



Executive Summary

INTRODUCTION/BACKGROUND

The City of Davis provides wastewater treatment for all residents and businesses within the City of Davis and two unincorporated areas: North Davis Meadows (north of Davis at Highway 113 and County Road 29), and El Macero (south of Davis adjacent to the southern city boundary). The City's Wastewater Pollution Control Plant (WPCP) currently serves a population of approximately 65,000. The City seeks to maintain a "small town" character; accordingly, the City has adopted policies to limit growth rates and will likely continue to grow at a controlled pace in the future. The latest General Plan update provides planning for City infrastructure through 2010. However, due to the significant lead-time required for planning, design and construction of wastewater treatment facilities, this Master Plan considers a 25-year planning period (i.e., through 2030). The strategy proposed as part of this Plan is designed to improve operational reliability and meet future regulatory requirements only while recognizing some uncertainties in those future requirements. This proposed project does not add wastewater treatment capacity since projections do not indicate a need for added capacity through the 25-year planning horizon.

Due to the variable effluent quality produced by the WPCP land based systems, historical discharge permits allowed the effluent to exceed the national standards for secondary effluent. In March 2001, however, the City was issued a National Pollution Discharge Elimination System (NPDES) permit which placed much tighter limits on biological oxygen demand (BOD) and total suspended solids (TSS) as well as required the construction of tertiary treatment facilities and ammonia

reduction. The permit was appealed to the State Water Resources Control Board (SWRCB), which ultimately, in 2003, remanded these and certain other requirements to the Regional Water Quality Control Board (RWQCB) for reconsideration. No action on the remand occurred, but the City proceeded in 2004 with development of a Strategic Master Plan for their wastewater facilities to outline the direction for future treatment, disposal, and reuse for the community.

OVERALL APPROACH/PROJECT PURPOSE AND GOALS

The overall approach for the Master Plan development was to have an open, participatory process to encourage creative, innovative thinking and to achieve consensus for the upcoming project. Multiple technical sessions (TS) were held with City staff, outside experts, community members from the Natural Resources Commission (NRC), and the project team. At these technical sessions, the project goals were established; current and potential future regulatory requirements were identified; alternative disposal, reuse, treatment and regulatory/legal options were brainstormed and screened; and the recommended project and strategic plan was discussed.

The purpose of the Master Plan is to provide a strategic plan that outlines wastewater treatment, disposal, and reuse facility needs for a 25-year planning horizon. The Master Plan outlines the facilities needed and steps required to: 1) meet treatment requirements specified in the existing 2001 NPDES permit, 2) provide flexibility to meet anticipated future regulatory requirements, 3) determine repair and replacement needs for the

facility, 4) improve reliability to ensure process performance, and 5) provide community benefits.

PROJECT REQUIREMENTS

Several project requirements were evaluated in the Master Plan, including current and future regulatory requirements, future wastewater flows, and the capacity and condition of existing treatment facilities.

Regulatory Requirements

The City's current NPDES Permit, which regulates the wastewater effluent quantity and quality upon discharge, was issued on March 16, 2001 (Order 5-01-067). In April 2001, the City filed a petition

with the SWRCB for review of the permit based largely on the permit's requirement for tertiary treatment addition and ammonia reduction, among other issues. Following the SWRCB's related ruling on a petition by the City of Vacaville, the Regional Board and City stipulated to, and the SWRCB granted, a stay and remand of several provisions and compliance schedules in the City's permit per Water Quality Order (WQO) 2003-0018. The permit provisions are stayed pending action on the remand or a revised permit issued by the RWQCB. Table 1 summarizes the 2001 NPDES permit effluent limits.

In addition to the effluent limits shown in Table 1, the remanded permit also required the construction of tertiary treatment (i.e., coagulation and

