impacts, specifically negative impacts to the tourism industry in the area due to loss of forest and contamination of lakes, streams, and wells.
f. The RD Offutt Expansion Project will result in negative impacts to native plants and wildlife habitat, specifically pollinator species due to the use of systemic insecticides.
g. The RD Offutt Expansion Project will result in negative impacts to cultural and treaty rights.

Petition for EAW at 1-2.

21. As material evidence, the Petition contained:

a. Internal DNR communications and draft documents regarding previous RD Offutt projects in the proposed Project area.
b. Two comment letters regarding the Winnemucca Farms Cass County Potato Farm Environmental Assessment Worksheet, one each provided by the Minnesota Pollution Control Agency (MPCA) and the DNR.
c. A series of letters from the office of Minnesota State Representative Jean Wagenius, Minnesota House of Representatives regarding the Winnemucca Farms Project.
d. Document, "Policy Brief, An Updated Look at Mancozeb: Concerns about Farmworker Reproductive and Child Developmental Health."
e. State Agency Factsheets:
    i. MPCA Factsheet: "Byron Township Stop, LCCMR Tour, July 17, 2013,"
    ii. Minnesota Department of Agriculture (MDA) 2014 factsheets regarding potato production, "Systemic activity of pesticides used for potato production,"
    iii. Explore Minnesota factsheet, "Tourism and Minnesota's Economy"

iv. DNR Factsheet: Species Profile for Blanding's Turtle (*Emydoidea blandingii*)

f. Published scientific journal articles and studies:
   i. "Environmental Fate of Soil Applied Neonicotinoid Insecticides in an Irrigated Potato Agroecosystem," published in *PLoS ONE*, May 13, 2014.
   ii. "Colonies of Bumble Bees (Bombus impatiens) Produce Fewer Workers, Less Bee Biomass, and Have Smaller Mother Queens Following Fungicide Exposure," published in *Insects,* June 1, 2015
   iii. "Neonicotinoid Residues in Wildflowers, A Potential Route of Chronic Exposure for Bees," published in *Environmental Science and Technology*, October 9, 2015.
   iv. "Land-use change and costs to rural households: a case study in groundwater nitrate contamination" published in *Environmental Research Letters*, June 30, 2014.
   v. "The Fungicide Clorothalonil is Nonlinearly Associated with Corticosterone Levels, Immunity, and Mortality in Amphibians" published in *Environmental Health Perspectives*, August 2011.
   vi. "Pesticides in Groundwater of the United States: Decadal-Scale Changes, 1993-2011" published in *Groundwater*, 2014.
   vii. "If Groundwater is Contaminated, Will Water from the Well be Contaminated?" published in Groundwater, 2014.
   viii. "Environmental and Economic Costs of the Application of Pesticides Primarily in the United States" published in *Environment, Development and Sustainability*, 2005.
   ix. "Acute Illnesses Associated with Pesticide Exposure at Schools" published in the *Journal of the American Medical Association (JAMA)*, September 14, 2005
   x. "Acute Pesticide Illnesses Associated with Off-Target Pesticide Drift from Agricultural Applications: 11 States, 1998-2006" published in *Environmental Health Perspectives*, August 2011.

g. News articles, including but not limited to, "Offutt defends his company's land stewardship", "In central Minnesota, potatoes are pushing out forest land," letter to the editor "Potato Giant article did not tell the whole story," and "Grower Turns Land into Pollinator Haven."

h. MPCA Office Memorandum, Subject: Response Summary, South Fork Whitewater River Fish kill on or about 7/28/2015.

i. Maps and aerial photos of the area identifying locations of the RD Offutt permit applications, groundwater flow and existing features.

j. Reports:
   i. "No Significant Risk Level (NSRL) for the Proposition 65 Carcinogen Clorothalonil" Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, January 2012.
   ii. "Pesticide Drift Monitoring in Minnesota: June 13, 2006 – August 13, 2009," published by the Pesticide Action Network North America, May 2012.
   iii. "The Impact of the Nations' Most Widely Used Insecticides on Birds," American Bird Conservancy, March 2013.

k. DNR Draft Strategic Plan for the Groundwater Management Program, October 2013.

l. Online resources:
   i. "Deforestation and Monarch Conservation," published by *Monarch Watch Blog*, March 21, 2008.

ii. "PANNA: Pesticide Drift Poisons in Central Valley," published by Pesticide Action Network, 2004.
iii. "Pesticide Volatilization," published by the United States Environmental Protection Agency, May 6, 2015.
iv. "Proposition 65 List of Chemicals: Chemicals Known to the State to Cause Cancer or Reproductive Toxicity," published by California Environmental Protection Agency, August 25, 2015.
v. "Chemical Watch Factsheet: Metam Sodium," published by Beyond Pesticides, September 2007.

22. RD Offutt provided the following additional information for consideration in relation to the petition on or about December 16, 2015.

    a. Technical Memorandum and maps of areas of pending water appropriations well permits, provided by Larry Kramka, Houston Engineering Inc., on behalf of RD Offutt Company.
    b. Letter and Badoura Focus Area Project Management Table provided by Nancy Quattlebaum Burke on behalf of RD Offutt Company.
    c. Document: Best Management Practices for Nitrogen Use on Irrigated Potatoes: RD Offutt Company Program, with reference materials from University of Minnesota Extension (undated, publication #08559), December 2015.
    d. Document: Potato Fungicide Best Management Practices to Prevent Drift and Minimize Volatilization, RD Offutt with reference materials from MDA (July 2014), and the University of Minnesota (2010), December 2015.

23. RD Offutt provided an additional technical memo in relation to the petition on or about January 6, 2016.

24. In addition to the information provided by the Petitioners and the Project Proposer, the DNR collected and reviewed additional information known to DNR regarding the potential effects alleged by the petition. This additional information included but was not limited to:

    a. Email and phone correspondence with DNR Groundwater Technical Supervisor
    b. Straight River Groundwater Management Area Draft Plan—December 8, 2015 Draft
    c. Email and phone correspondence with DNR Silviculture Program Coordinator
    d. DNR Operational Orders 59: Pesticide Use Guidelines
    e. DNR Division of Forestry Pesticide Use Guidelines
    f. Publication: Revised Forest Management Guidelines, Minnesota Forest Resources Council, 2012
    g. Email and phone correspondence with MPCA Watershed Division staff
    h. MPCA memo and attachments: "Key MPCA concerns regarding forest conversion to potato crop in north central lake country"
    i. Crow Wing River Watershed Restoration and Protection Strategy (WRAPS) Report, MPCA, January 2015
    j. Report: Nitrogen in Minnesota Surface Waters, MPCA, June 2013
    k. Email and phone correspondence with MDA Pesticide Unit staff, and Fertilizer Unit staff
    l. Document: Info to DNR on pesticides in potatoes 12-30-15 V-2, MDA, 2015.

m. Online resource: Characterizing Nitrates in Private Drinking Water Wells, Central Sands Summary 2014, MDA 2014.
n. Byron Township Water Quality Study Information and Data from 2014 and 2015, supported by multiple partners, including MDA and RD Offutt
o. 2014 Water Quality Monitoring Report, MDA Pesticide and Fertilizer Management
p. Email and phone correspondence with University of Minnesota Soil Scientist
q. Aerial photos and Geographical Information Systems data regarding parcel information from 2010, 2012, 2013, and 2015
r. Email and phone correspondence with DNR Ecological and Water Resources Division Staff
s. Report: An Evaluation of the Ecological Significance of the Badoura Woodlands, Hubbard County Minnesota, DNR, 2013
t. Email and phone correspondence with MDH Water Protection Unit staff and Health Risk Intervention Unit staff.
u. Report: Minnesota Drinking Water 2015 Annual Report for 2014, MDH, May 7, 2015
v. Memorandum: Chlorothalonil Registration Review Human-Health Assessment Scoping Document, US Environmental Protection Agency (USEPA), 2012
w. Presentation: Field Volatilization of Agricultural Pesticides, USEPA, 2008
x. Study: Concentrations and environmental risk of chlorothalonil in air near potato fields in Prince Edward Island, Canada, published in *Pest Management Science*, May 2011

25. Minn. Stat. 116D.04, subd. 2a(c) requires the RGU to prepare an EAW where a petition signed by not less than 100 individuals who reside or own property in the state "demonstrates that, because of the nature or location of a proposed action, there may be potential for significant environmental effects." *See also,* Minn. R. 4410.1100, subp. 6 and *Carl Bolander & Sons Co. v. Minneapolis,* 448 N.W. 2d N.W. 2d 804, 810 (Minn. Ct. App. 1992).

26. The RGU shall deny the petition if the evidence presented fails to demonstrate that the project may have the potential for significant environmental effects. In considering the evidence, the RGU must take into account the following factors:

    a. type, extent, and reversibility of environmental effects;
    b. cumulative potential effects of related or anticipated future projects;
    c. the extent to which environmental effects are subject to mitigation by ongoing public regulatory authority; and
    d. the extent to which environmental effects can be anticipated and controlled as a result of other available environmental studies undertaken by public agencies or the project proposer, including other Environmental Impact Statements (EISs).

Minn. R. 4410.1100, subp. 6 and Minn. R. 4410.1700, subp. 7.

27. An RGU is not required to undertake environmental review on the basis of speculative information. *Reserve Mining Co. v. Herbst*, 256 N.W. 2d 808, 829-30 (1977).

FINDINGS OF FACT

28. The Pineland Sands Area is a 785 square mile area located in northwestern and north central Minnesota. The area is a large expanse of surficial glacial outwash ranging from fine sand to fine gravel. The Pineland Sands Area includes Becker, Cass, Hubbard, and Wadena Counties.

29. The Pineland Sands Aquifer is a surficial glacial outwash aquifer located in part in Becker, Cass, Hubbard, and Wadena Counties. The aquifer is recharged primarily by precipitation. The aquifer is the source of base flow to most rivers, lakes, and streams within the Pineland Sands Area.

30. RD Offutt is in the business of growing and processing potatoes. Its business practice involves irrigating and growing potatoes in Minnesota's sandier soils to develop a uniform sized potato used in RD Offutt's french fry processing facility outside of Park Rapids, Minnesota. http://www.RD Offuttffuttcompany.com/our-history/

31. RD Offutt uses the fields covered by the water appropriation permits previously issued by the DNR (identified in finding 33) and proposes to use the fields associated with the Project to grow potatoes, corn, soybeans, and/or peas on a three- or four-year rotation cycle.

32. There are a number of domestic wells and communities in Becker, Cass, Hubbard, and Wadena Counties that rely on the Pineland Sands Aquifer for their drinking water supply.

33. Potlatch Corporation (Potlatch), a wood products manufacturer, has been a major land owner of forested lands in the Pineland Sands Area. At its peak, Potlatch owned approximately 49,000 acres in the Pineland Sands Area and managed these lands for timber production. Over the past several years, Potlatch has been divesting itself of its land holdings in the Pineland Sands Area. To date, Potlatch has sold more than 14,000 acres.

34. Both Minnesota Statutes and Minnesota Rules describe what an RGU must consider in response to a petition when it determines whether, because of the nature and location of the project, there may be a potential for significant environmental effect and thus requiring an EAW. Minn. Stat. § 116D.04, subd. 2a(c). The factors that must be considered are the nature and location of the project and the criteria for potentially significant environmental effects described in Minn. R. 4410.1700, subp. 7. *Id.* and Minn. R. 4410.1100, subp. 6. Neither Minnesota Rule nor Minnesota Statute direct or authorize an RGU to apply the threshold test for a mandatory EAW as part of consideration of a citizen's petition.

35. Of the 2 remaining pending applications for RD Offutt, only one involves conversion of forest to agricultural lands. These applications are proposed to irrigate 195 acres. These applications, identified in Finding 17, constitute the Project for the purposes of the petition.

36. The Jacobson field was not purchased from Potlatch and has been used for row agricultural purposes for many years. Portions of the Huntersville #6 Parcel have been used for timber production. These lands have been or are in the process of being converted to irrigated agriculture. Removal of forested area from the lands with the Project area has already occurred or is not proposed.

37. The authority to issue all water appropriation permits is vested in the DNR commissioner. Minn. Stat. §§ 1030.255 through 1030.315.

38. In approving water appropriation permits, the DNR commissioner must consider the impact of a groundwater appropriation on surface water bodies, water quality, and ecosystem health. Minn. Stat. § 1030.287 Subd. 2 and 3.

39. The current Project requires the issuance of 2 groundwater appropriation permits.

40. The DNR commissioner has approval authority over the requested groundwater appropriation permits required for the Project. Therefore, the commissioner has approval authority over the Project within the meaning of Minn. R. 44l0. l000, subp.3A. The act of submitting an application for a water appropriation permit is a strong indicator that the applicant intends to use the permit for its intended purpose once the permit is granted. It is reasonable to assume that RD Offutt intends to use the requested groundwater appropriation permits for crop irrigation in the immediate future should the permits be granted.

41. The 2 groundwater appropriation permit applications that are currently pending before the DNR as part of the Project would appropriate water from the Pineland Sands Aquifer.

42. The 2 groundwater appropriation permits covered by the Project and requested by RD Offutt will be used to irrigate fields to grow potatoes within a three- to four-year rotation to support its agricultural production business.

43. A project is defined as a "governmental action, the results of which would cause physical manipulation of the environment, directly or indirectly. Minn. R. 4410.0200, subp. 65.

44. A phased action "involves two or more projects undertaken by the same proposer "that a... [responsible governmental unit] ... determines: will have environmental effects on the same geographic area; and are substantially certain to be undertaken sequentially over a limited period of time." Minn. R. 4410.0200, subp. 60.

45. The 2 groundwater appropriation permits have been requested by a single applicant (RD Offutt), are within a single aquifer (the Pineland Sands Aquifer), are within a single geographic area (the Pineland Sands Area), and are reasonably certain to occur over a limited period of time.

46. Thus, the 2 groundwater appropriation permits covered by the Project constitute a phased action within the meaning of Minn. R. 4410.1000, subp. 4 and Minn. R. 4410.0200, subp.

47. The Project will result in the conversion of approximately 120 acres of previously forested timber or naturally vegetated land to irrigated cropped agriculture overlying the Pineland Sands Area, all of which would be subject to one DNR groundwater appropriation permit.

48. Land cover maps show that the proposed irrigation site for application 2014-2074 contained tree cover within about 50 percent of the proposed irrigated area prior to submission of the instant application. On November 23, 2015, the Applicant informed the DNR that it had relocated the

proposed irrigation permit at the site to allow approximately 55 acres of mature trees to remain on the parcel. The site is private property that is not subject to any special protections and agricultural use of the site is permitted by local zoning. Adjacent property is presently used for agriculture.

49. In determining whether to order a discretionary EAW, including in response to a citizens' petition, the governmental unit need only find "that there *may* be the potential for environmental effect." *Carl Bolander & Sons Co. v. Minneapolis,* 448 N.W. 2d N.W. 2d 804, 810 (Minn. Ct. App. 1992) (emphasis in the original) and Minn. R. 4410.1000, subp. 3A.

50. The first allegation in the petition is that the RD Offutt Expansion project will deplete the water resources contained in the Pineland Sands Aquifer, impacting area water resources.

51. Wells that are associated with irrigation permits in the area are either located in the Quaternary Water Table Aquifer (QWTA) or the Quaternary Buried Artesian Aquifer (QBAA). The QWTA aquifer wells are typically shallow (less than 100 feet deep) and use water from the surficial (water table) aquifer. Wells located in the QBAA are typically deeper wells which extend into aquifers, (sand or gravel layers), beneath a confining layer of glacial till of greater than ten feet.

52. Both of the water appropriations permits identified in Finding 17 would draw from wells located in the QBAA. Wells pumping from this aquifer are less likely to impact surface waters than wells pumping from surficial aquifers.

53. While buried aquifers (QBAA) are completed under a confining layer of glacial till, there is potential for water to flow between confining layers, in what is termed 'leakiness.' The 'leakiness' of a till is a direct function of its lithology, its thickness, and natural or pumping-induced vertical gradient. In locations where the till is highly leaky, pumping from wells completed in the buried aquifer (QBAA) can cause drawdown in the overlying surficial aquifer.

54. The 2 pending water appropriations permits described in Finding 17 have requested a total of 63.5 MGY.

55. The DNR has completed technical review for application 2014-1028, based on drawdown computations using pump test data submitted by the Applicant and not on data from any observation wells. Based on these computations, the DNR's regional groundwater specialist concluded that pumping Applicant's well at 600 gpm for 14 days would produce an estimated drawdown of 0.4 feet in the nearest domestic well (#411245) and an estimated drawdown of 0.3 feet in the second nearest domestic well (#801880). This was a conservative analysis that would be the equivalent of applying 5.95 inches of water in two weeks to the 75 acres, which is somewhat in excess of the irrigation requirements for corn, the most water-demanding crop of those listed by Applicant in the permit application.

56. The DNR's regional groundwater specialist reviewed the location of the well and the proposed appropriation under application 2014-1028 and determined that it was not expected to have any major impacts upon any nearby surface water features, including the Straight River. The specialist did recommend that the cumulative (collective) effects of appropriations within the

area be evaluated once a regional model has been developed for the Straight River Groundwater Management Area.

57. The groundwater specialist reviewed the well and boring record for Unique Well #803654 associated with application 2014-1028, and identified the source of the proposed appropriation as a Quaternary buried artesian aquifer. The groundwater specialist detailed the hydrogeology of the aquifer setting and regional groundwater flow system.

58. The Straight River Groundwater Management Area (GWMA) Project was developed by the DNR due to a significant increase in groundwater use in the geographic area in the last two decades. The Straight River GWMA was established to support better decision-making on groundwater appropriation permits and support the Park Rapids area's sustainable groundwater use.

59. The DNR is required to consider sustainability of all proposed water appropriations in determining if a permit should be issued or denied. The DNR is authorized to impose conditions on water appropriation permits to ensure water sustainability. Pursuant to the requirements of Minn. Stat. § 103, a previously issued water appropriation permit can be modified or revoked if it is determined that the appropriation is not sustainable. Minn. Stat. §103G.287, subd. 5.

60. The second allegation in the petition is that the RD Offutt Expansion Project will contaminate the aquifer, due to the application of synthetic fertilizers, potato insecticides, fungicides, herbicides, and fumigants to irrigated agricultural fields.

61. RD Offutt, in the December 2015 document Best Management Practices for Nitrogen Use on Irrigated Potatoes, states that, "R.D. Offutt Company (RDO) uses Best Management Practices in its application of nutrients to its potato crop."

62. Nitrogen fertilizer application in forested areas managed for timber is rarely used per DNR Division of Forestry staff. As noted by the MFRC Revised Forest Management Guidelines (2012), fertilizer is more beneficial to timber production when used later in the rotation. These guidelines further recommend that detailed nutrient analyses of the soil and fertilizer should be done before application.

63. The Minnesota Department of Health (MDH) has implemented the federal Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/l) of nitrate-nitrogen in source water for the safe consumption of drinking water.

64. According to MDH's Minnesota Drinking Water Annual Report for 2014, Park Rapids, located in the Pineland Sands Aquifer, was one of fifteen Community Public Water Supply systems with source water nitrate levels equal or greater to the federal MCL.

65. Central Sands Private Well Network, an effort coordinated by MDA starting in 2011, has conducted nitrate analysis for private wells within the Central Sands Region, which includes, but is not limited to, Becker, Wadena, Cass, and Hubbard Counties. Of the 113 private wells analyzed in these four counties in 2014 as part of this Network, approximately 11 percent had levels of greater than 3 mg/l, which MDH considers to be impacted by nitrate-nitrogen. Within the counties

of Becker, Wadena, Cass and Hubbard, several wells with elevated nitrate are in the area of Northern Wadena and Southern Hubbard Counties in the area of the proposed Project.

66. Surface waters in the area, including the Shell River and the Straight River, have been identified as impaired for dissolved oxygen (DO) by the MPCA. According to MPCA, DO levels are influenced by surface water conditions including, but not limited to: elevated nitrogen and phosphorus levels, elevated temperatures, and reduced flow.

67. The Crow Wing River Watershed Restoration and Protection Strategies (WRAPS) Report, published in January 2015, identified and recommended strategies for eliminating impairments of surface waters in the Crow Wing River Watershed. Both the Shell River and Straight River were identified in this report as impaired surface waters in this watershed. Strategies for impairment reduction included, but were not limited to, increasing forest acreage.

68. Per DNR Division of Forestry staff, pesticide application practices in forested areas managed for timber are typically limited to management for invasive species, and will typically include the spraying of herbicides, such as glyphosate, in areas affected by invasive vegetation. Fumigants, fungicides and insecticides are not routinely used.

69. MDA regularly monitors groundwater and surface water to better assess the impacts of pesticides to groundwater and surface water resources due to the normal use of pesticides in Minnesota. The MDA established a network of ten water quality monitoring regions, called Pesticide Monitoring Regions, (PMRs), throughout Minnesota for the purposes of collecting, assessing, and reporting monitoring data from both surface and groundwater samples. Cass, Becker, Wadena and Hubbard Counties fall in PMR 4 of MDA's water monitoring program network.

70. Recent monitoring results conducted by MDA identified pesticides most likely to be found in groundwater from the last five years (2010 to 2014) in Cass, Becker, Wadena and Hubbard Counties and PMR 4. These include the following: Chlorothalonil, Mancozeb, Metam sodium, Imidacloprid, Thiamethoxam, Clothianidin, Esfenvalerate, Metribuzin, and Metolachlor.

71. Monitoring Results indicated that herbicides, (metolachlor+degradates and metribuzin+degradates) and insecticides, (imidacloprid and thiamethoxam) were detected from Becker, Wadena and Hubbard Counties in varying concentrations and frequencies from 2010 to 2014 (Table 2). Chlorothalonil and esfenvalerate were not detected in any groundwater samples in PMR 4 from 2010 to 2014.

72. Potential impacts to water quality related to proposed water appropriations must be considered by the DNR in determining if a proposed water appropriation is sustainable. Minn Stat § 103G.287 Subd 2 and 5.

73. In order to prevent detrimental effects to the environment related to the contamination of groundwater with nitrates from nitrogen-derived fertilizers as a consequence of agricultural production, the DNR conditions permits on responsible water use, implementation of adequate soil and water conservation measures, and adherence to BMPs, including nitrogen BMPs, which have been included in previous water appropriations permits, including water appropriation

permit 2014-0678, as mentioned in Finding 10. The DNR could impose these conditions as necessary to protect against potential impacts to land and water resources from the high-nitrogen-need crops, such as corn and potatoes, that Applicant intends to irrigate.

74. The third allegation in the petition is that the RD Offutt Expansion Project will increase the health impacts to area residents due to pesticide drift.

75. The Petitioners have failed to cite to any specific examples of health impacts known to occur in Minnesota from pesticide drift, let alone any specific information regarding pesticide drift from the existing RD Offutt operations. Correspondence with the MDH and MDA has not resulted in either agency advising DNR of any formal complaints of pesticide drift associated with RD Offutt operations.

76. In the December 16, 2015 submittal "R.D. Offutt Company Potato Fungicide Best Management Practices to Prevent Drift and Minimize Volatilization," RD Offutt stated that the company's "…integrated pest management (IPM) incorporates all of [the University of Minnesota Extension Service best management practices (BMPs)…six core practices]," and that the company has "established its IPM Program based on the input from professionals at the University of Minnesota and North Dakota State University."

77. USEPA, in presentation materials from 2008, identifies field volatilization of agricultural pesticides, (i.e. the vapors of a pesticide leaving an application site after sprays have settled from both plant and soil surfaces), as a complicated issue which could have health impacts but warrants additional analysis and assessment related to toxicity and exposure issues.

78. MDA has developed guidance and BMPs for the minimization of drift and volatilization in response to citizen concerns about the detections of potato fungicide and other pesticides in air. Such detections may be indicative of drift or volatilization from agricultural, lawn, or garden use of pesticides. Risk evaluation suggested that concentrations were below USEPA levels of concern. However low the concentrations, the MDA developed BMPs to address citizens' concerns and to prevent the potential for any drift and to minimize volatilization of potato pesticides in July 2014. This MDA guidance regarding BMPs was included in RD Offutt's December 16, 2015 submittal and RD Offutt is using the BMPs as an ongoing part of its operations.

79. From 2009-2014 in Cass, Becker, Hubbard and Wadena Counties, the MDA investigated fifteen (15) complaints of pesticide drift and issued ten (10) financial penalty actions to the application companies and one (1) non-financial penalty action. There were no pesticide drift complaints investigated by the MDA in any of the above listed counties in 2015.

80. The fourth allegation in the petition is that the RD Offutt Expansion Project will result in significant deforestation.

81. The DNR's 2015 assessment of Potlatch's remaining 35,000 acres indicates that approximately 7,000 acres are at high risk of conversion to agriculture and approximately 11,000 are at medium risk of conversion to agriculture. Impacts associated with such a conversion include the loss of wildlife habitat, the loss of imperiled jack pine communities, the loss of wetlands, and impacts to

groundwater and surface water bodies associated with increased irrigation, agricultural practices, and loss of tree canopy.

82. The proposed Project does not currently contain any forest habitat.

83. The fifth allegation in the petition is that the RD Offutt Expansion Project will result in negative socioeconomic impacts, specifically negative impacts to the tourism industry in the area due to loss of forest and contamination of lakes, streams, and wells.

84. Potential socioeconomic impacts have been addressed within the findings of facts related to specific areas of impacts to resources, including lakes, streams, groundwater and forests.

85. The sixth allegation in the petition is that the RD Offutt Expansion Project will result in negative impacts to native plants and wildlife habitat, specifically pollinator species due to the use of systemic insecticides.

86. Within the Pineland Sands Aquifer area, there are several rare native plant communities (NPCs) characterized by jack pine woodland conditions. These include central poor dry pine woodland (FDc12), central dry pine woodland (FDc23), and central rich dry pine woodland (FDc24). As mentioned in the report, "An Evaluation of the Ecological Significance of the Badoura Woodlands, Hubbard County, Minnesota," these NPCs have been assigned conservation status ranks that reflect their risk of elimination in Minnesota. The conservation status ranks of these communities is as follows: FDc12, imperiled (S2 rank); FDc23, critically imperiled-imperiled (S1S2 rank) and globally imperiled (G2 rank); FDc24, critically imperiled to vulnerable (S1-S3 rank).

87. The DNR NPC database, which is one source of spatial NPC information, identifies 23,506 acres of the communities FDc12, FDc23, and FDc24 currently documented in Minnesota. The Pineland Sands Aquifer area contains approximately 10,131 acres of these communities, or 43 percent of the known statewide total, although this database does not include an exhaustive source of all NPC occurrences, and may more commonly identify NPCs in state-administered lands.

88. RD Offutt's December 2015 submittal stated, "RDO is committed to responsible and sustainable growing practices. Such practices help reduce the need for inputs such as nutrients and pesticides, and optimize crop yields." One of the practices given by RD Offutt is, "plant[ing] buffer zones whenever and wherever possible, including more than 2,500 acres of trees."

89. Multiple academic studies, including those provided by MPCA, and the Petitioners, have indicated the potential implications to pollinators' health due to their interaction with various types of pesticides. MDA Pesticide staff have stated that, in order to assess the impact of pesticides on pollinators by converting forest acreage to cultivated potato production, data on prevalent pollinator species (managed and unmanaged), their pollen and nectar sources, and nesting sites in the area would be needed. Data would also be needed on acreage, agronomic practices, and type, amount, frequency, and time of use of pesticides in potato production. It

should also be noted that a rotation of agricultural crops will inform the potential impacts to pollinators as well.

90. Generally, the potato is a self-pollinating crop and does not require bees for pollination and potato flowers do not produce nectar that is attractive to honey bees. Therefore, normal use of pesticides to control potato pests and diseases may not have direct significant impact on honey bees in the form of acute pesticide poisoning or colony losses. However, honey bees may collect pollen from potato flowers when other pollen sources are scant. In addition, the attractiveness of potato flowers to honey bees is not necessarily the same the potato flowers' attractiveness to other bee or pollinator species. For example, some bumble bee species are known to collect potato flower pollens.

91. Honey bees and other pollinator species may also be impacted negatively from the pesticides sprayed on bee-attractive weeds and wild plants in and around the fields. Weeds or other pollinator-attractive plants may be exposed to pesticides through direct spraying in the field or through drift around the fields. The area of potential impact of the proposed Project is small in comparison to other agricultural practices in the area.

92. The seventh allegation in the petition is the RD Offutt Expansion Project will result in negative impacts to cultural and treaty rights.

93. The proposed appropriations are within the 1855 ceded territory, but are not within the boundaries of either the White Earth or the Leech Lake Indian Reservations and are not subject to tribal jurisdiction. Furthermore, the 1855 treaty with the Ojibway bands does not reserve to the bands hunting, fishing, and gathering rights (usufructuary rights) outside the reservation boundaries in the 1855 ceded territory. Nor has any federal court recognized that the Ojibway bands have usufructuary rights in the 1855 ceded territory. Because the bands do hold off reservation usufructuary rights in the 1855 ceded territory and because the proposed appropriations are not within the boundaries of either the White Earth or Leech Lake Indian Reservations, the proposed Project does not have the potential to affect cultural treaty rights to hunt, fish, and gather.

94. In determining whether to order an EAW, a responsible governmental unit should consider whether, as a result of a proposed project, there may be the potential for cumulative environmental effects caused by the project. A cumulative potential effect is "the effect on the environment that results from the incremental effects of a project in addition to other projects in the environmentally relevant area that might reasonably be expected to affect the same environmental resource." Minn. R. 4410.0200, subp. 11a.

95. The DNR has a record of 448 issued water appropriations permits for agricultural irrigation in the Pineland Sands Aquifer area as of December 23, 2015. Of these permits, 168 are known to be on land owned by RD Offutt, with an additional 40 known to be connected to RD Offutt through leases and other agreements for the purposes of agricultural production.

