WASTEWATER DISPOSAL

REPORT

for

CITY of GREENFIELD

WASTEWATER TREATMENT PLANT

September 2003

Under the Direction of:

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Wastewater Disposal Report
City of Greenfield

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Report Summary

Treatment Plant Expansion

The September 2003 Capacity Expansion Report for the City of Greenfield Wastewater Treatment Plant prepared by Freitas + Freitas, Engineering and Planning Consultants under the direction of Terra Engineering, Inc., City Engineers for the City of Greenfield outlined specific improvements necessary to expand the plant to 2.0 MGD. These improvements included the following:

1. Installation of a new 1 MGD 45 foot diameter circular clarifyer.
2. Installation of a 30 foot diameter aerobic digester.
3. Installation of a small pump building for the new sludge and scum pumps.
4. Installation of interconnecting piping.
5. Expansion of the existing spray irrigation fields to accommodate increased disposal of the generated effluent.

Wastewater disposal will be accomplished by expansion of the existing spray irrigation fields from about 13 acres to 26 acres. This expansion will consist of grading the existing city owned fields, enlarging the existing spray irrigation pump station, and installing permanent buried spray irrigation distribution piping, control valves and spray heads.

The preliminary costs for a reclamation system are far greater than the City of Greenfield can afford. A reclamation project will not be considered as part of this plant expansion.

Salt Loadings

A possible method to reduce salt loading to the wastewater treatment plant would be the elimination of water softeners from residences in Greenfield. Another method would be the optimization of the home regenerated systems. Frequent and lengthy backwashing of the filter could be avoided by proper operation of the units.

The City of Greenfield will discourage the use of water softeners but does not anticipate changing the City wastewater ordinance to prohibit use of water softeners.

Ground Water Monitoring

Greenfield has been sampling 8 monitoring wells on a regular basis during the past 10 years but has not recorded the depth to groundwater for each well. Beginning on the next scheduled monitoring date, the depth to groundwater will be measured and recorded to better monitor the groundwater gradient.
.

Section 1 - Purpose of this Report

The wastewater treatment plant of the City of Greenfield was constructed in 1978 to treat and dispose of 0.5 MGD (million gallons per day) of domestic strength wastewater. 1993 improvements to the primary clarification system by the addition of a second circular clarifier increased the capacity of the treatment plant to 1.0 MGD. The year 2003 flows to the plant have been steadily increasing and are now averaging about 0.9 MGD.

A September 2003 Capacity Expansion Report for the City of Greenfield Wastewater Treatment Plant prepared by Freitas + Freitas, Engineering and Planning Consultants under the direction of Terra Engineering, Inc., City Engineers for the City of Greenfield outlined specific improvements necessary to expand the plant to this 2.0 MGD. These improvements included the following:

1. Installation of a new 1 MGD 45 foot diameter circular clarifyer.
2. Installation of a 30 foot diameter aerobic digester.
3. Installation of a small pump building for the new sludge and scum pumps.
4. Installation of interconnecting piping.
5. Expansion of the existing spray irrigation fields to accommodate increased disposal of the generated effluent.

The City of Greenfield wishes to increase the capacity to 2.0 MGD.

The Greenfield's wastewater treatment plant is governed by a permit issued by California Regional Water Quality Control Board. This permit is updated periodically to analyze performance and revise discharge requirements. The most recent permit, **Waste Discharge Requirements Order No. R3-2002 - 0062 dated May 31, 2002** had several provisions that the City of Greenfield needed to fulfill. Among them is Provision C-5 which states:

> The Discharger shall evaluate salt management practices and implement a long term Salt Management Program to access and reduce salt loading to the Facility. By March 1, 2003 the discharger shall submit a report to the Executive Officer identifying findings and making recommendations as needed to manage salts.

Also included in the recent permit is Provision C-6 which states:

> The Discharger shall submit an engineering report to the Executive Officer addressing:
>
> a. Whether the hydraulic gradient for groundwater below the Facility is consistent with the configuration of the monitoring wells;
> b. Whether current groundwater monitoring wells adequately represent groundwater upgradient and downgradient of the Facility.

> If the current groundwater monitoring system is inadequate, the Discharger shall propose a revised groundwater monitoring system with an implementation schedule.

Therefore, the purpose of this report is threefold:

1. To study the pond disposal system and to suggest improvements to these this component of the wastewater treatment plant.
2. To prepare a Salt Management Program.
3. To review the current groundwater monitoring system.

Section 2 - Description of the Existing Facility

The City of Greenfield's Wastewater Treatment Plant was reconstructed and completed in 1978. Additional plant improvements completed in 1993 increased the primary clarification capacity to 1.0 MGD. The plant provides treatment and disposal of sanitary sewage contributed by the residents of the City. Treatment and disposal is accomplished in accordance with the **Waste Discharge Requirements** (Appendix A) which have been established by the Regional Water Quality Control Board, Central Coast Region, State of California. **Figure 1 - Location Map** shows the location of the City of Greenfield in Monterey County. **Figure 2 – Vicinity Map** is a vicinity map for the wastewater treatment plant.

The basic disposal concept is to percolate all the wastewater into the ground in a manner that protects the public health, maintains or enhances the existing groundwater quality and does not create a visual or odor nuisance. No sewage effluent is discharged to any of the adjacent surface waters. The sewage quantities are such that with the ample amount of land available, treatment and disposal of sewage is quite simple and straightforward.

