

July 10, 2013

MEMORANDUM

FROM: John Tindall, P.E., Engineering Manager
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SUBJECT: **Southside Water and Sewer District, Wastewater-Reuse Permit Modification Application Review -- LA-000053-03 (Municipal Wastewater)**, Major Permit Modification Staff Analysis

1.0 Purpose

This Staff Analysis Memorandum provides the technical evaluation of the Southside Water and Sewer District's (SWSD) request to add 6.9 acres of irrigated acreage and recommends modifications to the existing reuse permit (LA-000053-03) issued July 10, 2009. The new acreage is within the fenced area currently being irrigated and permitted.

SWSD's consultant, J-U-B Engineers, submitted a report to the Idaho Department of Environmental Quality (DEQ) on April 15, 2013 titled "Southside Water and Sewer District, Reuse Permit Modification, April 2013" which contains the technical information for this request. The Idaho Recycled Water Rules require a permit modification when acreage used for irrigation is added (IDAPA 58.01.17.700.03).

Most of the existing permit conditions and limits will apply to the new acreage. New permit limits will be developed for hydraulic and nutrient loading rates and buffer distances for the new areas.

1.1 Summary of Current Conditions

The DEQ Staff Analysis dated June 10, 2009 (see memo from Jen Cole to Steve Tanner) and amended Staff Analysis dated July 10, 2009 (see memo from John Tindall to Steve Tanner) continue to provide the basis for the existing system. The current permit allows SWSD to irrigate 26.7 acres of an alfalfa/grass mixture from April to October. The permit expires on July 10, 2014 and work is beginning on a complete renewal of the permit.

SWSD has had no major compliance issues since 2009 based on the reviews of the annual reports. There have been months when the hydraulic loading rates exceeded the permitted loading rates but the over-all seasonal irrigation rates have been less than the permitted rate. For instance in June 2011 and 2012, the irrigation rates were about 10% and 25%, respectively, more than the monthly permit limit rates. The October 2012 irrigation rate was 217% higher than permit limit but this was approved by DEQ based on below average precipitation in August and September 2012. Ground water monitoring data since 2005 has shown a trend of higher downgradient chloride and nitrate concentrations. The statistical significance of these trends

relative to compliance with the Idaho Ground Water Quality Rule and any relationship to hydraulic loading rates will need to be examined during the permit renewal process. SWSD has either complied with or is scheduled to comply with all the compliance activities included in the permit.

Irrigation on the additional acreage will help reduce the hydraulic loading rates and could reduce the ground water chloride and nitrate concentrations if excessive hydraulic loading rates are contributing to the higher downgradient concentrations. SWSD installed the irrigation system to irrigate the new acreage in 2012.

The section numbering in this memo is the same as the numbering used in the 2009 Staff Analyses. This permit modification requires changes to the following sections:

- 4.2 Hydraulic Management Unit Configuration
- 4.3.2.1 Hydraulic Loading Rates
- 4.3.2.6 Coliform Disinfection Requirements
- 4.4 Ground Water
- 4.5 Soils Characterization
- 5.2 Loading Rate Related Recommendations
- 5.3 Hydraulic Management Unit (HMU) Recommendations

The 2009 Staff Analysis does not include a section on soil monitoring recommendations and this section will be added in this Staff Analysis:

- 5.4 Soil Monitoring Recommendations

4.2 Hydraulic Management Unit Configuration

Currently, the irrigation site consists of one hydraulic management unit (HMU), HMU-005301 covering 26.7 acres. SWSD has requested that an additional 6.9 acres be permitted within the current fenced irrigation site (see Figure 1). SWSD has extended the existing irrigation to cover the new areas as follows:

1. 0.6 acres - added to HMU-005301 - alfalfa/grass fodder field – manually set hand-line irrigation with impact sprinklers;
2. 4.4 acres – new HMU-005302 – mature conifer forest - manually set hand-line irrigation with impact sprinklers; and
3. 1.9 acres – new HMU-005303 – conifer seedlings - manually set hand-line irrigation with impact sprinklers.

SWSD will need to account for the different irrigation rates of the hand-line and center pivot when calculating the hydraulic loading rate for HMU-005301.

The north portion of the proposed HMU-005302 (0.75 acres) is currently not vegetated and should not be permitted for irrigation.