96. The total amount of water appropriated among the 448 issued permits for agricultural irrigation in the Pineland Sands Aquifer amounts to approximately 19 billion gallons per year. Average usage of water, as reported by permit holders, is approximately 9 billion gallons per year.

97. The contribution of the proposed Project to the existing water appropriations in the Pineland Sands area is small.

98. The DNR, as part of developing a study in the Pineland Sands Area, has been working with RD Offutt on potential data collection and analysis regarding groundwater usage and contamination and loss of forest habitat due to land conversion. Part of this study will be to develop baseline information for the aquifer regarding groundwater related issues. As part of the process of developing the data necessary to understand the long-term impacts of ground water appropriations in the areas within the Pineland Sands Aquifer subject to the greatest potential for agricultural development, the DNR has discussed with RD Offutt the need to collect data in the Badoura area. If the study is funded and proceeds, the DNR may issue RD Offutt temporary water appropriations permits for selected fields in the Badoura area to study the impact of agricultural appropriations on the both ground water aquifers and surface water bodies.

CONCLUSIONS

1. When determining whether a proposed project may have the potential for significant environmental effects, the RGU considers the evidence from the petition and other information known to the RGU in the context of the following factors:

    a. *type, extent, and reversibility of environmental effects;*
    b. *cumulative potential effects of related or anticipated future projects;*
    c. *extent to which the environmental effects are subject to mitigation by on-going regulatory authority; and*
    d. *the extent to which environmental effects can be anticipated and controlled as a result of other environmental studies undertaken by agencies or the project proposer, including other EISs.*

    See Minn. R. 5510.1100, subp. 6 (directing the RGU to consider the factors set forth in Minn. R. 4410.1700, subp. 7 in determining whether a project may have the potential for significant environmental effect) (emphasis added).

2. *Type, extent, and reversibility of environmental effects.*

    The proposed Project that would result in an additional 195 acres of additional irrigated agriculture in the Pineland Sands area would have limited environmental effects on water quality and quantity. Potential environmental effects related to water quantity in surface water or groundwater are reversible.

    Based on the Findings of Fact set forth in Findings 18 through 98, the DNR concludes that because the two remaining applications are associated with two fields, one of which has already been converted to agricultural use, and the BMPs employed on the fields will be designed to minimize impacts to both water quality and air quality, the volume of water proposed to be appropriated under the proposed permit applications will not adversely impact the aquifer, and the state retains

the right to modify appropriation permits to assure water sustainability. Any potential environmental effects associated with the proposed project, including environmental effects to the Pineland Sands Aquifer area ecosystem, the Jack Pine habitat, water depletion, water contamination, health impacts dues to pesticide drift, socio-economic impacts will be limited in extent, temporary, or reversible.

The proposed project will not have any potential effects to treaty cultural rights.

3. *Cumulative potential effects of related or anticipated future projects.*

   The proposed additional 195 acres of irrigated agricultural land is small in comparison to the existing irrigated agricultural land within the Pineland Sands Area that is also contributing to the potential cumulative impacts in the area. The impact of adding this acreage is anticipated to be *de minimis*.

   The Straight River GWMA has been implemented to address potential cumulative effects and any water appropriation permits issued to RD Offutt within this area will need to comply with measures identified as part of that effort, including possible permit modifications.

   The two proposed permit applications involve fields that would not involve further deforestation for agricultural production.

   The Project Proposer altered the proposed irrigated acres on one of the applications to avoid further removal of forest habitat.

4. *Extent to which environmental effects are subject to mitigation by on-going public regulatory authority.*

   Based on the Findings of Fact above, the DNR has determined that the alleged potential environmental effects, as described in Finding 20 are subject to mitigation by ongoing public regulatory authority, as discussed in Findings 59, 73, and 78, under the DNR water appropriations permit.

5. *Extent to which environmental effects can be anticipated and controlled as a result of other environmental studies undertaken by public agencies or the project proposer, or other EISs.*

   The following documents provide information that can be used to anticipate and control environmental effects of the RD Offutt Expansion Project in Becker, Hubbard, Cass and Wadena Counties:

   State of Minnesota, Department of Natural Resources, Straight River Groundwater Management Plan, Draft December 8, 2015.

   State of Minnesota, Minnesota Pollution Control Agency, Crow Wing River Watershed Restoration And Protection Strategy (WRAPS) Report, January 2015.

Ongoing Byron Township Water Quality Study

6. The RGU is required to deny a petition for an EAW if the evidence presented by the petitioner fails to demonstrate the project may have the potential for significant environmental effects. Minn. R. 4410.1100, subp. 6. As demonstrated in Paragraphs 18 through 98, the proposed RD Offutt Expansion project **does not** have the potential for significant environmental effects.

7. Any Findings that might be properly termed Conclusions and any Conclusions that might properly be termed Findings are hereby adopted as such.

ORDER

Based on the above Findings of Fact and Conclusions:

The Department of Natural Resources determines that an Environmental Assessment Worksheet **will not** be prepared for the proposed RD Offutt Expansion Project, in Hubbard, Becker, Cass and Wadena Counties, Minnesota, as requested by the petition submitted to the EQB.

Dated this 12th day of February 2016.

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

Barb Naramore

BARB NARAMORE
Assistant Commissioner

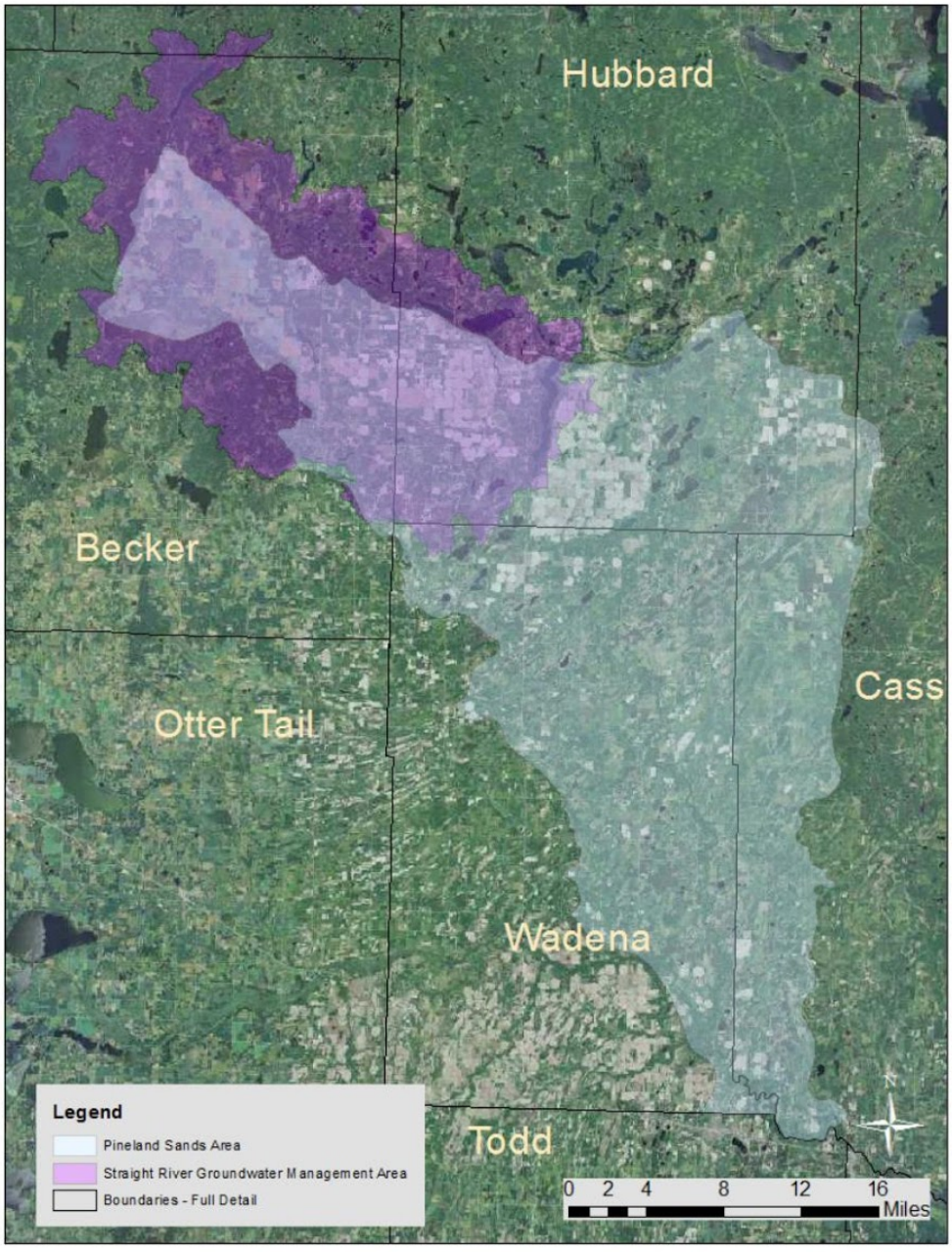

Figure 2-3 Straight River GWMA within context of the Pineland Sands

The total number of domestic wells that have been installed in the Straight River GWMA is 2,357. Information on domestic wells is maintained by the Minnesota Department of Health and county governments, not the DNR.

Reported groundwater use for agricultural irrigation in the Straight River GWMA was 5.288 billion gallons in 2013 (Figure 2-5). Not all active permits are pumping or using water, so Figure 2-5 displays only those "permits with use".

Of the reported agricultural groundwater use in 2013, 84% was used for major crop irrigation. Agricultural irrigation has increased water use by an average of 77 million gallons of water per year since 1988.

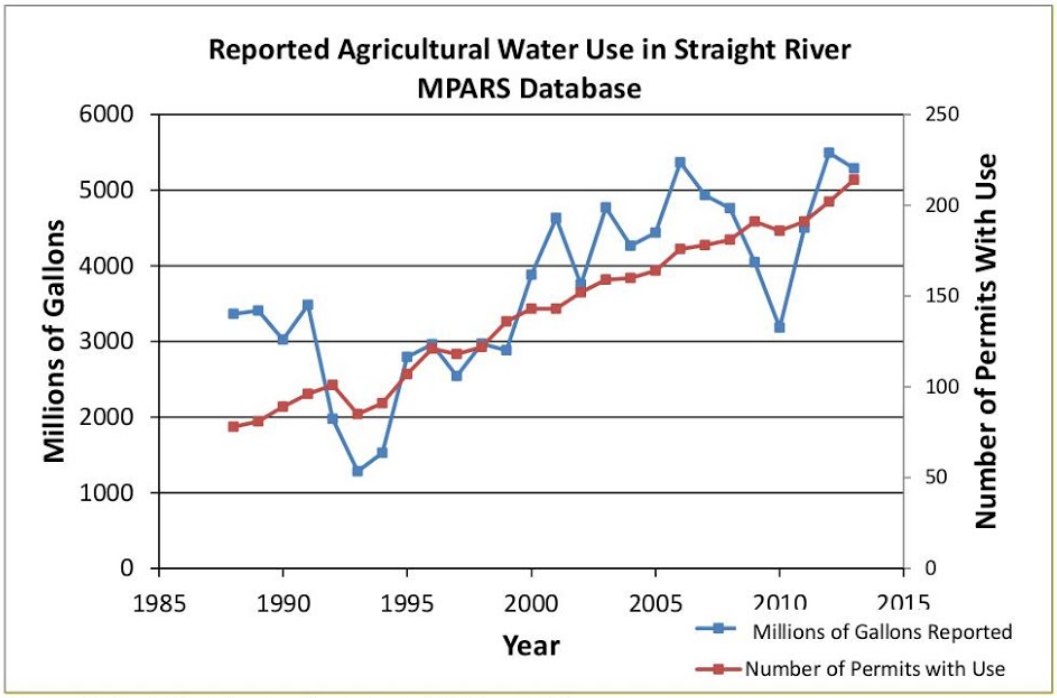

Figure 2-5 Agricultural groundwater use (1998 to 2013)

Groundwater use can change the amount of groundwater flowing toward and discharging into surface water features. The ecology of surface water features such as trout streams, calcareous fens, other wetlands, and springs can be sensitive to groundwater flow variations. Permit holders in the GWMA have helped develop important information to understand groundwater pumping impacts on surface water features through aquifer testing and water monitoring.

Water appropriation permits are designed to ensure that permitted volumes are reasonable, for a beneficial use, incorporate water conservation principles and help protect water quality. The DNR may require specific conservation practices as explicit conditions on some water appropriation permits. For example, some permits for golf course irrigation include conservation requirements.

Municipal Water Supply

Public water supply systems serving more than 1,000 people must have a water supply plan that is approved by DNR (Minn. Stat., 103G.291). In the Straight River GWMA, the City of Park Rapids is the

Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.

Groundwater and surface waters together make up a connected hydrologic system that is affected by climate, geology and soils, land use and land cover, water use, and water quality changes. Therefore, impacts to aquifers, ecosystems, and surface waters resulting from water appropriations are related under this objective.

Aquifer Sustainability

The first part of this objective deals with preventing harm to aquifers. The purpose is to ensure that groundwater continues to be available for use in the future while protecting ecosystems and surface waters (described below). Groundwater use always reduces aquifer storage unless there is an equivalent increase in recharge through surface-water infiltration. Limits on appropriations can help ensure aquifer sustainability.

In Minnesota Rules, parts 6115.0630 and 6115.0670, the concept of *safe yield* is used as the measure of limits on allowable groundwater use. The concept looks at the impact that water withdrawals from an aquifer have on aquifer water quality levels, and pressure (sometimes referred to as 'heads'). It does not address potential impacts to other resources such as surface waters. Safe yield is defined separately for water-table aquifers and for artesian (confined) aquifers (see Section 7 for glossary of terms).

For confined aquifers, a water elevation level in an observation well (obwell) may be set as a threshold for aquifer protection that ensures compliance with safe yield (Figure 3-1). To protect the aquifer from being drawn down too far, 25 percent of the 'available' head (water height above the top of the aquifer, before pumping) must remain in an observation well. A warning threshold of 50 percent of the available head may be established to allow time for contingency plans to be put in effect if water levels decline.

For water-table aquifers, safe yield is a total use rate that does not exceed the long-term average recharge rate (Minn. Rules 6115.0630). In short, output (pumping) for the aquifer does not exceed input (recharge) over the long term. Again, this does not account for impacts to surface waters, which are addressed in the next section. Pumping from confined aquifers typically causes water from the water table aquifer to flow down into the confined aquifers. Therefore, safe yield should be determined based on both direct and indirect withdrawals from water-table aquifers.

Water levels that have stabilized to a pattern of variations above the threshold indicate compliance with safe yield. Understanding pumping history and measured water levels is important when evaluating compliance with safe yield.

Declining water levels that remain above the threshold are expected in some situations, even while use remains within the safe yield. This occurs if pumping rates gradually increase over time, the system has not come into equilibrium with recent pumping rates, or natural fluctuations create a temporary downward trend.

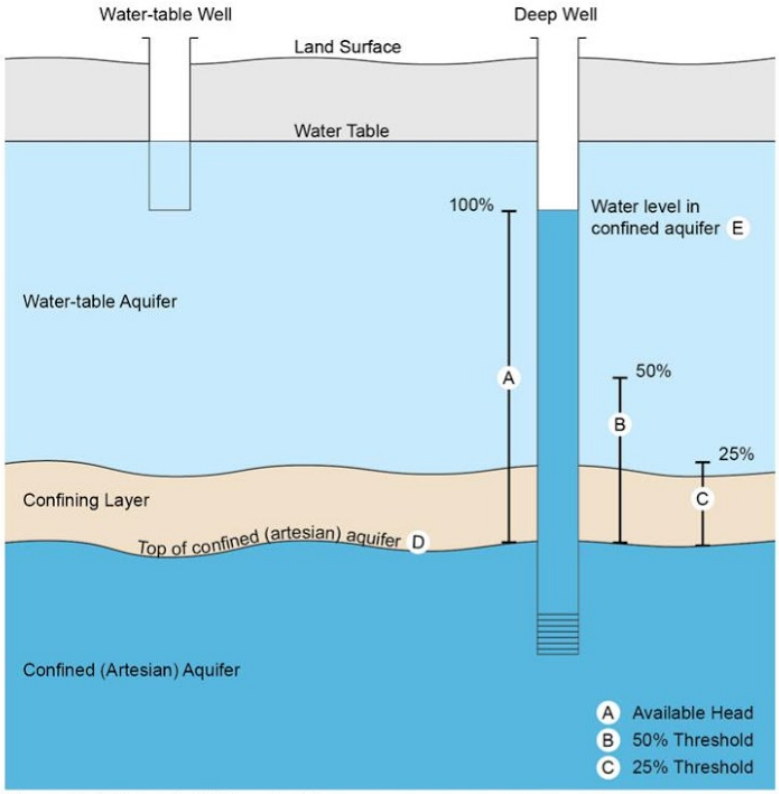

Figure 3-1 Safe yield thresholds

Schematic showing water-table and confined (artesian) aquifer conditions in relation to safe yield thresholds. The available head in the confined (artesian) aquifer is the distance (A) between the top of the confined aquifer (D) and the water level (E) in the deep well when not affected by pumping. The 50% threshold (B) is halfway between the top of the confined aquifer and the current water level in the deep well. The 25% threshold (C) is one-fourth of the way between the top of the confined aquifer and the current water level in deep well. Water levels in a confined aquifer must not stabilize below the 25% safe yield threshold.

Ecosystems and Surface Waters

The second part of Objective I deals with harm to ecosystems and negative impacts to surface waters when groundwater is overused. The groundwater system is part of the water cycle, eventually destined to discharge to surface waters such as rivers, lakes, wetlands, or springs. Taking groundwater from water table aquifers can divert water from streams, lakes, and wetlands. Overuse of groundwater can significantly alter surface water features and the biological communities, recreation, and other uses that those waters support.

Surface water appropriations are governed by Minn. Stat., sec. 103G.285. Groundwater appropriations are governed by Minn. Stat., sec. 103G.287. Groundwater appropriations may also be subject to additional limits based on their surface water impacts as follows (Minn. Stat, sec. 103G.287, subd. 2):

Groundwater appropriations that will have negative impacts to surface waters are subject to applicable provisions in section 103G.285.

Surface-water pumping (appropriation) has a direct and immediate effect on flow or water level in the surface water features from which the water is withdrawn. The same is not true for groundwater appropriations. Determining whether groundwater appropriations have negative impacts to surface waters is complex. Generally, the effect on connected surface water features is both delayed and spread out or 'flattened' in time and is typically distributed among multiple water features.

Several statutes frame the determination of negative impacts to surface waters:

1. Appropriations from lakes listed in Bulletin 25[1] are limited to a total annual volume of water amounting to 1/2 acre-foot per acre of water basin (6 inches over the surface area of the water body) (Minn. Stat., sec. 103G.285, subd. 3). Statute also calls for the setting of protective elevations that consider aquatic vegetation, fish and wildlife, recreation, existing uses, and slope of the littoral zone. Appropriations from small lakes (< 500 acres) must be discouraged because of their greater vulnerability (Minn. Stat., sec. 103G.261, item d).
2. Appropriations taken directly from surface water bodies are limited according to the requirements establishing and enforcing *protected flows* for streams and rivers or *protective elevations* for lakes and wetlands (Minn. Stat., sec. 103G.285). These are intended to accommodate the range of needs and uses of water bodies. For surface-water appropriations, consumptive appropriations may not be made from watercourses during periods of specified low flows (i.e. protected flows) or from lakes and wetlands when water levels are below the protective elevation (Minn. Stat., sec. 103G.285, subd. 2 and 3).
3. Minnesota Statutes protect trout streams from surface water appropriations (Minn. Stat., sec. 103G.285, subd. 5) because they are particularly dependent on steady flow, stable cold water temperatures, and sufficient oxygen levels. These conditions depend on a steady supply of groundwater from springs or diffuse seepage. The goal is to limit stream depletion due to groundwater pumping.
4. Public water wetlands may not be drained unless replaced (Minn. Stat., sec. 103G.221), and temporary drawdown is only allowed if certain conditions are met, including: improving navigation and recreational uses, improving fish or wildlife habitat, exposing sediments in order to remove nutrients or contaminants, to alleviating flooding of agricultural land or allowing mining of metals (Minn. Rules, part 6115.0270).
5. Public water wetlands may not be drained unless replaced (Minn. Stat., sec. 103G.221), and temporary drawdown is only allowed if certain conditions are met, including: improving navigation and recreational uses, improving fish or wildlife habitat, exposing sediments in order to remove nutrients or contaminants, to alleviating flooding of agricultural land or allowing mining of metals (Minn. Rules, part 6115.0270).

The 2015 Minnesota Legislature directed the DNR (Laws of Minnesota 2015, First Special Session, chapter 4, article 4, section 143), to take the following actions concerning sustainability thresholds: "the commissioner of natural resources shall consult with interested stakeholders and submit a report to the Legislative Water Commission and the chairs and ranking minority members of the house of representatives and senate committees and divisions with jurisdiction over the environment and natural

[1] DNR Staff, 1968. An Inventory of Minnesota Lakes. Division of Water, Soils and Minerals, Minnesota Conservation Department. Bulletin 25, 498 p.

resources policy and finance on recommendations for statutory or rule definitions and thresholds for negative impacts to surface waters as described in Minnesota Statutes, sections 103G.285 and 103G.287, subdivision 2. Stakeholders must include but are not limited to agricultural interests; environmental interests; businesses; community water suppliers; state, federal, and local agencies; universities; and other interested stakeholders.

In January 2016, the DNR submitted a report entitled: "Report to the Minnesota State Legislature: Definitions and Thresholds for Negative Impacts to Surface Waters." The DNR will use the approach described in this report to determine if negative impacts to streams, lakes, or wetlands are occurring due to groundwater appropriation within the GWMA. (The report is available on the DNR website. The executive summary of the report provides a succinct description of the approach, and it is included in this plan as Appendix D.)

Section 5 of the GWMA Plan provides a set of actions to meet Objective I.

Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.

Water conservation is a key component of ensuring sustainability and an important objective within the GWMA. Efficient use increases the water available for current and future uses and can help reduce stress on the water resource. Explicit conditions may be placed on appropriation permits that require conservation practices appropriate to a specific use.

Conservation Requirements for Municipal Systems

Minnesota Statute, sec. 103G.291 requires public water suppliers serving more than 1,000 people to implement demand reduction measures by January 1, 2015. The City of Park Rapids is the only municipality within the GWMA that serves more than 1,000 people.

The measures must include a rate structure or outline a program that achieves demand reduction. Minnesota Statute, sec. 103G.291 also requires public water suppliers to adopt and enforce water-use restrictions when the governor declares a critical water deficiency. The restrictions must limit watering lawns, washing vehicles, irrigating golf courses and parks, and other nonessential uses.

Demand reduction measures reduce water use and must include a conservation rate structure or a conservation program. Demand reduction measures have been incorporated into the City of Park Rapids Water Supply Plan. The City of Park Rapids' new water supply plan is due in 2017.

Agricultural Irrigation

New water use permit applications for agricultural irrigation include a check box to indicate if a soil and water conservation plan has been approved by the local SWCD. Conservation conditions can also limit the amount of water reasonably needed for a particular agricultural situation (soil types, climate, and crop type).

Other Appropriation Categories

Although specific data are not tracked for other categories of water use, there are conservation-related conditions on some other permits. Conservation requirements have been developed for golf courses

and apply to newer permits or permit amendments. Typical permit language requires that the permitees shall, whenever practical and feasible, employ water conservation techniques and practices.

Non-permitted water users across the GWMA should also practice water conservation. The DNR supports conservation requirements for private and non-permitted use established through local jurisdictions such as watershed districts and municipal governments.

Section 5 of the GWMA Plan provides a set of actions to meet Objective II.

Objective III. Groundwater use in the GWMA does not degrade water quality.

Minnesota Statute 103G.287, directs the DNR to consider the effects of water quality in water appropriations. Management activities in the Straight River GWMA will require continued coordination between the existing state agencies that are responsible for groundwater and surface water quality, including: Minnesota Department of Agriculture (MDA), the Minnesota Department of Health (MDH), the Minnesota Pollution Control Agency (MPCA), Board of Water and Soil Resources (BWSR) and the DNR.

Pumping groundwater does not directly degrade the quality of the water in the aquifer in most circumstances, unless too much water is applied and nutrients are flushed out of the rooting zone. However, excessive pumping can cause water levels in wells to fall below the top of a buried aquifer, resulting in conversion to a water-table condition. In some circumstances this can lead to changes in water chemistry and degradation of water quality. Compliance with safe yield for buried aquifers prevents this situation from occurring as described under Objective I.

The effects of groundwater pumping on existing contamination must be considered when evaluating groundwater appropriation permits. Groundwater pumping can cause existing groundwater pollution to move or spread. Changes in groundwater levels and pressures can increase the movement of pollutants between aquifers or increase the spreading of pollutants within the same aquifer.

In some cases, pollution containment wells are used to limit movement of contaminated groundwater into less or uncontaminated areas of the aquifers. The MPCA, in cooperation with the responsible parties, determines duration and volume of pumping to contain pollution plumes and limit the movement or spreading of groundwater contamination.

Finally, water quality considerations in surface-water features must be incorporated into groundwater appropriation thresholds for surface-waters. Changes to the amount of groundwater flow into surface-water features can affect elements of water quality such as temperature, oxygen levels and contaminants.

Section 5 of the GWMA Plan provides a set of actions to meet Objective III.

Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

The purpose of this objective is to manage water appropriations in accordance with the allocation priorities in Minn. Stat., sec. 103G.261. Domestic water use is the first priority for allocation of waters.

> (1) first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions of section 103G.285, subdivision 6;
> (2) second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;
> (3) third priority, agricultural irrigation, and processing of agricultural products involving consumption in excess of 10,000 gallons per day;
> (4) fourth priority, power production in excess of the use provided for in the contingency plan developed under section 103G.285, subdivision 6;
> (5) fifth priority, uses, other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and
> (6) sixth priority, nonessential uses.

A *well interference* problem occurs when groundwater appropriation causes the water level in public water supply well(s) or private, domestic well(s) to fall below the reach of those wells (Minn. Stat., sec. 103G.287 subd. 5 and Minn. Rules, part 6115.0730). According to Minn. Stat., sec. 103G.287, subd. 5, this applies to public water supply and private domestic wells constructed according to the state well code (Minn. Rules, part 4725). An interference complaint can only be valid for a domestic well if that well was constructed before appropriation permits allegedly causing the interference were issued and there are adequate water supplies available.

An interference problem may be resolved by modifying the affected well, replacing the well with a deeper well, replacing the well with an alternate water supply (e.g. connection to a public system), or modifying permitted pumping rates or schedules. Potential for well interference is considered when evaluating new water appropriation permits or amendment applications. The DNR follows procedures described in Minn. Rules, part 6115.0730 to mitigate potential interference that may be caused by new or increased appropriations and to respond to interference complaints.

Well interference is almost always a local issue. Groundwater information from the site of the well interference will continue to be needed, collected, and evaluated to weigh the risk for well interference due to new or amended appropriations. These evaluations will continue to require pumping tests and/or local aquifer monitoring.

A *water use conflict* occurs when water demands among existing and proposed users exceed the available waters. A water use conflict can only be resolved by limiting or restricting the rate, volume, and/or timing of water appropriations. The available waters must first be determined based on resource sustainability (Objectives I and II) before allocating the available waters among users. The DNR follows procedures described in Minn. Rules, part 6115.0740 to resolve water use conflicts. (See Appendix C.)

Section 5 of the GWMA Plan provides a set of actions to meet Objective IV.

Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

Objectives I, II, III and IV (above) can only be tracked and achieved with an effective permitting system. Permits provide key data on groundwater use and the means to limit use if necessary to meet sustainability objectives. To be in compliance with current state requirements, individuals and organizations must, at a minimum, do the following if requesting 10,000 gallons of water per day or one million gallons of water per year:

- Obtain a water appropriation permit
- Pay annual fees
- Report annual water use according to permit conditions

Each groundwater appropriation permit holder is required to report the volume of water use on an annual basis. The reported volume must be accurate to within 10%. The use of water flow meters for reporting volumes is required. However, the commissioner may approve alternate methods of measuring water volume. As a result, the use of timing devices has become a method for reporting annual water use.

Permit holders must also comply with special conditions placed on their permits that are designed to ensure sustainability and/or monitor resource conditions. Some permits may include special conditions, such as groundwater-level monitoring from wells specifically constructed for that purpose.

The DNR commissioner can modify water appropriation permits in a manner consistent with Minnesota statute and rule. These modifications can be in response to water use conflicts as noted above or, more broadly, to assure permitted water use is sustainable. For more information see Appendix B.

Objective V is meant to emphasize the importance of permitting and permit compliance to meet the sustainability goals of the Straight River GWMA.

Section 5 of the GWMA Plan provides a set of actions to meet Objective V.

4. Status of the GWMA in Terms of the Objectives

This section describes our current understanding of the status of the Straight River GWMA with respect to the five objectives described in Section 3. Based on the five objectives, the definition of sustainability with respect to groundwater is that use:

- Does not harm aquifers and ecosystems
- Does not negatively impact surface waters
- Is reasonable, efficient and meets water conservation requirements
- Does not degrade water quality
- Does not create unresolved well interferences or water use conflicts

All of the sustainability objectives must be achieved to attain overall sustainability of groundwater use in the GWMA.

Status of Objective I. Aquifers, Ecosystems and Surface Waters

Objective I: Groundwater use in the GWMA does not harm aquifers and ecosystems and does not negatively impact surface waters

Groundwater, surface waters and groundwater-dependent ecosystems are interrelated. Groundwater levels fluctuate in response to a number of influences including climate, land use, and groundwater use. Managing for sustainable use of groundwater requires quantitative knowledge of the influences on groundwater and its connection to surface water.