The major portion of the settleable solids are removed by settling in the primary sedimentation tank and then decomposed by aerobic digestion. The settled wastewater is then conveyed to a series of ponds where treatment of dissolved organic matter through a natural oxidation process occurs. Final effluent disposal is accomplished by percolation through the sandy soil into the ground, eventually reaching the groundwater underlying the area. In addition, a spray irrigation system with an estimated capacity of 0.9 MGD has been added to the disposal facilities.

The treatment facilities provide primary treatment for solids removal followed by oxidation and percolation. Criteria applicable to this plant for the present design conditions are summarized below. **Figure 3 – Existing Plant Layout** shows the existing plant layout. **Figure 4 – Process Flow Schematic** is a schematic of the treatment process.

Existing Plant Design Criteria

Wastewater Flows and Loads

Average flow	1.00 mgd
Peak flow, process	3.00 mgd
Peak flow, hydraulic	5.0 mgd
Biochemical Oxygen Demand BOD	240 mg/l = 2000 lb/day

Suspended Solids SS	240 mg/l = 2000 lb/day
Primary Treatment	
Headworks Channel	0.1 to 2.5 MGD
Grinder Screen	0.1 to 2.5 MGD
Flow Measuring	0.1 to 2.5 MGD
Primary Sedimentation	
Removal Rate	60% of SS
Removal Lbs	1,200 lbs
Number of Units	2
Surface Loading	707 gal/sf per day
Detention Time	2.2 hours
Weir Overflow	5,300 gal/lf per day
Sludge Digestion and Disposal	
Aerobic Sludge Digesters	
Volatile SS (75% of SS)	900 lbs per day
Removal Rate	40%
Volume Treated	347 cubic feet per day
Number	1
Size	30 ft. Ø x 13.5 ft depth
Volume	9600 cubic feet
Solids Retention Time	27 days
Rotary Lobe Blower	10 HP
Blower Capacity	500 CFM
Loading Rate	0.04 lb. VSS/cf per day
Sludge Drying Lagoons	
Loading	315,360 lbs per year
Number	6
Area	62,500 sf
Volume	125,000 cubic feet
Loading Rate	2.52 lb/cf. per year
Effluent Disposal	
Oxidation	
Number	3
Area	6.25 ac
Depth	5 ft
Detention Time	5.1 days
BOD Loading	200 lb/acre per day
Percolation Ponds	
Number	2
Area	4.21 ac
Depth	5 ft
Percolation Rate	47,850/gal/ac/day
Capacity	0.21 MGD
Spray Irrigation Fields	
Acreage	13 ac

Application	0.9 MGD
Application Rate	2.3 inches per day

The design of the major plant units generally follows conventional practice. The treatment structures are constructed of reinforced concrete and the pond embankments are constructed of compacted native soil. All sewage flow through the plant is by gravity and the only process pumping used is for transferring sludge and scum from the sedimentation tank into the digestion tank. The plant water system includes a well on the plant site. Well water is pumped into a hydropneumatic tank.

The process flow through the plant to the disposal area is represented schematically in **Figure 4 – Process Flow Schematic** The flow enters the plant headworks through a 14 inch diameter cast iron pipe which conveys the raw sewage from the collection system to the plant. At the headworks the sewage passes through dual grinders installed in 1998 which shred the solids, and through a 6 inch Parshall flume which measures the flow.

The sewage then passes into the primary sedimentation tank where quiescent settling occurs. Here most of the settleable and much of the suspended solids settle to the bottom of the tank and are pumped to the digester. Scum is also removed from the surface of the sedimentation tank to a scum pit from which the scum is periodically pumped to the digester.

The effluent from the sedimentation tank flows over weirs and in the 18 inch diameter effluent pipe which conveys the wastewater to the pond area.

The 3 disposal ponds provide oxidation which supports biological activity to further treat the wastewater. 2 percolation ponds serve as disposal ponds.

Transfer piping between all the ponds is provided which enables removing any one pond from service for scarifying or maintenance without preventing use of the remaining ponds. The transfer piping is arranged so a number of combinations of series and parallel operation of the oxidation and percolation ponds may be accomplished.

The oxidation ponds normally are operated in parallel with the flow divided approximately equally to each pond.

Maintenance requires that the percolation ponds be occasionally taken out of service. When this occurs the entire flow is diverted to another pond. This operating condition normally lasts approximately two days when it occurs.

Sludge and scum pumped from the sedimentation tanks into the digesters are decomposed aerobically and stabilized. A diffused aeration piping is installed which is designed to operate 24 hours per day. Supernatant and overflow pipes are connected which allow a simple, manually controlled process to be maintained.

Aerobic digestion is used for three principal reasons; ease of operation, cost advantage, and minimal odor potential. The Greenfield sewage has a high sulfur content with a resulting

hydrogen sulfide odor problem when operating under anaerobic conditions; thus through the use of the aerobic digestion process, the possible generation of hydrogen sulfide is minimized.

The digesters can be operated either on a continuous or a fill and draw basis. Waste digested sludge can be piped to either the upper or lower drying beds and then removed and used on adjacent fields or may be buried after drying.

Section 3 - Existing Flows and Water Balance

Existing Flows

Wastewater flows to the treatment plant have been steadily increasing during the past five years. Shown below on **Table 1 - Wastewater Flows** is a table showing average daily flow and peak daily flow for each of the last six years.

