## #8 Golden Grain Energy - Mason City Ethanol Plant Energy and Water Usage vs. Cities within a 10 mile radius

	ol Plant without CO <sub>2</sub> Capture		*****	**2022	
No.	Ethanol Plant/ Town	Population	**Water Permit Value MGY	**2023 Water Usage MGY	Comments
Ethan	ol Plant - Near Mason City, Iowa		-	=	
	Golden Grain Energy - Mason City Plant		683.0	405.0	Without CO <sub>2</sub> capture water requirement
	Combined Towns All Water Usage		776.7	776.7	City residential use assumes 70 gal./person/day
1	Portland	50	1.28	1.28	Water usage too small to require a permi
2	Rock Falls	150	3.83	3.83	Water usage too small to require a permit
3	Rudd	358	9.15	9.15	
4	Plymouth	375	9.58	9.58	
5	Rockford	758	19.37	19.37	
6	Nora Springs	1,369	34.98	34.98	
7	Mason City	27,338	698.49	698.49	
	Percentage of ethanol plant usage of total water usage	30,398	46.8%	34.3%	
Concl	usion: Without CO2 Capture				
	This ethanol plant consumes 34% of the water used by the within the surrounding 10 mile radius (314 square miles).	cities and plant			

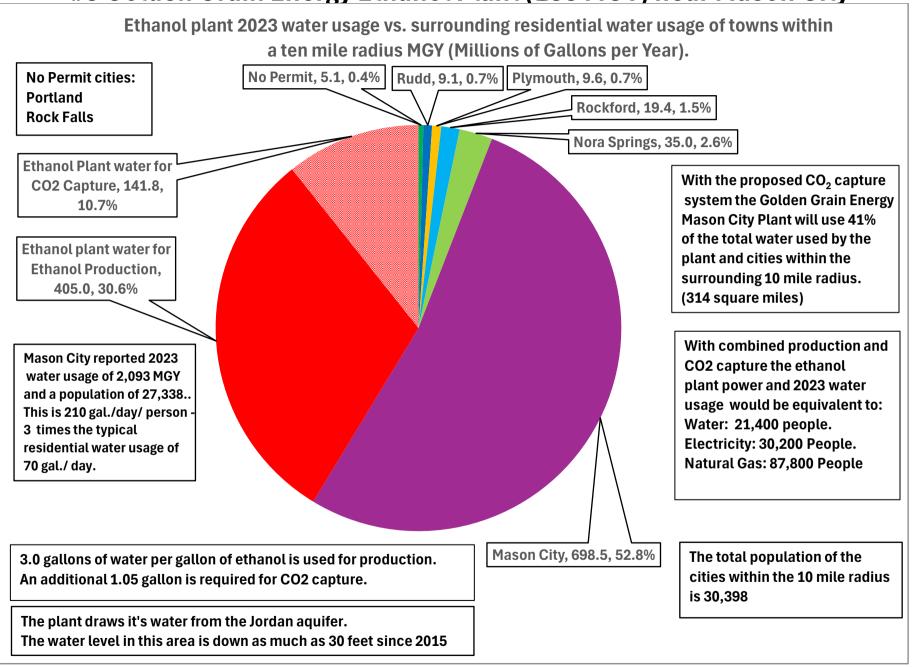
## #8 Golden Grain Energy - Mason City Ethanol Plant Energy and Water Usage vs. Cities within a 10 mile radius

