

November 1, 2011

MEMORANDUM

TO: R. Todd Crutcher, P.E.
Engineering Manager, Boise Regional Office

FROM: Valerie Greear, P.E.
Boise Regional Office

SUBJECT: **Staff Analysis of the City of Greenleaf (Canyon)
Draft Wastewater Reuse Permit LA-000225-01 (Municipal Wastewater)**

1.0 Purpose

The purpose of this memorandum is to present the basis for the requirements included in the draft Wastewater Reuse Permit No. LA-000225-01 (WRP) for the municipal wastewater treatment and reuse system owned and operated by the City of Greenleaf, and to satisfy the requirements of the *Recycled Water Rules* (Rules), IDAPA 58.01.17.400.05, for issuing wastewater reuse permits.

The permit application prepared by HyQual, P.A., SPF Water Engineering, and Civil Dynamics, and other submittals related to the project were used to develop the draft WRP No. LA-000225-01, which is hereby being released for a 30-day review and comment period. After the public review period is closed, DEQ will provide written responses to all relevant comments and prepare a final permit for the wastewater reuse facilities for the City of Greenleaf.

2.0 Summary of Events

The Department of Environmental Quality (DEQ) received an application from the City of Greenleaf, hereafter referred to as the City or permittee, for a WRP on November 23, 2010. The application was determined to be complete on December 23, 2010, and a preliminary decision to prepare a draft permit was disclosed in a letter sent to the permittee on January 22, 2011. Concurrently, the City completed plans and specifications for, and received approval to construct, a wastewater treatment plant and wastewater collection system, funded through a State Revolving Fund (SRF) loan managed by DEQ. The City is also pursuing a National Pollutant Discharge Elimination System (NPDES) permit to allow the discharging of wastewater to the West End Drain during the non-growing season. The City is requesting a WRP that will allow them to utilize slow rate land application during the summer months.

The City entered into a Consent Order agreement with DEQ on May 1, 2003, and an Amended Consent Order on June 8, 2006. The Consent Orders were the result of a failing large soil adsorption system and a deteriorated collection system. The Amended Consent Order required that the City have completed design approval, received bids, awarded bids, and issued a notice to proceed for construction of a system that would replace the drain field and repair or replace the collection system within four (4) years of the effective date of the Amended Consent Order, and within seven (7) years of that date they would cease using the drain field and have a repaired or replaced collection system. The City has begun construction on the Wastewater Treatment Plant (WWTP), and the collection system is essentially complete, although the service lines won't be connected until the WWTP is operational. It is anticipated that the WWTP will be operational by the summer of 2012.

3.0 Site and Process Description

The City purchased a 70.07 acre site located northeast of the City, and is proposing to utilize a portion of the land for Class B wastewater reuse. A 16.2 acre center pivot, referred to as the South Field, and 26.2 acres for level basins, referred to as the North Field, are proposed to be used for irrigation with recycled water. The application also discusses future drip irrigation of poplar trees on 12 acres located on the north side of the South Field, but this would not occur during the five year permit term of the proposed permit, and was not included at this time. Refer to Attachment A to this document for a general layout of the treatment facilities.

The City received DEQ approval of the plans and specifications for a WWTP in April, 2011, and anticipates construction to last through the spring of 2012. Treatment will include screening, oxidation ditches, secondary clarification, tertiary treatment sand filtration, and disinfection using chlorination. Recycled water can then be transmitted directly to either reuse site (the center pivot or the level basins), or can be stored in a 680,000 gallon equalization/storage lagoon.

The City is anticipating that their NPDES permit will contain a phosphorus concentration limit of 0.07 mg/L for discharges from May through September. To avoid having to treat wastewater to the level required to meet these limits, the City intends to reuse wastewater effluent during these months and utilize the discharge permit during the non-growing season only.

With the exception of April and October, the Irrigation Water Requirement (IWR) of the crop(s) grown will exceed the amount of recycled water produced. Therefore, supplemental irrigation water is required in order to ensure that healthy crops are grown. Water from sources bordering the site is available for use; Wilder Irrigation District (Wilder ID) will be used on the South Field, and water from the West End Drain will be utilized on the North Field.