Table 1
Wastewater Flows

Year	ADF	PF
1999	0.805	1.185
2000	0.853	1.030
2001	0.856	1.009
2002	0.868	1.320

ADF = Average day flow in MGD
PF = Peak daily flow in MGD

Water Balance

To understand the operation of the existing disposal system, an estimate of the total yearly amount of effluent that must be disposed of is required. This is called a water balance calculation. The water balance is composed of the total yearly effluent entering the treatment plant, the total yearly evaporation from the disposal pond surfaces, and the total yearly rainfall on the ponds. This calculation will give the total yearly amount of water which must be disposed of by percolation.

The water balance is computed using the following base criteria for the Greenfield Wastewater Treatment Plant:

Plant Flow = 2 MGD
Evaporation per year = 65 inches per year
Rainfall per year = 11 inches per year

What is total amount of water generated?

Total Water (TW) = (MGD x 365 days)/ (7.48 gallons/ft^3 x 43,560 ft^3/acre)

Total Water (TW) = 2,240.40 acre ft/year

Evaporation per Year = 65"/12 = 5.42 feet per year

Volume of evaporation per year on 5 existing ponds

Oxidation Pond Areas

Oxidation Pond #1	2.13 acre
Oxidation Pond #2	2.13 acre
Oxidation Pond #3	1.99 acre
Total	6.25 acres

Disposal Percolation Pond Areas

Percolation Pond #4	2.13 acres
Percolation Pond #5	2.08 acres
Total	6.25 acres

Disposal Spray Fields Areas

Spray Fields	26.25 acres
Total	26.25 acres

The total area for evaporation and precipitation is 36.71 acres (all the land surface area).

The total area for disposal is 32.50 acres (the disposal percolation ponds + disposal spray fields).

Total evaporation and precipitation will be taken over the total pond and irrigation field area of 36.71 acres.

Total evaporation (TE) = 5.42 ft. x 36.71 acres
= 199.0 acre foot per year

Total precipitation 11"/12" = .92 feet per year

Total precipitation (PT) = 0.92 ft x 36.71 acres
= 33.77 acre foot per year

Water to be disposed of = TW - TE + PE
= 2,240.2 – 199.0 + 33.77
= 2,075.0 acre feet per year

This amount will be rounded up to 2,100 acre feet per year.

Therefore, a total of about 2,100 acre feet of water per year must be disposed of by the 32.50 acres of percolation and spray irrigation systems. This is 64.6 acre feet per acre per year or about 2.1 inches per day over the existing disposal pond and spray irrigation area.

Section 4 - Treated Water Quality

Although there is no required treatment limits for the primary portion of the plant, sampling for pH, “Total" Nitrogen, Total Dissolved Solids (TDS), Sodium, Chloride, Sulfate, and Boron are required for the effluent delivered to the disposal ponds. The 2002 Annual Average for these constitutes is shown on **Table 2 - Primary Effluent Quality** below:

Table 2
Primary Effluent Quality

Biochemical Oxygen Demand (BOD)	96 mg/l
Suspended Solids (SS)	96 mg/l
pH	7.6
"Total" Nitrogen	51 mg/l
TDS	700 mg/l
Sodium	128 mg/l
Chloride	166 mg/l
Sulfate	173 mg/l
Boron	0.15 mg/l

The BOD and SS have been estimated from performance of similar wastewater treatment plants.

The important constituent to be noted here is "Total" Nitrogen. This is important because most of the nitrogen not removed during percolation of the wastewater could become nitrates in the groundwater. Groundwater nitrate concentrations exceeding the potable water quality standards are of concern in Monterey County.

The 51 mg/l concentration of the primary effluent before percolation could result in groundwater concentrations approaching the potable water standard of 45 mg/l nitrate if significant nitrogen is not removed during percolation or spray irrigation effluent disposal.

Section 5 - Analysis of Facilities

A. Treatment and Disposal Ponds

Expansion of the treatment facilities is shown on **Figure 5 – Proposed Treatment Plant Expansion Plan**. Although the original design for the plant allocated two of the five ponds for oxidation and the remaining three for percolation, the oxidation ponds were not sealed and thus allow percolation. Therefore, we consider all five ponds percolation ponds.

As previously stated, the ponds were design as follows:

Oxidation	
Number	3
Area	6.25 ac

Depth	5 ft
Detention Time	5.1 days
BOD Loading	200lb/acre/day
Percolation Rate	47,850/gal/ac/day
Capacity	0.30 MGD
Percolation Ponds	
Number	2
Area	4.21 ac
Depth	5 ft
Spray Irrigation Fields	
Acreage	13.0 acres

Typical pond design parameters are shown below:

Detention time	10-40 days
BOD loading	60-120 lb./acre/day
Liquid loading	4 to 20 inches/week
Annual Application	18 to 500 feet/year
Land required for 1 MGD	2 to 62 acres
Expected Treatment Performance:	
BOD and SS removal	85 to 99%
Nitrogen removal	0 to 50%
Phosphorus removal	60 to 99%

These values are taken from **"Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities"** EPA Manual 430/9-78-001.

As can be seen, these ponds were originally designed for a higher than typical BOD loading. Increasing the design flow from 1.0 MGD to 2.0 MGD will double the BOD loading to about 400 lb per acre per day.

There are no standard design values for percolation rate as each particular site is unique because of its geology and soil profile.

Increasing the design flow to 2 MGD will double the required percolation rate to about 100,000 gals per acre per day. The ponds will dispose of about 3.5" per day or 25" per week. This amount is greater than the typical design values noted.

Since there are no required effluent quality requirements for these ponds and at the present rate of about 1.0 MGD no overflows are observed, it is difficult to judge the total capacity for them.