1         Portland         50         1.3         1.3         0.10%         Water usage too small to require a perm           2         Rock Falls         150         3.8         3.8         0.29%         Water usage too small to require a perm           No Permit         200         5.1         5.1         0.4%           Rudd         358         9.1         9.1         0.7%           Plymouth         375         9.6         9.6         0.7%           Rockford         758         19.4         19.4         1.5%           Rockford         758         19.4         19.4         1.5%           Mason City         27338         698.5         698.5         52.8%           Ethanol plant water for Ethanol Production         683.0         405.0         30.6%         Without CO2 Capture water requirement	Ethan	ol Plant with CO <sub>2</sub> Capture					
Portland   So	No.	Ethanol Plant/ Town	Population	Permit Value	Water Usage	Water Usage	Comments
Rock Falls   150   3.8   3.8   0.29%   Water usage too small to require a perm   No Permit   200   5.1   5.1   0.4%	Ethan	ol Plant - Near Mason City, Iowa	-	-	-	-	City residential use assumes 70 gal./person/day
No Permit   200   5.1   5.1   0.4%	1	Portland	50	1.3	1.3	0.10%	Water usage too small to require a permit
Rudd   358   9.1   9.1   0.7%	2	Rock Falls	150	3.8	3.8	0.29%	Water usage too small to require a permit
4 Plymouth 375 9.6 9.6 0.7%  5 Rockford 758 19.4 19.4 1.5%  6 Nora Springs 1369 35.0 35.0 2.6%  7 Mason City 27338 698.5 52.8%  8 Ethanol plant water for Ethanol Production 683.0 405.0 3.6% Without CO2 Capture water requirement 9 Ethanol Plant water for CO2 Capture 141.8 141.8 10.7% Additional CO2 Capture water requirement 141.8 10.7% Additional CO2 Capture water requirement 141.8 10.7% Additional CO2 Capture water requirement 141.8 10.7% Additional CO3 Capture water requirement 141.8 10.7% Additional CO		No Permit	200	5.1	5.1	0.4%	
Solution	3	Rudd	358	9.1	9.1	0.7%	
Solution	4	Plymouth	375	9.6	9.6	0.7%	
Nora Springs   1369   35.0   35.0   2.6%				19.4	19.4	1.5%	
Mason City   27338   698.5   52.8%	6	Nora Springs	1369	35.0	35.0		
8 Ethanol plant water for Ethanol Production 9 Ethanol Plant water for CO <sub>2</sub> Capture 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement 141.8 141.8 10.7% Additional CO <sub>2</sub> Capture water requirement for CO <sub>2</sub> Capture value used to cities and plant water value water value water value water requirement for towns and Ethanol plant - MGY 1328.5 Total water requirement for towns and Ethanol plant - MGY 1328.5 Total water requirement for towns and Ethanol plant - MGY 1328.5 Total water requirement for ethanol plant - MGY 1328.5 Total water value water v	7		27338	698.5	698.5	52.8%	
9 Ethanol Plant water for CO <sub>2</sub> Capture  Total Plant and Towns 30,398 1601.4 1323.4 100.0%  Percentage of ethanol plant usage of total water usage 51.5% 41.3%  Conclusion: With CO2 Capture  This ethanol plant consumes 41% of the water used by the cities and plant within the surrounding 10 mile radius (314 square miles)  *Ethanol Production Capacity of Plant - MGY Factor: Water required to cool and compress the CO <sub>2</sub> for capture - MGY Water/ MGY Ethanol Calculate additional water required for CO <sub>2</sub> Capture - MGY 11.75 Calculate ratio of gallons of water/ gallons of Ethanol 3.0 Total water requirement of towns and Ethanol plant - MGY 781.8 Total water requirement of towns - MGY Ratio of ethanol plant water use vs. surrounding area 0.70 Percentage of ethanol plant usage of total water usage 41.2%	8			683.0	405.0	30.6%	Without CO2 Capture water requirement
Total Plant and Towns 30,398 1601.4 1323.4 100.0%  Percentage of ethanol plant usage of total water usage 51.5% 41.3%  Conclusion: With CO2 Capture  This ethanol plant consumes 41% of the water used by the cities and plant within the surrounding 10 mile radius (314 square miles)  *Ethanol Production Capacity of Plant - MGY 135  Factor: Water required to cool and compress the CO <sub>2</sub> for capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO <sub>2</sub> Capture - MGY 141.75  Calculate ratio of gallons of water/ gallons of Ethanol 3.0  Total water requirement of towns and Ethanol plant - MGY 1328.5  Total water requirement of towns - MGY 781.8  Total water requirement for ethanol plant - MGY 546.8  Ratio of ethanol plant water use ws. surrounding area 0.70  Percentage of ethanol plant usage of total water usage 41.2%	9	,		141.8			Additional CO <sub>2</sub> Capture water requirement
Percentage of ethanol plant usage of total water usage  Conclusion: With CO2 Capture  This ethanol plant consumes 41% of the water used by the cities and plant within the surrounding 10 mile radius (314 square miles)  *Ethanol Production Capacity of Plant - MGY  Factor: Water required to cool and compress the CO2 for capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO2 Capture - MGY  Calculate ratio of gallons of water/ gallons of Ethanol  Total water requirement of towns and Ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Ratio of ethanol plant water use vs. surrounding area  Percentage of ethanol plant usage of total water usage  41.2%		Total Plant and Towns	30 398	1601 4	1323 4	100.0%	<u> </u>
Conclusion: With CO2 Capture  This ethanol plant consumes 41% of the water used by the cities and plant within the surrounding 10 mile radius (314 square miles)  *Ethanol Production Capacity of Plant - MGY  Factor: Water required to cool and compress the CO <sub>2</sub> for capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO <sub>2</sub> Capture - MGY  Calculate ratio of gallons of water/ gallons of Ethanol  Total water requirement of towns and Ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Ratio of ethanol plant water use vs. surrounding area  Percentage of ethanol plant usage of total water usage  41.2%	· ·					100.070	
Factor: Water required to cool and compress the CO <sub>2</sub> for capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO <sub>2</sub> Capture - MGY  Calculate ratio of gallons of water/ gallons of Ethanol  Total water requirement of towns and Ethanol plant - MGY  Total water requirement of towns - MGY  Total water requirement for ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requi	Concl	This ethanol plant consumes 41% of the water used by th	e cities and plant				
Factor: Water required to cool and compress the CO <sub>2</sub> for capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO <sub>2</sub> Capture - MGY  Calculate ratio of gallons of water/ gallons of Ethanol  Total water requirement of towns and Ethanol plant - MGY  Total water requirement of towns - MGY  Total water requirement for ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Substitute of towns - MGY  Total water requirement for ethanol plant - MGY  Percentage of ethanol plant water usage of total water usage  41.2%							
capture - MGY Water/ MGY Ethanol  Calculate additional water required for CO <sub>2</sub> Capture - MGY  141.75  Calculate ratio of gallons of water/ gallons of Ethanol  Total water requirement of towns and Ethanol plant - MGY  Total water requirement of towns - MGY  Total water requirement for ethanol plant - MGY  Ratio of ethanol plant water use vs. surrounding area  Percentage of ethanol plant usage of total water usage  1.05  141.75  1328.5  701  141.75  1	*Etha	nol Production Capacity of Plant - MGY	135				
Calculate ratio of gallons of water/ gallons of Ethanol 3.0  Total water requirement of towns and Ethanol plant - MGY 1328.5  Total water requirement of towns - MGY 781.8  Total water requirement for ethanol plant - MGY 546.8  Ratio of ethanol plant water use vs. surrounding area 0.70  Percentage of ethanol plant usage of total water usage 41.2%		·	1.05				
Total water requirement of towns and Ethanol plant - MGY  Total water requirement of towns - MGY  Total water requirement for ethanol plant - MGY  Total water requirement for ethanol plant - MGY  Substituting the state of the	Calcul	Calculate additional water required for CO <sub>2</sub> Capture - MGY 141.75					
Total water requirement of towns - MGY  Total water requirement for ethanol plant - MGY  Ratio of ethanol plant water use vs. surrounding area  Percentage of ethanol plant usage of total water usage  41.2%	Calculate ratio of gallons of water/ gallons of Ethanol						
Total water requirement for ethanol plant - MGY 546.8  Ratio of ethanol plant water use vs. surrounding area 0.70  Percentage of ethanol plant usage of total water usage 41.2%							
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Total Population within the 10 mile radius 30,398							
	Total	Population within the 10 mile radius	30,398				