An allowance for the application of Class C recycled water to the level basins is included in the draft WRP. This allowance is included in the case that off-specification water is generated, e.g. Class B turbidity or chlorination requirements are not met and effluent cannot be retreated and must be discharged. The wastewater lagoon can also be used to store off-specification wastewater in an emergency, but if this were to happen then all of the water being stored in the lagoon would no longer be considered Class B water. To avoid this situation, the level basins can be utilized as long as the water meets at least Class C disinfection standards (see Section 5.3 of this document).

Solids management is not discussed in the permit application, but if the permittee ever desires to land apply sludge or other solids, a Waste Solids Management plan is required prior to application.

The anticipated existing and design flow rates are shown in Table 1.

Table 1: Existing and Design Flow Rates in Million Gallons per Day (MGD)

| Parameters | Existing | Design¹ |
|---------------------------|-----------------|---------------------------|
| Average Day | 0.075 | 0.197 |
| Average Day Maximum Month | 0.092 | 0.24 |
| Maximum Day | 0.092 | 0.24 |
| Peak Hour | 0.2 | 0.3 |

¹Design flow rates are estimated for year 2030.

The WWTP is designed to produce Class B recycled water, as defined in the IDAPA 58.01.17.601.02 of the Rules, and shown in Table 2.

Table 2: Class B Wastewater Requirements from the Recycled Water Rules, IDAPA 58.01.17.601.02

| Parameter | Requirement |
|--------------|---|
| Treatment | Oxidized, coagulated, clarified, and filtered |
| Disinfection | Chlorine disinfection providing residual total chlorine of not less than one (1) mg/L after a minimum contact time of thirty (30) minutes |
| | The median number of total coliform organisms can not exceed 2.2/100 mL, as determined from the last 7 days for which analysis was completed, and no sample shall exceed 23/100 mL. |
| Turbidity | The daily arithmetic mean of all turbidity measurements shall not exceed 5 NTU, and turbidity shall not exceed 10 NTU at any time. |

Additional site specific treatment requirements and buffer zones can apply to Class B systems, which are discussed in following sections.

4.0 Environmental Discussion

4.1 Soils Evaluation

According to the National Resource Conservation Service (NRCS), soil characteristics of the South Field are Greenleaf-Owyhee silt loam, with 0-1% (GwA), 0-3% (GwB) and 0-7% (GwC) slopes, and the soil characteristics of the North Field are saline-alkali Bram silt loam (BsA and BrA) and strongly saline-alkali Letha fine sandy loam (LtA). Excerpts of NRCS soil descriptions as well as the soils classification and tabular data are provided in the permit application, and show that the soil of the South Field is well suited for land application of reuse water with moderate to moderately slow permeability, an available water holding capacity of 7.5 inches, low to moderately low organic matter content, high fertility, and is well drained and very deep. The North Field is not as well suited for land application, and the permittee proposes amendments prior to its use for land application.

Two soil samples were taken and three test pits were dug to assess the state of the North Field soils. The soils were determined to have normal to high electrical conductivity, relatively high exchangeable Sodium percentage and strongly basic pH levels. The permit application includes the recommendation to reclaim the site by adding soil amendments such as lime, gypsum or elemental sulfur to reduce the sodic conditions and to test the soil infiltration rates. Depending on what kind of infiltration rates are observed, a drainage ditch could be added along the north side of the site to improve soil drainage, and some of the salts could be leached out prior to the first land application event.

Due to observed conditions and NRCS soils classifications, the permittee proposes to irrigate the North Field with level basins, which are flood irrigated with several adjustable outlet valves located approximately through the middle of the basins (see the map included in Attachment 1). The South Field, which has been shown to be productive for agricultural applications, will be irrigated with a center pivot.

The draft permit includes annual soil sampling requirements for both fields for standard constituents (Electrical Conductivity (EC), Nitrate-Nitrogen, Ammonium-Nitrogen, pH, and Plant Available

Phosphorus). This soils sampling is generally included in WRPs to not only ensure that nutrients aren't accumulating in the soil as a result of land application activities, but also so that the permittee can apply fertilizer and other soil amendments if necessary for crop health.

Staff also recommends that the WRP contain a requirement the North Field soil samples be analyzed for Sodium Absorption Ratio (SAR), sodium, calcium, magnesium, potassium, and percent organic matter prior to the first water reuse event, to provide a baseline for soil conditions, and then again in 2015, prior to the last growing season in the permit cycle. The permittee can thus evaluate the soil conditions for reclamation or the need for further amendments in the permit renewal application.