However, removal of "Total" Nitrogen will only be reduced as the rate of disposal increases.

B. Spray Irrigation System

The spray irrigation system was not part of the original treatment plant construction and was added within the last 10 years to provide for better nitrogen removal from the effluent.

The spray irrigation pump takes suction from both percolation pond #4 and percolation pond #5. This pump has a capacity of about 600 gpm which would allow disposal of about 1.0 MGD if operated continuously.

A fixed irrigation system of about 13 acres presently distributes the effluent from these ponds to about 30 irrigation heads at a time. This is shown on **Figure 6 – Proposed Disposal Site Map**. The spray field operated in this manner requires about 1 day to drain either of these ponds. The weeds which grow in the disposal area are disked quarterly or when the height is greater than the irrigation head.

Typical design values for wastewater spray irrigation fields are shown below:

	Low Rate	**High Rate**
Liquid Loading	0.5 to 1.5 in/wk	1.5 to 4 in/wk
Annual Application	2 to 4 ft/yr	4 to 18 ft/yr
Land Required for 1 MGD capacity	280 to 500 acres	62 to 280 acre
Expected Treatment Performance:		
BOD and SS removal	98%	98%
Nitrogen removal	85%	85%
Phosphorus removal	80 to 99%	80 to 99%

These values are taken from **"Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities"** EPA Manual 430/9-78-001.

The existing loading rate for 1.0 MGD disposal is about 20 in/wk. Shown below are the calculations:

Loading rate = Disposal Amount / Available Area
= (1,000,000g/7.48gpcf)/ (13.0ac x 43,560 sf/ac)
= 0.24 ft/day
= 19.8in/wk.

Increasing the disposal flow to 2.0 MGD and doubling the spray irrigation field area will duplicate the existing loading rate of about 20 in/wk.

As can be seen, spray irrigation disposal of the wastewater effluent is preferable to percolation disposal because of the greater removal of "Total" Nitrogen.

Since the percolation ponds and the spray irrigation fields will be operating above the usual high limits of similar facilities for the increased capacity of 2 MGD, more disposal ponds or irrigation fields are needed.

Spray irrigation of the effluent is preferable to percolation pond disposal because of the more efficient removal of the remaining BOD, suspended solids, and "Total" nitrogen of the primary clarifiers.

Therefore, a spray irrigation system should be designed to essentially duplicate the existing spray system to increase spray fields to 26 acres to bring the capacity to 2 MGD.

Section 6 – Wastewater Reclamation

Reclamation and reuse of municipal wastewater for nonpotable applications has been practiced for almost a century in the arid west and southwest U.S., and for more than 30 years in parts of the southeast, most notably Florida. The use of reclaimed water is dependent on several factors, including regulatory constraints. In the absence of federal regulations, the regulatory burden rests with the State of California.

Title 22, Chapter 3, of the California Code of Regulations provides guidance, treatment requirements, and water quality criteria for California. These requirements are based on experience at water reclamation plants, research and demonstration studies, attainability, and expertise of regulatory officials, public health specialists, and environmental engineers.

The important characteristic of any reclamation project that distinguished it from wastewater disposal is the existence of a demonstrated need for the water. This need is most clearly demonstrated when the user agrees to pay for the water and when the rate of use is dependent on the needs of the user and not the amount offered by the supplier. Irrigation with reclaimed water is more environmentally acceptable than land disposal of wastewater because of the public benefit provided by the irrigation, but it may not provide dependable wastewater disposal capacity, unless there is provision for discharge of excess reclaimed water.

Wastewater reclamation projects which presently exist in Monterey County are shown on **Table 3 – Monterey County Wastewater Reclamation Facilities** below:

Table 3
Monterey County
Wastewater Reclamation Facilities

1. Carmel Valley Ranch
2. Las Palmas Ranch
3. Laguna Seca Developments
4. Pebble Beach Community Services District
5. Castroville Project

The main use of wastewater reclamation at these facilities is irrigation.

Title 22, Chapter 3, of the California Code of Regulations provides guidance, treatment requirements, and water quality criteria for wastewater reclamation. This code categorizes and

determines treatment requirements for reclaimed water according to the four potential uses summarized on **Table 4 – Title 22 Potential Reclamation Uses** below:

Table 4
Title 22 Potential Reclamation Uses

#	Use	Treatment Type	
1.	Irrigation of Food Crops		
	A. Spray Irrigation	1	
	B. Surface Irrigation	2	
	C. Surface Irrigation of Orchards and Vineyards	3	
2.	Irrigation of Fodder, Fiber and Seed Crops	3	
3.	Landscape Irrigation		
	A. Golf Courses, Cemeteries and Freeway Landscapes	2	
	B. Parks, Playgrounds and School yards	1	
4.	Recreational Impoundments		
	A. Non-restricted Recreational Impoundment		1
	B. Restricted Recreational Impoundment	2	
	C. Landscape Impoundment	2	
5.	Potable Groundwater Recharge and Other Potential Uses	4	

Type 1 Treatment for spray irrigation of food crops, playgrounds and schoolyard landscape irrigation must be treated by oxidation, coagulation, sedimentation, filtration, and highly efficient disinfection.

Type 2 Treatment for surface irrigation of food crops and for spray irrigation of golf courses, cemeteries, freeway landscaping and turf grass must be treated by oxidation and highly efficient disinfection.