4.3.2.1 Hydraulic Loading Rates

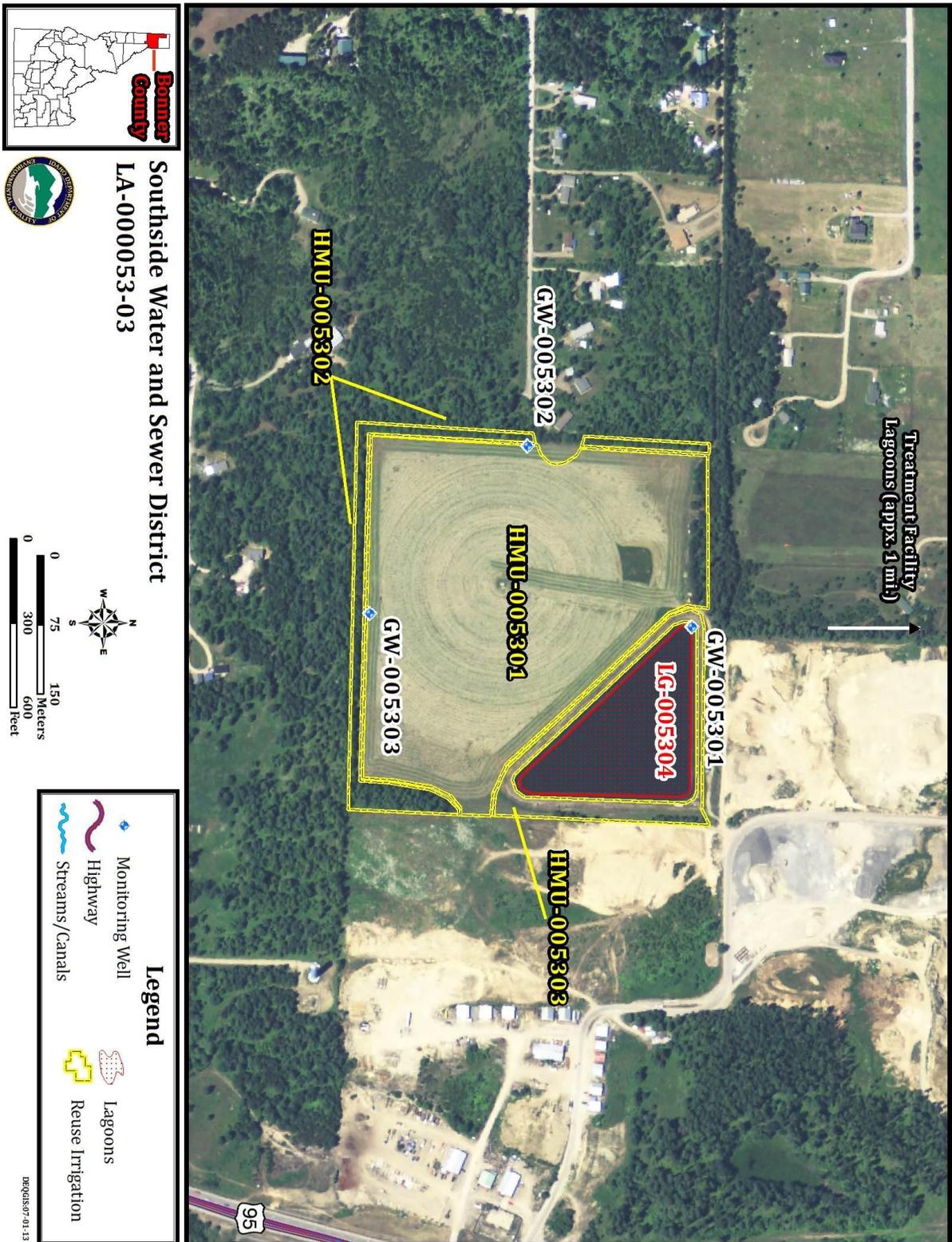
4.3.2.1.1 Alfalfa/Grass Fodder Crop (HMU-005301)

No change from current permitted irrigation rates. Refer to Section 5.2 of this document for the revised hydraulic loading rate recommendations.