Two types of information are needed to make water-appropriation permitting decisions that protect aquifers, surface water resources, and associated biological communities. First, acceptable levels of hydrological impacts must be determined for each type of feature. General considerations are discussed in Section 3, but site specific thresholds may be needed for particular surface-water features. Second, an estimate of how and the degree to which existing or proposed water appropriations may change the hydrological regime must be made. The projected or interpreted impacts may then be compared to the specific thresholds.

Aquifers

Substantial growth (85%) in water demand in the Straight River GWMA has occurred in the last 25 years. Continued growth in groundwater demand is expected for parts of the GWMA. There is sufficient data available to evaluate compliance with safe yields in the GWMA. Although further work is needed to evaluate the risk of exceeding safe yield under potential future scenarios, practical assessments are achievable.

Observations reflect impacts of current and historical climate and land-use changes in addition to pumping history. Continued growth in groundwater demand is expected for parts of the GWMA

To determine safe yield and understand trends we need to review information on

- Climate data and trends (how much water is entering and exiting the system)
- Groundwater-level data and trends (to show relationship between use and natural climate fluctuations)
- Groundwater model results (to better understand the interrelated system)

Climate Data and Trends

The main driver of groundwater recharge is climate. The climate in the Straight River GWMA is characterized by variable weather. The 'normal' condition is for substantial ups and downs in precipitation, evaporation, and other climatic factors that affect hydrology.

Precipitation and other climatic factors affect groundwater recharge and groundwater levels. Relatively small changes in precipitation over large areas can have a significant effect on groundwater recharge and groundwater levels. The current climate monitoring network may be inadequate for determining this important part of the water balance in the GWMA. The network should be evaluated and expanded to fill data gaps.

In addition to changes in the amount of annual precipitation, the timing (e.g., wetter springs), nature (e.g., larger rain events over shorter periods), and distribution of precipitation also is important. Rainfall, temperature, relative humidity and other weather conditions are important for predicting the amount of water present in the Straight River GWMA.

Based on precipitation data from the Minnesota Climatology Working Group (State Climatology Office), the long term average annual precipitation in Park Rapids from 1885-2014 is 25.23 inches. The yearly precipitation data is shown in Figure 4-1.

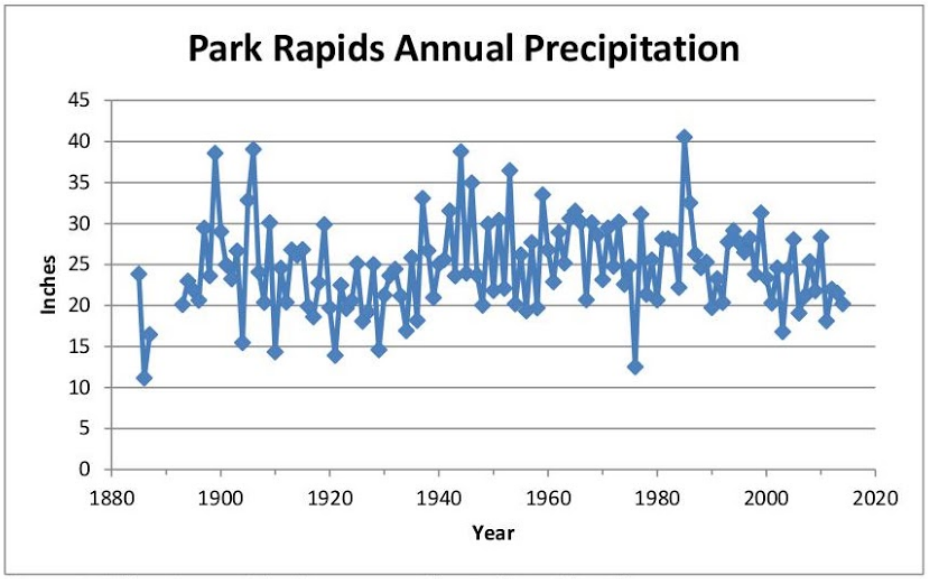

Figure 4-1 Historic precipitation patterns for Park Rapids, Minnesota

There are 5 locations where precipitation is recorded through DNR's MNGage system of volunteers, reported on a monthly basis, and coordinated by Soil and Water Conservation Districts. There is one automated station that provides real time climate data at the airport in Park Rapids. These can be a good source of a wider range of weather information in the Straight River. The Community Collaborative Rain, Hail and Snow Network, or CoCoRaHS, is a network of volunteer weather observers in the United States and Canada who take daily readings of precipitation and report them to a central

data store over the internet. There are no CoCoRaHS sites in the GWMA, but there is one located near the town of Menahga.

There is one cooperative DNR stream gaging station in this GWMA. In addition, DNR has installed 11 additional gaging sites. The cooperative site is fitted with real time weather data including precipitation, wind speed and relative humidity. The remaining 11 sites are manually downloaded. Figure 4-2 shows all the precipitation and gaging monitoring stations.

The University of Minnesota has developed a method of improving irrigation water management, resulting in more effective use of water in above ground irrigation systems using current weather conditions. This is known as the Checkbook Method. Increasing the number of sites within the Straight River GWMA at which detailed weather conditions are recorded and disseminated in real time would allow more accurate information upon which to base irrigation efficiency decisions.

Four new weather stations were installed for the Todd, Wadena and Hubbard Irrigation Scheduler Program and the information is available on the program's website (http://www.hubbardswcd.org/). The program just completed its third year (2015) and covers parts of the Straight River GWMA. Through the process of irrigation water scheduling, an irrigation technician is able to help producers determine how much water is needed to keep their crop healthy throughout the growing season by calculating the evapotranspiration rates for each of the major crops grown in the area. Each weather station contains information such as high and low temperatures, growing degree days, and evapotranspiration. There is a gap in precipitation monitoring in the Becker county portion of the GWMA.

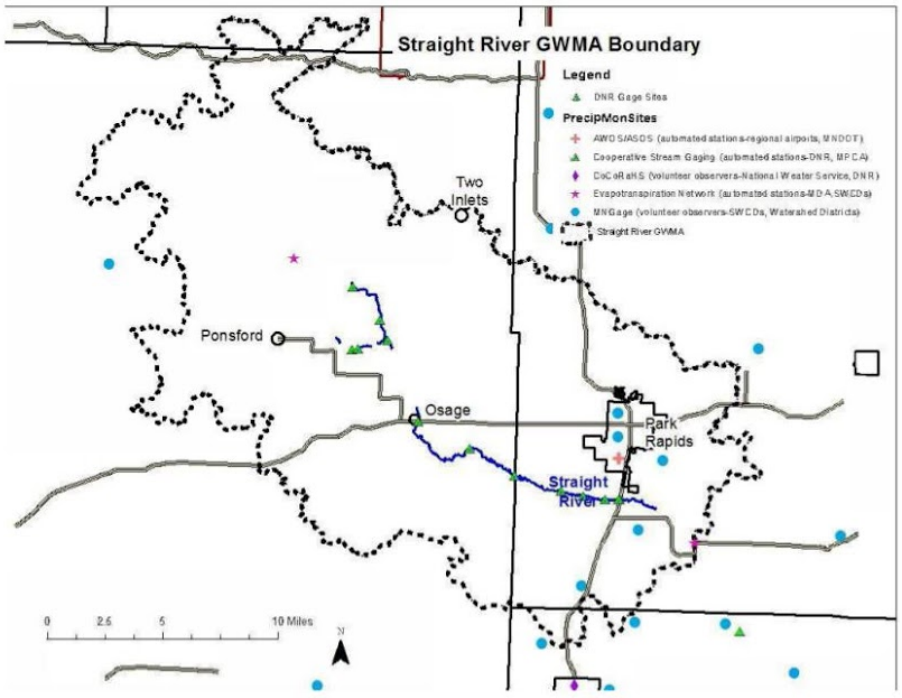

Figure 4-2 Precipitation and gaging sites in and around the GWMA

Groundwater Recharge

Aquifers are recharged by water from precipitation moving downward through the soil. The amount of groundwater recharge is affected by:

- the amount of precipitation
- the amount of precipitation that runs off the soil and into streams, lakes or wetlands
- the amount of precipitation that evaporates directly from the soil or is taken up by plants and transpired

The United States Geological Survey reports groundwater recharge for Straight River GWMA ranges between 5.15 and 6 inches. The majority of the sand and gravel aquifer is reported to have a recharge rate of 5.34 inches per year.

Groundwater-Level Data

Monitoring

Monitoring groundwater levels is an important element of groundwater management and ensuring compliance with safe yield. Monitored groundwater levels must be viewed in the context of natural climate fluctuations and groundwater pumping history.

Since 1944, DNR has managed a statewide network of water-level observation wells. Water-level readings are available via the DNR web page (http://www.dnr.state.mn.us/waters/cgm/index.html). There are 56 actively measured DNR observation wells within the GWMA boundary area.

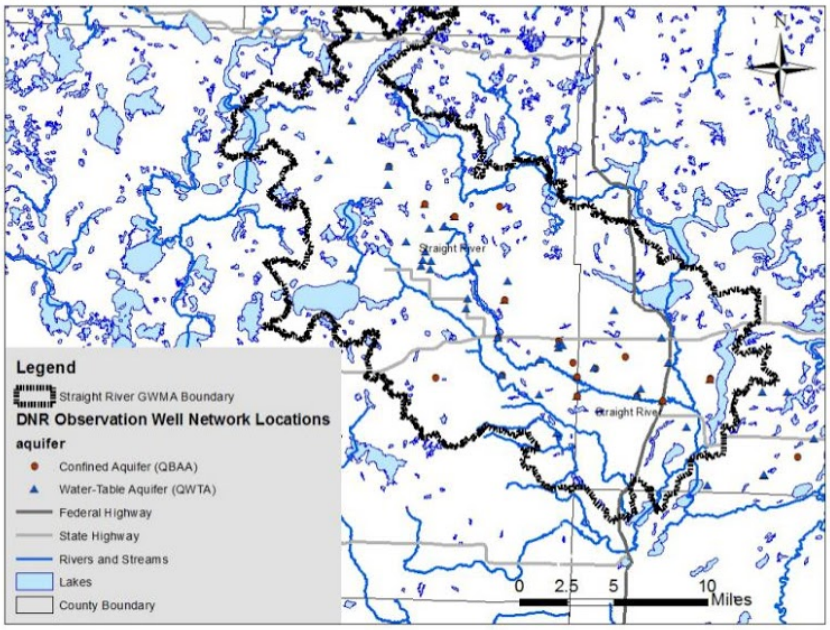

Figure 4-3 DNR observation wells in the Straight River GWMA

Figure 4-3 shows the location of the DNR instrumented observation wells within the GWMA boundary area. Forty one wells are constructed in the water table aquifer and fifteen are constructed into buried artesian aquifers.

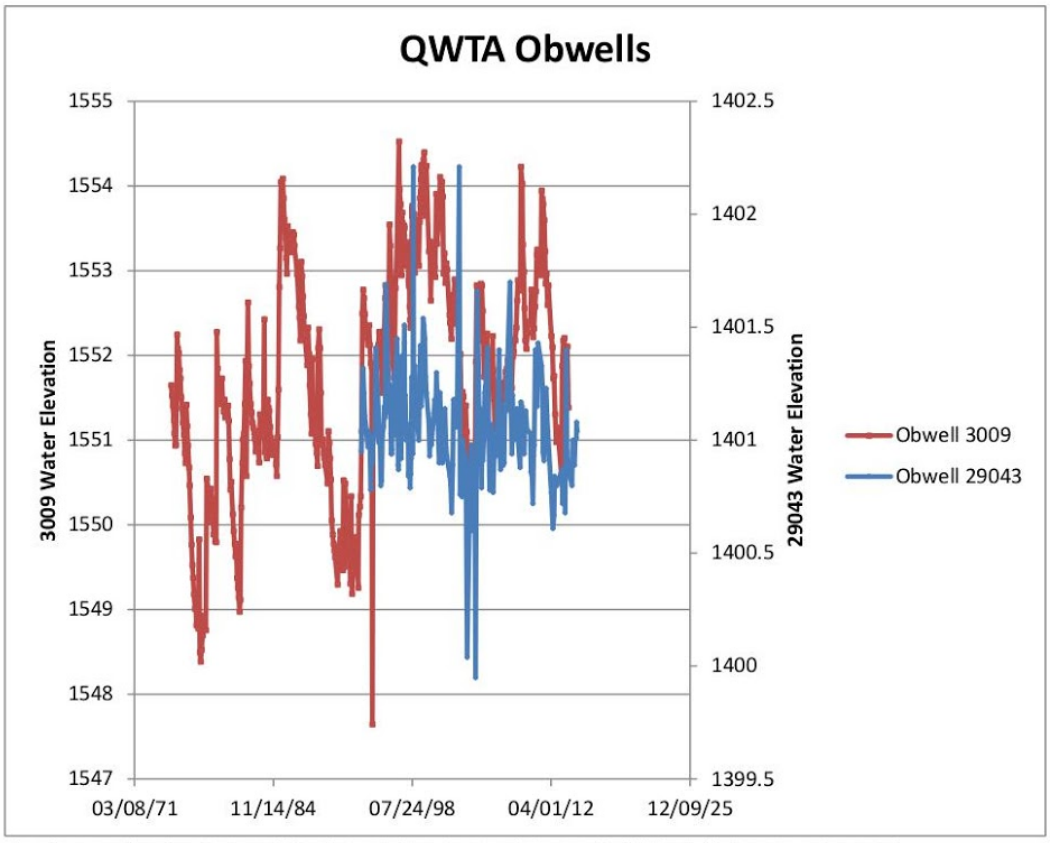

Figure 4-4 Observation well hydrographs water table aquifer (obwells 3009 and 29043)

The water elevation histories shown on Figure 4-4 are from two water table aquifer wells and demonstrate the range of historic water level highs and lows. Observation well 3009 is located nineteen miles northwest of observation well 29043. The location of these wells is highlighted in Figure 4-3. The water levels are shown as water elevation or feet above sea level datum. The difference in level elevation (approximately 150 ft.) gives an indication of the horizontal groundwater gradient between the locations.

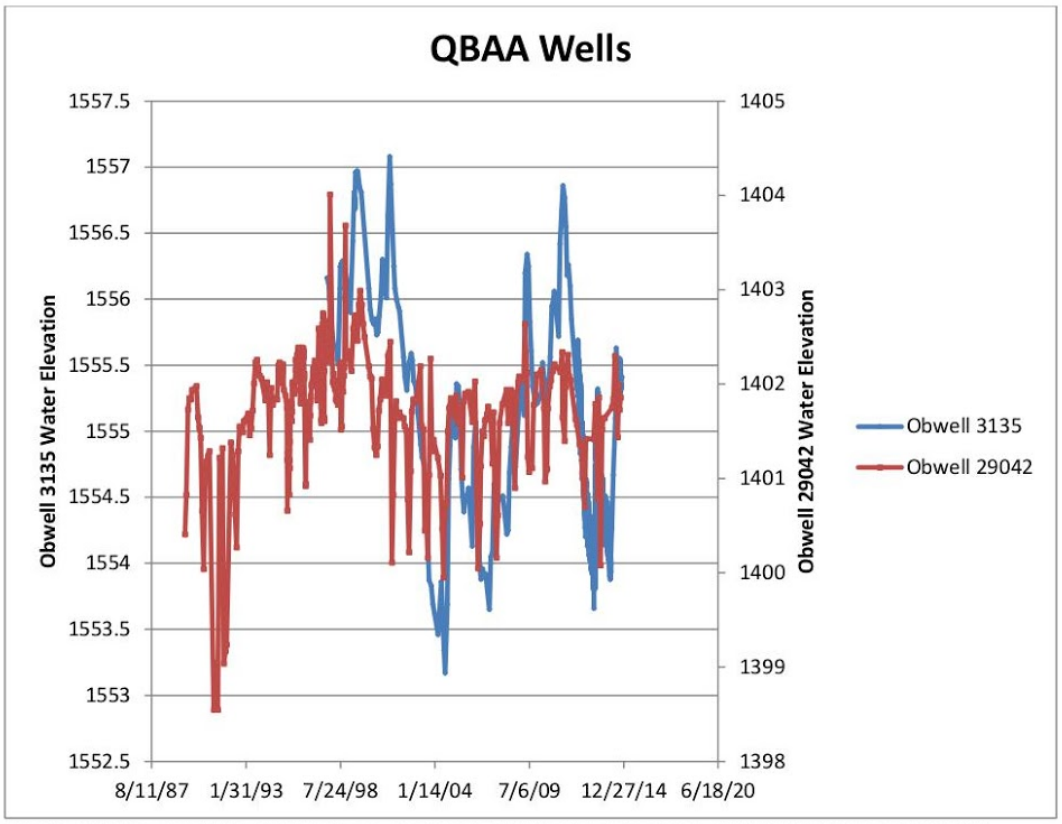

Figure 4-5 Observation well hydrographs buried drift artesian aquifer (obwells 3135 and 29042)

The water level hydrograph in Figure 4-5 shows the water elevation history for two DNR observation wells that are constructed into buried drift artesian aquifers. Observation well 3135 is located nineteen miles northwest of observation well 29042. The location of these wells is highlighted in Figure 4-3. The water levels are shown as water elevation or feet above sea level datum. The difference in level elevation (approximately 150 ft.) gives an indication of the horizontal groundwater gradient between the two locations. Multiple water level decline events demonstrate that water level declines are caused by water use. A similar relationship exists for the water-table aquifer, where groundwater levels will fluctuate in response to seasonal groundwater pumping.

Using data for groundwater models

Groundwater levels are measured in groundwater level obwells. Observation well data is necessary to calibrate computer models that can be used to predict water levels in areas where no groundwater measurements exist. The more observation well data that can be applied to the computer model, the more accurate the model becomes.

A groundwater model was developed by the consulting firm Camp Dresser and McKee during the late 1980s. The results can be reviewed in their December 1999 report, "Development of a Modflow Model of the Straight River Basin". Since this model was completed, both the number of wells and annual

pumping volumes have increased beyond the modeled estimates. Computer groundwater model technology, capabilities and the understanding of the input variables have also changed. Portions of this model may serve as a useful framework or starting point for a new and updated groundwater model. An assessment of what may be required to update the model is needed.

Groundwater Recharge

Recharge cannot be directly measured, but recharge can be estimated using climate, soils, and groundwater data.

A particular area of high uncertainty is evaporation. Monitoring data gaps exist for evaporation and groundwater recharge. Only two evaporation network sites are sited within the GWMA (Figure 4-6). Additional sites would be needed to evaluate the entire GWMA.

Surface Waters

Evaluating groundwater-surface water interactions is more complex than evaluating aquifer levels. Determining thresholds of negative impact on surface waters from groundwater pumping is also complex. Therefore, the DNR proposes establishing specific thresholds for specific watercourses, water basins, watersheds, or hydrologic areas in those parts of the state where water use is at risk of causing negative impacts. (Please read Appendix D for more information on negative thresholds for surface waters.)

Monitoring data are the foundation for impact assessment. There is a relatively dense network of precipitation gauges, observation wells, lake gauges, in the Straight River GWMA. There are five stream gauges; however, only the downstream gauge by Hwy. 71 has a long period of record (about 30 years). Monitoring gaps are likely to be identified, as improved impacts assessment methods are implemented.

Several previous studies have documented impacts to the Straight River that were attributed to groundwater appropriations.

A study by the United States Geological Survey (USGS) in 1988-1990 concluded that groundwater appropriations may impact the Straight River by reducing flows up to 34 percent during the irrigation season, and stream temperature may be affected by 0.5° C to 1.5° C if groundwater appropriation rates continued at the levels observed during that particularly hot, dry summer of 1988 (Stark et. al., 1994).

A study by MN DNR, Division of Waters in 1996-1998 documented an atypical increase in winter stream flow along the river reach between Becker CR 125 and Hubbard CR 115 and concluded that stream flow is likely impacted from water appropriations by at least 2 cfs to 4 cfs within that reach, or approximately 4% to 8% of the average July – August stream flow. Additional flow losses occur naturally in the river between CR 115 and TH 71. These natural losses are exacerbated by groundwater appropriations during extremely low flows as documented in 1988-89. The study also used modeling to evaluate the effects of groundwater appropriations on stream water temperatures by assuming that all groundwater appropriations affect the stream flow equally, which is a simplification of the real variability of impact. If all groundwater appropriations were added to the stream flow, then the resultant flows would increase from 5% to 50% above the existing modeled conditions, and the exceedance value of the lethal limit temperature for brown trout (25° C) was lowered a maximum of 10% and averaged 2% less when compared to existing conditions. The river reach between CR 115 and TH 71 had the most consistent

reductions in temperatures using this simplified analysis (approximately 1.0° C). These reductions were significant when compared to the associated modeling errors (MNDNR Waters, 2002). This suggests that reductions in water use through improved efficiency and other conservation practices may provide benefits to the stream environment and water temperature-dependent aquatic organisms that reside in the Straight River.

Annual stream water temperature monitoring from June through September by MN DNR Fisheries has documented significant increasing trends. Average daily stream temperatures at Becker CR 125 increased 1.01° C during the ten year period from 2003 to 2013. Nearby air temperatures also increased, but at a lower rate. Average daily air temperatures increased 0.61° C during that same period. Maximum daily stream temperatures increased 1.42° C, while maximum daily air temperatures increased only 1.01° C. Minimum daily stream temperatures increased 1.01° C, but minimum daily air temperatures increased only 0.001° C.

Limited dissolved oxygen within the Straight River from Straight Lake to the confluence with the Fish Hook River was the listed stressor for the river's various life forms as determined by the MPCA in its 2010 listing of impaired Minnesota waters. Since 2002, water-quality sample results indicate that low dissolved oxygen levels in the Straight River have persisted to the detriment of stream life. The Crow Wing River Watershed Total Maximum Daily Load (TMDL) report that was prepared to address the impairment listing described water temperature as the primary stressor to low dissolved oxygen levels in the Straight River. Additional data collected by MPCA as part of the Crow Wing River Watershed Monitoring and Assessment in 2010-2011 confirmed the 2010 impairment listing. The Monitoring and Assessment Report stated: "This portion of the Straight River flows through an agricultural area with high groundwater withdrawals. Further investigation is needed to determine if groundwater withdrawals are influencing the dissolved oxygen levels within the Straight River." A Watershed Restoration and Protection Strategy report was prepared by MPCA in 2015 as the final phase of the Crow Wing River watershed assessment process. The report notes that "changes in the groundwater and surface water interactions in the streams, particularly near Park Rapids, are resulting in altered stream hydrology that is stressing fish communities."

Straight River, Upper Straight Creek and Straight Lake Creek support naturally reproducing populations of trout. Straight Lake Creek was stocked with Brook Trout from 1946-1978 and with Brown Trout in 1961, 1985 and 1986. Both species are now naturally reproducing in this stream. Upper Straight Creek was stocked with Brown Trout from 1948-1966 and with Brook Trout since 1967. Enough natural reproduction has occurred since switching to the Minnesota Wild strain of Brook Trout in 2010 that stocking may be discontinued in Upper Straight Creek. A 1930 fishing contest in the Park Rapids area recorded both Brook and Brown Trout, while an earlier contest registered only Brook Trout. During the first fisheries survey of the Straight River in 1947, both Brook and Brown Trout were sampled. The first record of Brown Trout stocking was in 1947 but since they are not native, they were obviously introduced prior to that. The second fisheries survey in 1961 recorded both Brown Trout and Rainbow Trout, which were also stocked periodically between 1955 and 1978. Only Brown Trout were sampled in 1976 and 1981 fisheries surveys and in annual sampling since 1986 on the Straight River. No Brook Trout have been sampled in any fisheries survey since 1947 on the Straight River. The disappearance of Brook Trout from the Straight River is likely due to warmer temperatures. Although exact causes are unknown, it is likely that land use changes from predominately forest to agriculture and poor road crossings have contributed to the warmer temperatures and the shift from Brook Trout to Brown Trout. Brown Trout stocking continued through 1990, when they were discontinued, because natural reproduction was sufficient to maintain a high quality trout fishery.

Ideally, stream flow impacts should be re-evaluated with existing appropriation amounts and the longer period of record for stream flow data. Stream flow impacts should be re-evaluated (compared) using re-created natural flow conditions. Temperature impacts and resulting dissolved oxygen level impacts as a result of appropriations need to be evaluated further.

Status of Objective II. Water Conservation

Objective II. Groundwater use in the GWMA is reasonable, efficient and complies with water conservation requirements.

Municipal Water Supply and Water Conservation

Public water supply systems serving more than 1,000 people must also have a water supply plan approved by the DNR. In the Straight River GWMA, the city of Park Rapids serves over 1,000 people and must have a water supply plan (Minn. Stat., sec. 473.859). The plan lays out future challenges and options for a community's water supply and the community commits to certain water use and conservation goals. Through its ongoing replacement of leaking water lines, audits, implementation of a conservation rate structure and other measures, the City of Park Rapids continues to reduce per capita water demand.

Agricultural Irrigation and Water Conservation

Permits for agricultural irrigation may include "conditions" that become part of the permit, such as a requirement that the permitee develop a conservation plan with help from the Soil and Water Conservation District. These conservation plans may include irrigation water conservation, as well as following Best Management Practices for nitrogen management.

Status of Objective III. Water Quality

Objective III. Groundwater use in the GWMA does not degrade water quality

The quality of groundwater in the Straight River GWMA is very important. Nitrates and other chemicals have been found in groundwater in the Straight River GWMA. In some areas, nitrate levels exceed health risk limits. Poor groundwater quality may limit the use of groundwater. In public meetings and in written comments submitted to the DNR, people have expressed concern about how land-use practices and extensive groundwater pumping for agricultural irrigation may affect both the availability of water to support the ecosystem and the quality of drinking water, particularly for private wells located within the Straight River GWMA.

Nitrate

Nitrate in drinking water is a public health concern. The health risk limit is set by the Minnesota Department of Health (MDH) and is 10 mg/l in drinking water. Within the Straight River GWMA, this concentration has been exceeded in some private domestic wells and municipal wells in the water-table aquifer (QWTA). Nitrate in groundwater can occur naturally in low concentrations, and in some areas, concentrations can increase due to land use practices. Nitrogen is an essential plant nutrient critical for crop production. Nitrate-nitrogen is a constituent in some fertilizers, can be derived from other forms of

nitrogen fertilizer, or is produced in the soil by microorganisms from organic and inorganic nitrogen sources.

In the Straight River GWMA, municipal drinking water sources that take water from shallow unconfined aquifers show nitrate-nitrogen contamination that in places exceed the health risk limit set by MDH. Confined aquifers in the GWMA generally have lower levels of nitrate-nitrogen contamination. The presence of nitrate-nitrogen can also be an indicator of other water contaminants. Nitrate-related issues in the GWMA require further study.

Water temperature is a measure of water quality, particularly for cold-water streams like the Straight River and its tributaries. Water temperatures in the Straight River have sometimes exceeded lethal thresholds for Brown Trout. Water temperature is the primary stressor for low dissolved oxygen levels that led to an impairment listing for the Straight River in 2010.

Status of Objective IV. Well Interferences and Water-Use Conflicts

Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

Well Interferences

There have been no formal well interference complaints in the Straight River GWMA. DNR considers potential for well interference when evaluating new water-appropriation permit or amendment applications.

Water-Use Conflicts

There are no standing water-use conflicts in the Straight River GWMA. It is possible that water-use conflicts could arise from cumulative impacts of multiple users. Improved methods for evaluating surface-water impacts could reveal water-use conflicts not previously identified.

Status of Objective V. Permits

Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

Compliance

There are no identified groundwater users in the GWMA operating without a required permit. It is possible, however, that there are unidentified groundwater uses that require a permit. A thorough audit of water wells has not been conducted for the GWMA. Beginning in July 2013, new wells requiring a water-appropriation permit must receive preliminary approval from the DNR prior to construction. This will help the DNR monitor compliance.

DNR staff obtains compliance reports from the Minnesota Permitting and Reporting System (MPARS) electronic permits database. When pumping volume exceeds the appropriation permit amount (overuse), the DNR investigates and takes appropriate action. In general, compliance with permitted volumes is high in the Straight River GWMA. Special circumstances may lead to actual use exceeding permitted volume in a given year, such as waterline breaks, other system problems, or one-time uses. In addition to the limits on annual volume and maximum pumping rate, some permits may include special conditions, such as groundwater-level monitoring. DNR will follow the established statute and

rule processes for permit changes. For further information on water appropriation permit modifications, please see Appendix B.

5. DNR Actions

Prior sections of the Straight River GWMA Plan have described the area; introduced the sustainability goals, objectives and aquifer sustainability thresholds for the area; and presented the DNR's current understanding of natural resources and appropriations with respect to the sustainability thresholds. Section 4 described some of the information and data gaps that need to be addressed to continue to manage groundwater sustainably. This section restates the sustainability goal for the GWMA, and introduces the specific actions by each objective that DNR plans to take to meet the sustainability goal.

The GWMA GOAL:

In the Straight River Groundwater Management Area (GWMA), the use of groundwater will be sustainable, and therefore, will not harm ecosystems, water quality, or the ability of present and future generations to meet their needs.

Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.