4.2 Surface Water Evaluation

The site is bordered on the north by the Riverside Canal, and on the south by a concrete-lined Wilder Irrigation District (Wilder ID) lateral irrigation ditch. The West End Drain divides the site into the north and south fields, borders the North Field on the west, and discharges into the Riverside Canal at the northwest corner of the North Field. The Riverside Canal discharges into the Dixie Slough, which discharges to the Boise River.

Because the water in the West End Drain and Riverside Canal discharge to the Boise River, they are subject to water quality degradation limits that are being extrapolated upstream to comply with the Snake River - Hells Canyon Total Maximum Daily Load (TMDL). As previously noted, the permittee is working with DEQ and EPA to obtain an NPDES permit allowing discharge of effluent to the Riverside Canal during the winter months. Potential limits in the NPDES permit are anticipated for phosphorus, temperature, and Total Suspended Solids (TSS).

Although it is possible that there is a connection between the ground water passing under the site and the surface water, in particular the West End Drain, it is not expected that land application of treated effluent will impact surface water with respect to these parameters of concern. Analysis of phosphorus concentrations in site soils, wastewater effluent, and crop residue will be collected, and the phosphorus concentration of land applied effluent is expected to be less than crop uptake. If the site is managed well, the land application of phosphorus should not result in an impact to surface water.

The City holds a water right from the Wilder ID ditch for 30 acres of the south portion of the site (only 16 acres will be utilized for reuse at this time). The permittee is pursuing a water right claim for use of water from the West End Drain to supplement irrigation of the North Field. The ability to use supplemental water on this field will be necessary to sustain a healthy crop.

A flood plain map was provided with the permit application, and shows that the areas within the flood plain are limited to the banks of the West End Drain. The permittee is not proposing construction within the flood plain.

Buffer zones between land application sites and surface water are required to limit the potential for wastewater effluent to enter surface water. These are addressed in the Idaho DEQ *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater* (Guidance), where the recommended distance to ditches and canals is 50 feet. The proposed WRP includes this buffer zone requirement for the South Field (center pivot). The North Field will utilize flood irrigation, where there is no potential for overspray. The permittee proposed a 20 foot buffer zone between the North Field and the West End Drain and Riverside Canal. By design, the level basins retain the irrigation water, and are surrounded by

a 10 foot wide roadway. Therefore, a 20 foot buffer zone between the North Field and the surrounding surface water is considered reasonable and is included in the proposed WRP.

The permit application contains a discussion of prevention of runoff from either field, and Section E of the draft permit includes a compliance condition for the permittee to provide an updated Runoff Management Plan following construction, where the permittee will detail how runoff will be prohibited from both sites.

Monitoring of surface water does not appear to be necessary to show compliance with the WRP, and has not been included in the draft WRP. Surface water was analyzed during data gathering for this and the NPDES permit applications, and surface water will continue to be analyzed in accordance with the anticipated NPDES permit requirements.

4.3 Ground Water and Hydrogeologic Evaluation

The permit application states that the surficial geology in the vicinity of the City of Greenleaf consists of sandy silt deposited by Bonneville Flood slack water and more recent alluvial sediments. There are local, intermediate, and regional scale ground water flow systems. The shallow aquifer is recharged by seepage from canals, laterals, ponds and lakes, and infiltration from excess irrigation and precipitation. Discharge from shallow aquifers occurs as discharge to drains and the Boise River, withdrawals via wells, and evapotranspiration in areas where ground water levels are near ground surface.

The permit application states that the depth to ground water is between 15 feet below ground surface (bgs) on the southern property to approximately 5 feet bgs near the north and west boundaries. Ground water is generally considered to flow in an approximately northwesterly direction in the Treasure Valley, following the general direction of the rivers, canals, and drains.

The permit application contains the available Well Driller's Reports for ground water wells within ¼ mile of the site, and an analysis of them. The summary states that the shallow materials in the upper 30-40 feet bgs are variable, consisting of soil, clay, sand and gravels with some ground water evident. Below that are layers of clay intermixed with sandy layers. The depths to top water producing sand for three local wells are 92, 150 and 196 feet bgs.