4.3.2.1.2 Mature Conifer Forest (HMU-005302)

No irrigation can occur in areas of this HMU where there are no trees growing. The northern portion of this HMU (0.8 acres of the 4.4 acres) will require tree planting and irrigation should not occur in this area until trees have been planted. This area could be included in the renewed permit in 2014 if trees have been planted.

Figure 1



Using the approach for calculating the mean irrigation water requirements (IWR) for native conifer forests recommended in the DEQ document titled “Guidance for Forested/Poplar Site Nutrient and Hydraulic Loading”, the proposed native conifer forested area mean precipitation deficit and IWR are as follows based on photos of the forested areas included in the technical report submitted with the permit modification request (SWSD, 2013) and an assumption that the site has an 80% canopy density and no appreciable understory (see Tables 4.1 and 4.2):

Table 4.1 Precipitation Deficit (P_{def}) Data*

Month	Orchards Precipitation Deficit (P_{def}) Data		Corrected for Canopy Density ($0.89 * P_{def}$)		IWR (75% irrg. eff.)
	mm/day	in/month	mm/day	in/month	in/month
January	-0.35	-0.43	-0.31	-0.38	
February	0.09	0.10	0.08	0.10	
March	0.40	0.49	0.36	0.43	
April	0.83	0.98	0.74	0.90	1.20
May	1.54	1.88	1.37	1.67	2.23
June	4.75	5.61	4.23	5.16	6.88
July	8.78	10.72	7.81	9.54	12.72
August	7.97	9.73	7.09	8.66	11.54
September	4.54	5.36	4.04	4.93	6.58
October	0.81	0.99	0.72	0.88	1.17
November	-2.18	-2.57	-1.94	-2.37	
December	-1.48	-1.81	-1.32	-1.61	
				Total	42.32 inches

*Based on mean data from <http://data.kimberly.uidaho.edu/ETIdaho/stninfo.py?station=108137> for Orchard (no cover) and 75% irrigation efficiency. Precipitation deficit was adjusted for an irrigated crop. Sandpoint KSPT weather station data in ET Idaho 2012 is calculated based on no irrigation provided (only precipitation). Rick Allen with the Kimberly Research and Extension Center of the University of Idaho recommended the method to convert precipitation deficit data for a crop from “non-irrigated” weather station data to the precipitation deficit for an irrigated crop by subtracting the ET potential from the ET actual and adding this quantity to the precipitation deficit data for the crop.

Table 4.2 Irrigation Water Requirements (IWR) of Native Conifer Forest (inches/acre)

Month	IWR (inches/acre)
April	1.20
May	2.23
June	6.88
July	12.72
August	11.54
September	6.58
October	1.17
Total	42.32

Refer to Section 5.2 of this document for revised hydraulic loading rate recommendations.

4.3.2.1.3 Conifer Seedlings (HMU-005303)

SWSD proposes to irrigate the acreage where the conifer seedlings are planted at rate of 16 gallons per acre per day over the growing season from April to October (153 irrigation days). This rate is equivalent to 2,450 gallons per acre (0.09 inches) over the irrigation season or 4,651 gallons over the 1.9 acre HMU. SWSD's goal for first few years will be to irrigate only enough to keep the seedlings alive. These irrigation rates were recommended by Ralph Wheeler of Idaho Panhandle Forestry who prepared a report for SWSD dated January 28, 2013 on the seedlings (SWSD, 2013).

Refer to Section 5.2 of this document for revised hydraulic loading rate recommendations.

4.3.2.2 Nitrogen Management and Loading Rates

The only change to the permit will be nitrogen loading rate limits for the forested sites (HMU-005302 and HMU-005303).

4.3.2.2.1 Mature Conifer Forest (HMU-005302)

Approximately 20% of the tree canopy is open based on photos of the forested site (SWSD, 2013). Using the draft DEQ document titled "Guidance for Forests/Poplar Site Nutrient and Hydraulic Loading, July 2012" to estimate the maximum nitrogen loading rate, 131 lbs.N/acre-year was calculated as shown below.