1. The DNR will improve monitoring of groundwater levels, basin water levels, stream flows, climate, groundwater-associated biological communities and water use within the GWMA to inform DNR permit decisions.
    a. The DNR will continue to build a comprehensive hydrological and climate monitoring system for the GWMA. DNR will coordinate with federal, state, and local agencies in these efforts. The following are some initial efforts that may be adjusted over time:
        i. Stream flow monitoring - Re-establish 2 Straight River stream-flow monitoring sites at former sites on County Roads 125 and 115.
        ii. Wetland Monitoring - Install 2 gages per basin at wetland basins (public water basins 29-0550, 03-01400, and 03-0700).
        iii. Lake Level Monitoring - Install at least 2 additional lake (possibly Long and Straight Lakes) gages to the existing gages.
        iv. Groundwater level Monitoring - Install 4 new monitoring wells in addition to the existing 30 wells in close proximity to the Straight River stream gage sites to determine pumping impacts on surface and groundwater.
        v. Investigate whether there are opportunities to coordinate monitoring wells to be used by multiple permitees.
        vi. Identify additional climate monitoring requirements for more precise evapotranspiration estimates.
        vii. Increase the amount of citizen precipitation and weather reporting through recruitment to the Minnesota Volunteer Precipitation Observing Program and the Community Collaborative Rain, Hail & Snow Network (real-time).
    b. The DNR will continue to enhance water use information within the GWMA.
        i. Partner with LGUs and Con Agra Foods/Lamb Weston/RDO Frozen Foods and other businesses in the use of Supervisory Control and Data Acquisition (SCADA) or similar technologies for data collection and communication.
    c. DNR will develop and use the most appropriate groundwater models and methods to predict volumes, rates and water level impacts from groundwater appropriations, as well as describe the current groundwater conditions and characterize the nature and extent of the primary aquifers and the relationship of surface water and groundwater.

d. Develop additional information on groundwater associated biological communities to inform water appropriation decisions.
e. Conduct a baseline inventory of existing water use practices within the GWMA.

2. The DNR will develop and apply sustainability thresholds for aquifers, ecosystems and surface waters in the GWMA[2].
   a. The DNR will use safe yield for aquifers to determine limits to appropriation permits in the GWMA[3].
   b. The 2015 Minnesota Legislature directed the DNR (Laws of Minnesota 2015, First Special Session, chapter 4, article 4, section 143), to take the following actions concerning sustainability thresholds: "the commissioner of natural resources shall consult with interested stakeholders and submit a report to the Legislative Water Commission and the chairs and ranking minority members of the house of representatives and senate committees and divisions with jurisdiction over the environment and natural resources policy and finance on recommendations for statutory or rule definitions and thresholds for negative impacts to surface waters as described in Minnesota Statutes, sections 103G.285 and 103G.287, subdivision 2. Stakeholders must include but are not limited to agricultural interests; environmental interests; businesses; community water suppliers; state, federal, and local agencies; universities; and other interested stakeholders." In January 2016, the DNR submitted a report entitled: "Report to the Minnesota State Legislature: Definitions and Thresholds for Negative Impacts to Surface Waters." The DNR will use the approach described in this report to determine if negative impacts to streams, lakes, or wetlands are occurring due to groundwater appropriation within the GWMA. (The report is available on the DNR website. The executive summary of the report provides a succinct description of the approach, and it is included in this plan as Appendix D.)

3. The DNR groundwater appropriation permits will integrate sustainability limits, individual and cumulative permit analysis, and will include evaluation of existing permits within the GWMA.
   a. The DNR will evaluate each new permit application individually, as well as in conjunction with other permits in the related aquifer systems to address issues associated with the cumulative impacts of appropriations across the aquifer.
   b. The DNR will complete a review of all existing permits in the GWMA within 5 years, and if necessary, adjust permits to achieve sustainable groundwater use (DNR will follow the established statute and rule processes for permit changes – see Appendix B). [4]
   c. Where needed and in accordance with statutory requirements, DNR will limit current and future appropriations.

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[2] Sustainability means that groundwater and surface water levels, water quality, and ecosystems are not harmed and that present and future generations will be able to meet their need for water.

[3] Safe yield for artesian conditions means the amount of groundwater that can be withdrawn without degrading water quality or causing a continual decline in groundwater levels that results in a change from artesian to water table condition. Safe yield for water table conditions means the amount of water that can be withdrawn without degrading the quality of the water in the aquifer and without allowing the long term average withdrawal to exceed the available long term average recharge to the aquifer system based on representative climatic conditions.

[4] The DNR has not determined the detailed steps and timeline for how we will evaluate and implement any necessary changes to existing permits. However, we recognize that this is a vital component of GWMA planning, and we are committed to working with permitees as we develop that process.

d. Improve communication tools that will allow the public to more clearly understand the permitting process including modifying the language in the preliminary well notification letter.

4. DNR will improve communication on the status of Objective 1 (aquifers, ecosystems, surface waters) in the GWMA.
   a. The DNR will create a new GWMA reporting system that will be understandable by the public, and it will include results of data collection and analysis in the GWMA.
   b. The DNR will hold at least two GWMA Advisory Team meetings per year. They will be open to the public.
   c. The DNR will increase education and outreach to the public about sustainable use of groundwater in the GWMA.

5. The DNR will improve access to data collected and analyzed by other organizations in the GWMA.
   a. The DNR will actively support and participate in the development of a more comprehensive and accessible data management system within the GWMA, including website improvements.
   b. The DNR will work with Minnesota Pollution Control Agency (MPCA), Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH), Con Agra/Lamb/Weston/RDO, etc., to improve access to data collected and analyzed by other organizations in the GWMA.

6. The DNR will ensure that the City of Park Rapid's Water Supply Plan includes actions that must be taken if cumulative aquifer withdrawals exceed thresholds or if negative impacts on surface waters are occurring due to groundwater withdrawals in the GWMA.

7. The DNR will promote groundwater recharge in the GWMA, consistent with sound water quality management.
   a. The DNR will work with other organizations and agencies including watershed districts, counties and local units of government to identify important groundwater recharge areas and opportunities to enhance recharge.
   b. The DNR will support local government efforts to protect important groundwater recharge areas through zoning and land use planning.
   c. The DNR will update the groundwater sensitivity maps for the GWMA within 5 years.

Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.

1. The DNR will ensure that groundwater users are complying with water conservation requirements in their water supply plans and permits.
   a. The DNR will include water conservation requirements in appropriate permits as framed by statute, rule and public water supply plans.
   b. The DNR will evaluate compliance with water conservation requirements on permits that include them. (DNR will be in contact with permit holders, as we do these reviews.)
   c. When considering a permit transfer request or amendment request to increase appropriations in this GWMA, DNR will evaluate a permit holder's performance in meeting conservation requirements in their permit and the conservation goals contained in applicable water supply plans.
   d. The DNR will partner with local units of government, such as Soil and Water Conservation Districts (SWCDs), to assist in developing and complying with conservation requirements in water appropriation permits.

e. The DNR will update the information it uses to develop water conservation requirements specific to each water use category.

2. The DNR will improve communication about and promote the values of water conservation in the GWMA.
   a. DNR will promote lessons learned about water conservation from working farms, municipalities, industries, and other water users in the GWMA.
   b. DNR will include descriptions and evaluations of water conservation practices in the GWMA in the new GWMA reporting system.
   c. DNR will update its website to include links to organizations with water conservation information (e.g., SWCDs, United States Department of Agriculture, and University of Minnesota Technical Assistance Program).

3. The DNR will work with other organizations to promote appropriate water storage and aquifer recharge in the GWMA.

4. The DNR will promote the use of water conservation strategies, such as re-use of water in the City of Park Rapids community water supply planning, in the GWMA.

Objective III. Groundwater use in the GWMA does not degrade water quality.

1. The DNR will include compliance with local, state, and federal water quality regulations as permit conditions.
   a. The DNR will coordinate with local, state, and federal agencies to identify water quality regulations that apply to groundwater use and clarify how best to assure compliance.

2. The DNR will ensure that permitted appropriations do not degrade water quality by moving known contaminants.
   a. The DNR will work with PCA, MDH and MDA to determine the most suitable methods to evaluate the risk of moving known contaminants for new and existing permits.[5]

3. The DNR will ensure that the City of Park Rapids Water Supply Plan takes into account contaminant management.

4. The DNR will improve communication about known contaminants and pollution management in the GWMA.
   a. The DNR will use a new reporting system to describe and evaluate status of contamination and pollution plume management in the GWMA.
   b. The DNR will work with MDA, MDH, MPCA and others to share data about water quality among agencies.
   c. The DNR will work with MDA, MDH, MPCA and others to better interpret water quality data.

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[5] The DNR has not determined the detailed steps and timeline for how we will evaluate and implement any necessary changes to existing permits. However, we recognize that this is a vital component of GWMA planning, and we are committed to working with permitees as we develop that process. We also recognize that water conservation can be an important tool to reduce contaminant movement.

5. The DNR will ensure the permitted appropriations do not increase known water quality contamination of a surface water feature.

Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

1. The DNR will continue to review permit applications to identify and reduce the likelihood of well interferences and water use conflicts.

2. The DNR will resolve well interferences and water use conflicts applying the framework outlined in statute and rule.

3. The DNR will improve information on aquifer characteristics in the GWMA to improve its ability to identify and reduce the likelihood of interferences and conflicts prior to permit approval.

4. The DNR will increase education and awareness about resolving well interferences and water use conflicts.

Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

1. The DNR will improve its capacity to detect unpermitted groundwater use.
   a. The DNR will complete periodic analyses to identify potential unpermitted groundwater use in the GWMA and take appropriate action.
   b. The DNR will conduct follow-up reviews of preliminary well approval actions to determine compliance with permit requirements.
   c. The DNR will provide updated information to well drillers and consultants on existing laws and the water appropriation permit application process.
   d. The DNR will facilitate the public's ability to identify and report unpermitted use.

2. The DNR will ensure that permitted volumes reflect actual use and that actual use does not exceed permitted volumes.
   a. The DNR will evaluate water use reports and will contact permit holders whose reports indicate inaccuracies.
   b. The DNR will monitor water use and bring permitees into compliance whose reported use is higher than permitted.
   c. The DNR will help permit holders adjust permitted volume to better match actual use and need, consistent with other plan objectives.

3. The DNR will ensure that water users comply with conditions on appropriation permits.
   a. The DNR will help bring permit holders into compliance with their permit conditions.
   b. The DNR will focus on permits that have been reviewed to address challenges of cumulative impacts and sustainability thresholds (Objective 1, action 3).

6. Implementation Schedule

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.					
I.1	DNR will improve monitoring of groundwater levels, basin water levels, stream flows, climate and water use within the GWMA to inform DNR permit decisions.				
I.1.a.	DNR will continue to build a comprehensive hydrological and climate monitoring system for the GWMA. DNR will coordinate with federal, state, and local agencies in these efforts. The following are some initial efforts that may be adjusted over time:				
I.1.a.i.	Stream flow monitoring - By 2018, reestablish 2 Straight River stream-flow monitoring sites at former sites on County Roads 115 and 125.	**DNR Ecological and Water Resources (EWR) Water Monitoring and Surveys Unit**, EWR Regional Appropriations staff	New	1	
I.1.a.ii.	Wetland Monitoring - By 2018, install 2 gages per basin at wetland basins (public water basins 29-0550, 03-01400, and 03-0700).	**EWR Water Monitoring and Surveys Unit** with input from EWR Hydrogeology and Groundwater Unit.	Existing but enhance	1	
I.1.a.iii.	Lake Level Monitoring - By 2018, install at least 2 additional lake (possibly Long and Straight Lakes) gages to the existing gages.	**EWR Water Monitoring and Surveys Unit** with input from EWR Hydrogeology and Groundwater Unit. Coordinate with DNR Fish and Wildlife (FAW).	Existing but enhance	1	
I.1.a.iv.	Groundwater level Monitoring - Install 4 new monitoring wells in addition to the existing 30 wells in close proximity to the Straight River stream gage sites to determine pumping impacts on surface and groundwater.	**EWR Water Monitoring and Surveys Unit** with input from EWR Hydrogeology and Groundwater Unit	Existing but enhanced	1-2	

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
I.1.a.v.	Investigate whether there are opportunities to coordinate monitoring wells to be used by multiple permitees.	**EWR Hydrogeology and Groundwater Unit** with input from EWR Water Monitoring and Surveys Unit, EWR Regional Appropriations staff, and EWR Water Regulations Unit	New	1-2	
I.1.a.vi.	Identify additional climate monitoring requirements and wind speed for more precise evapotranspiration estimates.	**EWR Water Monitoring and Surveys Unit - State Climatology Office** with input from EWR Hydrogeology and Groundwater Unit	New	3-4	
I.1.a.vii.	Increase the amount of citizen precipitation and weather reporting through recruitment to the Minnesota Volunteer Precipitation Observing Program and the Community Collaborative Rain, Hail & Snow Network (real-time).	**EWR Water Monitoring and Surveys Unit, State Climatology Office, and University of Minnesota** with input from EWR Hydrogeology and Groundwater Unit	Existing but enhance	3-4	
I.1.b.	DNR will continue to enhance water use information within the GWMA.	**EWR Hydrogeology and Groundwater Unit,** EWR Regional Appropriations staff	Existing but enhance	2-3	
I.1.c.	DNR will develop and use standard groundwater models and methods to predict volumes, rates and water level impacts from groundwater appropriations.	**EWR Hydrogeology and Groundwater Unit,** EWR Regional Appropriations staff	New	1-2	
I.1.d.	Develop additional information on groundwater associated biological communities to inform water appropriation decisions.	**EWR Regional Plant Ecologist**	New	2-3	

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
I.1.e.	Conduct a baseline inventory of existing water use practices within the GWMA.	**EWR Hydrogeology and Groundwater Unit,** EWR Regional Appropriations staff	New	1-2	
I.2	DNR will develop and apply sustainability thresholds for aquifers, ecosystems and surface waters in the GWMA[i].				
I.2.a.	DNR will use safe yield for aquifers to determine limits to appropriation permits in the GWMA[ii].	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit	New	1	
I.2.b.	The DNR will determine negative impacts to surface water features (streams, lakes, wetlands) using the approach that is described in the 2016 "Report to the Minnesota State Legislature: Definitions and Thresholds for Negative Impacts to Surface Waters."	**EWR Regional Appropriations staff,** EWR Information, Monitoring and Assessment section, EWR Conservation Assistance and Regulation Section	New	1-3	
I.3	DNR groundwater appropriation permits will integrate sustainability limits, individual and cumulative use analysis, and will include evaluation of existing permits within the GWMA.				
I.3.a.	DNR will evaluate each new permit application individually and in conjunction with other appropriation permits in the related aquifer systems to address issues associated with the cumulative impact of appropriations across the aquifer.	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit, EWR Water Monitoring and Surveys Unit	Existing but enhance	3	I.1.c
I.3.b.	DNR will review all existing permits in the GWMA within 5 years, and if necessary, adjust permits to achieve sustainable groundwater use. [iii]	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit	New	1-5	I.1.c I.2.a.b.c
I.3.c.	DNR will limit current and future appropriations where needed and in accordance with statutory procedural requirements."	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit, EWR Water Monitoring and Surveys Unit	Existing but enhance	1-5	I.2.a.b.c

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
I.3.d.	Improve communication tools that will allow the public to more clearly understand the permitting process (e.g. press releases, daily notices during drought periods, etc.).	**EWR Water Regulations Unit,** EWR Comm. and Planning Unit	Existing but enhance	2	
I.4	DNR will improve communication on the status of Objective 1- aquifers, ecosystems and surface waters in the GWMA.				
I.4.a.	DNR will create a new GWMA reporting system that is understandable by the public and will include results of data collection and analysis within the GWMA.	**EWR Comm. and Planning Unit,** EWR Regional Appropriations staff	New	1-3	
I.4.b.	DNR will hold two Straight River GWMA Advisory Team meetings per year that are open to the public.	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit, EWR Water Monitoring and Surveys Unit	Existing but enhance	1-5	
I.4.c.	DNR will increase education and outreach to the public about sustainable use of groundwater in the GWMA.	**EWR Water Regulations Unit,** EWR Comm. and Planning Unit	Existing but enhance	1-2	
I.5	DNR will improve access to data collected and analyzed by other organizations in the GWMA.				
I.5.a.	DNR will actively support and participate in the development of a more comprehensive and accessible data management system within the GWMA, including website improvements.	**EWR Comm. And Planning Unit,** EWR Regional Appropriations staff	New	2-3	
I.5.b.	DNR will work with Minnesota Pollution Control Agency (MPCA), Minnesota Department of Agriculture (MDA), Minnesota Department of Health (MDH), Con Agra/Lamb/Weston/RDO, etc., to improve access to data collected and analyzed by other organizations in the GWMA.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	2-3	

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
I.6	DNR will ensure that the City of Park Rapids Water Supply Plan includes actions that must be taken if cumulative aquifer withdrawals exceed limits or results in negative impacts to surface waters.				
I.7	DNR will promote groundwater recharge in the GWMA, consistent with sound water quality management.				
I.7.a.	DNR will work with other organizations and agencies including watershed districts, counties, and other local units of government to identify groundwater recharge areas and opportunities to enhance groundwater recharge.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	2-3	
I.7.b.	DNR will support local government efforts to protect important groundwater recharge areas through zoning and land use planning.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	2-3	
I.7.c.	DNR will update the groundwater sensitivity map for the GWMA within 5 years.	**EWR Regional Appropriations staff**, EWR Hydrogeology and Groundwater Unit, EWR Water Monitoring and Surveys Unit	Existing but enhance	3	
Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.					
II.1	DNR will ensure that groundwater users are complying with water conservation requirements in their water supply plan and permits.				
II.1.a.	DNR will include water conservation requirements in all appropriate permits as framed by statute, rule and public water supply plans.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	Existing but enhance	1-3	
II.1.b.	DNR will evaluate compliance with water conservation requirements for all permits that include them (DNR will be in contact with permit holders as we do these reviews).	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	Existing but enhance	1-2	

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
II.1.c.	When considering permit transfer requests or amendment requests to increase appropriations in the GWMA, DNR will evaluate permit holders' performance in meeting conservation requirements in their permit and the conservation goals contained in applicable water supply plans.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	1-2	
II.1.d.	DNR will partner with local units of government such as Soil and Water Districts (SWCDs) to assist in developing and complying with conservation requirements in water appropriation permits.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	1-2	
II.1.e.	DNR will update the information it uses to develop water conservation requirements by water use category.	**EWR Water Regulations Unit,** EWR Regional Appropriations staff	Existing but enhance	2-3	
II.2	DNR will improve communication about and promote the values of water conservation in the GWMA.				
II.2.a.	DNR will promote lessons learned about water conservation by municipalities, industries, and other water users in the GWMA.	**EWR Hydrogeology and Groundwater Unit,** EWR Regional Appropriations staff	New	1-2	
II.2.b.	DNR will include descriptions and evaluations of water conservation practices in the GWMA in a new GWMA reporting system.	**EWR Comm. And Planning Unit,** EWR Regional Appropriations staff	New	3-4	I.4.a
II.2.c.	DNR will update its website to include links to organizations with water conservation information (e.g., SWCD's, United States Department of Agriculture, University of Minnesota Technical Assistance Program, etc.).	**EWR Comm. And Planning Unit,** EWR Regional Appropriations staff	New	1-2	
II.3	DNR will work with other organizations to promote appropriate water storage and aquifer recharge in the GWMA.				
II.4	DNR will promote the use of water conservation strategies in the City of Park Rapids water supply planning in the GWMA..				
Objective III. Groundwater use in the GWMA does not degrade water quality.					

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
III.1	DNR will include compliance with local, state, and federal water quality regulations as permit conditions.				
III.1.a.	DNR will coordinate with local, state, and federal agencies to identify water quality regulations that apply to groundwater use and clarify how best to assure compliance.	**EWR Regional Appropriations staff,** EWR Water Regulations Unit	New	2-3	
III.2	DNR will ensure that permitted appropriations do not degrade water quality by moving known contaminants.				
III.2.a.	DNR will evaluate all new permits to address their role in the moving known contaminants.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	Existing	1-2	
III.2.b.	DNR will evaluate all existing permits in the GWMA for their role in moving known contaminants. [iv]	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	3-4	
III.3	DNR will ensure that the City of Park Rapids Water Supply Plan takes into account contaminant management.				
III.4	DNR will improve communication about known contaminants and pollution management in the GWMA.				
III.4.a.	DNR will create and use a new reporting system to describe and evaluate status of contamination and pollution plume management in the GWMA.	**EWR Regional Appropriations staff,** EWR Comm. And Planning Unit	New	2-3	
Objective IV. Groundwater use in the GWMA does not create well interferences or water use conflicts.					
IV.1	DNR will continue to review permit applications to identify and reduce the likelihood of well interferences and water use conflicts.				
IV.2	DNR will resolve well interferences and water use conflicts applying the framework outlined in statute and rule.				
IV.3	DNR will improve information on aquifer characteristics in the GWMA to improve its ability to identify and reduce the likelihood of potential interferences and conflicts prior to permit approval.				
IV.4	DNR will increase education and awareness about resolving well interferences and water use conflicts.				

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.					
V.1	DNR will improve its capacity to detect unpermitted groundwater use.				
V.1.a.	DNR will complete an annual analysis to identify potential unpermitted groundwater use in the GWMA and take appropriate action.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	1-5	
V.1.b.	DNR will conduct follow-up reviews of preliminary well approval actions to determine compliance with permit requirements.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	2-3	
V.1.c.	DNR will provide information to well drillers and consultants on existing laws and the water appropriation permit application process.	**EWR Regional Appropriations staff,** EWR Hydrogeology and Groundwater Unit	New	1-5	
V.1.d.	DNR will facilitate the publics' ability to identify and report unpermitted use.	**EWR – Water Regulations Unit,** EWR Regional Appropriations staff.	New	1-5	
V.2	DNR will ensure that permitted volumes reflect actual use and that actual use does not exceed permitted volumes based on established limits.				
V.2.a.	DNR will evaluate water use reports and will contact permit holders whose reports indicate inaccuracies.	**EWR Water Regulations Unit,** EWR Regional Appropriations staff	Existing but enhance	1-2	
V.2.b.	DNR will monitor permitted versus reported use and bring permitees whose reported use is higher than permitted use into compliance.	**EWR Regional Appropriations staff,** EWR Water Regulations Unit	Existing	1-3	
V.2.c.	DNR will work with permit holders to adjust permitted volume to better match actual use and need, consistent with other plan objectives.	**EWR Regional Appropriations staff**	Exisiting	1-3	
V.3	DNR will ensure that water users comply with conditions on appropriation permits.				

Action ID	Action	Responsible Organization, DNR Unit or Individual (Primary in Bold)	Existing or New	Plan Year	Notes
V.3.a.	DNR will work with permit holders to bring them into compliance with their permit conditions.	**EWR Regional Appropriations staff**	Existing but enhance	1-5	
V.3.b.	DNR will focus on permits that have been reviewed to address challenges of cumulative impacts and sustainability thresholds (Objective 1, action 3).	**EWR Regional Appropriations staff**	New	3-5	

7. Glossary

Aquifer – any water-bearing bed or stratum of earth or rock capable of yielding groundwater in sufficient quantities that can be extracted (Minn. Rule, part 6115.0630, subp. 2)

Appropriating – withdrawal, removal, or transfer of water from its source regardless of how the water is used (M.S. 103G.001, Subd.4)

Artesian aquifer or confined aquifer – a water body or aquifer overlain by a layer of material of less permeability than the aquifer. The water is under sufficient pressure so that when it is penetrated by a well, the water will rise above the top of the aquifer. A flowing artesian condition exists when the water flow is at or above the land surface (Minn. Rule, part 6115.0630, subp. 4).

Basin – a depression capable of containing water which may be filled or partly filled with waters of the state. It may be a natural, altered, or artificial depression (Minn. Rule, part 6115.0630, subp. 5)

Buried artesian – an aquifer composed of glacially associated sands and/or gravels, over which a confining layer of clay or till was deposited

Conservation rate – a water fee (rate) structure that encourages conservation and may include increasing block fees, seasonal rates, time of use rates, individualized goal rates, or excess use rates (Minn. Stat., sec. 103G.291, subd. 4(a))

Demand reduction measures – actions that reduce water demand, water losses, peak water demands, and nonessential water uses. Demand reduction measures must include a conservation rate structure, or a uniform rate structure with a conservation program that achieves demand reduction (Minn. Stat., sec. 103G.291, Subd. 4(a)).

Evapotranspiration – the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Groundwater – subsurface water in the saturated zone. The saturated zone may contain water under atmospheric pressure (water table condition), or greater than atmospheric pressure (artesian condition) (Minn. Rule, part 6115.0630, subp. 11)

Native plant community – a group of plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms

Negative Impact – refers to the relationship of groundwater use to surface waters. See Minn. Stat., section 103G.287, subd. 2 which states "Groundwater appropriations that will have negative impacts to surface waters are subject to applicable provisions in section 103G.285" (this affects altered and natural watercourses, which includes trout streams and basins).

Nested Obwells – Two or more adjacent water-level observation wells completed in different aquifers, or different depths within the same aquifer. Used to determine vertical differences in groundwater levels or heads.

Normal (climate) – the average of a climate variable such as precipitation or temperature over a standard 30-year period (e.g. 1981–2010)

Obwell – a water-level observation well in the DNR network

Potential evaporation or free water surface evaporation – evaporation from a thin film of water having no appreciable heat storage (Farnsworth et al., 1982).

Protected flow – the amount of water required in the watercourse to accommodate instream needs such as water-based recreation, navigation, aesthetics, fish and wildlife habitat, water quality, and needs by downstream higher priority users located in reasonable proximity to the site of appropriation (Minn. Rule, part 6115.0630, subp. 12)

Protective elevation – the water level of the basin necessary to maintain fish and wildlife habitat, existing uses of the surface of the basin by the public and riparian landowners, and other values which must be preserved in the public interest (Minn. Rule, part 6115.0630, subp. 13)

Recharge – the addition of water to the groundwater system

Safe yield – *water table condition:* the amount of groundwater that can be withdrawn from an aquifer system without degrading the quality of water in the aquifer and without allowing the long term average withdrawal to exceed the available long term average recharge to the aquifer system based on representative climatic conditions (Minn. Rule, part 6115.0630, subp. 15)

artesian condition: the amount of groundwater that can be withdrawn from an aquifer system without degrading the quality of water in the aquifer and without the progressive decline in water pressures and levels to a degree that will result in a change from artesian condition to water table condition (Minn. Rule, part 6115.0630, subp. 15)

Transpiration – the process of transport of water from plant roots to above ground parts where it is released to the atmosphere as vapor

Water table aquifer or unconfined aquifer – an aquifer where groundwater is under atmospheric pressure (Minn. Rule, part 6115.0630, subp. 17)

Water-use conflict – A situation where the available supply of waters of the state in a given area is limited to the extent that there are competing demands among existing and proposed users which exceed the reasonably available waters (Minn. Rule, part 6115.0740. subp. 1).

Well interference – A situation where an appropriation reduces water levels beyond the reach of public water supply and private domestic wells constructed according to Minn. Rules, part 4725 (Minn. Stat., sec. 103G.287, subd. 5; Minn. Rules, part 6115.0730).

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9. Appendix A

Minnesota Executive Agency Commitments to the Straight River GWMA Plan

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Minnesota Department of Agriculture

The Minnesota Department of Agriculture (MDA) supports the Minnesota Department of Natural Resources (MDNR) led approach to managing groundwater through the development of Groundwater Management Areas (GWMA). The MDNR is the lead agency for managing groundwater appropriations consistent with statutory requirements for sustainability including providing for ecosystem needs. The MDA has statutory responsibilities and expertise in addressing agricultural contributions to water quality concerns. The MDA will provide support in our areas of responsibility and expertise to the MDNR and local communities in GWMAs.

Overview of the MDA Role

The MDA is the lead state agency for addressing pesticides and nitrate from fertilizer in groundwater. MDA also has related regulatory and non-regulatory responsibilities for pesticide and fertilizer management including storage, handling and cleanup of contaminated facilities. The primary statutory authority for these activities comes from the Groundwater Protection Act [MN Statutes (MS) Chapter 103H], the Pesticide Control Law (MS 18B), and the Fertilizer, Soil Amendment, and Plant Amendment Law (MS 18C). The MDA coordinates with University of Minnesota Extension, soil and water conservation districts, farmers, agronomists and other interested parties to promote and support the most current science based best management practices to reduce potential agricultural contaminants in groundwater and for irrigation management.

The MDA has developed a Pesticide Management Plan (PMP) and a Nitrogen Fertilizer Management Plan (NFMP) which outline a formal approach to addressing pesticide and nitrate contamination in groundwater. The MDA will provide assistance to the MDNR within GWMAs primarily through the implementation of the NFMP and the PMP. The MDA will provide technical support for evaluating levels of pesticide and nitrate contamination, identifying potential sources and protective actions for nitrate and pesticides in groundwater, and other related work within a GWMA. The MDA approach emphasizes review of existing data on local agricultural practices and identifying appropriate voluntary best management practices (BMPs) to ensure that the best available science is used for addressing local problems, and on working closely with local farmers, crop advisors, local government, other agencies, and other interested parties to address nitrate or pesticide issues.

Nitrogen Fertilizer

The Nitrogen Fertilizer Management Plan (NFMP) is the state's blueprint for prevention, evaluation and mitigation of the impacts of nitrogen fertilizer on groundwater. Within GWMAs, MDA will participate in issues related to nitrate in groundwater using the processes identified in the NFMP. This includes monitoring and assessment, development and implementation of BMPs, and other prevention and mitigation activities. Some specific activities are provided below.

Where nitrates in groundwater may be of concern within GWMAs, MDA assistance will be guided by the NFMP and could include:

- Conduct monitoring and assessment of groundwater for nitrates;
- Evaluate nitrate data;
- Engage with the agricultural community, U of M Extension and other local stakeholders to provide information and solicit feedback;
- Provide advice on appropriate nitrogen fertilizer BMPs and other practices;
- Survey of current adoption of BMPs and agricultural practices;
- Assist agricultural community through information and education activities such as farmer meetings, on farm demonstration, technical assistance on nitrogen management practices;
- Follow-up evaluation to determine BMP effectiveness and adoption; and,
- Evaluation of other practices that should be considered.

Pesticides

The Pesticide Management Plan (PMP) is the state's blueprint for prevention, evaluation and mitigation of occurrences of pesticides or pesticide breakdown products in groundwater and surface waters of the state. The PMP includes components promoting prevention, developing appropriate responses to the detection of pesticides or pesticide breakdown products in groundwater and surface waters, and providing responses to reduce or eliminate continued pesticide movement to groundwater and surface water.