Type 3 Treatment for surface irrigation of feed, fodder, fiber, seed crops, orchards, and/or vineyards must be primary treated and shall contain not more than 0.5 ml/l/hr of settleable solids.

Type 4 Treatment for potable groundwater recharge and other potential uses must be determined by the State Department of Health Services on an individual site analysis.

The Greenfield Wastewater Treatment Facility provides treatment that is **Type 3 Treatment.**

All uses of reclaimed wastewater must be approved by the Monterey County Health Department and the Regional Water Quality Control Board. For Greenfield the types of reclamation with some potential are **#1 – Irrigation of Food Crops**, **#2 – Irrigation of Fodder, Fiber and Seed Crops** and **#3 – Landscape Irrigation.**

Potential Uses

Current farming operations in the Greenfield area include the following:

1. peppers, tomatoes and other vegetables
2. alfalfa, Sudan grass and other cut fodder
3. turf grass
4. pasture, orchards and vineyards
5. tree farming
6. wheat, barley and other grains

The irrigation of food crops (orchards, vineyards, berries, wheat, barley, grains, peppers, tomatoes and other vegetables), requires a higher water quality than can be provided by the existing treatment facility.

The irrigation of turf grass, pasture and cut fodder can be done with the currently produced water quality. In particular, the nitrogen content of the wastewater is beneficial for the production of leafy vegetation. Most farmers would welcome inexpensive irrigation water. However, they generally require that the water be piped to their fields and would require some subsidy to make wastewater irrigation cost effective.

Agricultural irrigation would require **Type 1 Treatment**. A treatment, storage, pumping, and pipeline distribution system would need to be constructed to use reclaimed wastewater for agricultural purposes. The peak day use, peak month use and the total yearly use for farming and crop irrigation was not determined because of the uncertainty of use by farmers.

For fodder, fiber, turf grass and/or seed crops, it is necessary to quantify the amount of irrigation water needed into a rate of application.

The irrigation water requirement (**L_w**) of a crop over a specified period of time is defined as the depth of water needed to meet crop water loss through evapotranspiration (**ET_o**) minus rainfall precipitation (**P**) times leaching rate (**LR**) times the efficiency of the irrigation system (**E_u**). This equation is shown below:

$$\mathbf{L_w = ET_o - P \times LR \times 1/E_u}$$

where
L_w = Irrigation water requirement (inches)
ET_o = Crop evapotranspiration loss (inches)
P = Rainfall precipitation (inches)
LR = Soil Leaching Rate (%)
E_u = Irrigation System Efficiency (%)

Shown on **Table 5 – Irrigation Water Potential Requirement** below is an estimate of the irrigation water requirement for Greenfield based on evapotranspiration rate for grass (Central Coastal Interior Valley), average annual precipitation of 12 inches, a leaching rate of 110% and an irrigation system efficiency of 67%:

Table 5
Irrigation Water Potential Requirement
City of Greenfield

Month	Et_o (inches)	P (inches)	ET_o-P (inches)	LR (%)	E_u (%)	L_w (inches)
January	1.6	2.69	-1.09	110.0	0.67	
February	2.1	1.94	0.16	110.0	0.67	0.26
March	3.3	1.35	1.95	110.0	0.67	3.20
April	4.3	1.04	3.26	110.0	0.67	5.35
May	5.7	0.35	5.35	110.0	0.67	8.78
June	6.2	0.13	6.07	110.0	0.67	9.97
July	6.7	0.00	6.70	110.0	0.67	11.00
August	6	0.00	6.00	110.0	0.67	9.85
September	4.8	0.13	4.67	110.0	0.67	7.67
October	3.8	0.72	3.08	110.0	0.67	5.06
November	2.3	1.42	0.88	110.0	0.67	1.44
December	1.5	2.33	-0.83	110.0	0.67	
Total	**48.30**	**12.10**				**62.59**

As can be seen, the maximum irrigation water requirement (**L_w**) is about 11 inches during the month of July.

The median strip and right of way of Highway 101 as it passes through Greenfield are currently not landscaped or irrigated. The highway traverses through town for a distance of about 2.5 miles. The landscapable area within the City limits is estimated to be about 16 acres.

Although CALTRANS has not expressed active interest in conducting a reclamation irrigation operation, this agency does place higher priority on landscape irrigation projects if they are supplied with reclaimed water. The City could encourage this project to increase reclamation. Thus, median strip irrigation is feasible from a technical point of view. An agreement would need to be negotiated with CALTRANS, which should not be expected to pay all the costs for pipe installation, plants, and landscape maintenance.

The maximum total monthly wastewater reclamation use for the peak month of July spray irrigation of Highway 101 right of way would be about 4.8 million gallons. The total yearly use of spray irrigation of Highway 101 would be about 27.3 MG.

Assuming reclamation irrigation 8 hours per day on weekdays, the peak month average daily usage would be about 218,000 gallons per day at a rate of 455 gpm.

Highway irrigation would require **Type 2 Treatment**. A treatment, storage, pumping, and pipeline distribution system would need to be constructed.