A well located on a property east of the South Field was sampled to assess local ground water quality. The results are shown in the following table.

Table 3: Local Ground Water Quality
Sample taken from a well just east of the South Field.

| pH | TDS | EC | Chloride | Total Phosphorus | Nitrate |
|------|----------|--------------|----------|------------------|-----------|
| 7.91 | 280 mg/L | 291 umhos/cm | 5.6 mg/L | 0.056 mg/L | <0.3 mg/L |

The ground water analysis does not show that any constituents are elevated above the ground water quality standards in the Idaho Ground Water Quality Rule, IDAPA 58.01.11.

A Well Acceptability Analysis was conducted in accordance with the procedure outlined in the Guidance to determine the acceptability of the proposed land application area relative to private water supply wells located near the site. The Guidance gives a baseline buffer zone recommendation of 500 feet, but closer distances can be deemed acceptable based on various factors such as effluent quality and hydraulic isolation. The closest well for which a Well Driller's Report was available is located east of the South

Field, on a property over 125 feet from the site (a different well than that from which the data in Table 3 was collected). The report for this well shows a sandy brown clay layer and two blue clay layers before the screened portion of the well. The other two reports, one for a well west of the site and one further east of the site, show clay layers as well.

Based on the apparent hydraulic isolation of nearby wells, the shallow ground water levels at the site, the Class B effluent quality, and the lack of wells within a quarter mile down gradient of the site, staff concludes that there is minimal concern that land application activities will affect the beneficial uses of ground water. Therefore, dedicated monitoring wells are not considered to be necessary at this site. Staff also does not recommend that ground water monitoring of any domestic wells be required, and this has not been included in the draft permit.

5.0 Hydraulic and Constituent Loading Rates and Proposed Limits

5.1 Hydraulic Loading

As discussed in Section 3.0, the city intends to discharge treated effluent to the Riverside Canal during the winter months (October – April) and reuse effluent for irrigation during the growing season (April – October). During the months of April and September, when crop irrigation demand is low, effluent will be both discharged and reused.

The following table shows the IWR for alfalfa, which was calculated using data on the University of Idaho extension service website, ET_{Idaho} 2009: Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho, using data for the Parma Agrimet station. It should be noted that these numbers differ slightly from those presented in the permit application, due to a newer data set being used for this evaluation. The IWR was calculated in the manner presented in the permit application, which assumed an irrigation efficiency of 80% for center pivots, and 70% for level basins. Due to soil characteristics, the productivity of the crop grown on the level basins was assumed to be 80%, and to amend the soil in the basins, a leaching fraction of 10% was allowed.

Table 4: Irrigation Water Requirement for Alfalfa
 Inches per month and million gallons (MG) per month.

| | South Field, Center Pivot 16 Acres ¹ | | North Field, Level Basins 26.2 Acres ² | | Total MG/mo |
|--|--|-------|--|-------|-----------------------|
| | in/mo | MG/mo | in/mo | MG/mo | |
| Mar | 1.5 | 0.7 | 1.5 | 1.1 | 1.7 |
| Apr | 5.1 | 2.2 | 5.2 | 3.6 | 5.9 |
| May | 5.9 | 2.6 | 6.0 | 4.2 | 6.8 |
| Jun | 7.3 | 3.2 | 7.3 | 5.2 | 8.3 |
| Jul | 8.4 | 3.6 | 8.4 | 5.9 | 9.6 |
| Aug | 7.8 | 3.4 | 7.8 | 5.5 | 8.9 |
| Sep | 5.3 | 2.3 | 5.3 | 3.8 | 6.1 |
| Oct | 2.8 | 1.2 | 2.8 | 2.0 | 3.2 |
| Total: MG/Growing Season (GS) | | 19.1 | | 31.3 | 50.4 MG/GS |

¹80% Irrigation Efficiency, 100% Productivity.

²70% Irrigation Efficiency, 80% Productivity, 10% Leaching allowance.

The existing average daily flow rate of wastewater is estimated to be 0.075 mgd, and the design flow rate (for the year 2030) is 0.197 mgd. That calculates to an effluent discharge of approximately 2.25 million gallons per month (MG/mo) currently and a projected volume of 5.91 MG/mo in 2030. For the months in which the IWR exceeds the supply of recycled water, the permittee holds irrigation water rights to supplement the water requirement, as discussed in Section 4.2. In the months of March and October when supply exceeds the irrigation demand, the permittee anticipates being able to discharge to surface water without the strict limits on phosphorus concentration, also discussed in Section 4.2.