If pesticides in groundwater are a concern within GWMAs, the MDA will provide assistance using the processes identified in the PMP. This assistance may include:

- Collection and analysis of data on the presence of pesticides and pesticide degradates in groundwater;
- Evaluation of monitoring data for common detection determinations in groundwater;
- Evaluation of BMPs;
- Engaging the agricultural community, U of M Extension and other stakeholders in evaluating and implementing BMPs;
- Evaluating actions to mitigate the effects of specific pesticides in common detection for groundwater;
- Development of voluntary pesticide-specific BMPs; and,
- Evaluation of BMP use and effectiveness.

MDA Point Source Authority

In addition to non-point source activities shown above, MDA has responsibilities and regulatory authority for overseeing agriculture chemicals from point sources as directed in MS 18C (fertilizer storage, handling, distribution, use and disposal), MS 18D (agricultural chemical liability) and MS 18E (agricultural chemical response and reimbursement). As provided in these statutes, MDA will exercise these authorities as needed to address potential point sources of contamination such as releases from bulk storage facilities within GWMAs.

Irrigation

MDA, in cooperation with the University of Minnesota Extension, will provide technical support for irrigation water management to reduce the potential for impacts from nitrogen fertilizer and pesticides to groundwater. MDA will promote current irrigation practices that use the best available science. This

could include practices such as increasing water use efficiency, irrigation scheduling, fertigation, and other irrigation management practices.

Variation based on unique circumstances for each GWMA:
The above outlines the general approach of MDA involvement within GWMAs. This approach will be modified as appropriate to address the unique circumstances of each GWMA.

Minnesota Department of Health

Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.

1. MDH will act to implement the federal Safe Drinking Water Act by focusing on a 'source to tap' strategy of multiple protections to ensure the delivery of safe drinking water to all Minnesotans connected to a public water system.
2. MDH will enforce the Minnesota Well Code to ensure wells meet current construction and maintenance standards.
3. MDH will focus Wellhead Protection plan development and implementation efforts that protect drinking water resources and public health.
4. MDH will coordinate with state agency efforts to evaluate and improve local (e.g., LUGs, NGOs) capacity to manage groundwater and drinking water issues.
5. MDH will support and prioritize activities that protect both public and private groundwater resources that are used as a source of drinking water.

Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.

1. MDH will focus Wellhead Protection plan development and implementation efforts to encourage sustainable land and water uses.
2. MDH will assist public water systems in identifying conservation activities when developing wellhead protection plans, especially activities that align with regional efforts within groundwater management areas.
3. MDH will continue to advise on storm-water infiltration practices in vulnerable wellhead protection areas.
4. Subject to legislative funding, MDH will conduct a thorough review of state rules, regulations, and policies relative to water reuse.
5. MDH will evaluate and encourage the adoption of conservation practices where multiple benefits can be achieved that conserve groundwater resources and improve the quality of drinking water in GWMAs.

Objective III. Groundwater use in the GWMA does not degrade water quality.

1. MDH will coordinate with state agency efforts to evaluate and improve local (e.g., LUGs, NGOs) capacity to manage groundwater and drinking water resources.

2. MDH will focus Wellhead Protection plan development and implementation efforts that encourage sustainable land uses and the adoption of conservation practices that result in reduced nutrient loss and other anthropogenic impacts that degrade drinking water quality and may impact human health.
3. MDH will assist public water systems in developing water monitoring networks, especially unconfined aquifer settings where drinking water sources are vulnerable.
4. MDH will promote the use of groundwater and land use modeling to demonstrate both the costs and benefits associated with changes in land use on both water quantity and quality.
5. MDH will coordinate with DNR, MPCA, MDA, USGS and others on monitoring, regulation, and prevention efforts for contaminants of emerging concern, including the development of health-based guidance, if appropriate.
6. MDH will coordinate with DNR and others to examine if regional aquifer management approaches might be of value to public water systems, local units of government, and other stakeholders concerned with drinking water protection.

Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

1. MDH will share with DNR staff the data and groundwater models developed for wellhead protection purposes. These may assist in evaluation of hydraulic impacts of potential new high capacity wells that are located in close proximity to drinking water supply management areas.

Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

1. MDH will assist the DNR technical staff with the coordination and evaluation of compliance issues/impacts on the public water systems.
2. MDH will coordinate with DNR on data exchange for new potential high-capacity wells in groundwater management areas.

Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency has reviewed the Straight River Groundwater Management Area Plan and determined that the agency can support the DNR's goals for the GWMA through the following actions organized by Plan objectives:

Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.

A. MPCA - Monitor the waters of the state within the GWMA to assess their quality, using a systematic intensive watershed approach to determine physical, chemical and biological integrity.
B. MPCA - Identify and investigate groundwater – surface water interactions
C. Work with local government units to promote and implement best management practices to protect surface and groundwater quality
D. MPCA – Support development of shared data system with DNR, MDH, MDA and other organizations

Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.

A. MPCA - Identify and investigate groundwater – surface water interactions with in the GWMA
B. MPCA - Pollution Prevention and MnTAP consultations for water conservation
C. MPCA - Participate with other agencies to encourage water re-use where appropriate
D. MPCA – participate in development of new groundwater models to better understand flows, recharge rates and water balances within the GWMA.

Objective III. Groundwater use in the GWMA does not degrade water quality.

A. MPCA - Monitor the waters of the state to assess their quality, using a systematic intensive watershed approach to determine physical, chemical and biological integrity.
B. MPCA – continue to monitor statewide ambient well network as an early warning system identifying contaminant threats to shallow and vulnerable aquifers in GWMAs and elsewhere. MPCA will make data/results available to interested parties via EQuIS or MPCA website. MPCA will consider installing additional wells if in GWMAs if needed, in conjunction with partner agencies who oversee groundwater monitoring (MDA, MDNR, and MDH).
C. MPCA - Minimize and regulate, with local partners pollutant discharges via permits, technical/financial assistance, and enforcement. E.g. septic systems, feedlots, spray irrigation permits, landfills.
D. MPCA (w/MDH, MDA, USGS) –adapt monitoring, prevention, regulation and remediation efforts for contaminants of new/emerging concern
E. MPCA - Work with local government units to promote and implement best management practices to protect surface and groundwater quality, including storm-water management

Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

A. MPCA - Identify and investigate groundwater – surface water interactions

B. MPCA – help develop new groundwater models to better understand flows, recharge rates and water balances

Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

A. MPCA – Support DNR efforts to identify all appropriate permit conditions related to MPCA regulatory authority.

Board of Water and Soil Resources

The Minnesota Board of Water and Soil Resources has reviewed the Straight River Groundwater Management Area Plan and determined that the agency can support the DNR's goals for the GWMA through the following actions, organized by Plan objectives:

DNR Objective I. Groundwater use in the GWMA does not harm aquifers and ecosystems, and does not negatively impact surface waters.

A. *BWSR will encourage local government units (Counties, Soil and Water Conservation Districts and others) to consult with the DNR to obtain groundwater management information relevant to their plan updates.*
B. *BWSR will support local governments' efforts to incorporate groundwater management objectives in their plans and to incorporate groundwater protection provisions in their regulatory programs. BWSR will develop guidance to help these local governments to adopt plans, policies and actions that are consistent with DNR objectives for management and protection of groundwater resources.*
C. *BWSR will encourage the participation of Soil and Water Conservation Districts in the DNR Observation Well program.*
D. *Consistent with BWSR's responsibility to administer the Wetland Conservation Act (WCA), BWSR will:*
    a. *support DNR's effort to develop tools to better estimate the effects of groundwater withdrawals on the quantity, quality and biological diversity of wetlands, and*
    b. *as requested, on a case-by-case basis, review and comment on applications for groundwater withdrawals that have the potential to affect wetlands.*
E. *BWSR will attend future GWMA Advisory Team meetings to maintain communication with DNR and provide a link to LGUs.*

DNR Objective II. Groundwater use in the GWMA is reasonable, efficient, and complies with water conservation requirements.

A. *BWSR will continue to encourage the development of groundwater management activities (e.g., irrigation scheduling program and pivot uniformity tests) within their existing and future grant programs.*
B. *BWSR will support local units of government in their development of local plans to address groundwater protections.*

DNR Objective III. Groundwater use in the GWMA does not degrade water quality.

A. *BWSR will support local governments' efforts to incorporate groundwater management objectives in their plans and to incorporate groundwater protection provisions in their regulatory programs.*
B. *BWSR will encourage local governments to consult with the DNR to obtain groundwater management information relevant to their plan updates.*

DNR Objective IV. Groundwater use in the GWMA does not create unresolved well interferences or water use conflicts.

This objective does not relate to BWSR programs and responsibilities.

DNR Objective V. All groundwater users in the GWMA have the necessary permits to use groundwater.

This objective does not relate to BWSR programs and responsibilities.

Appendix B
Process Summary: Preliminary Well Construction, Water Appropriation Permitting and Permitting for Municipal Water Supply Plan

Well Construction – Preliminary Assessment

The following provides a high-level summary of steps for a water appropriations permit applicant and the DNR will take to obtain a preliminary assessment of proposed well.

1. Applicant logs into MPARS to obtain approval for a new well.
2. The Appropriation Hydrologist reviews the approval request.
3. The approval request may be sent to the Groundwater Specialist for review.
4. The approval request may be sent to management for review in very complex cases.
5. A letter is sent to the applicant that may describe the resources of concern in the area (if any) and whether the anticipated appropriation is likely to meet the applicable requirements for obtaining a permit to pump water.
6. The applicant may be informed of the need to gather additional information, conduct aquifer tests, or install observation wells before applying for a DNR Water Appropriation Permit.
7. The DNR may follow up to ascertain if the applicant constructed of the well.

Appropriation Permit Actions

The following provides a high-level summary of steps to obtain a water appropriations permit.

1. Applicant completes the preliminary assessment for well construction.
2. Applicant logs into MPARS to request a DNR Water Appropriation Permit or to amend an existing Water Appropriation Permit.
3. The DNR Appropriation Hydrologist reviews the request and may send the initial request to the Groundwater Specialist for review at this point.
4. Additional information may be requested from the applicant to form a complete application, or to provide enough information with which to make a sound decision. The applicant may be informed of the need to conduct an aquifer test.
5. Meetings may be held with the applicant.
6. The Appropriation Hydrologist will generate the invoice for the permit application fee, or amendment application fee and it will be sent to the applicant using MPARS.
7. The applicant uses MPARS to pay the invoice.
8. When the application is complete and the fee is paid the application is forwarded to the County, SWCD, Watershed District, other relevant parties and other DNR staff for review. They are allowed 30 days to review the proposal and submit comments to the DNR.
9. If concerns exist, the applicant will be notified of the concerns and allowed to address those concerns. DNR staff is available for discussion regarding any issues related to the permit application or natural resource concerns. Additional actions may need to be taken by the applicant to address the concerns. An aquifer test may need to be conducted by the applicant.
10. If the issues are addressed, the Appropriation Hydrologist will draft the Permit in MPARS. The appropriate conditions will be added to the permit to address the need for water level monitoring, or other actions, by the applicant.
11. A DNR representative will issue the DNR Appropriation Permit using MPARS.

High-Level Process for Community Public Water Supplies

The following provides a high-level summary of steps for a municipal water appropriations permit applicant and the DNR will take to obtain a high capacity well permit within the scope of an approved water supply plan.

1. City develops local Water Supply Plan, receives DNR approval & city adopts (approved WSP identifies future water needs & source water(s))
2. City submits Well Construction Preliminary Assessment to DNR prior to drilling well
3. DNR provides site-specific WCPA information to city
4. City drills well (MDH notification)
5. City submits permit amendment or application
6. DNR & city coordinate with other agencies (MDH, MPCA, Met Council, watershed districts, counties) and engage in comment period
7. DNR determines if aquifer testing is needed; if so,
    a. City prepares and submits aquifer test plan; DNR must approve
    b. City conducts aquifer tests with monitoring (input from DNR)
    c. DNR reviews aquifer test results
8. DNR makes permit decision
9. Issued permits have applicable permit conditions

Water Appropriation Permit Modifications

Consistent with Minnesota Statute and Rule, the DNR Commissioner can modify water appropriation permits. However, statute and rule also protect the permit holder.

For instance, water appropriation permit holders are afforded due process through Minnesota Statute and Rule. If the permit holder does not agree with a permit decision, they may request a contested case hearing.

Contested case hearings are used in many states. They are informal court proceedings governed by state law that can be used to protect rights, duties and privileges of the affected parties. The purpose of contested case hearings is to provide decision makers with the highest quality information available to render permit decisions, and to provide third party review of an appeal made to a state agency decision.

Modifications to water appropriation permits are described very specifically by Minnesota Statute and Rule:

- The DNR is prohibited from modifying or restricting the authorized amount of groundwater that is used for agricultural irrigation between May 1 and September 30, unless the DNR determines that the authorized amount of appropriation endangers a domestic water supply. [1] This is designed to provide some assurance of a water source to bring the crop through to harvest.
- Whenever a permit is proposed to be modified, there is an opportunity for the permit holder to demand a contested case hearing.
- From the initial decision whether to issue or deny a permit, to the proposed modification of an existing permit due to the establishment of a protected flow or protected elevation in a nearby surface water feature, the applicant or permit holder has the opportunity to a public hearing.[2]

[2] Minn. Rules, 6115.0670, Subp. 3.

- If there is a water use conflict, where there is limited water availability, resulting in the commissioner proposing adjustments to permits in an area that are competing for the same inadequate water source, the action is taken by the DNR only after the permit holders or applicants are notified and given the opportunity for a hearing.[3]
- Most terminations are subject to advanced notice and opportunity for a hearing. An exception would be, for example, when a permittee requests termination.[4]
- The public hearings that can be requested are conducted as contested case hearings under Minn. Stat. Chapter 14, and are conducted by the Office of Administrative Hearings.[5]
- Permits that authorize appropriation from surface water sources may be temporarily suspended as a result of periods of extremely low rainfall. This is defined as when the flows measured in their watersheds fall below a certain point, typically the Q90 flow. Applicants for surface water appropriations are required to have a feasible contingency plan for these situations or agree to withstand the results of not being able to appropriate water (after suspension).[6]

It should be extremely rare for a permit holder to face a permit modification without significant advance warning. However, if a permit modification is necessary and the permit holder or applicant disagrees with the permit decision, Minnesota Statute and Rules provide for a hearing.

If the DNR found the existing authorized water use in an area to be unsustainable, DNR would provide advanced notice and involve permit holders in finding a solution.

[3] Minn. Rules, 6115.0740, Subp. 3.
[4] Minn. Rules, 6115.0750, Subp. 8.
[5] Minn. Stat., 103G.311
[6] Minn. Stat., 103G.285, Subd. 6.

Appendix C
Minnesota Rule Guiding Water Use Conflicts

MINNESOTA RULE 6115.0740 WATER USE CONFLICTS (www.revisor.leg.state.mn.us)

Subpart 1. **Conflict defined**.
For the purpose of these rules a conflict occurs where the available supply of waters of the state in a given area is limited to the extent that there are competing demands among existing and proposed users which exceed the reasonably available waters. Existing and proposed appropriations could in this situation endanger the supply of waters of the state so that the public health, safety, and welfare would be impaired.
Subp. 2. **Procedure**.
Whenever the total withdrawals and uses of ground or surface waters would exceed the available supply based on established resource protection limits, including protection elevations and protected flows for surface water and safe yields for groundwater, resulting in a conflict among proposed users and existing legal users the following shall apply:

A. In no case shall a permitees be considered to have established a right of use or appropriation by obtaining a permit.

B. The commissioner shall analyze and evaluate the following:

(1) the reasonableness for use of water by the proposed and existing users;

(2) the water use practices by the proposed and existing users to determine if the proposed and existing users are or would be using water in the most efficient manner in order to reduce the amount of water required;

(3) the possible alternative sources of water supply available to determine if there are feasible and practical means to provide water to satisfy the reasonable needs of proposed and existing users.

C. If conflicts can be resolved by modifying the appropriation of the proposed and existing users, the commissioner shall do so.

D. If conflicts cannot be resolved through modification of proposed and existing permits the commissioner shall base the decision regarding issuance of new applications and retention, modification, or termination of existing permits on the basis of existing priorities of use established by the legislature as follows:

(1) If the unresolved conflict involves users who are or would be in the same priority class, the commissioner shall require the proposed users and existing permitted users to develop and submit a plan which will provide for proportionate distribution of the limited water available among all users in the same priority class. The commissioner shall withhold consideration of new applications and shall, if the existing permitted appropriations endanger the supply of waters of the state, suspend or limit existing permits until a plan is approved by the commissioner.

The plan must include proposals for allocating the water which address the following: possible reduction in the amounts of appropriation so that each user would receive a proportionate amount of water for use; and possible restrictions in the timing of withdrawals so that each user would be allowed to withdraw a proportionate share of water for use over certain periods of time.

If the commissioner approves the proposed plan, new permits will be issued and existing permits will be amended in accordance with that plan.

If the commissioner determines that the proposed plan is not practical or reasonable, the commissioner shall develop a new plan or modify the proposed plan to provide proportionate share of water among the users involved. The commissioner shall issue new permits and amend existing permits based on that plan.

(2) If the unresolved conflict involves users who are or would be in a different priority class the available water supply shall be allocated to existing and proposed users based on the relative priority of use. Highest priority users shall be satisfied first. Any remaining available water supply shall be allocated to the next succeeding priority users, until no further water is available. Users in the same priority class shall be offered the same options as provided in subitem (1).

Subp. 3. **Notice and hearing**.

All actions by the commissioner shall be made after notice and opportunity for public hearing.

Statutory Authority: MS s 103G.315; 105.415

Published Electronically: June 11, 2008

Appendix D

Executive Summary of the Report to the Minnesota State Legislature: Definitions and Thresholds for Negative Impacts to Surface Waters

Background and purpose

This report was prepared in response to Laws 2015, chapter 4, article 4, which directed the Department of Natural Resources (DNR) to consult with interested stakeholders and develop recommendations for statutory or rule definitions and thresholds for negative impacts to surface waters.

The DNR is charged with *managing* water resources to assure an adequate and sustainable supply for multiple uses. Minnesota has a modified riparian water law system, in which landowners have the right to make reasonable use of the abutting surface waters or the groundwater beneath their land, as defined and regulated by the water appropriation permitting program. The water itself is a public trust resource, and the state grants the right to water beyond personal use – above 10,000 gallons per day or one million gallons per year – through water appropriation permits. In recent years, it has become increasingly clear that Minnesota's water resources, while abundant in many areas, are not unlimited. In some areas, increasing water withdrawals are using more groundwater than is naturally being recharged. In other areas, groundwater supplies are limited due to the underlying geology. Groundwater contamination is also a limiting factor in many areas.

The variability of Minnesota's climate and geography mean that rainfall is not always available in the quantities we need at the times when it is most needed. Increasing demands on both surface water and groundwater supplies can cause negative impacts to the ecosystems and riparian uses of streams, lakes, and wetlands. While water levels fluctuate naturally throughout the year and across multiple years, water appropriations can push low levels lower, significantly reducing stream flows and more frequently putting fish, wildlife, plant communities and riparian uses at risk.

This report examines the effects of groundwater use on rivers and streams, lakes, and wetlands. DNR's analysis and recommendations are based on the fact that surface water bodies go through seasonal and multi-year cycles of high and low water levels. The seasonal patterns, known as the seasonal hydrograph, are primary drivers in creating and maintaining the unique ecology and associated aquatic and riparian habitats of each water body. To preserve the seasonal hydrograph, protected flows must be established for streams, and protection elevations for lakes and some wetlands. These protection levels can then be translated into a quantity of water that can be sustainably withdrawn. Multi-year dry cycles and extreme droughts also serve important ecological functions, but may require a different approach to determining sustainable water use—e.g., water use that is ecologically sustainable under the normal seasonal hydrograph may need to be reduced during extreme drought.

This report was prepared with input from a broad range of stakeholders, as described in the Introduction and Appendix A. This report also incorporates and summarizes scientific studies, including an examination of approaches used in other states and countries. The recommendations in this report represent the DNR's suggestions to further define and describe methods of determining protected flows and protection elevations. These recommendations are based on the DNR's assessment of available information, analytical tools and the practicality of applying them in Minnesota.

Recommendations

The recommendations in this report fall into three categories: 1) definitions to be added in statute; 2) integration of statutory provisions dealing with surface water and groundwater; and 3) approaches to determining the thresholds for streams, lakes, and wetlands.

Definitions

The following definitions are recommended to be added in statute:

- Negative impact to surface waters – in relation to water appropriations, a change in hydrology sufficient to cause ecosystem harm or alter riparian uses long-term.
- Ecosystem harm – in relation to water appropriations, to change the biological community and ecology in a manner that results in a less desirable and degraded condition.
- Sustainable diversion limit – in relation to water appropriations, a maximum amount of water that can be removed directly or indirectly from a surface water body in a defined geographic area on an annual basis without causing a negative impact to the surface water body.

Statutory changes

The DNR also recommends combining many of the provisions in section 103G.285, which deals with surface water appropriations, and 103G.287, which deals with groundwater, into a single "Water Appropriations" section. This revision would recognize the interconnected and interdependent nature of surface and groundwater resources while removing the circular references between the two sections of statute that make it difficult to identify and assess 'negative impacts.'

Approach to determining thresholds

A "threshold" is essentially the point at which negative impacts occur. Thresholds can be estimated based on data and scientific literature. Calculating thresholds at a statewide scale is not appropriate or practical, however, given the number of variables involved – e.g., which species or which riparian uses are negatively impacted. The diversity of Minnesota's surface water and groundwater resources, land use, and climatic factors would make a single number misleading and inappropriate for many locations and conditions. The precautionary principle would require that any such statewide threshold be set to be protective of the most vulnerable resource, thereby unnecessarily restricting water use in many areas. Therefore, the DNR proposes establishing specific thresholds for specific watercourses, water basins, watersheds, or hydrologic areas in those parts of the state where water use is at risk of causing negative impacts.

Streams: The DNR's research and a review of scientific literature indicate that a 20% change in hydrologic regime (relative to the August median base flow) will negatively affect the ecosystem, while a change less than 10% is not likely to be detectable. Setting a diversion limit of no more than 10% of the August median base flow will preserve the seasonal variability of the natural hydrology under all but the most extreme drought conditions. A 15% diversion limit would preserve much of the seasonal variability, but is not adequate to protect ecosystems during periods of drought. We recommend a 10% limit in most circumstances, but recognize a diversion limit of up to 15% may be appropriate in some areas where water uses are less dependent on a consistent supply.

Lakes: The DNR recommends an approach that establishes sustainable diversion limits for two categories of lakes.

Lakes connected to stream systems that outflow most of the time. For these lakes, the outflowing stream's diversion limit would be applied to the lake and a separate protection elevation for the lake would not be necessary.

Lakes with infrequent surface outflow. For these lakes, protection elevations specific to the lake could be established based on key considerations related to hydrology, ecology, and riparian uses. Water levels at and above the protection elevation are expected to maintain the characteristic hydrology, ecology, and riparian uses of the lake most of the time. Water levels below the protection elevation put one or more of the water body's resources or uses at risk. The protection elevation is used to establish the sustainable diversion limit.

Wetlands: Different types of wetlands have distinct and characteristic seasonal water levels that maintain their characteristic plant and animal communities. Most wetland types in Minnesota depend to some extent on groundwater for at least some part of the growing season. Some wetland types, such as fens, are highly connected to and dependent on groundwater, while others, such as floodplain forests, are more directly influenced by surface-water. However, as yet there is no systematic method for evaluating potential negative impacts on wetlands due to groundwater appropriations, due to limited wetland-related hydrologic data.

The DNR is proposing to establish a comprehensive wetland hydrology characterization and monitoring program statewide. An initial step in this process is to begin testing the feasibility of establishing target hydrographs for the various wetland types, with a particular focus on areas of the state experiencing a heavy demand for groundwater appropriation. A target hydrograph is a range of acceptable water levels throughout the year for each various wetland types, extending from "normal" levels to infrequent or rare low levels that stress the characteristic plant and animal communities. The target hydrograph would be used as a guide for developing allowable diversion limits throughout the growing season to maintain the characteristic hydrologic regime.

Impacts to wetlands are also regulated under other authorities, primarily the Minnesota Wetland Conservation Act and the Public Waters Permit Program. The DNR's goal under this approach would be to avoid wetland drainage that would trigger regulation under those programs.

Methodology

The DNR would focus its efforts to set thresholds for negative impacts primarily in those areas of the state where the intensity of groundwater use and/or scarcity of groundwater supplies is causing concern, such as the groundwater management areas or individual water bodies known to be negatively affected by groundwater use. In these areas, the DNR will implement the following steps:

1) establish negative impact thresholds for surface water bodies;
2) establish sustainable diversion limits that will maintain protected flows and protection elevations of those water bodies;
3) conduct groundwater modeling to determine the effects of groundwater withdrawals on the surface water bodies; and
4) assess to what degree individual groundwater withdrawals may need to be adjusted.

Applying this approach to water use permitting

Water users, whether they are public suppliers, agricultural irrigators, industry, businesses or golf courses, need reliability and predictability. Establishing negative impact thresholds and sustainable

diversion limits should ultimately improve the predictability and consistency of water appropriation decisions. It should also reduce the need to modify permits during drought and thus allow water users to rely on a fixed quantity in most years, although extreme drought conditions extending over multiple years may still call for emergency water use restrictions.

Establishing negative impact thresholds and sustainable diversion limits is the first step in the process of allocating water resources among individual appropriators. Further discussion is needed as to how best to engage current and prospective water users in allocation decisions once we have determined the amount of available water in a given hydrologic area.

Minnesota's water appropriation statutes were formulated in an era when groundwater resources were viewed as essentially unlimited. Allocating water resources in an environment where those resources may in fact be limited calls for additional research and discussion. Our statutes and rules may need to be revised to provide better guidance. The DNR is currently researching potential models of water allocation systems used in other states and regions as part of this larger discussion.

Local governments also play a significant role in the water allocation process through their planning and land use controls, which help to determine the number and nature of residential, commercial, and industrial water users in a given community. In planning for future development, local governments should carefully consider the sustainability of their water supplies and the extent to which new water-intensive uses should be allowed or encouraged. A planning process that considers the needs of all water users, future needs, and opportunities for water conservation can help to sustainably manage existing and proposed water use.

Conclusions

- **Minnesota is in the "urgency room," not the "emergency room," in terms of water use management.**
- **The state's water management policies, statutes, and rules are strong and conceptually sound. However, the state's water management statutes could be improved by clarifying terminology and better recognizing the interconnected nature of surface water and groundwater.**
- **There is a strong scientific basis for maintaining the natural dynamic patterns of surface water bodies by establishing protected flows for individual streams, protection elevations for individual basins, and target hydrographs for wetlands.**
- **Over the next five years, the DNR intends to set protected flows, protection elevations, and target hydrographs for water bodies in places where demand for water may be exceeding sustainable supplies. The changes to statute recommended in this report would help support that work.**

present the results to the COLA committee in early December. They also will make a pamphlet for distribution to other COLAs, lake associations and websites.

Conover and seven other master's students will once again receive guidance from Dr. Fischer and a COLA committee.

Straight River Watershed and Groundwater Management Area

Doug Kingsley, Area Supervisor for the Minnesota Department of Natural Resources (DNR) Fisheries office, gave a presentation on various aspects of the Straight River watershed, including changing uses that have begun to affect the health of the river and prompted the designation of the watershed as one of three state Groundwater Management Areas (GWMA), the purpose of which is to study sustainable water use.

Those changes have included conversion of over one-half of forested lands in the watershed to agricultural or residential development use, which has resulted in changing the physical characteristics of the stream, causing it to get wider and shallower, and increased runoff that often carries pollutants, fertilizers and pesticides.

The increased agricultural use in the area's sandy, fast-draining soils has resulted in higher nitrate levels in the groundwater, in the stream, and the Park Rapids municipal drinking supply, he reported. The increased residential development has increased impervious surfaces, runoff and vegetation removal, and decreased nutrients.

Kingsley reported, however, that there have been attempts to reduce these effects by instituting agricultural Best Management Practices, including less tillage, crop rotation, and reduced fertilizer and pesticide use.

He also said that bridges and culverts have often been constructed undersized to save money, set too high in the stream or at an improper slope, which has restricted fish passage, altered the stream and increased water temperatures.

Kingsley said that permitted use of groundwater had been steadily increasing, due largely to agricultural irrigation, and that studies on the effect of increasing groundwater use show that it may have reduced inflows into the Straight River by up to 30 percent. In turn, reductions in groundwater inflows into the river and overuse of springs – which keeps temperatures low –increases water temperatures, as does damming a river.

Kingsley said that DNR Fisheries has monitored stream temperatures with data loggers during the open water season since 2003 (though not in 2006, 2009 or 2011), and that they have found a statistically significant increasing trend. He said that studies of air temperatures for those same periods did not find corresponding trends of the same statistical significance.

He said that increasing temperatures affect the ability of the river to sustain an environment healthy enough for the river's famed brown trout to flourish, and that 2012 produced the river's highest water temperatures, and the greatest proportion of time within a range of what is called "thermal stress" and "lethal" conditions for the fish.

In addition to the increasing water temperature trend, the river has also seen a decrease in dissolved oxygen, which happens as temperatures increase. Dissolved oxygen is required by almost all aquatic organisms to survive, and because of the reduction in the Straight River, it was listed by the Minnesota Pollution Control Agency as impaired for dissolved oxygen in 2010, which, then, also affected the ability of the trout to survive.

In the year-long process of monthly meetings of the advisory committee of the Straight River GWMA, Kingsley opined that the future sustainability of groundwater use will "depend on the willingness of public leaders and private users to make wise decisions about water use."