City parks and schools provide landscape irrigation opportunities for the use of reclaimed water. The location of the existing parks and school areas are shown on **Table 6 – Potential Irrigation Users** below:

Table 6
Potential Irrigation Users
City of Greenfield

Facility	Location	Area (ac.)
City Parks		
Patriot Park	13th Street & Elm Ave.	16.0
Library Park	9th Street & Palm Ave.	0.3
Maple Ave. Park	5th Street & Maple Ave.	0.2
Primavera Tot Lot	10th Street and Primavera Ave.	0.1
Dart Park	Baywood Ave. & Dart Way	0.6
Cabernet Park	Pinot Ave. & Cabernet Ave.	1.3
Hutchison Park	Between Parkside Drive & Hutchison Dr.	0.6
Park Total		**19.1**
Schools		
Oak Avenue School	Oak Ave.	2.4
Vista Verde School	Elm Street & Heidi Drive	6.4
Greenfield High School	El Camino Real	45.9
School Total		**54.7**
Total Park and School		**74.5**
Available irrigation area (40% +/- total area)		**29.8**

Assuming that 40% of the area of the parks and schools are areas which are landscaped and that about 11 inches of irrigation water need be applied to the landscaped areas during the peak irrigation month of July, the maximum daily rate of reclaimed wastewater use for irrigation would be 0.3 MGD. The maximum total monthly wastewater reclamation use for the peak month of July would be about 8.9 MG million gallons. The total yearly use of irrigation would be about 50.9 MG.

Irrigation of city parks would require **Type 1 Treatment**, a very high level treatment. A treatment, storage, pumping, and pipeline distribution system would need to be constructed.

Wastewater reclamation and reuse by industrial or commercial operations in the Greenfield area could include:

1. Commercial reuse for toilet flushing.
2. Irrigation of landscaped areas

The reuse of reclaimed wastewater for commercial toilet flushing and landscape irrigation purposes would reduce the net water demand for a commercial development. This would be accomplished through installation of a dual piping system by the developer. The pipes carrying reclaimed water would be clearly marked and special provisions would be made to prevent cross-connections between the potable supply to sinks and the nonpotable supply to toilets.

Additional treatment over and above Title 22 requirements may be required to prevent nuisance odor and discoloration problems. Although there are no State Health Department regulations governing this type of reuse, the County Health Department may exercise discretionary regulatory authority. Because toilet flushing often uses the major portion of the water supplied to a commercial building, this type of reuse system can effectively reduce water demand, and increase reclaimed water demand. It has no effect on the wastewater flow volumes to be treated, although it reduces the required disposal capacity.

Without any identified users, it is not possible to determine potential usage factors for this type of use. Therefore, the peak day use, peak month use and the total yearly use is not determined.

Required Reclamation Facilities

A. Upgraded Treatment

The effluent from the renovated wastewater treatment plant is considered primary wastewater and is the basis for the following discussions about upgraded levels of treatment.

The typical configuration for upgraded treatment for a **Type 1 Treatment** plant would consist of using the existing primary effluent from the treatment plant with the addition of coagulant feed facilities for lime and/or alum, a clarifier with sludge removal and disposal facilities, a granular media filters and a chlorine contact basin which provides a 2 hour contact time.

B. Storage, Pumping and Distribution System

Installation of a storage tank or reservoir after an upgraded treatment system containing about 50% of the peak day use would be needed to provide convenient storage for the distribution system pumps during off peak demand periods.

A distribution system consists of pumps, piping and chlorine contact facilities would need to be added. For users at a sufficient distance from the treatment plant, chlorine contact time is provided in the piping system.

Distribution pipelines could be laid out running to the west toward town and to the north from the plant site to provide a network to serve approximately 10,000 acres of farmland. Perhaps 1,000 acres of this would actually be irrigated if the water were supplied. A pipeline along Highway 101 and through town could provide irrigation water to both the parks and the highway right of way.

C. Possible Reclamation Project

A possible reclamation project would be to upgrade the existing treatment plant to provide reclamation water to spray irrigate Highway 101, City Parks and Schools This system would consist of constructing a treatment, pumping, disinfection and distribution system which would allow reclaimed wastewater to be taken from the wastewater treatment plant site and delivered to the City's parks, schools and along the freeway right of way for landscape irrigation.

This system would include constructing a treatment, storage, pumping, disinfection, and distribution system which would allow reclaimed wastewater to be treated and delivered from the wastewater treatment plant to all the landscaped parks within the City of Greenfield. This alternative is shown on **Figure 7 – Possible Reclamation Project.**

This alternative would require **Type 1 Treatment**. The facilities needed for this alternative would consist of a ground vault concrete wetwell, two booster pumps, prefabricated treatment plant with coagulation, sedimentation, filtration and disinfection units, chlorine solution tank and metering pump, 250,000 gallon storage tank, three booster pumps, and pipeline forcemain to the loop the city and travel to all city parks.

The estimated construction costs of this system are shown on **Table 7 – Preliminary Estimate** below:

Table 7
Preliminary Estimate
Reclamation Wastewater Treatment Plant, Greenfield, CA

Item #	Description	Quantity	Unit	Unit Cost	Cost
Treatment Plant Site					
1	Site Work	1	LS	$ 25,000.00	$ 25,000.00
2	Reclamation Treatment Plant	1	LS	$ 500,000.00	$ 500,000.00
3	250,000 Gallon Tank	1	LS	$ 150,000.00	$ 150,000.00
4	Pumps & Motors	3	Ea	$ 15,000.00	$ 45,000.00
5	Electrical System	1	LS	$ 100,000.00	$ 100,000.00
Distribution System					
6	12" Distribution Pipe	9,000	LF	$ 100.00	$ 900,000.00
7	8" Distribution Pipe	13,000	LF	$ 75.00	$ 975,000.00
8	Valves	50	Ea	$ 2,500.00	$ 125,000.00
Subtotal for Construction					**$ 2,820,000.00**
Contractor Profit and Construction Contingencies				**15.00%**	**$ 423,000.00**
EIR, Engineering & Inspection				**25.00%**	**$ 705,000.00**
Total Project					**$ 3,948,000.00**

The advantage of this system is that a complete dual water system would be constructed which could allow almost any kind of water reclamation and reuse presently approved by the Department of Health Services.