Calculation of the net N requirement for the native conifer forest (HMU 9) (DEQ, 2012);

Equation 1
$$N_{rate} = \frac{(N_{uptake} - N_{cr})}{(1 - N_{loss})} = \frac{N_{req}}{(e_f)}$$

where:

N_{rate} = Nitrogen (N) loading rate

N_{loss} = N losses from denitrification and volatilization

e_f = uptake efficiency factor (1 - N_{loss})

N_{uptake} = N net uptake

N_{cr} = N credits

$N_{req} = N_{uptake} - N_{cr}$ = N net requirement

$$N_{rate} = \frac{(N_{uptake} - N_{cr})}{(1 - N_{loss})}$$

Nutrient Uptake Calculations

Condition	Value (DEQ, 2012)
Assume similar to Douglas-fir juvenile plantation, < 25 years old; Forest canopy covers 80% of the site	88 lbs./ac N uptake
Sparse understory (0-10% coverage)	0 lbs./ac N uptake
Denitrification/volatilization rate	33%
Assume no appreciable change in soil storage from initial time of recycled water application to the end of permit cycle ($N_{cr} = 0$).	0 lbs. N/ac credit

The values are then substituted into Equation 1 to calculate the estimated nitrogen loading rate:

$$N_{rate} = \frac{[(88 + 0) - 0]}{(1 - 0.33)} = 131 \text{ lbs. N/acre/year}$$

Total nitrogen concentration in the irrigated water is typically less than 10 mg/L. At the estimated hydraulic loading rate of 42 inches/acre/year, the total nitrogen loading rate on the forested acreage would be about 95 lbs.N/acre/year.

4.3.2.2.2 Conifer Seedlings (HMU-005303)

At the proposed annual volume to be irrigated on the seedlings (4,651 gallons) over the irrigation season and a total nitrogen concentration in the irrigation water of 10 mg/L, the total nitrogen loading rate for this HMU will be 0.20 lbs.N/acre/year. The supplemental nitrogen requirements for the seedlings will also be minimal for a few years.

4.3.2.6 Coliform Disinfection Requirements

The disinfection requirements and buffer distances are proposed to remain the same as follows (see Table 4.3):

Table 4.3 Recommended Buffer Zones and Disinfection Requirements

Buffer Zone Distances (based on sprinkler irrigation)	Disinfection Level* (total coliform)	Distance to Public Access	Distances to Inhabited Dwellings	Distance to streams	Distance to private water sources	Distance to public water sources	Single sample maximum total coliform level
	2.2 /100 ml	0 feet	100 feet	100 feet	500	1000	23/100 ml

*Compliance determination method for disinfection requirements is as follows:

For determining compliance with the 2.2 / 100 ml disinfection level, the median value of the last five (5) results must not exceed 2.2 / 100 ml. In addition, no single sample value shall exceed 23 / 100 ml.

The home on the west side of the irrigation site will require a 100 foot buffer which is shown on Figure 1 in how the HMUs are configured.

4.4 Ground Water

The three (3) existing monitoring wells that are listed in the current permit will continue to be used. As shown in Figure 1 on pg. 3, the west and south monitoring wells are now in the new HMU-005302 and the north well is in HMU-005303. A buffer radius around the wells will need to be maintained where no irrigation occurs to prevent contamination of the wells. The wells are constructed with surface seals to prevent contamination along the well casing.

4.5 Soils Characterization

The existing permit requires annual soil monitoring of the fodder crop field (HMU-005301). Annual soil monitoring of the two (2) new HMUs would be appropriate to characterize the impacts from irrigation.

5.2 Loading Rate Related Recommendations

5.2.1 Alfalfa/Grass Fodder Crop (HMU-005301)

It is recommended that hydraulic loading limits be established based on average irrigation water requirements (IWR) for the specific crops which is the same approach as used in the 2009 permit. The approved cropping plan for the site includes rotation of alfalfa and a timothy/grass hay mixture. Due to the fact that during the permit period, two types of crops will be cultivated, it is recommended that the hydraulic loading limit reflect the IWR of each of the crops. SWSD will need to evaluate the percentage of each crop to arrive at a proportionately composited IWR. Tables 5.1 and 5.2 include the recommended hydraulic loading limits based on IWR by month for each crop in the single, 27.3 acre HMU based an irrigation efficiency of 78%. Refer to Section 4.3.2.1 of this document for the assumptions and methodology used for calculating IWR for this site.

Table 5.1. Recommended monthly hydraulic loading limits for alfalfa (frequent cuttings) – HMU-005301.