## #8 Golden Grain Energy - Mason City Ethanol Plant Energy and Water Usage vs. Cities within a 10 mile radius

Water Use				
Typical water use per person per day - Gallons/ person/ day	70			
Equivalent # of people ethanol plant water use w/o CO2 capture	15,851			
Equivalent # of people ethanol plant water use w/ CO2 capture	21,399			
Electricity Use				
Electricity to produce Ethanol - kWh/ gallon EtOH for production	0.6			
Total Electricity used to produce ethanol - kWh	81,000,000			
Electrical use to capture CO2 - kWh/ gallon EtOH	0.377			
Total Electricity used to capture CO2 - kWh	50,895,000			
Total electricity to produce ethanol and capture CO2 - kWh	1.319E+08			
Typical electrical use/ residence - kWh/year	10,476.0			
Equivalent number of residences	12,590.2			
Number of people / residence	2.4			
Equivalent number of people	30,216			
Natural Gas Use				
Natural gas use per gallon of ethanol for production - BTU's/ gal.	26,000			
Natural gas use for ethanol plant - BTU's	3.510E+12			
Natural gas use per gal. of ethanol for CO2 capture - BTU's/ gal.	0			
Typical Natural Gas use/ residence - BTU's/ year	96,000,000			
Equivalent number of residences	36,563			
Number of people / residence	2.4			
Equivalent number of people	87,750			
* Ethanol Capacity per Iowa Renewable Fuels Association	** Water usage pe	r the greater of D	NR WACOP P	ermit or 3 times e

## #8 Golden Grain Energy Ethanol Plant (135 MGY) near Mason City



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