The disadvantage of this alternative is that it is very expensive and would require a level of operations and maintenance expertise that presently does not exist within the Public Works Department of the City of Greenfield

The preliminary costs for a reclamation system as outlined above are far greater than the City of Greenfield can afford. A reclamation project will not be considered as part of this plant expansion

Section 7 - Recommended Treatment Plant Improvements

As previously stated, the September 2003 Capacity Expansion Report for the City of Greenfield Wastewater Treatment Plant prepared by Freitas + Freitas, Engineering and Planning Consultants under the direction of Terra Engineering, Inc., city engineers for the City of Greenfield outlined specific improvements necessary to expand the plant to this 2.0 MGD. These improvements included the following:

1. Installation of a new 1 MGD 45 foot diameter circular clarifyer.
2. Installation of a 30 foot diameter aerobic digester.
3. Installation of a small pump building for the new sludge and scum pumps.
4. Installation of interconnecting piping.
5. Expansion of the existing spray irrigation fields to accommodate increased disposal of the generated effluent.

Expansion of the existing spray irrigation fields from about 13 acres to 26 acres will consist of grading the existing city owned fields, enlarging the existing spray irrigation pump station, and installing permanent buried spray irrigation distribution piping, control valves and spray heads.

These improvements are shown on **Figure 5 – Proposed Expansion Site Map** and **Figure 6 – Proposed Disposal Site Map**.

The preliminary costs for a reclamation system as outlined above are far greater than the City of Greenfield can afford. A reclamation project will not be considered as part of this plant expansion.

Section 8 - Salt Management Program

Basin Plan

As previously stated, wastewater disposal is governed by the **Water Quality Control Plan for the Central Coastal Basin** prepared for the California State Water Resources Control Board by the Central Coast Regional Water Quality Control Board. The purpose of this Basin Plan is to show how the quality of the surface and ground waters in the Central Coast Region should be managed to provide the highest water quality reasonably possible.

This **Basin Plan** lists the various water uses and it describes the water quality which must be maintained to allow those uses. An Implementation Plan describes the programs, projects, and other actions which are necessary to achieve the standards established in this plan. A number of plans and policies to protect water quality have been adopted by the two agencies. Which include regional and statewide surveillance and monitoring programs?

The Regional Board implements the **Basin Plan** by issuing and enforcing waste discharge requirements to individuals, communities, or businesses whose waste discharges can affect water quality. These requirements can be either State Waste Discharge Requirements for discharges to land, or federally delegated National Pollutant Discharge Elimination System (NPDES) permits for discharges to surface water. Methods of treatment are not specified. When such discharges are managed so that: 1) they meet these requirements; 2) water quality objectives are met; and, 3) beneficial uses are protected, water quality is controlled.

The **Basin Plan** also encourages water users to improve the quality of their water supplies, particularly where the wastewater they discharge is likely to be reused. Public works or other projects which can affect water quality are reviewed and their impacts identified. Proposals which implement or help achieve the goals of the Basin Plan are supported; the Regional Board makes water quality control recommendations for other projects.

The following sections from the **Basin Plan** which specifically apply to the City of Greenfield are highlighted below:

SECTION III.E. - GROUND WATER

1. Ground water recharge with high quality water shall be encouraged.
2. In all ground water basins known to have an adverse salt balance, total salt content of the discharge shall not exceed that which normally results from domestic use, and control of salinity shall be required by local ordinances which effectively limit municipal and industrial contributions to the sewerage system.
3. Wastewaters percolated into the ground waters shall be of such quality at the point where they enter the ground so as to assure the continued usability of all ground waters of the basin.

SECTION IV.D. - GROUND WATERS

Wastes discharged to ground waters shall be free of toxic substances in excess of accepted drinking water standards; taste, odor, or color producing substances; and nitrogenous compounds in quantities which could result in a ground water nitrate concentration above 45mg/l.

SECTION V.C. - SALT DISCHARGE

1. Emphasize control of brine disposal into public sewer systems by requiring affected dischargers to comply with normal salt increments, to adopt salt source control ordinances, and to conduct wastewater monitoring programs.
2. Minimize degradation of water during transport from points of use; minimize leakage of poor quality water during transport from salt affected areas through salt free lands to salt sinks for disposal.
3. Regulate importation of water into any basin or sub basin and regulate the reuse of waters in upstream portions of sub basins which is of poorer quality than existing or imported supplies. If such import or transport to up-slope areas for reuse is allowed, take suitable steps to mitigate short and long term adverse effects of increased salt load resulting from this recycling.
4. Increase recharge of underground water storage basins (where recharge is possible) using surplus winter or spring runoff waters.
5. Actively support measures designed to protect and to improve quality of waters imported into areas with unfavorable or poor salt balance.
6. Regulate reclamation of new lands which would contribute large quantities of salts or pollutants to water supplies
7. Where water supplies are limited, restrict use of reclaimed waters to existing irrigated acreage rather than develop new irrigated acreage to utilize the reclaimed water.

SECTION V.H.8. - SALINITY MANAGEMENT

Salt source control measures should be implemented by municipalities having excessive mineral quality in wastewaters discharged to land or inland waters; control of salinity through water supply improvements is recommended.