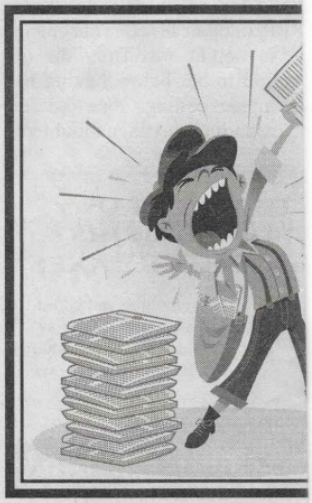
Other business

Communication Director Larry Roberts presented past president Dan Kittilson with a Certificate of Appreciation for his five years service as president.

"Dan has been the spokesman for this organization for a long time," Roberts said. "He is a dedicated and serious individual when it comes to protecting the lakes and rivers in Hubbard County."

Sharon Natzel gave an update on the "Information Gathering Activity" that has been collecting data over the last few months on how to improve various aspects of COLA's operations, the results of which will be incorporated into COLA's activities in the future.

Jeff Mosner gave an update on the proposed Sandpiper pipeline, including the fact that the Minnesota Public Utilities Commission had ruled for further study of six alternatives to Enbridge's original proposed route. He said the PUC will delay consideration of the route permit until first completing the Certificate of Need process.



MWP 10-1-14

Straight River Watershed Unit

HUC 07010106050

The Straight River Subwatershed is in the northwest central portion of the Crow Wing River Watershed. Located primarily in Becker and Hubbard Counties and draining approximately 79 square miles, it is one of the smallest subwatersheds within the Crow Wing Watershed. The Straight River is a coldwater system that has long been known by sportsman for its trophy class brown trout fishery which draws many anglers to this area year after year. Land use is predominantly cropland. The MDNR actively manages the Straight River for trout, employing available protection and habitat enhancement strategies to prevent degradation of the resource from surrounding watershed development, which is primarily row crop agriculture. The outlet monitoring site is represented by MPCA's Water Chemistry/EQuIS station S002-960 and Biological station 10UM041 located at US Highway 71, approximately three miles south of Park Rapids. The water chemistry data at this location was collected by the Cass County Soil and Water Conservation District with the biological data collected by MPCA staff. Data from Biological/EquIS station S004-793 (biological station 10UM061) located further upstream on the Straight River was also used during the assessment process of this unit.

Table 15. Aquatic life and recreation assessments on stream reaches: Straight River Watershed Unit.

AUID Reach Name, Reach Description	Reach Length (miles)	Use Class	Biological Station ID	Location of Biological Station	Aquatic Life Indicators:									Aquatic Life	Aquatic Rec.
					Fish IBI	Invert IBI	Dissolved Oxygen	Turbidity	Chloride	pH	NH$_3$	Pesticides	Bacteria		
07010106-517 Straight River Headwaters to Straight Lk	4.6	1B,2A,3B	10UM060	Upstream of Minimum Maintenance Rd off of Bass Bay Ave, 5 mi. NW of Osage	MTS	MTS	IF	IF	--	IF	--	--	--	FS	NA
07010106-558 Straight River Straight Lk to Fish Hook R	17	1B,2A,3B	10UM061 10UM041	Upstream of CR 123, 1 mi. S of Osage Upstream of Hwy 71, 3 mi. S of Park Rapids	MTS	MTS	EXS	MTS	MTS	EXP	MTS	--	MTS	NS	FS

Abbreviations for Indicator Evaluations: -- = No Data, NA = Not Assessed, IF = Insufficient Information, MTS = Meets criteria; EXP = Exceeds criteria, potential impairment; EXS = Exceeds criteria, potential severe impairment; EX = Exceeds criteria (Bacteria).

Abbreviations for Use Support Determinations: NA = Not Assessed, IF = Insufficient Information, NS = Non-Support, FS = Full Support

Key for Cell Shading: = existing impairment, listed prior to 2012 reporting cycle; = new impairment; = full support of designated use.

Aquatic life assessment and/or impairments have been deferred until the adoption of Tiered Aquatic Life Uses due to the AUID being predominantly (>50 percent) channelized or having biological data limited to a station occurring on a channelized portion of the stream.

Table 18. Lake water aquatic recreation assessments: Straight River 11-HUC.

Name	DOW#	Area (ha)	Trophic Status	Percent Littoral	Max. Depth (M)	Avg. Depth (M)	CLMP Trend	Mean TP (µg/L)	Mean chl-a (µg/L)	Secchi Mean (M)	Support Status
Straight	03-0010-00	193	M	42	19.2	7	NT	22	11	3	FS

Abbreviations: ↘ – Decreasing/Declining Trend **H** – Hypereutrophic **FS** – Full Support
↗ – Increasing/Improving Trends **E** – Eutrophic **NS** – Non-Support
NT – No Trend **M** – Mesotrophic **IF** – Insufficient Information

Summary

All of the biological stations established within the subwatershed were located on the Straight River, which is divided into two AUIDs (07010106-517 and 07010106-558) with 517 being the uppermost headwater portion. F-IBI scores from the Straight River were excellent. The Straight River is classified as a Northern Coldwater stream and aside from its ability to support and sustain a cold-water fish assemblage, it has long been known as one of the best trout fisheries in the state. Though it is has an excellent fishery, the subwatershed itself has been developed. Row crop and pasture/hay land make up approximately 50% of the land use in the Straight River Subwatershed and most of this is located near the central and lower portions near Straight Lake. The sampling that occurred in the headwater portion was represented by biological station 10UM060. Numerous (14) fish species were captured including sensitive species such as mottled sculpin and brook trout. However, the habitat noted at this station was only Fair with the most obvious negative aspect of the habitat being a lack of coarse substrate and poorer stream morphological characteristics. M-IBI scores were not as high as the F-IBI, falling below or near the threshold yet remaining above the lower confidence limit. The lower M-IBI scores were attributed to the more homogenous habitat, reflecting a macroinvertebrate assemblage that lacked coldwater taxa and a diversity of functional feeding groups. Further downstream (07010106-558), sampling that occurred at biological stations 10UM061 and 10UM041 were similar with several sensitive fish (brown trout, mottled sculpin, and hornyhead chub) and macroinvertebrate (Baetisca and Acerpenna) species identified.

Water quality data were available on two segments of the Straight River. Segments extending from the headwaters to Straight Lake and then onto the Fish Hook River were assessed. The reach of the Straight River extending from the lake to the Fish Hook River was previously listed in 2010 for a DO impairment. Data collected since the listing supports this assessment. This portion of the Straight River flows through an agricultural area with high groundwater withdrawals. Further investigation is needed to determine if groundwater withdrawals are influencing the dissolved oxygen levels within the Straight River. Although DO is an obvious point of concern, the biology and particularly the fish communities are exceptional and indicative of the good habitat and water chemistry that generally occurs throughout the Straight River. Finally, the Straight River was determined to be supporting recreational activities with no bacterial exceedances.

Only one of three lakes greater than four hectares (ten acres) within the Straight River Subwatershed was assessed for aquatic recreation. Straight Lake was determined to be supporting aquatic recreational use. Chl-a levels exceeded the ecoregional standard and TP levels were elevated yet still within the standard. Despite these high levels the water transparency of Straight Lake was good. Straight Lake lies in an area containing both agricultural activity and undisturbed forested areas. The area and depth of the lake combined with a potential short residence time may be preventing more extensive eutrophication.

Minnesota Department of Agriculture

CLEAN WATER LAND & LEGACY AMENDMENT

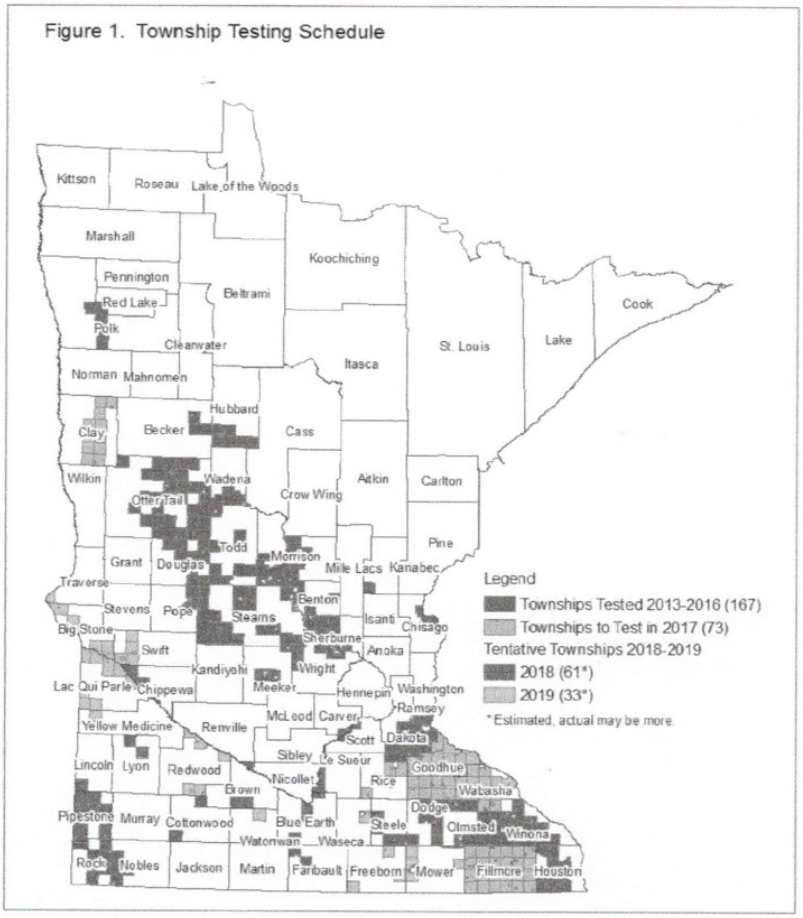
Township Testing Program Update-February 2017

The Minnesota Department of Agriculture (MDA) conducted a major revision of the Nitrogen Fertilizer Management Plan (NFMP) in March of 2015. The plan calls for an assessment of nitrate conditions at the township scale. The MDA determines current nitrate-nitrogen concentrations in private wells, on a township scale, through the Township Testing Program. The MDA has identified townships throughout the state that are vulnerable to groundwater contamination and have significant row crop production. More than 70,000 private well owners will be offered nitrate testing in over 300 (35 to 59 townships per summer) townships by 2019 (Figure 1).

How does it work?

The MDA works with local partners such as counties and soil and water conservation districts (SWCDs) to coordinate private well nitrate testing using Clean Water Funds. The map in Figure 1 serves as a starting point for planning sample locations and is modified based on local expertise from the counties or SWCDs.

Figure 1. Township Testing Schedule

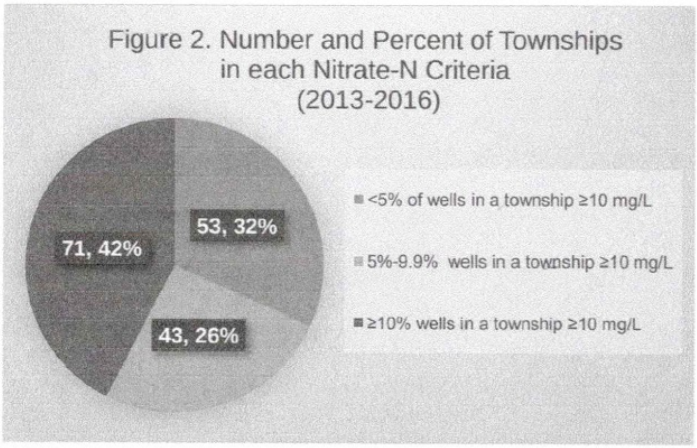


Each selected township is offered testing in two steps, the "initial" sampling and the "follow-up" sampling. In the initial sampling, all township homeowners using private wells are sent a nitrate test kit. If nitrate is detected in their initial sample, the homeowner is offered a follow-up nitrate test, pesticide test and well site visit. Trained MDA staff visit willing homeowners to resample the well and then conduct a site assessment. The assessment helps to identify possible non-fertilizer sources of nitrate and to see the condition of the well. A well with construction problems may be

more susceptible to contamination. It is common for the TTP to sample 50 to 150 wells per township.

Approximately 10 townships in the Red River Valley will be tested in order to evaluate whether the Beach Ridge sand and gravel deposit is creating a narrow band of vulnerable groundwater in that region.

Results



As of January 2017, 167 vulnerable townships from 19 counties participated in the TTP from 2013 to 2016 (Figure 2). In the167 townships tested, 71 (42%) have 10% or more of the wells over the 10 milligram per liter (mg/L) Health Risk Limit (HRL) for Nitrate-N. In contrast, it was determined that in 53 townships less than 5% of the wells were over the HRL for Nitrate-N.

Overall, 9.5% (1,912) of the 20,042 wells exceeded the HRL for Nitrate-N (Table 1). Figure 3 shows the percentage of wells over the HRL for each township during the initial sampling. These results have yet to be analyzed for possible nitrogen sources, so the final percentage of wells over the HRL from a non-point source may change based on follow-up sampling.

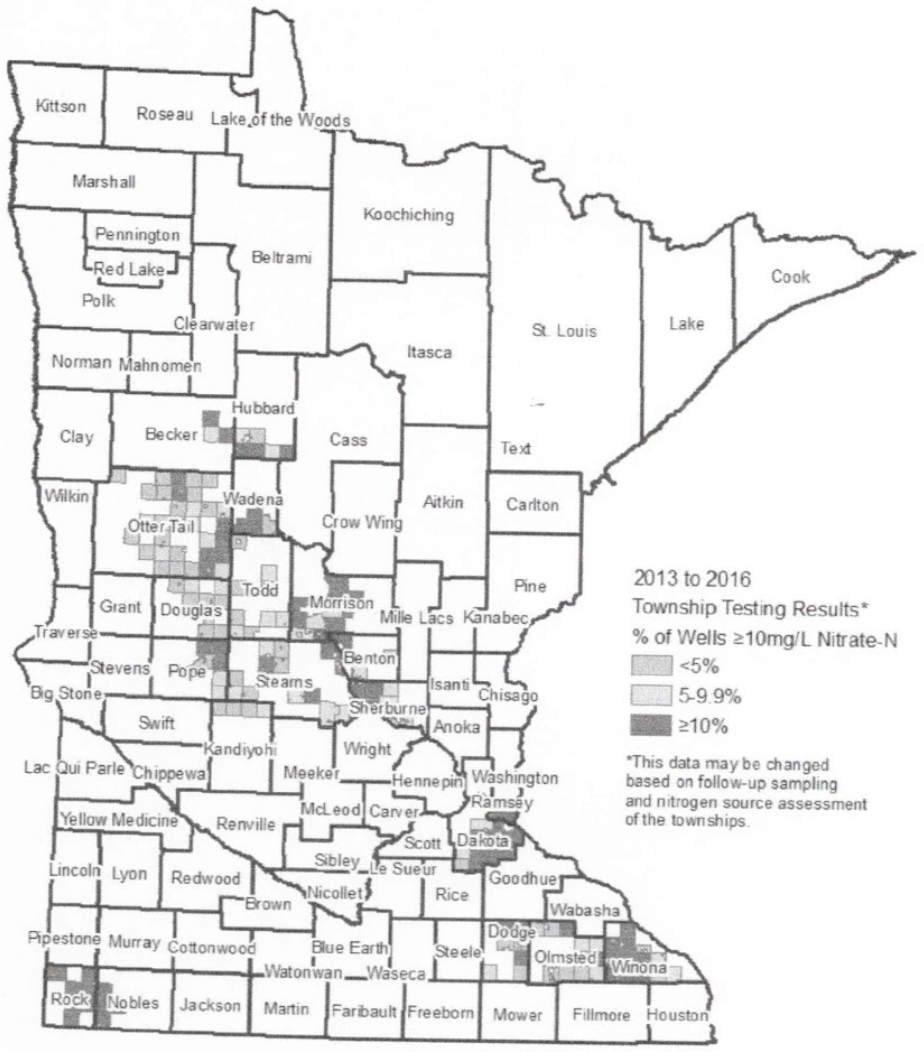
Next Steps

Once the follow-up sampling is completed, the MDA conducts an analysis of the results and prepares a final report for each county (visit www.mda.state.mn.us/townshiptesting).

The MDA uses the final results to determine if additional action is needed, as described in the Minnesota Nitrogen Fertilizer Management Plan (NFMP). Find more information about the NFMP on the MDA website at www.mda.state.mn.us/nfmp.

Table 1. Townships Tested 2013-2016	<3	3<10	≥10	≥10
Total Wells	Nitrate-Nitrogen mg/L (ppm)			
	Number of Wells			Percent
20,042	15,721	2,409	1,912	9.5%

Figure 3. Initial Township Testing Results.



Hubbard County: Overview of Nitrate Levels in Private Wells (2016)

The Minnesota Department of Agriculture (MDA) determines current nitrate-nitrogen concentrations in private wells, on a township scale, through the Township Testing Program. The MDA has identified townships throughout the state that are vulnerable to groundwater contamination and have significant row crop production. The MDA plans to offer nitrate testing to 70,000 private well owners in over 300 townships by 2019.

Each selected township is offered testing in two steps, the "initial" sampling and the "follow-up" sampling. In the initial sampling, all township homeowners using private wells are sent a nitrate test kit. If nitrate is detected in their initial sample, the homeowner is offered a follow-up nitrate test, pesticide test and well site visit. Trained MDA staff visit willing homeowners to resample the well and then conduct a site assessment. The assessment helps to identify possible non-fertilizer sources of nitrate and to see the condition of the well. A well with construction problems may be more susceptible to contamination.

Hubbard County Highlights

- # of Vulnerable Townships Tested: 6
- Households Receiving Kits: 2,899
- # of Wells Tested: 1,106
- % of Wells Over the Health Standard: 10.5%

The MDA and the Hubbard Soil and Water Conservation District worked together to select townships and implement the nitrate testing project. The following townships were selected: **Badoura, Crow Wing Lake, Henrietta, Hubbard, Straight River and Todd.** The initial sampling in Hubbard County started in 2016 and follow-up sampling is scheduled for 2017.

Results

The initial well dataset contains all wells tested (1,106) regardless of well construction issues and sources of nitrate. The Health Standard for nitrate-N in drinking water is 10 mg/L. The results from the initial well dataset are summarized in the table and map below.

Table: Hubbard County Initial Well Dataset Results, 2016.

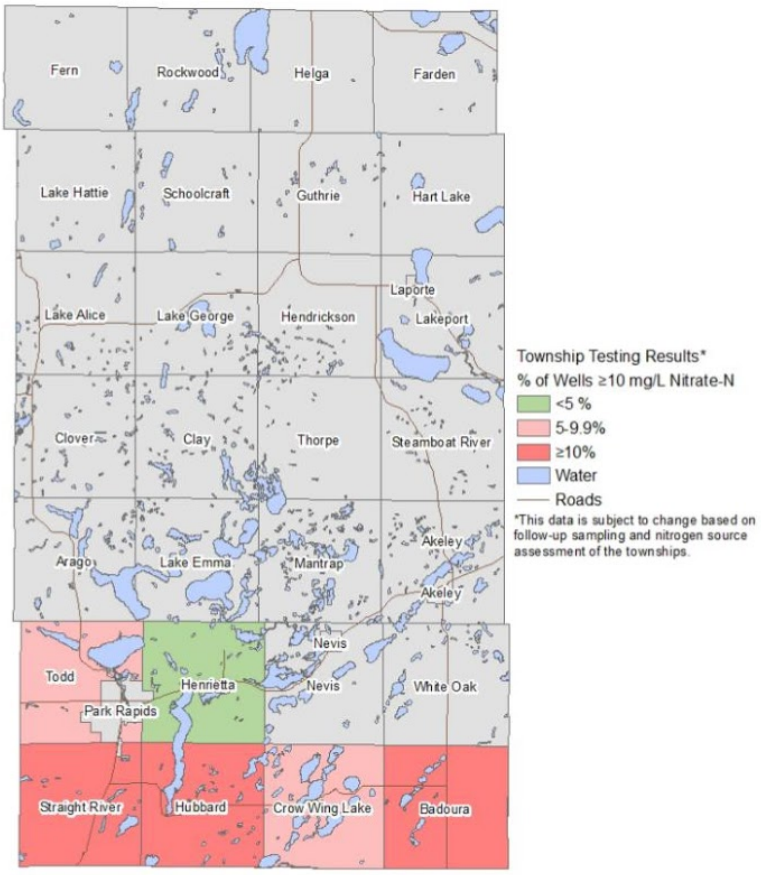
Township	Number of Wells Tested	Min Nitrate-N mg/L or PPM	Max Nitrate-N mg/L or PPM	Mean Nitrate-N mg/L or PPM	Median Nitrate-N mg/L or PPM	Percent of Wells ≥10 mg/L
Badoura	41	<0.03	32.8	3.8	<0.03	17.1%
Crow Wing Lake	208	<0.03	32.6	2.0	<0.03	8.7%
Henrietta	259	<0.03	20.2	1.5	0.1	3.5%
Hubbard	241	<0.03	46.3	5.2	0.3	19.5%
Straight River	137	<0.03	26.1	2.6	<0.03	10.2%
Todd	220	<0.03	26.9	2.7	<0.03	9.5%
Total	**1,106***	**<0.03**	**46.3**	**2.9**	**<0.03**	**10.5%**

**All well types included.*

Published January 2017

Minnesota Department of Agriculture

Figure: Hubbard County Initial Well Dataset Map, 2016.



Next Steps

Once the follow-up sampling is completed, the MDA conducts an analysis of the results and prepares a final report for each county (visit www.mda.state.mn.us/townshiptesting). The Hubbard County Final Report will be available in 2018.

The MDA uses the final results to determine if additional action is needed, as described in the Minnesota Nitrogen Fertilizer Management Plan (NFMP). Find more information about the NFMP on the MDA website at www.mda.state.mn.us/nfmp.

Funding Acknowledgement

Funding for this project is provided by the Clean Water, Land and Legacy Amendment

CLEAN WATER LAND & LEGACY AMENDMENT

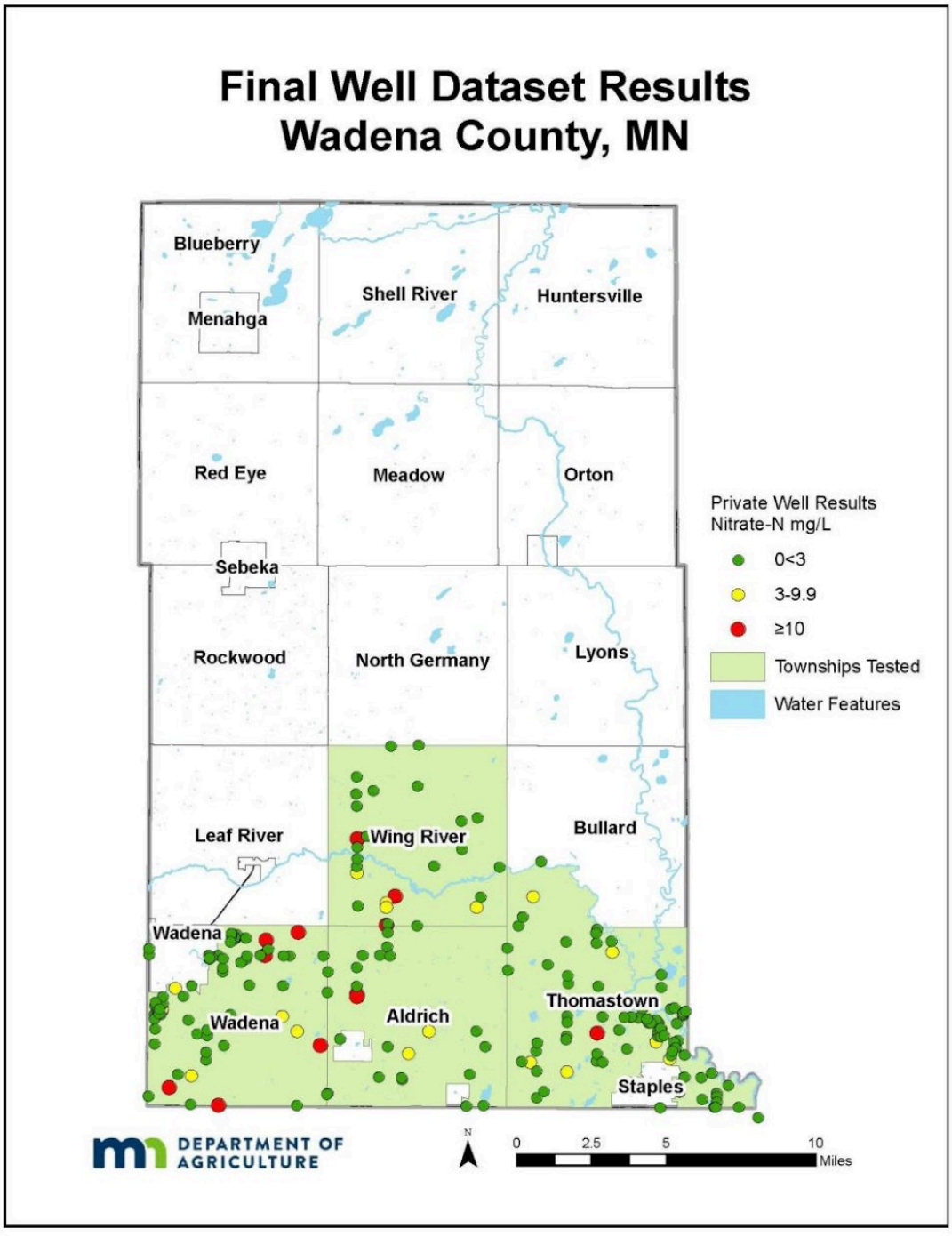


Figure 2. Well Locations and Nitrate Results from Final Well Dataset in Wadena County

Table 3. Wadena County Township Testing Summary Statistics for Final Well Dataset

Township	Total Wells	Values			Percentiles					Number of Wells					Percent				
		Min	Max	Mean	(50th) Median	75th	90th	95th	99th	<3 mg/L	3<10 mg/L	≥5 mg/L	≥7 mg/L	≥10 mg/L	<3 mg/L	3<10 mg/L	≥5 mg/L	≥7 mg/L	≥10 mg/L
		Nitrate-N mg/L or parts per million (ppm)																	
Aldrich	24	<DL	21.7	2.3	<DL	0.9	6.4	21.6	21.7	20	2	2	2	2	83.3%	8.3%	8.3%	8.3%	8.3%
Thomastown	93	<DL	10.9	0.7	<DL	<DL	2.0	6.0	10.4	86	6	6	4	1	92.5%	6.5%	6.5%	4.3%	1.1%
Wadena	76	<DL	27.6	2.5	0.1	2.3	9.7	12.5	25.8	62	7	12	9	7	81.6%	9.2%	15.8%	11.8%	9.2%
Wing River	29	<DL	22.1	2.8	<DL	3.4	8.3	19.2	22.1	21	5	4	3	3	72.4%	17.2%	13.8%	10.3%	10.3%
Total	222	<DL	27.6	1.8	<DL	1.2	5.8	10.8	21.8	189	20	24	18	13	85.1%	9.0%	10.8%	8.1%	5.9%

<DL stands for less than detectable limit. The detectable limit is <0.03 mg/L nitrate. The 50th percentile (75th, 90th, 95th, and 99th respectively) is the value below which 50 percent (75%, 90%, 95% and 99%) of the observed values fall.

As discussed previously, the areas selected were deemed most vulnerable to nitrate contamination of groundwater. Table 4 compares the final results to the percent land area of vulnerable geology (MDNR. MGS and UMD, 1997) and row crop production (USDA NASS Cropland Data Layer, 2013) in each township. The percent land area considered vulnerable geology and in row crop production was estimated using a geographic information system known as ArcGIS.

Table 4. Township Nitrate Results Related to Vulnerable Geology and Row Crop Production, Wadena County

Township	Final Total Wells	Percent Vulnerable Geology	Percent Row Crop Production	Percent ≥7 mg/L	Percent ≥10 mg/L
				Nitrate-N mg/L or parts per million (ppm)	
Aldrich	24	93%	39%	8.30%	8.30%
Thomastown	93	88%	28%	4.30%	1.10%
Wadena	76	100%	49%	11.80%	9.20%
Wing River	29	87%	18%	10.30%	10.30%
Total	222	92%*	33%*	8.10%	5.90%

* Represents an average value

ESTIMATES OF POPULATION AT RISK

The human population at risk of consuming well water over the HRL of 10 mg/L nitrate-N was estimated based on all sampled wells. An estimated 336 people in Wadena County's study area may have drinking water over the nitrate HRL (Table 5). Nitrate contamination is a significant problem across much of Wadena County. Additional public awareness and education programming will need to take place in many of the townships.