5.2 Constituent Loading

The anticipated average constituent concentrations in effluent based on WWTP design are shown in Table 5 as follows.

Table 5: Anticipated Average Effluent Constituent Concentrations

| Total Nitrogen | Total Phosphorus | BOD ₅ ¹ | COD ² |
|----------------|------------------|-------------------------------|------------------|
| 20 mg/L | 4 mg/L | 10 mg/L | 13.3 mg/L |

¹5-day Biological Oxygen Demand

²Chemical Oxygen Demand

The draft WRP contains the standard monitoring requirements for constituents, which includes monthly analysis of effluent for BOD₅, Total Kjeldahl Nitrogen (TKN), Nitrate + Nitrate Nitrogen, Ammonia, and Total Phosphorus. A brief discussion of nitrogen and phosphorus and the associated application rate limits is included as follows.

Nitrogen:

Using the DEQ guidance, the permittee estimated the Total Nitrogen (TN) uptake from alfalfa to be 320 lb/acre/yr. Rotation crops may consist of corn silage, winter wheat, barley or orchard grass, which range from 150 lb/acre/yr to 360 lb/acre/yr of TN uptake. The effluent is expected to have an average TN concentration of 20 mg/L, which results in an application rate of approximately 51 lb/acre/yr during 2012, and 71 lb/acre/yr by 2017. Therefore, nitrogen is not a limiting factor in wastewater reuse application rates, and in fact nitrogen will probably need to be applied through fertilizers or other means periodically to assure a healthy crop.

A limit on nitrogen application does not appear to be necessary, and was not included in the proposed WRP. The monitoring of nitrogen concentration in wastewater, wastewater application rates, soil nitrogen concentrations, and crop uptake of nitrogen should be adequate to assess if nitrogen application rates become excessive. The draft permit would require that the permittee report the amount of nitrogen applied to the land from both the wastewater and supplemental sources such as fertilizer.

Phosphorus:

The permittee referenced the University of Idaho for the predicted values of phosphorus uptake in crops. The estimates presented range between 28 lb/acre/yr for winter wheat and 51 lb/acre/yr for corn. Assuming even application across the site, at a 4 mg/L effluent concentration the TP application will be between 14 lb/acre/yr to start, and increase to 37 lb/acre/yr at the design life.

DEQ regulates phosphorus in land application sites based on whether a connection between ground water and surface water is demonstrated. If so, then phosphorus limits are sometimes included in reuse permits. Although it is likely that there is a connection between ground water and surface water at the north site due to the proximity of the drains, it is anticipated that the application rate of phosphorus will be below the crop uptake.

Monitoring of phosphorus in the soil is included in the permit as discussed in Section 4.1. If it appears, based on analysis of this data, that phosphorus is building up in the soils to a degree where there may be breakthrough to ground water, a limit for phosphorus application may be necessary in future permitting cycles. No limits are proposed at this time however, and have not been included in the draft WRP.

5.3 Disinfection

The draft WRP contains the disinfection limits set forth in the Rules. For Class B effluent, the total median number of Total Coliform organisms cannot exceed 2.2 CFU/100mL as determined from the bacteriological results of the last 7 days for which the analysis has been completed, or 23 CFU/100 mL in any confirmed sample. For Class C effluent, Total Coliform cannot exceed 23/100mL as determined by the bacteriological results of the last five (5) days for which analyses have been completed, and no confirmed sample can exceed 230/100mL. The monitoring section of the permit, Section G, requires that wastewater analyzed daily for Total Coliform at a point following disinfection.

The disinfection limit for Class B effluent, as set forth in the Rules, is a total chlorine residual of not less than 1 mg/L after a contact time of 30 minutes at peak flow. Chlorine contact time will occur between filtration and the effluent pump station in a 36 inch pipe contact chamber. Total chlorine residual is required to be monitored at least daily.