Salt Loadings to Greenfield's Wastewater Treatment Plant

Wastewater is used water containing suspended and dissolved substances from the users of the domestic water supplied by the City potable water distribution system. Among the users are residences, commercial buildings, industrial plants, and institutions such as schools and hospitals. Depending on the amount, type, and form of the uses, the wastewater characteristics will vary. Greenfield's water users are almost totally residential, commercial, and institutional in nature. This group of users produces a wastewater that is commonly known as domestic wastewater having about 240 mg/l suspended solids (SS) and 240 mg/l biochemical oxygen demand (BOD).

Characteristics are grouped into three categories; physical, chemical and biological. Salts are considered a physical characteristic as they are dissolved solids which are present in the potable water and during use additional dissolved solids are added to the wastewater.

Greenfield has good potable water quality with total dissolved solids (TDS) of about 434 milligram per liter (mg/l), sodium concentration of about 39 mg/l and chloride concentration of about 33 mg/l. Hardness is about 230 mg/l (as measured by $CaCO_3$). Optimum hardness is about 100 mg/l.

Effluent from the wastewater treatment plant has total dissolved solids (TDS) of about 678 mg/l, sodium concentration of about 126 mg/l and chloride concentration of about 126 mg/l. Therefore water usage in Greenfield adds about 244 mg/l TDS, 87 mg/l sodium and 93 mg/l chloride to the water. These additions are within the usual range for water to wastewater use.

Wastewater from Greenfield is percolated to the Salinas Valley groundwater basin. The groundwater flows beneath the wastewater disposal fields in a generally northward direction. Greenfield is required to monitor the quality of the groundwater both upstream and downstream of the treatment plant. Data from year 2002 monitoring shows that Greenfield dilutes the TDS by about 29 mg/l, but adds about 39 mg/l sodium and 59 mg/l chloride to the groundwater.

Table 8 – Salt Loadings shown below is a summary of the salt loadings for the Year 2002:

Table 8

2002 Salt Loadings to Greenfield Wastewater Treatment Plant

	TDS	Sodium	Chloride
Water Supply	434	39	33
Treatment Plant Effluent	678	126	126
Upgradient Groundwater Monitoring Wells	795	80	56
Downgradient Groundwater Monitoring Wells	774	119	115

TDS is Total Dissolved Solids measured in mg/l.
Sodium is sodium concentration measured in mg/l.
Chloride is chloride concentration measured in mg/l.

Added By Use to WWTP

TDS	244 mg/l
Sodium	87 mg/l
Chloride	93 mg/l

Change in Groundwater Flowing Underneath Plant

TDS	-21 mg/l
Sodium	39 mg/l
Chloride	59 mg/l

Water Softening

Water softening is a contributor of TDS, sodium and chloride to wastewater. Greenfield does not limit nor prohibit use of home water softening units. Two types of home softening units are generally available both using the ion exchange method to remove hardness from the drinking water. These units exchange hardness causing ions of calcium and magnesium included in the drinking water for non hardness causing ions of sodium with a resin included in a filter mechanism. One type uses a removable pressure filter containing the exchange resin that is replaced periodically by a provider. The pressure filter is then regenerated at a facility outside of Greenfield. The second type is completely self contained having the filter backwashed with brine generated from rock salt in water to refill the exchange resin. The filter backwash is disposed of in the wastewater collection system with frequent and lengthy backwashing a possible large contributor of salts.

The public works staff estimates that less than 10% of the residences in Greenfield have these types of systems although exact numbers are not known.

Possible Methods to Reduce Salt Loadings

A possible method to reduce salt loading would be the elimination of water softeners from residences in Greenfield. If the estimated 10% use of water softeners is a reasonable number, elimination of this type of water softener system would probably be an insignificant reduction in sodium and chloride to the wastewater stream. This prohibition is not desired by the City of Greenfield.

Another method would be the optimization of the home regenerated systems. Frequent and lengthy backwashing of the filter could be avoided by proper operation of the units.

Revised City Discharge Requirements

The City of Greenfield will discourage the use of water softeners but does not anticipate changing the City wastewater ordinance to prohibit use of water softeners.

Section 9 - Groundwater Monitoring

Groundwater beneath the wastewater disposal fields is monitored through the use of eight groundwater monitoring wells constructed in December 1991. The location of these wells is shown in **Figure 8 - Monitoring Wells**. The wells are upgradient and downgradient of the disposal area. Water samples from these monitoring wells are taken at least semi annually (March and September) and required to be analyzed for the following constituents:

Depth to groundwater	Sulfate
pH	Nitrite
Total Dissolved Solids	Nitrate
Sodium	Total Kjedahl Nitrogen
Chloride	Total Nitrogen

Boron

Enclosed in **Appendix B** is the February 1992 Report of Stall Gardner & Dunne Inc. which outlines the construction of these wells and their relationship to the groundwater basin.

Greenfield has been sampling these wells on a regular basis during the past 10 years but has not recorded the depth to groundwater for each well. Beginning on the next scheduled monitoring date, the depth to groundwater will be measured to better monitor the groundwater gradient.

At this time, we believe that the existing monitoring wells are placed adequately.

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APPENDIX A

WASTE DISCHARGE REQUIREMENTS

APPENDIX B

INSTALLATION OF GROUND WATER MONITORING WELLS
CITY OF GREENFIELD WASTEWATER DISPOSAL AREA
GREENFIELD, CALIFORNIA

STALL GARDNER & DUNNE, INC.