Table 1 - Summary of 2001 NPDES Permit⁽¹⁾

| Constituent | Averaging Period | Existing Limit | Proposed New Limit |
|-------------------------------|--------------------|----------------------|---------------------------|
| BOD5, mg/L | Monthly Average | 30 | 10 |
| | Daily Maximum | 90 | 20 |
| TSS, mg/L | Monthly Average | 50 | 10 |
| | Daily Maximum | 150 | 20 |
| Chlorine, mg/L | | 0.02 - Daily Maximum | 0.02 - One-hour Average |
| Total Coliform, MPN/100mL | Monthly Median | 23 | 2.2 - Seven-day Median |
| Turbidity, NTU | Daily Maximum | No limit | 5 |
| | Daily Average | | 2 |
| Selenium, ug/L | Weekly Average | 5 | 5 - Four-day Average |
| | One-hour Average | | 20 |
| Copper, ug/L | One-hour Average | No limit specified | 50 at hardness = 200 mg/L |
| | Four-day Average | | 16 at hardness = 200 mg/L |
| Ammonia ⁽³⁾ , mg/L | Thirty-day Average | No limit | 1.94 for pH = 8, T = 18°F |
| | One-hour Average | | 5.62 for pH = 8 |

Notes:

- (1) The NPDES Permit has been remanded to the RWQCB for further proceedings, based on a November 2003 SWRCB Water Quality Order, WQO 2003-0018.
- (2) Based on California Toxics Rule and U.S. EPA National Recommended Water Quality Criteria to Protect Freshwater Aquatic Life; values listed are dependent upon hardness and are located in a lookup table attached to permit.
- (3) Based on U.S. EPA National Ambient Water Quality Criteria Recommended to Protect Freshwater Aquatic Life; values listed are dependent upon temperature and pH and are located in a lookup table attached to permit.

filtration). The permit established performance-based standards, identical to the disinfected tertiary requirements of Title 22, California Code of Regulations. While not specified in the permit, it is anticipated that disinfected tertiary Title 22 compliance may be required in the future. Meeting the Title 22 disinfected tertiary standards would allow for unrestricted reuse of the City's effluent and would also provide the City more flexibility in its discharge and/or reuse in the future.

Though not included in the 2001 NPDES permit as an effluent limit, another constituent of concern addressed was salinity measured in the form of electrical conductivity (EC), total dissolved solids (TDS), and chloride. High salinity wastewater, when used for irrigation purposes, could increase salt levels within the crop root zone causing potential plant growth issues. The City was required to conduct a salt loading study identifying salinity sources, reasonable potential to exceed water quality objectives, and potential control measures. The "Engineering Report on the Assessment of Effects, Sources, and Control of Dissolved Salts at the City of Davis Wastewater Treatment Plant" (Salt Study) was completed in April 2003.

Along with salinity, the remanded NPDES permit also required monitoring of aluminum. Future effluent limits for aluminum and salinity constituents (i.e., EC, TDS, and chloride) may be based, respectively, on EPA ambient water quality criteria and United Nations agricultural water quality goals for the protection of sensitive crops as summarized in Table 2. The existing effluent exceeds the criteria for these constituents. Meeting the limits for EC and TDS would require significant modifications to the existing treatment process and would not likely be met other than through reverse osmosis (RO) treatment. Alternatively, a change in the drinking water source could significantly reduce concentrations of these constituents.

In addition to the requirements and constituents already discussed, the City also completed a Reasonable Potential Analysis in 2005 as part of their NPDES permit renewal process on their existing effluent. Results from this analysis indicate that lead, cyanide and iron may also be potential constituents of concern. Stricter limits for selenium and methyl mercury are also anticipated to be implemented during the planning horizon (i.e., before 2030); however, potential limits for selenium and methyl mercury are not yet known.

Table 2 - Water Quality Criteria for Aluminum and Salinity

| Constituent | Basis for Criteria | Criteria |
|-------------|--|---|
| Aluminum | US EPA Ambient Water Quality Criterion | 87 ug/L, 4-day average ⁽¹⁾ 750 ug/L, one-hour average |
| TDS | UN Agricultural Goal for Sensitive Crops | 450 mg/L |
| EC | UN Agricultural Goal for Sensitive Crops | 700 umhos/cm |
| Chloride | UN Agricultural Goal for Sensitive Crops | 106 mg/L |

Note:

(1) A footnote in the EPA Criterion document notes that this value may not be applicable to all water bodies, based on background aluminum concentrations that exceed it.

Population Projection

For the purposes of this Master Plan, projections for city growth are needed due to the long-term projection limitations of the existing General Plan. The "planning period" of the General Plan, adopted in 2001, extends only to January 2010. Action LU 1.1e in the General Plan calls for creating a growth management system "to keep the population of the City below 64,000 in 2010." However, the City's population for January

2005 was 64,401 as estimated by the State Department of Finance (DOF), with five years remaining in the General Plan planning period.