Month	IWR (Inches)	Monthly Volume irrigating 27.3 Acres (Million Gallons)
April	1.94	1.44
May	5.10	3.78
June	5.20	3.85
July	8.22	6.09
August	7.53	5.58
September	4.20	3.11
October	0.56	0.42
Total	32.75	24.27

Table 5.2. Recommended monthly hydraulic loading limits for timothy grass/ hay – HMU-005301.

Month	IWR (Inches)	Monthly Volume irrigating 27.3 Acres (Million Gallons)
April	1.31	0.97
May	4.05	3.00
June	6.25	4.63
July	8.19	6.07
August	6.66	4.94
September	4.29	3.18
October	0.38	0.28
Total	31.13	23.07

It is recommended that the total nitrogen loading rate limit will continue to be 150% of crop uptake based on actual crop yield and no phosphorous loading rate limit, as covered in the existing permit.

5.2.2 Mature Conifer Forest (HMU-005302)

It is recommended that hydraulic loading limits for the conifer forest be established based on average irrigation water requirements (IWR) for an orchard as discussed in Section 4.3.2.1.2.

The proposed hydraulic loading rate limits are shown in Table 5.3 for the 3.6 acres of mature trees. This excludes the approximately 0.8 acres of area on the north perimeter of the site that currently has very few trees and should not be irrigated until revegetation has occurred.

Table 5.3

Month	IWR (inches)	Monthly Volume irrigating 3.6 Acres (Million Gallons)
April	1.20	0.12
May	2.23	0.22
June	6.88	0.67
July	12.72	1.24
August	11.54	1.13
September	6.58	0.64
October	1.17	0.11
Total	42.32	4.13

It is recommended that the total nitrogen loading rate limit be 131 lbs.N/acre/year, as discussed in Section 4.3.2.2.1 and no phosphorous loading rate limit.

5.2.3 Conifer Seedlings (HMU-005303)

It is recommended that hydraulic loading limits for the conifer seedlings be established based on the recommends of Ralph Wheeler of Idaho Panhandle Forestry as discussed in Section 4.3.2.1.3. The proposed hydraulic loading rate limits are shown in Table 5.4 for the 1.9 acres of conifer seedlings:

Table 5.4

Months	IWR (inches)	Volume irrigating 1.9 Acres (Gallons)
April - October	0.09	5,000

Additionally, the limit will allow for greater than these hydraulic loading limits to keep the seedlings alive. SWSD will need to justify exceeding these rates.

It is recommended that there be no total nitrogen loading limit for the conifer seedlings because the estimated nitrogen applied (see Section 4.3.2.2.2 of this document) will be negligible with the proposed hydraulic loading rate limit. Annual reporting of the nitrogen loading will still be required. No phosphorous loading rate limit is proposed.

5.3 Hydraulic Management Unit (HMU) Recommendations

It is recommended that the following acreage be permitted for irrigation:

1. HMU-005301 acreage increased by 0.6 acres to a total of entire 27.3 acres
2. Add HMU-005302 – 3.6 acres of mature conifer forest
3. Add HMU-005303 – 1.9 acres of conifer seedlings

5.3.1 Hydraulic Management Unit Compliance Determination Recommendations

It is recommended that compliance with the permitted hydraulic loading rates be based on actual acreage irrigated. It is recommended that permitted nitrogen loading rates be based on the actual crop yields for the fodder crop and literature recommendations for the conifers.

5.4 Soil Monitoring Recommendations

It is recommended that two (2) new soil monitoring units be added for monitoring soil in the new HMUs. The sampling frequency should be the same as the current permit requirement which is annually and the monitored parameters should be the same (electrical conductivity, nitrate-N, ammonium-N and pH).

6.0 References

“Guidance for the Reclamation and Reuse of Municipal and Industrial Wastewater.” Published by Idaho DEQ at: http://www.deq.idaho.gov/water/permits_forms/permitting/guidance.cfm.

Southside W&S District (SWSD), “Reuse Permit Modification, April 2013”, JUB Engineers.

Southside W&S District, 2009-2012 Reuse Permit Annual Reports.

DEQ Staff Analysis for Southside W&S District, Permit #LA-000053-03, June 10, 2009.

DEQ Staff Analysis for Southside W&S District, Permit #LA-000053-03, July 10, 2009.