Table 5. Estimated Population with Well Water at or over 10 mg/L Nitrate-N, Wadena County

Township	Estimated Households on Private Wells*	Estimated Population on Private Wells*	Estimated Population ≥10 mg/L Nitrate-N**
Aldrich	199	429	83
Thomastown	242	820	41
Wadena	389	858	170
Wing River	201	460	59
Total	1,031	2,567	336

* Data collected from the Minnesota State Demographic Center, 2013
** Estimates based off of the 2013 estimated households per township gathered Minnesota State Demographic Center and percentage of wells at or over the HRL from the initial well dataset

CENTRAL SANDS PRIVATE WELL NETWORK FOR NITRATE 2017 RESULTS

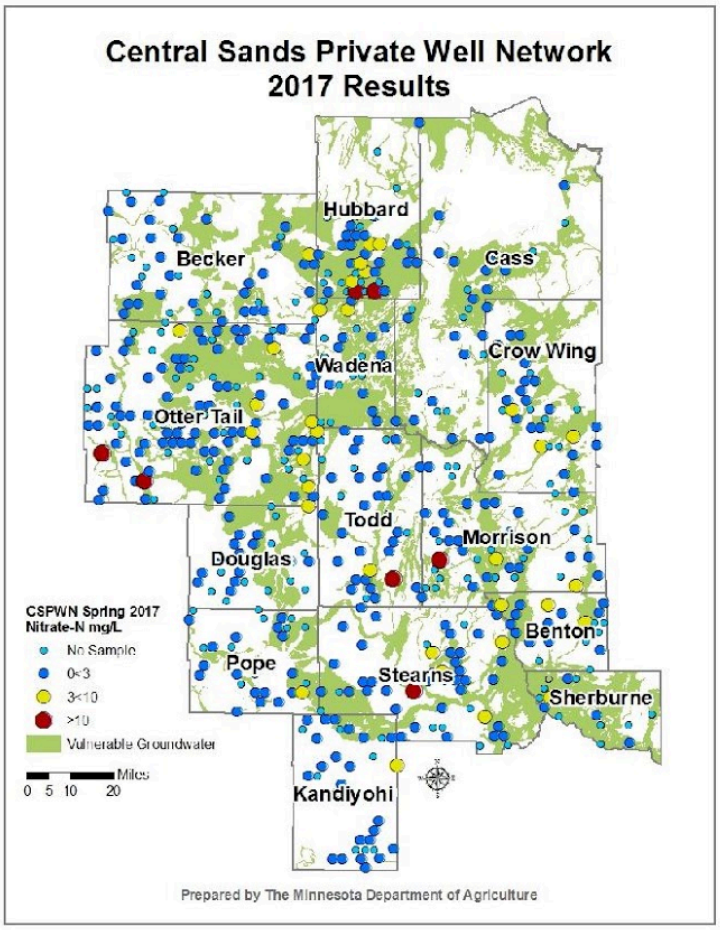
The Minnesota Department of Agriculture developed the Central Sands Private Well Network in 2011 because of concerns about high nitrate levels in private drinking water wells. Drinking water high in nitrate can cause serious health effects in infants. The state's Health Risk Limit for nitrate-nitrogen is 10 mg/L.

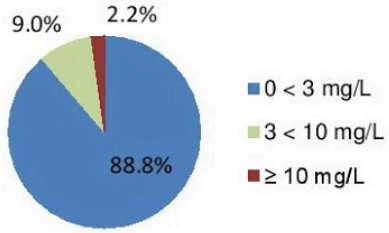
The Central Sands region has soils that may be vulnerable to groundwater contamination. The long-term goal of the network is to determine nitrate trends in the region. To the greatest extent possible, the same households have been tested since 2011.

In 2017, 367 private drinking water wells were sampled for nitrate.

2017 Nitrate-N Results

- 88.8% of results were < 3 mg/L
- 9.0% of results were 3<10 mg/L
- 2.2% of results were ≥10 mg/L





Nitrate-N mg/L	2011	2012	2013	2014	2015	2016	2017
Total Samples	534	506	487	432	402	397	367
0 < 3	90%	89%	89%	89%	89%	90%	89%
3 < 10	7%	8%	8%	7%	7%	7%	9%
≥ 10	4%	3%	3%	3%	4%	4%	2%

Percent rounded to the nearest whole number

On a regional scale, 98% of participating wells have water that is below the Health Risk Limit for nitrate-nitrogen. Results from 2017 are similar to previous years with 89% of nitrate results <3 mg/L, 9% in the 3<10 mg/L range, and 2% ≥10 mg/L. Even with the decline in participation rates since 2011, the overall picture is still representative of the network as the proportion of wells in each nitrate category remains nearly the same. The trend of lower nitrate wells leaving the network is consistent each year. As of 2017, roughly 86% of dropped wells previously had results <3 mg/L.

DEPARTMENT OF AGRICULTURE

This could not be done without the help of homeowner volunteers! Thank you for making this program possible. Your participation is helping to protect local groundwater.

Wadena Soil & Water Conservation District

CLEAN WATER LAND & LEGACY AMENDMENT

2017 NITRATE RESULTS BY COUNTY

Counties	Total Wells	Nitrate–N Summary Statistics					Percentage of Wells		
		Min	Max	Mean	Median	90th[1]	<3 mg/L	3<10 mg/L	≥10 mg/L
		Nitrate-N mg/L or parts per million (ppm)					Percent		
Becker	29	<0.03	3.7	0.2	<0.03	0.8	96.6%	3.4%	0.0%
Benton	14	<0.03	9.0	1.6	0.08	5.7	78.6%	21.4%	0.0%
Cass	18	<0.03	1.7	0.3	<0.03	1.3	100.0%	0.0%	0.0%
Crow Wing	23	<0.03	5.7	0.9	0.03	3.5	87.0%	13.0%	0.0%
Douglas	16	<0.03	3.6	0.2	<0.03	0.2	93.8%	6.3%	0.0%
Hubbard	26	<0.03	21.1	2.3	<0.03	6.0	73.1%	19.2%	7.7%
Kandiyohi	25	<0.03	6.8	0.4	<0.03	0.8	96.0%	4.0%	0.0%
Morrison	25	<0.03	20.3	1.4	<0.03	3.3	88.0%	8.0%	4.0%
Otter Tail	84	<0.03	16.0	1.0	<0.03	4.1	88.1%	9.5%	2.4%
Pope	16	<0.03	3.2	0.3	<0.03	0.6	93.8%	6.3%	0.0%
Sherburne	6	<0.03	36.4	6.7	<0.03	33.2	66.7%	16.7%	16.7%
Stearns	40	<0.03	18.0	1.1	<0.03	3.8	87.5%	10.0%	2.5%
Todd	29	<0.03	10.8	1.0	<0.03	2.5	93.1%	3.4%	3.4%
Wadena	16	<0.03	5.3	0.6	<0.03	3.4	87.5%	12.5%	0.0%

[1]The 90th Percentile means that 90% of reported results are below this value.

Nitrate concentrations varied between counties in the Central Sands region. Sherburne County had the highest percentage of wells (16.7%) greater than 10 mg/L. However, Sherburne County has the smallest sample size (6 wells), so one high result can disproportionally affect the mean for a county. An important aspect of the Central Sands Private Well Network (CSPWN) is that it was statistically designed to look at long term trends as a whole region and not on a county by county basis.

Wells with results in the range of 3 to 10 mg/L are considered impacted but safe for drinking; the water is above natural levels of nitrate but below the Health Risk Limit. Groundwater in this range is being impacted by activities on the land surface. Benton County (21.4%), Hubbard County (19.2%), and Sherburne County (16.7%) have the highest percentage of impacted wells.

The Minnesota Department of Agriculture will continue to offer free nitrate sampling kits to participating well owners on an annual basis. Wadena Soil and Water Conservation District will continue to provide local coordination for the entire network. If you have any questions, please contact Kimberly Kaiser at kimberly.kaiser@state.mn.us or by phone: 651-201-6280.

Updated January 2018

DEPARTMENT OF AGRICULTURE

Wadena Soil & Water Conservation District

CLEAN WATER LAND & LEGACY AMENDMENT

R. D. Offutt reduces its Pineland Sands water permit applications to five

By Carrie Hitchcock

North Dakota-based potato grower R. D. Offutt has reached an agreement with the Minnesota Department of Natural Resources (DNR) to voluntarily reduce the number of water appropriation applications in the Pineland Sands area of northern Minnesota from an original 54 earlier this year to five.

Last April, there had been another voluntary reduction by Offutt from those original 54 requests to 18. That move came prior to a ruling by the Minnesota Court of Appeals on the company's case against the DNR's order for a discretionary Environmental Assessment Worksheet (EAW). That order put a stop to any further land conversion of thousands of acres of pine forest to farmland.

The Pineland Sands aquifer covers portions of Hubbard, Becker, Cass and Wadena counties. Because the sandy soils in this area leave it particularly vulnerable to contamination, and because the increasing pace of pines-to-potatoes conversion leaves the aquifer's groundwater vulnerable to overuse, the DNR had ordered the EAW in order to collect information on potential environmental impacts from further appropriations.

With this latest reduction in applications by Offutt, the DNR will rescind its previous order for the EAW and treat the remaining five applications like any other permit applications.

At a telephone press conference held on Thursday, September 10, DNR Assistant Commissioner Barb Naramore said that they made the decision to rescind the EAW after reviewing the nature, number and location of the remaining five permit applications.

"We don't see the potential for significant environmental effects from these five applications," Ms. Naramore said, "in terms of impact to water availability, water quality, or potential for habitat loss that were concerns when we originally issued our discretionary EAW order."

She added that they were confident that any environmental issues associated with the five applications could be identified and addressed through their established water appropriation permitting process.

Groundwater and land use special study proposed

While saying that the DNR is "pleased with the outcome" of their extensive discussions with Offutt over the past few months, Naramore admitted that they remain concerned about the continuing land conversion and increased crop irrigation in the Pineland Sands.

"These trends are not tied to a single company, however, or single area in that aquifer," she said, still anticipating ongoing permit applications from other farming operations in the area.

Because of those continuing concerns, the DNR is now proposing a special study on land and groundwater use in the area.

"Study results will help inform future land use and guide our management decisions in the area," Naramore said.

In collaboration with the Minnesota Pollution Control Agency and the state's departments of Agriculture and Health, they are working to develop a conceptual and preliminary study scope. Offutt will be a partner in the study as well, to help support data collection.

The proposed study's preliminary scope would consist of two phases. The first phase would focus on establishing baseline conditions around water quantity, quality and land cover in the area, from which models could be developed to help understand their "complex interactions." They also expect this phase to yield insights into the environmental effects of land conversion and increased irrigation in order to identify potential sustainability thresholds.

The second phase would have a longer-range focus, based on the monitoring data obtained. It could include looking at the potential for different crop rotations to avoid or minimize the environmental effects associated with irrigated crop production.

Naramore said they will seek funding at the 2016 legislative session, with a preliminary estimate for study costs at about $1.5 million.

She also said that the DNR wants to build on the work already done on the proposed Straight River Groundwater Management Area (GWMA) plan, which addresses sustainable groundwater use for now and in the future. Naramore said she believes the two studies can complement each other, particularly with the GWMA's focus on working with local communities to help inform the DNR's groundwater management practices.

Offutt's perspective

Offutt CEO Keith McGovern said at the press conference that his company is "looking forward to the results of the study so we don't make requests for permits that aren't good for the environment. We have no intention of making further requests until we get more information."

McGovern said that of the five remaining applications, one is located west of Park Rapids on the Shell Prairie; another is in the area of 2013's Green Valley fire, south of Hubbard near Menahga; another is three miles east and somewhat north of Huntersville; and two are south of Badoura. He said that each center pivot irrigator used by Offutt covers approximately 120 acres of land.

Benefit for Joe Weaver this

4/24/2018 No small potatoes: Dept of Natural Resources requires EAW for pinelands to spud fields project - Bluestem Prairie
Excerpt from Blue Stem Prairie article, Feb 5, 2015

Good Stewards or Toxic Taters?
While DNR Commissioner Tom Landwehr praised the R.D. Offutt Company's efforts at reducing ag chemical use in its fields even as he put brakes on the project,
others, such as the Toxic Taters campaign, have not been as generous in the past.
Nor is this the first time the conversion of jack pine forests to potato acres has generated headlines. In October 2013, Josephine Marcotty at the Star Tribune reported
In

In central Minnesota, potatoes are pushing out forest land:

Agriculture is eating into central Minnesota's forests so aggressively that state regulators and a prominent legislator are sounding the alarm about threats to
wildlife habitat and a large, sensitive aquifer that stretches below parts of four counties.
The latest case is a 1,500-acre project in Cass County, which triggered a contentious legislative hearing last month over the owner's plans to grow potatoes for
McDonald's and other customers on land that was covered with trees just 10 years ago.
In recent years, 5,000 to 6,000 acres of pine forests in Cass, Wadena and neighboring counties have been cleared for chemically intensive row-crop agriculture,
and state officials say nearly 100 square miles of timber land now owned by Potlatch Corp. is at risk as the company divests itself of commercial forests in
Minnesota.
Similar tensions could face the entire state faces as it copes with persistent water contamination and overuse, regulators say. The risk is especially worrisome
along the border between traditional farm lands and the forested areas in central Minnesota, where contaminants can percolate straight through sandy soils into
groundwater, and from there to trout streams and popular lakes.
Several local communities already face huge costs to taxpayers in their struggle to find drinking water that is not contaminated with agricultural fertilizer.
"Groundwater and drinking water have not been issues until recently," said Rep. Jean Wagenius, DFL-Minneapolis, chair of the House committee that held
hearings this month. "But that's the public conversation I want to have."
Given the scale of the project now underway, Wagenius wasn't overreacting with her concern.
But there's more in the 2013 article that should give readers pause:
R.D. Offutt's project in Cass County is a case that shows what's at stake and the powerful forces driving land conversion. It also has focused the legislature's
attention on an increasingly difficult question on the environmental impacts: Who should pay?
Offutt, based in Fargo, is the nation's largest potato grower and a supplier to McDonald's and other food companies. The Freshwater Society, a Minnesota
environmental group, found in a recent analysis that Offutt is the largest single irrigator in the

state, with rights to pump up to 12 billion gallons of water per year on 30,000 acres.

Recently, it acquired 1,459 acres of cleared commercial forest land from Potlatch, pulled out the stumps, drilled four deep wells and installed high-capacity pumps.

"I was speechless," said Jeff Broberg, a geologist who sits on a legislative advisory committee and saw the work underway this summer while on a site visit. On one side of the road was an aspen forest full of birds and blueberries, he said. On the other, he said, "the habitat destruction was complete. It might as well have been pavement after that."

Rising land prices

At the October hearing, Keith McGovern, an Offutt manager, said the company does not intend to increase its potato production. Offutt bought the land so it could improve crop rotation on other fields — which can be better for the soil and the environment — without reducing its overall potato supply to a plant it co-owns in Park Rapids.

(Keith McGovern is the son-in-law of Ronald Offutt, emeritus CEO of RDO, so that wasn't just a branch manager.)

In short, the company is stripping Minnesota of tens of thousands of its forest lands in order to make the soil safe for crop rotations.

And as is clear from the 2013 report to Thursday's action, the scale of the deforestation has grown. For other reports, check out the Associated Press's report in the Strib, Minnesota agency puts brakes on conversion of pine forests to potato fields and Zach Kayser's article in the Bemidji Pioneer, Pine forests into potato fields: DNR temporarily halts N.D. company's clear-cutting of Minnesota woods.

MDH Minnesota Department of Health

Minnesota Well Index

Search by Zoom to Tools Basemaps Other Links Help

BADOURA STATE FOREST

DOMESTIC WELL AT RESIDENCE
617078

ONE OF THE LATEST FOREST-TO-FIELD CONVERSIONS BY R.D OFFUTT CO (160 ACRES)

806745
DNR APPROPRIATION PERMIT 2017-0537, WELL BORED IN THE MIDDLE OF 4-40 ACRE PARCELS

N

WHITE OAK TWP AND NORTH END OF BADOURA, HUBBARD CO | CASS CO, HIRAM TWP AND NORTH END OF DEERFIELD TWP


0-69
HUB-17-11
319 P
318P
317 P
WEGWO'S LAKE
WHITE OAK TWP, HUBBARD CO
CASS CO, HIRAM TWP
CASS CO

LIKELY TO BE NEXT DEVELOPED BY RDO BUSINESS PARTNER

MDH Minnesota Department of Health

Minnesota Well Index

Search by Zoom to Tools Base Maps Other Links Help

WHITE OAK TWP AND NORTH END OF BADOURA TWP, HUBBARD CO

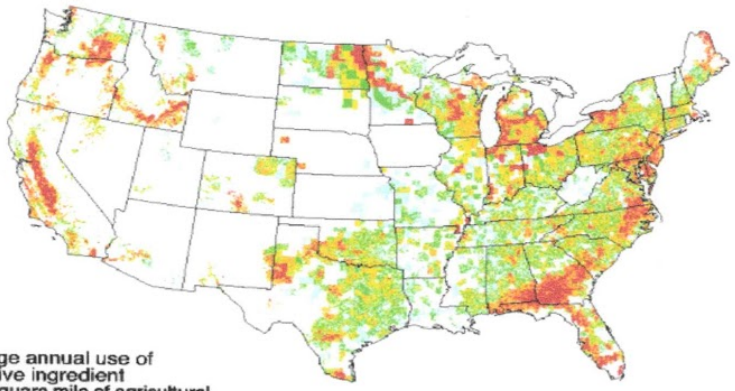
CASS CO, HIRAM TWP AND NORTH END OF DEERFIELD TWP

CASS CO 41

WELL IS 806745, MN DNR PERMIT 2017-0537
ONE OF THE LATEST FOREST-TO-FIELD CONVERSIONS BY RD OFFUTT CO (160 ACRES)

CHLOROTHALONIL - fungicide

2002 estimated annual agricultural use



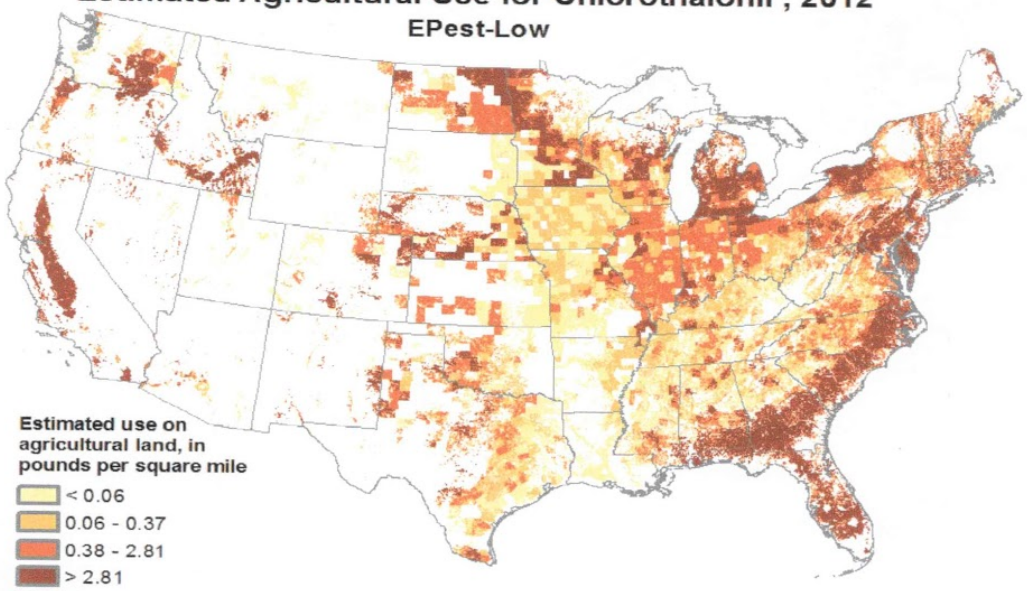
Average annual use of active ingredient (pounds per square mile of agricultural land in county)

- no estimated use
- 0.001 to 0.013
- 0.014 to 0.054
- 0.055 to 0.221
- 0.222 to 1.505
- >= 1.506

Crops	Total pounds applied	Percent national use
peanuts	2692238	34.95
potatoes	2266557	29.43
tomatoes	808315	10.49
watermelons	247934	3.22
dry onions	204136	2.65
cherries	179482	2.33
green beans	169852	2.21
cucumbers and pickles	158010	2.05
cranberries	134391	1.74
pumpkins	122117	1.59

Estimated Agricultural Use for Chlorothalonil , 2012

EPest-Low



Estimated use on agricultural land, in pounds per square mile

- < 0.06
- 0.06 - 0.37
- 0.38 - 2.81
- > 2.81
- No estimated use

USGS ESTIMATES

New Jersey Department of Health and Senior Services

HAZARDOUS SUBSTANCE FACT SHEET

Common Name: **CHLOROTHALONIL**

CAS Number: 1897-45-6
DOT Number: UN 2588
DOT Hazard Class: 6.1 (Toxic)

RTK Substance number: 0415
Date: April 1998 Revision: June 2005

HAZARD SUMMARY

* **Chlorothalonil** can affect you when breathed in.
* **Chlorothalonil** should be handled as a CARCINOGEN--WITH EXTREME CAUTION.
* Contact can irritate the skin and eyes.
* Breathing **Chlorothalonil** can irritate the nose, throat and lungs causing cough, phlegm and/or tightness in the chest.
* Repeated overexposure may cause nosebleeds and skin rash.
* **Chlorothalonil** may affect the kidneys.

IDENTIFICATION

Chlorothalonil is a white, odorless crystalline (sand-like) solid which may be found in a liquid formulation. It is used as a fungicide for plants and crops.

REASON FOR CITATION

* **Chlorothalonil** is on the Hazardous Substance List because it is cited by DOT, DEP, IARC, IRIS and EPA.
* This chemical is on the Special Health Hazard Substance List because it is a **CARCINOGEN**.
* Definitions are provided on page 5.

HOW TO DETERMINE IF YOU ARE BEING EXPOSED

The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information and training concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard, 1910.1200, requires private employers to provide similar training and information to their employees.

* Exposure to hazardous substances should be routinely evaluated. This may include collecting personal and area air samples. You can obtain copies of sampling results from your employer. You have a legal right to this information under OSHA 1910.1020.
* If you think you are experiencing any work-related health problems, see a doctor trained to recognize occupational diseases. Take this Fact Sheet with you.

WORKPLACE EXPOSURE LIMITS

No occupational exposure limits have been established for **Chlorothalonil**. This does not mean that this substance is not harmful. Safe work practices should always be followed.

* **Chlorothalonil** may be a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

WAYS OF REDUCING EXPOSURE

* Enclose operations and use local exhaust ventilation at the site of chemical release. If local exhaust ventilation or enclosure is not used, respirators should be worn.
* Wear protective work clothing.
* Wash thoroughly immediately after exposure to **Chlorothalonil** and at the end of the workshift.
* Post hazard and warning information in the work area. In addition, as part of an ongoing education and training effort, communicate all information on the health and safety hazards of **Chlorothalonil** to potentially exposed workers.

ECHO® 720 Agricultural Fungicide

SAFETY DATA SHEET

OSHA HCS (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product identifier

Chemical Name	1,3-Benzenedicarbonitrile, 2,4,5,6-tetrachloro
Trade Names	ECHO® 720 Agricultural Fungicide
CAS No.	1897-45-6
EPA Identification Number	EPA Reg. No. 60063-7

Relevant identified uses of the substance or mixture and uses advised against

Identified Use(s)	Fungicide
Uses Advised Against	Do **NOT** aerosolize or atomize to produce inhalable-size particles.

Details of the supplier of the safety data sheet

Company Identification	Sipcam Agro USA, Inc. 2525 Meridian Parkway, Suite 350 Durham, NC 27713 United States of America
Telephone	(919) 226-1195

Emergency telephone number

Emergency Phone No.	CHEMTREC 24 hr. 1-800-424-9300 / 1 (703) 527-3887 (Collect calls accepted)

SECTION 2: HAZARDS IDENTIFICATION

Classification of the substance or mixture

OSHA HCS (29 CFR 1910.1200) — Acute Tox. 2; Eye Dam. 1; Carc. 2; STOT SE 3

Label elements

This chemical is a pesticide product registered by the United States Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets (SDS) and for workplace labels of non pesticide chemicals. The labeling information below applies to non-pesticide workplace labels. For pesticide label information, refer to Section 15.

Hazard Symbol(s)

Signal Word(s): **DANGER**

Hazard Statement(s):

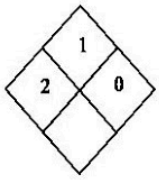
Fatal if inhaled (Aerosol / Mist).

Causes serious eye damage.

Suspected of causing cancer.

May cause respiratory irritation (Aerosol / Mist).

MATERIAL SAFETY DATA SHEET



1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME(S): VAPAM® HL Soil Fumigant; METAM 426; METAM SODIUM 42% TECHNICAL; METACIDE 42; VAPAM® RUP; TERRACIDE 510; RID-A-VEC® II; RID-A-VEC®
CHEMICAL NAME: Sodium –methyldithiocarbamate solution
MOLECULAR FORMULA: $C_2H_4NNaS_2$
GENERAL USE: Soil Fumigant
PRODUCT DESCRIPTION: Orange to light yellow-green liquid with the possibility of an amine or a sulfur odor.
EPA Registration Number(s): 5481-421; 5481-423; 5481-446; 5481-468; 5481-477
Registration Number (Under the Canadian Pest Control Products Act): 29128
MSDS No.: 141_23
Current Revision Date: 1 December, 2008

MANUFACTURER:
AMVAC CHEMICAL CORPORATION
4100 E. Washington Blvd.
Los Angeles, CA 90023-4406
Phone: 323-264-3910
FAX: 323-268-1028

EMERGENCY TELEPHONE NUMBERS:
MANUFACTURER: 323-264-3910
TRANSPORTATION (24 HOURS)
CHEMTREC: 800-424-9300
OTHER (24 HOURS)
AMVAC: 323-264-3910

2. COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT	WT %	CAS No.
Sodium –methyldithiocarbamate (VAPAM®, Metam Sodium)	42.0%	137-42-8
Inert Ingredients	58.0%	

Ingredients not precisely identified are proprietary or nonhazardous. Values are not product specifications.

OSHA HAZARDOUS COMPONENTS (29 CFR1910.1200)

COMPONENT	HAZARD	OSHA PEL*	ACGIH TLV*
NONE LISTED			

* Exposure Limits 8 hrs. TWA (ppm)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

DANGER! Dilution with water may generate poisonous gases (Methyl isothiocyanate (MITC) or Hydrogen sulfide). Dilution with acids may generate flammable gases (Carbon disulfide or Monomethylamine). WARNING: Product is corrosive to skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Harmful if swallowed. Harmful if inhaled. Harmful if absorbed through the skin. Irritating to eyes, nose and throat. Do not get on skin or clothing. Avoid breathing vapor or spray mist. Do not get in eyes.

Toxic to fish. Do not contaminate water bodies.

POTENTIAL HEALTH EFFECTS

ROUTE(S) OF ENTRY: Skin contact, inhalation, ingestion, and eye contact with the liquid product. As a result of use of the product, applicators and other persons present in the area of the application can be exposed to MITC and/or hydrogen sulfide. These chemicals can be evolved as gases from the soil of an application. MITC has a horseradish like odor and can be very irritating to the eyes. Hydrogen sulfide has a rotten egg odor and can be very offensive. If either odor is detected near an application of Metam, notify the applicator of the problem and take appropriate measures to minimize/avoid exposure. The nose becomes deadened to a hydrogen sulfide odor, so not being able to detect the odor any longer does not mean the exposure has ended.

SIGNS OF ACUTE OVEREXPOSURE: Overexposure to Metam Sodium as sold may result in damage to the skin, skin irritation, excessive salivation, sweating, fatigue, weakness, nausea, headache, dizziness, eye, nose, throat and respiratory tract irritation. In addition, dilution to use levels results in the release of methyl isothiocyanate (MITC) and/or hydrogen sulfide. Overexposure to MITC may result in strong skin and eye irritation, running nose, dizziness, cramps, nausea, vomiting, and mild to severe disturbances of the nervous system. Overexposure to hydrogen sulfide may result in severe irritation to the eyes and mucous membranes. In addition, exposure may result in headache, dizziness, excitement, staggering gait, diarrhea, difficult or painful urination, difficult breathing, chronic pulmonary edema, coma and death.

SIGNS OF CHRONIC OVEREXPOSURE: Same as above, plus conjunctivitis, photophobia, digestive disturbances, weight loss, general bodily weakness, and blurred vision. In addition, laboratory studies have shown that exposure to the active ingredient, followed by ingestion of alcohol, may cause an adverse reaction, including low blood pressure, rapid heart beat, and flushing of the skin. Consumption of alcohol during and after exposure to this product should be avoided.

3. HAZARDS IDENTIFICATION, cont'd

OTHER POTENTIAL HEALTH EFFECTS: Laboratory studies have shown some carcinogenic effects and some developmental effects in laboratory animals. *In vitro* laboratory studies have shown some evidence of mutagenicity, but there is no conclusive evidence *in vivo*. Exposure monitoring studies conducted during agricultural applications of Metam sodium have shown that human exposure is extremely low; therefore, any potential risk to humans from Metam sodium exposure is considered minimal.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Impaired pulmonary function and preexisting eye problems may be aggravated. Preexisting skin diseases may also be aggravated by exposure to the decomposition products.

Care should be exercised and all label instructions should be followed, in the handling of products containing Metam Sodium.

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4. FIRST AID MEASURES

EYES: Immediately flush the eyes with copious amounts of clear, cool running water for a minimum of 15 minutes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eyes and lids with water. Contact a physician immediately. If there will be a delay in getting medical attention, rinse the eyes for at least another 15 minutes.

INHALATION: Remove victim to fresh air. If breathing has ceased, clear the victim's airway and start mouth-to-mouth artificial respiration. If breathing is difficult, give oxygen. Contact a physician immediately.

INGESTION: Immediately dilute the swallowed product by giving large quantities of water, but do not induce vomiting. If vomiting occurs, give fluids again. Have a physician determine if condition of patient will permit induction of vomiting or evacuation of stomach. Never give anything by mouth to an unconscious person. Contact a physician immediately.

SKIN: Immediately flush all affected areas with large amounts of clear water for at least 15 minutes. Remove contaminated clothing. Do not attempt to neutralize with chemical agents. Wash clothing before reuse. If skin irritation develops, contact a physician immediately.

NOTE TO PHYSICIANS: Treat symptomatically. Contact your local, state, or national poison control center for further information.

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5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

Flash Point: > 200˚F (TCC)
Autoignition Temperature: Not available
Flammable Limits:
Lower flammable limit: Not available
Upper flammable limit: Not available

5. FIRE FIGHTING MEASURES, cont'd

EXPLOSIVITY:

Mechanical Impact:	Not available. Not expected to be sensitive to mechanical impact.
Static Discharge:	Not available
Rate of Burning:	Not available
Explosive Power:	Not available

HAZARDOUS COMBUSTION PRODUCTS: This product can release toxic fumes of methylisothiocyanate (MITC) and hydrogen sulfide, as well as nitrogen oxides, when heated to decomposition or diluted with water.