Achieving adequate disinfection is dependent upon removal of colloidal material, which is measured as turbidity. The requirements in the draft WRP are those set forth in the Rules for a wastewater treatment facility producing Class B reuse water. As such, the draft WRP contains the requirement that the daily arithmetic mean of all daily measurements shall not exceed 5 NTU, and turbidity shall not exceed 10 NTU at any time. Turbidity measurements are to be taken post-filtration and pre-disinfection.

5.4 Buffer Zones and Posting Requirements

The buffer zones included in the WRP generally follow those recommended in the Guidance for flood and sprinkler irrigation. Exceptions to these buffer zones are as follows. The distance between the level basins and man-made canals and ditches is limited to 20 feet, as opposed to the recommended 50 feet. This is due to the low potential for runoff, and is discussed in Section 4.2 of this document. The distance to domestic wells was reduced from the recommended 500 feet to 100 feet, as a result of the findings of a Well Acceptability Analysis performed by the permittee, and discussed in Section 4.3 of this document.

The draft WRP requires that signs be installed identifying the areas as being irrigated with reuse water. The signs should read "Caution: Recycled Wastewater – Do No Drink" or equivalent in both Spanish and English. The Guidance recommends that these signs be installed at 250 foot intervals around the site. The draft WRP requires that, at a minimum, signs be installed at each access point to the reuse application fields, and at each corner. Signs should also be installed at all effluent reuse hose bib faucets.

5.5 Site Management – Compliance Activities

General management of the site is addressed in the draft WRP as Compliance Activities in Section E. The draft WRP contains requirements for the permittee to submit to DEQ for review and approval a Plan of Operation, a Sampling and Analysis Plan, and a Runoff Management Plan. Once approved, these plans will be included by reference in the permit and be enforceable as part of the permit.

CA-225-01 – Plan of Operation

The Recycled Water Rules and the Wastewater Rules require that a facility maintain a Plan of Operation, or Operation and Maintenance Manual (O&M Manual). It is understood that an O&M Manual for the WWTP will be submitted to DEQ per the SRF funded loan agreements. The draft WRP includes a requirement to submit to DEQ for review and approval a Plan of Operation that will specifically cover wastewater treatment as it relates to wastewater reuse. It is intended to be a comprehensive guide for the overall management and day-to-day operation of the site relevant to reuse water, and address the requirements of the reuse permit in an operational guide manner. The plan should include operation procedures for off-specification wastewater, including DEQ notification, and procedures for response to complaints.

In the draft WRP, the plan is required to be approved prior to the application of reuse water, and an updated plan is due 60 days after one complete year of operation.

CA-225-02 – Sampling and Analysis Plan

Submittal of a Sampling and Analysis Plan for DEQ review and approval is recommended for inclusion in the draft WRP. The plan would address all sampling and monitoring procedures required in the permit, and include an accompanying Quality Assurance Project Plan (QAPP). The plan should include adequate written procedures for sample acquisition and handling in order to avoid inconsistencies and problems related to unreliable data.

CA-225-03 – Runoff Management Plan

The draft permit includes the requirement that an updated Runoff Management Plan be submitted 60 days after one complete year of wastewater reuse operations. An initial Runoff Management Plan was included in the permit application. The plan should address best management practices (BMPs) and other control structures designed to prevent runoff of reuse water to any property not owned by the permittee. The plan should also address BMPs employed to minimize ponding.

CA-225-04 – Updated Map

The draft WRP includes a condition to submit a map (or maps) delineating the actual acreages, buffer zones, berms, and any other information relevant to wastewater reuse as it applies to the WRP. The map(s) should include the serial numbers for the HMUs and monitoring locations. The activity is due 60 days following one complete year of wastewater reuse. Upon receipt, this will be included by reference into the permit and will update Figure 2 in Appendix 2 of the WRP.

CA-225-05 – Permit Renewal Application

A permit renewal application is due 6 months prior to the permit expiration date.

6.0 Recommendation

DEQ staff recommends issuance of draft WRP No. LA-000225-01 for the City of Greenleaf for a 30 day public comment period. The draft permit addresses disinfection requirements, constituent and hydraulic loading limits, and wastewater treatment plant performance. Monitoring and reporting requirements to evaluate the wastewater treatment system and site performance and to determine compliance with permit requirements have been specified. Compliance activities, as recommended in the staff analysis, are incorporated in Section E of the permit.

Attachment A: General Layout