City staff utilized two sources of information for projecting residential units and population beyond 2005. The first source was an adopted resolution, passed by City Council on March 8, 2005, that allows for projecting population to January 2010. This adopted resolution implemented a growth rate of 1 percent (or 261 units based on the City's total residential units in January 2005) plus exempted units (which include affordable housing). Based on this direction, City staff estimates that this would equate to an average of 325 units per year through the five-year period, or to January 2010. The second source was information provided to the Sacramento Area Council of Governments (SACOG) for the 2030 projections of the "Blueprint" transportation and land use project. This information indicated that the City would grow at an annual average rate of approximately 1 percent or 261 units (based on the City's total residential units in January 2005) to January 2030.

Davis residents are currently considering a new development, Covell Village. The City Council has approved the project for consideration by public vote in a November 2005 election. The growth projections used for this Master Plan are assumed to apply regardless of whether the Covell Village project is approved by the voters.

Because the City's General Plan is nearing build-out, future growth, at this 1 percent annual rate, requires adding new buildable land uses to the General Plan. Thus, the actual future population in Davis is dependant on a variety of factors that cannot be predicted. Importantly, the projections used in this analysis are a tool for future planning; they do not represent plans by the City to accommodate this level of population.

Based on the growth rate information presented, population projections are developed by multiplying the projected number of residential units built per year by an assumed 2.5 persons per equivalent dwelling unit (EDU). This estimate of additional population is then added to the existing population served by wastewater facilities.

Projected Wastewater Flow

The WPCP is currently permitted for a dry weather discharge capacity of 7.5 mgd. The NPDES permit states that dry weather is typically May through October and that, during this time, dry weather flows discharged shall not average greater than 7.5 mgd within the reporting period. This permitted capacity takes into consideration higher influent flows during wet weather periods. The Master Plan evaluates flow for the average dry weather maximum month (ADWMM) and average dry weather (ADW), defined as the average of three consecutive low-flow months. These flow conditions are important in sizing future facilities and evaluating individual treatment unit capacity.

ADWMM flows typically occur in May, which often has wet weather events and high groundwater conditions. During the NPDES permit renewal process, the City requested that the permit define ADW as the three consecutive low-flow months, as this is more reflective of actual dry weather conditions. Thus, ADW flow values are used to project the hydraulic capacity of the WPCP facility. These ADW flow projections can then be compared to the permitted capacity of 7.5 mgd.

Table 3 summarizes historical service area population, total influent flows and influent per capita flow values. Both the ADW and ADWMM per capita flow values are determined by dividing the influent flow by the historical population. During a public hearing on Covell Village, the 95-gallon per day, per-capita (gpdpc) value was discussed and used to present future flows to the plant. However, to be consistent with the definition of the permitted discharge capacity, the ADW flow

Table 3 - Historical Population, Total Influent Flow, and Per Capita Flow Values

| Year | Service Area Population ⁽¹⁾ | Growth (%/year) | ADW Flow (mgd) ⁽²⁾ | ADW Per Capita Flow (gpdpc) | ADWMM Flow (mgd) ⁽³⁾ | ADWMM Per Capita Flow (gpdpc) |
|---------|--|-----------------|-------------------------------|-----------------------------|---------------------------------|-------------------------------|
| 2000 | 61,665 | | 5.22 | 85 | 6.04 | 98 |
| 2001 | 63,210 | 2.5 | 5.25 | 83 | 5.82 | 92 |
| 2002 | 64,706 | 2.4 | 5.43 | 84 | 5.97 | 92 |
| 2003 | 65,200 | 0.8 | 5.47 | 84 | 6.29 | 96 |
| 2004 | 65,890 | 1.1 | 5.55 | 84 | 6.43 | 98 |
| Average | | 1.7% | | 84 | | 95 |

Note:

- (1) Based on May 2005 Population Estimates, California Department of Finance plus an estimated 1,358 people living in El Macero and North Davis Meadows.
- (2) Average dry weather (ADW) flow calculated as the average of the three low-flow months of the year, typically July through September.
- (3) Average dry weather max month (ADWMM) flow is the maximum flow during May through October, typically occurs during May.

per capita value of 84 gpdpc is used for projecting influent wastewater flow through the planning horizon.