EXTINGUISHING MEDIA: This product is not flammable. However, this product may support combustion under fire conditions and will generate toxic fumes under fire conditions. Base extinguisher media on surrounding materials. **NOTE:** Dilution with water may cause generation of flammable and toxic fumes of MITC and Hydrogen sulfide. See **Chemical Stability** information in SECTION 10.

FIRE FIGHTING INSTRUCTIONS: Evacuate nonessential personnel from the area. Wear self-contained breathing apparatus and impervious clothing. Clean all clothing before reuse.

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6. ACCIDENTAL RELEASE MEASURES

GENERAL: Use adequate ventilation and appropriate personal protective equipment (PPE, Section 8). Contact with moisture in the soil can generate the flammable and toxic gases MITC and Hydrogen sulfide. Keep bystanders upwind and away from the spill.

SMALL SPILL: Cover with absorbent (clay, sawdust, straw, kitty litter, etc.), to absorb the liquid and vapors. Sweep into an open drum. Clean the area with common powdered household detergent and a stiff brush and just enough water to make a slurry. Absorb and sweep into the same open drum. Rinse with water, absorb, and add to the waste drum. Close the drum and dispose of properly.

LARGE SPILL: Dike the spill to prevent contamination of local water sources. Siphon the majority of the liquid into drums for use or disposal, depending on the circumstances. Clean the area as described for a small spill.

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7. HANDLING AND STORAGE

HANDLING: Prevent skin contact. Do not breathe fumes. Wear appropriate personal protective equipment. Wash thoroughly and change clothes after handling. See product label for more detailed handling procedures.

STORAGE: Do not contaminate water, food or feed by storage or disposal. Store product in a cool, dry, locked place out of reach of children. Do not store below 32˚F. Product crystallizes at lower temperatures. See label for specific instructions.

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8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: A well-ventilated area is recommended for handling Metam Sodium. Use of mechanical or local exhaust systems is recommended.

RESPIRATORY PROTECTION: A properly FIT-TESTED NIOSH/MSHA approved respirator fitted with organic vapor cartridges may be required when working with this product. Specific use regulations are listed on the label.

SKIN PROTECTION: Chemical resistant gloves, body covering clothing that has long sleeves and long pants, and chemical resistant shoes or boots, are required to prevent skin contamination. A chemical resistant apron may be required under certain circumstances. Wear clean clothes daily. Wash well with soap and water after handling this product. See the label for more specific instructions.

EYE PROTECTION: Safety glasses must be worn whenever working with chemicals. Face-sealing goggles (or full-face respirators) are required whenever ventilation is poor or a rotten egg odor is detected.

OTHER PROTECTION: An eyewash station and a safety shower should be located in the work area.

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9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:	Liquid
APPEARANCE:	Orange to light yellow-green liquid.
ODOR:	Essentially odorless to fairly strong odor of amine or sulfur.
BOILING POINT:	112˚C/234˚F
FREEZING/MELTING POINT:	0˚C
VAPOR PRESSURE (mm/Hg):	24 mm Hg @ 25˚C
VAPOR DENSITY:	Not available
SPECIFIC GRAVITY:	1.21 g/mL @ 20˚C/4˚C(68˚F/39˚F)
BULK DENSITY:	10.1 lb/gal
EVAPORATION RATE:	1.0 as compared to water.
PERCENT VOLATILE BY VOL:	82% (to 150˚C)
SOLUBILITY IN WATER:	Miscible
pH:	9.5 - 11.0
PARTITION COEFFICIENT (W/O):	Not applicable

---

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Metam Sodium decomposes, when diluted with water, to methyl isothiocyanate (MITC, a lachrymator and moderate poison) and/or to hydrogen sulfide (a highly poisonous gas). Use the solution promptly after mixing. Do not allow the solution to stand. As originally packaged, Metam Sodium solutions are stable under normal storage conditions for up to 2 years.
Metam Sodium can also decompose to carbon disulfide and monomethylamine (both highly flammable) if contacted with a strong acid.

INCOMPATIBILITY: This product is incompatible with additional water and strong aqueous acids. In addition, it is corrosive to copper, brass, and zinc, and may soften and/or discolor iron.

HAZARDOUS DECOMPOSITION PRODUCTS: When treated with water or heated to decomposition, this product will give off toxic fumes of methyl isothiocyanate (MITC), hydrogen sulfide, and nitrogen oxides. If treated with strong acids, fumes of carbon disulfide and monomethylamine will be given off.

HAZARDOUS POLYMERIZATION: This product will not polymerize.

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11. TOXICOLOGICAL INFORMATION

GENERAL: Information has been included for the product and for two potential decomposition products in order to help potential users to have a clearer idea of the hazards associated with this product.

Toxicological Category	Specific Application	Metam Sodium (Product)	MITC (Decomposition)	Hydrogen sulfide (Decomposition)
INGESTION	Oral LD_{50} (rat):	812 mg/kg	55-220 mg/kg	
INHALATION	Inhalation LC_{50} (rat)	2.28 mg/L	1.9 mg/L air (1 hr)	444 ppm
DERMAL	Skin LD_{50} (rabbit)	>2020 mg/kg	33 - 202 mg/kg	
IRRITATION	Eye (rabbit) Skin (rabbit)	Mild Irritant Moderate Irritant	Corrosive Corrosive	Corrosive No information
OTHER	Skin sensitization (guinea pig)	Sensitizer	Sensitizer	No Information

11. TOXICOLOGICAL INFORMATION, cont'd

TERATOGENICITY: Laboratory studies on Metam Sodium 42% have shown some developmental effects in laboratory animals.

MUTAGENICITY: Laboratory studies on Metam Sodium 42% have shown some evidence of mutagenicity *in vitro* but no conclusive evidence *in vivo*.

CARCINOGENICITY: Laboratory studies on Metam Sodium 42% have shown some carcinogenic effects in laboratory animals.

REPRODUCTIVE TOXICITY: Laboratory studies on Metam Sodium 42% have shown no evidence of reproductive toxicity in laboratory animals.

TOXICOLOGICALLY SYNERGISTIC PRODUCTS: No data are available for Metam Sodium products.

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12. ECOLOGICAL INFORMATION

GENERAL: This product is toxic to fish. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters.

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13. DISPOSAL CONSIDERATIONS

PESTICIDE DISPOSAL: Do not contaminate water, food or feed by disposal. Wastes resulting from the use of this product may be disposed on site by use according to the label or at an approved waste disposal facility. Be sure to check with the appropriate Federal, State and local authorities to determine the current regulations for your area.

CONTAINER DISPOSAL: Do not reuse the empty container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose in a sanitary landfill, or by incineration, or, if allowed by State and local authorities, by burning. If the container is burned stay out of the smoke. Be sure to check with the appropriate Federal, State and local authorities to determine the current regulations for your area.

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14. TRANSPORTATION INFORMATION

DOT CLASS:	8
UN NUMBER:	UN3266
IMDG CLASS (Sea):	8
MARINE POLLUTANT:	Yes
IATA (Air):	8
PACKING GROUP:	III
HAZARD LABEL(s):	CORROSIVE
ADR CLASS (Road):	Not listed in ADR
PROPER SHIPPING NAME(s):	Corrosive liquid, basic, inorganic, n.o.s.(Metam Sodium 42%)
REPORTABLE QUANTITY:	No

14. TRANSPORTATION INFORMATION, cont'd

PACKAGING

GENERAL DESCRIPTION: Bulk; 55 gallon poly drums; 300 gallon stainless steel and rigid plastic tote bins

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15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS: This product is registered under EPA/FIFRA Regulations. It is a violation of Federal Law to use this product in any manner inconsistent with its labeling. Read and follow all label directions. This product is excluded from listing requirements under EPA/TSCA.
When these products are used for small areas they are considered to be RESTRICTED USE PESTICIDES. Due to acute toxicity, retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's Certification.

CANADIAN REGULATIONS: This product is registered under the Pest Control Product Act of Canada (CPR). It is a violation of Canadian Law to use this product in any manner inconsistent with its labeling. Read and follow all label directions.
This product has been classified according to the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

SARA TITLE III DATA

Section 311 & 312 Hazard Categories:

Immediate Health Hazard:	Yes
Delayed Health Hazard:	Yes
Fire Hazard:	No
Reactive Hazard:	No
Sudden Pressure Release Hazard:	No

Section 302 Extremely Hazardous Substances: None

Section 313 Toxic Chemicals: Metam Sodium (CAS 137-42-8) - 42%

CERCLA/EHS Reportable Quantity (RQ): None

STATE REGULATIONS:

CALIFORNIA (Proposition 65): Warning: This product contains Metam Sodium, a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

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16. OTHER INFORMATION

MSDS STATUS:

Date This Revision: 1 December, 2008
Date Previous Revision: 14 November, 2007
Person Responsible for Preparation: Gary A. Braden

REASONS FOR REVISION: Annual Review. Registration of this product in Canada has necessitated changes in the header, section 1 and section 15.

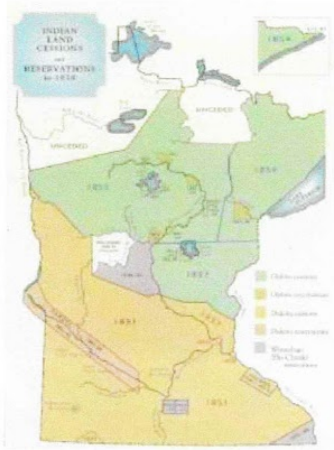
DISCLAIMER: This information is provided for the limited guidance to the user. While AMVAC believes that the information is, as of the date hereof, reliable, it is the user's responsibility to determine the suitability of the information for its purposes. The user is advised not to construe the information as absolutely complete since additional information may be necessary or desirable when particular, exceptional, or variable conditions or circumstances exist (like combinations with other materials), or because of applicable regulations. No express or implied warranty of merchantability or fitness for a particular purpose or otherwise is made hereunder with respect to the information or the product to which the information relates.

ABBREVIATIONS:

ACGIH	-	American Conference of Governmental Industrial Hygienists
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act
DOT	-	Department of Transportation
EHS	-	Extremely Hazardous Substance
EPA	-	Environmental Protection Agency
FIFRA	-	Federal Insecticide, Fungicide, and Rodenticide Act
HIS	-	Health Information Services
IARC	-	International Agency for Research on Cancer
IATA	-	International Air Transport Association
IMDG	-	International Maritime Dangerous Goods
NTP	-	National Toxicology Program
OSHA	-	Occupational Safety and Health Agency
SARA	-	Superfund Amendments and Reauthorization Act
TSCA	-	Toxic Substances Control Act

Treaty of Washington, 1855

Creator: Andrew B. Stone



Map of Indian Land Cessions and Reservations to 1858.

The Treaty of Washington (1855) is a milestone in the history of Ojibwe people in Minnesota. The agreement ceded a large portion of Ojibwe land to the U.S. government and created the Leech Lake and Mille Lacs reservations.

The U.S. government acquired most Ojibwe land in eastern Minnesota in the Treaties of St. Peters (1837) and La Pointe (1854). In early 1855, it began planning a new treaty to buy most of the remaining Ojibwe land in the territory's north-central woods.

Traders like Henry Rice supported a new treaty because it would help pay off the debts they claimed the Ojibwe owed. Rice had invested in the lumber industry and stood to profit from logging on Ojibwe land. He claimed, however, that the treaty would mostly benefit the Ojibwe. According to Rice, they were "starving" as hunters and gatherers and needed government aid to become farmers.

Thousands of Ojibwe, from different bands and with different interests, had attended the 1854 negotiations at La Pointe, making it difficult for U.S. representatives to get what they wanted. Commissioner of Indian Affairs George Manypenny did not want to repeat this situation in 1855. He instructed agent David Herriman to invite only a handful of Ojibwe leaders to Washington, DC, including Bagone-giizhig (Hole-in-the-Day the Younger) and Eshkibagikoonzh (Flat Mouth). They were not told the purpose of the visit—only that the government wished to discuss their lands in Minnesota.

The Mille Lacs band were upset about not being invited to the negotiations and sent their own delegation. Though it is unclear if they arrived in time, the terms of the final treaty applied to them.

Negotiations took place during three meetings held February 17–20. The U.S. government named Bagone-giizhig and Eshkibagikoonzh "head chiefs" and negotiators for the Ojibwe as a whole. Despite this, the delegations met separately and defended unique interests.

Manypenny argued that when the Ojibwe became farmers, they would have more land than they needed—land that the government wanted to buy. Bagone-giizhig and Eshkibagikoonzh replied that the Ojibwe would need support to transition to a farming economy and tried to negotiate a higher price.

They finally agreed that the Mississippi bands (including the Mille Lacs Ojibwe) would be paid $20,000 for twenty years. They would also receive $50,000 to pay debts and $10,000 in goods. The Pillager and Lake Winnibigoshish bands agreed to similar terms. Both parties assumed that the Ojibwe would continue to hunt and fish in the ceded territory.

Although the Mille Lacs band already lived on land ceded in 1837, they wanted their own permanent reservation, like those set aside in the 1854 Treaty of La Pointe. The 1855 treaty created this reservation on the southern side of Lake Mille Lacs. It set aside a second reservation at Leech Lake for the Pillager band.

To the Ojibwe negotiators, the treaty may have seemed the best of a limited number of options. Treaty payments had become crucial for the Ojibwe economy. Reservations reduced Ojibwe land but came with a promise that the people would not have to abandon their homes. Some Ojibwe leaders saw the reservation system as a way to protect a small part of their land from whiskey sellers, immigrants, and lumber companies.

Memo

792199_ParkRapidsTW_2014_aqt02498

MINNESOTA MDH DEPARTMENT OF HEALTH

Date: March 31, 2015

To: Park Rapids WHP Project File (PWSID: 1540000)

From: Justin Blum

Subject: Analysis of the Park Rapids TW (792199) Pumping Test, October 9-24, 2014, Confined Outwash Aquifer

Test No. 2498

The test performed on Park Rapids TW (792199) was conducted as described below. Data about test location, scope, and timing are presented in Tables 1 and 2. The data were analyzed using standard methods cited in references. Analysis graphs are presented in Appendix 1 and are summarized in Table 3. Maps, field notes, and any other test documentation are from Leggette, Brashears and Graham, Inc. (LBG) report to the city of Park Rapids.

Result Summary

Conceptual model: leaky confined radial porous media flow

Representative aquifer values:

Transmissivity (T):	19,200	ft^2/day
Aquifer Thickness (b):	50	Feet
Hydraulic Conductivity (k):	384	ft/day
Storativity (S):	5.9e-4	
Leakage Factor (L):	4300	Feet
Hydraulic Resistance (c):	960	Days

Boundaries: leakage

Remarks: Transmissivity and Storativity is known +/- 10%, characteristic leakage factor is a minimum value and could be as large as 6900 feet in the vicinity of the pumped well. Therefore, hydraulic resistance is a minimum value and may be as large as 2500 days.

Test Type:

☒ Constant Rate ☐ Variable Rate ☐ Recovery ☐ Step Drawdown ☐ Other (Describe)

☐ Data scanned ☐ Data entered

Table 1. Aquifer Test Information

Test Location	Park Rapids
Well Owner	Park Rapids
Test Conducted By / For	Leggette, Brashears, and Graham (DNR)
Aquifer	Glacial outwash
Confined / Unconfined	Confined
Date/ Time Monitoring Start	9/20/2012 8:40:00
Date/ Time Pump off Before Test	
Date/ Time Pumping Start	10/9/2012 12:45:00
Date/ Time Recovery Start	10/24/2012 16:06:50
Date/ Time Test Finish	11/1/2012
Flow Rate	1130 gpm
Data Collection Methods	Manual, transducer
Number of Observation Wells	3 constructed in aquifer, 11 total

Table 2. Wells Monitored During the Test

Well Name (Unique Well No.)	Radial Distance (feet)	Static Water Levels (feet below measuring point)			Change in Water Level (feet)	Aquifer
		Start	Mid-test	End		
Pumped Well:						
TW 792199	1				14.7	
Ob Wells:						
Ob1 792197	137				6.7	
Irr2 680803	3264				1.15	
Crookston W. 455794	8007				~ 0.05	

Table 3. Analysis Results

Transient Analysis					
Well Name (Unique Well No.)	**Transmissivity, T (ft^2/ day)**	**Storage Coefficient, S**	**Analysis Method**	**Time Period Emphasis**	**Plot No. Remarks**
Pumped Well:					
792199	7,520	NA	Theis		1
Ob Wells:					
Ob1 (792197)	14,400	1.9e-5	Theis		2
Irr 2 (680803)	32,000	5.6e-3	Theis		3
Crookston W. (455794)	--	--	Theis		4, Not analyzable
Distance Drawdown Analysis	**19,200**	**5.9e-4**	Walton t/r^2	Pumping	5, L ~ 4300 feet
	20,300	4.8e-4	Walton t/r^2	Recovery	6, L ~ 4700 feet

Steady-state Analysis				
Transmissivity, T (ft^2/ day)	**Characteristic Leakage, L (feet)**	**Hydraulic Resistance, c (days)**	**Analysis Method**	**Plot No. Remarks**
19,200	**4,300**	960	de Glee	7

Representative aquifer properties are bolded.

Test Description

See LBG report to the city of Park Rapids.

Evaluation of Test Results

LBG conducted and documented the test in a competent and thorough manner. The qualitative analysis of the data is particularly well done. However, the data collection and report was focused on the DNR's concerns - specific to the short-term potential impacts caused by a new pumping well. Additional useful information exists in these data for groundwater flow model development. Therefore, this analysis of aquifer properties should be considered to be an addition (and not contradictory) to that in LBG's report.

Most notably, the hydraulic response is affected by leakage. This was identified in the LBG analysis of the closest observation well, 792197, but is not really apparent unless the furthest observation well that showed an analyzable response, 680803, is included in the analysis.

The Theis analyses produce transmissivity that increases with radial distance. This is consistent with a leaky-confined setting. The transient distance-drawdown analyses, Walton t/r^2 plots:

- demonstrate the leaky response;
- produce relatively consistent aquifer properties, and;
- demonstrate the relatively high efficiency of the pumped well.

The leaky response of the aquifer is particularly apparent in the recovery data. The steady-state analysis is also consistent with that of the Walton t/r^2 plots.

LEGGETTE, BRASHEARS & GRAHAM, INC.

PROFESSIONAL GROUNDWATER AND ENVIRONMENTAL ENGINEERING SERVICES

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FAX (651) 490-1006
www.lbgweb.com

February 28, 2013

Mr. Brian Hiles, PE
Lead Engineer
Ulteig Engineers, Inc.
1041 Hawk Street
Detroit Lakes, MN 56501

Re: **Phase 2 Hydrogeologic Study**
Aquifer Pumping Test Results
City of Park Rapids
Park Rapids, Minnesota

Dear Mr. Hiles

This letter report provides the results of the constant-rate aquifer pumping test (test) and related groundwater assessment work completed by Leggette, Brashears & Graham, Inc. (LBG) on behalf of Ulteig Engineers, Inc. (Ulteig) and the City of Park Rapids (City). This work is referred to herein as the Phase 2 Hydrogeologic Study (Phase 2).

The test was completed between October 9th and November 1st 2012 by pumping a newly installed 12-inch diameter test well (Test Well) located in the City's existing well field. Water levels were monitored in the Test Well, newly installed observation wells, and select private wells located within an approximate 2-mile radius of the Test Well (Study Area). The locations of the City wells, Test Well, and observation well network are shown on Figures 1, 2 and 3.

1.0 INTRODUCTION

1.1 Purpose

The purpose of the test was to: 1) assess the long-term sustainability of the upper confined aquifer at a pumping rate of approximately 1,100 gallons per minute (gpm); 2) evaluate potential well interference; 3) evaluate the water quality under the stress of pumping; and, 4) meet the Minnesota Department of Natural Resources, Division of Ecological and Water and Resources' (DNR) water appropriation permitting requirements for future withdrawal from the upper confined aquifer. Ulteig also sampled water from the Test Well for pilot testing purposes to evaluate long-term water treatment options. If developed, this water will be used alone or blended with the existing City well water to supply to the City's proposed iron-manganese water treatment plant or bypassed to the distribution system after chemical treatment.

- The upper confining clay unit present below the well field and appears to be laterally extensive across the Study Area to the west and hydraulically upgradient ("upstream") of the well field;

- This confining unit protects the upper confined aquifer from potential contamination sources by impeding vertical groundwater flow between the water table and upper confined aquifer;

- Drawdown in the upper confined aquifer reached steady state conditions at the pumping rate of 1,130 gpm indicating the rate of recharge was equal to the rate of pumping.

- The water level in OW-1 at the end of pumping was 28 feet above the DNR's safe yield threshold. Based on the aquifer conditions observed during the test and assuming these do not change significantly, the upper confined aquifer can sustain a well pumping at the tested rate without breaching the DNR's 50% safe yield threshold;

- It appears the water table aquifer is not influenced by pumping the upper confined aquifer at 1,130 gpm in the area of the well field. Therefore, no significant impacts to the water table aquifer are anticipated over the long-term as a result of pumping the upper confined aquifer at this location;

- The drawdown observed outside of the well field area as a result of the Test Well pumping at 1,130 gpm is insignificant relative to the available head above the top of the upper confined aquifer. Therefore, interference to domestic wells and irrigators by a new well pumping at 1,130 gpm is not a concern;

- The irrigation wells west of the well field will influence the upper confined aquifer at the well field. Based on the minimal influence observed (~ 0.2 feet) in OW-1 during the test as a result of the two irrigators that operated for a short period during the test, the combined drawdown that will occur in a new production well from additional irrigators is not a concern;

- Chemistry results show the water table aquifer and the upper confined aquifer are chemically different, further supporting that significant mixing of groundwater between the two is not occurring;

- The reducing conditions in the upper confined aquifer indicate that denitrification may be occurring or would likely occur in the event that elevated nitrate concentrations reached this aquifer; and,

- The presence of tritium in the water table aquifer and the absence of tritium in the upper confined aquifer further support the ability of the upper confining layer in the well field and Study Area to impede downward flow of groundwater.

7.0 RECOMMENDATIONS

Based on the available data, results of this assessment, and the above conclusions, LBG believes the uppermost confined aquifer can be developed into a reliable source of higher-quality water for the City. LBG makes the following recommendations:

To: RD Offutt Company June 21, 2019

15357 US 71,

Park Rapids, MN 56470

Mr. Tim Nolte

26914 181st Ave

Sebeka, Mn 56477

Minnesota Valley Irrigation

602 Ash Ave Ne

Wadena, Mn 56482

From: 2019 Petitioner's Representative for EAW

Mike Tauber

2540 Co 41 Nw

Backus, MN 56435

Pursuant to Mn Rules 4410.1100 subp. 4, please consider this letter as notice given that a petition for an Environmental Assessment Worksheet is being filed with the Environmental Quality Board concerning RD Offutt Company's, Mr. Tim Nolte's, and Mn Valley Irrigation's continued potato field expansions using water appropriations, forest-to-field conversions and chemical applications in and around the Pineland Sands Area.

Thank you for your attention to this matter.

Respectfully,

Mike Tauber

"Continue to contaminate your bed and you will one night suffocate in your own waste."

-Chief Seattle

7,163 views | Dec 12, 2018, 09:00am

How Investing In Regenerative Agriculture Can Help Stem Climate Change Profitably

Devin Thorpe Contributor
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Investing in regenerative agriculture has the potential to address not only the food supply but also climate change, peace and conflict resolution and the water supply to boot. **This impact investing strategy could be the biggest lever for creating positive change available to investors today.** It also appears to generate healthy financial returns.

Craig Wichner, 49, founder and managing partner for Farmland LP, a fund manager that invests in converting conventional farmland to regenerative, organic farming. "It has so many benefits to the environment, to human society," he says. "But we're also demonstrating that you can grow a great, healthy, wonderful food and be more profitable than conventional agriculture systems."

Farmland LP acquires traditionally managed farmland, typically used to produce commodity crops and converts it to organic using regenerative practices. Wichner reports generating gross margins of 40 to 50% on wine grapes. Margins hover around single digits for conventionally-grown commodity crops, which is why the firm works to convert its farms to other crops. He notes that returns during the three-year organic conversion period are lower.

David LeZaks, 37, leads regenerative food systems projects for Delta Institute, a nonprofit that has worked to identify market-based solutions to environmental, social and economic problems for the past 20 years.

Watch the full interview with Wichner and LeZaks in the video player at the top of the article.

Craig Wichner CREDIT: FARMLAND LP

LeZaks, who holds a Ph.D. in Environmental Resources and collaborates with Farmland LP, describes his work this way: "I design disruptive infrastructure that positions us to unlock substantial capital flows into the regenerative agriculture sector."

"With the current system that focuses on growing more cheap food, we face a dire situation that intensifies the degradation of critical farmland," he says. "Recent

evidence demonstrates that by re-orienting capital and the institutions and people that move capital, we can reverse farmland degradation and build regenerative food systems that undo much of the damage that has been done over the past century."


David LeZaks CREDIT: DELTA INSTITUTE

Kari Cohen, projects branch chief for the Financial Assistance Programs Division at USDA's Natural Resources Conservation Service (NRCS), notes that Delta Institute was awarded a Conservation Innovation Grant in 2017 to help drive market-based solutions in resource conservation.

"The Delta Institute project, a part of this conservation finance cohort, is developing a regenerative agriculture investment toolkit," he says. "Regenerative agriculture is a farming system that goes beyond 'sustainable' and aims to improve natural resource conditions in conjunction with agricultural production."

Carbon and Climate Change

Wichner explains how farming contributes to climate change. "The current agriculture system, the chemical-based agriculture system, is really geared around growing these commodity crops planting annual crops year after year after year that essentially degrades and burn down the carbon in the soil and the nutrients in the soil."

In contrast, regenerative agriculture increases carbon sequestration in the soil. "When you switch to a slightly more complex form of agriculture you... actually find that you can increase the carbon in the soil, increase the overall health of the soil, increase its biological activity. It's not just dead soil anymore; it becomes nice and vital and you actually get increased crop production," he explains.

While Farmland LP focuses on converting farms from commodity crops to higher value products, the principles of regenerative agriculture can be applied to

commodity crops, too. LeZaks notes, "As an example, in a study published last year (attached) that looked at “conventional” compared to “regenerative” corn production, the farms in the study yielded less, but were more profitable."

Peace and Conflict Resolution

Scarce resources contribute to the risk of conflict. Traditional agricultural practices contribute to desertification, according to Johanna Walderdorff, vice president of Growth for Peace Organization. “The loss of habitable land will force people to relocate in search for more fruitful land. As they move towards vegetated areas, there are usually people who already own that particular land,” she says. The movement of people can lead to conflicts.

Regenerative agriculture helps to fight desertification and can help to keep people on their traditional land. “Working on the soil is the first step, and therefore the baseline for us to work with nature, anything else comes after. This is what regenerative agriculture does,” she adds.

Water Supply

Unhealthy soil requires more water to produce the same amount of food. Healthy soil, in contrast, resulting from regenerative agricultural practices holds more water and requires less be added.

Furthermore, all organic agriculture omits the use of chemical fertilizers and pesticides, eliminating any risk—however small—of excess fertilizers contaminating rivers or of pesticides or herbicides fouling drinking water.

As a side note, the report LeZaks cited above also showed that regenerative, insecticide-free farms that "proactively design pest-resilient food systems" have one-tenth the observed number of pests as the insecticide-treated crops on conventional farms.

Financial Returns

Ricardo J. Salvador, director and senior scientist, food & environment program at the Union of Concerned Scientists, says he grew up using regenerative

agricultural practices. It was the way his family in southern Mexico traditionally farmed. He didn't learn another approach until he got to college at New Mexico State University in 1976.

He explains how Farmland LP generates financial returns from his perspective as a soil scientist.

> "Their business model is predicated on improving the value of the asset they manage for their investors. It was unique at the time they started to interpret this as improving the quality of soil (organic matter content, fertility, water holding capacity, biodiversity.) A recent study demonstrates that inside of a decade of taking over management of their properties all of these characteristics (and several others measuring total system productivity, resilience and profitability) improved markedly. From study of this report, observation of their evolving business, and direct conversations with their technical staff, it is clear to me that they are superb agronomic managers.

The USDA's Cohen explains how LeZaks' work at Delta Institute contributes to financial returns. "The Delta Institute's project is designed to increase investment in regenerative agriculture. Regenerative agriculture systems have the potential to increase financial returns to landowners and investors through higher yields, more resilient operations, certification marketing, and the sale of ecosystem services credits such as carbon credits."

Mark Gogolewski, the CEO of Realization Films, is an investor in Farmland LP, which has a total of $160 million under management, including 15,000 acres of farmland. He says, "They have significantly raised the value of all of the acquisitions."

He notes, however, that he gets satisfaction from seeing the land converted to a regenerative approach. "Farmland has found a recipe for success that also delivers real good. How often do you get to say that?"

"I was looking at farmland because I believe in owning real assets. I had and have a strong belief that farming remains as one of the most important assets in our

country and our world," Gogolewski notes. "Plus, these assets can and should be managed far, far better for both optimizing economic activity, while being a strong steward to the long-term value of this key environmental asset."

Growth for Peace Organization's Walderdorff argues for changing our perspective. "We speak of trees because they are high, we talk about rising ocean levels because it's visual, but desertification has been gradual, and the microorganisms are underneath the soil, and thus have been ignored. Our survival depends on the survival of the smallest organisms on the planet. "

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Devin Thorpe Contributor

Deeply optimistic, I'm an author, educator and speaker; I call myself a champion of social good. Through my work, I hope to help solve some of the world's biggest proble... **Read More**