Projected influent wastewater ADW flows are developed by multiplying the projected population by the ADW average per capita flow value of 84 gpdpc. Table 4 summarizes the projected population used for planning along with the projected ADW influent flow for the planning period. Based on the projected influent flows shown in Table 4, the ADW flow is not projected to exceed the existing WPCP permitted capacity of 7.5 mgd during the 25-year planning horizon. Prudent planning, however, would call for maintaining the permitted capacity of 7.5 mgd and not decreasing capacity as part of this project. This provides for long-term operating margins that are beneficial to the City. The Master Plan considers the recommended project as an improvement project to improve reliability and to bring the existing WPCP's discharge capacity of 7.5 mgd ADW flow into regulatory compliance with an anticipated NPDES permit. The recommended project will be carried forward in the California Environmental Quality Act (CEQA) process.

Table 4 - Projected Population and Influent Flows

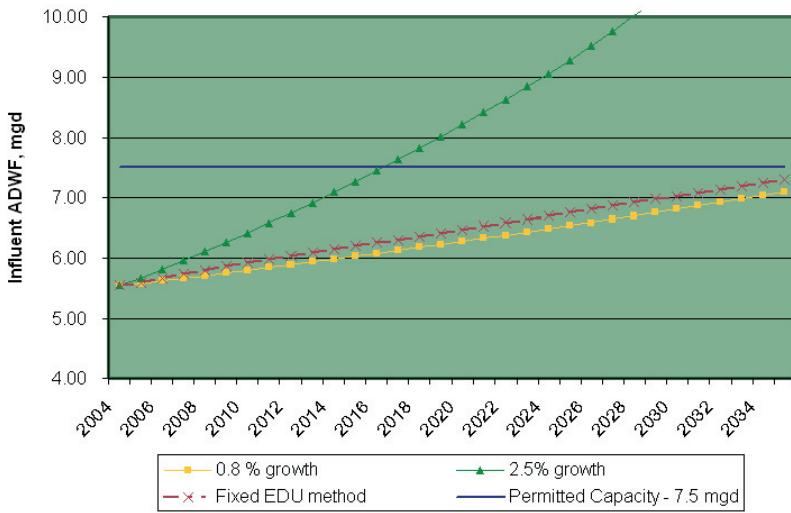
| Year | Projected Population Served ⁽¹⁾ | ADWF, mgd (Using 84 gpdpc) |
|------|--|----------------------------|
| 2004 | 65,890 | 5.55 |
| 2010 | 70,122 | 5.89 |
| 2015 | 73,329 | 6.16 |
| 2020 | 76,502 | 6.43 |
| 2025 | 79,692 | 6.69 |
| 2030 | 82,882 | 6.96 |

Note:

- (1) Estimated assuming fixed EDU increase per year based on DOF and SACOG population projection information.

As indicated in Table 3, the population growth rates over the last five years have varied from 0.8 percent to 2.5 percent. For comparison purposes, the flow projections shown in Table 4 are compared with flow projections resulting from high and low population growth rates as observed in the past five years. This comparison of projected

Figure 1 - Projected Influent Flow Comparison



flows is illustrated graphically in Figure 1. Actual growth is likely to be somewhere within this range and will depend on the future growth policies adopted by the City. Using the high growth rate of 2.5 percent, the ADW flow would exceed 7.5 mgd in 2016. Even using this high growth rate, the City has some time until additional capacity is needed. A capacity expansion project would not be implemented until “triggered” by observed flows at the WPCP, which is discussed in more detail under the Strategic Plan Section.

Evaluation of Existing Facilities

The City’s original WPCP, constructed in 1970, consisted of influent pumping, comminutors, grit removal, primary sedimentation, oxidation ponds,

disinfection, and anaerobic solids treatment. The overland flow process was added in 1980 and modified in 1985 to provide additional polishing treatment. In 1989, the disinfection system was upgraded with a new chlorine contact basin and chemical storage facility. Expansion and upgrade of the WPCP facilities were completed in 1999, which included expansion of primary sedimentation, anaerobic digestion, and solids drying. As part of the 1999 project, a portion of one of the oxidation ponds was converted into two aerated ponds and a Lemna, or duckweed, pond system. Figure 2

illustrates a simplified schematic of the existing treatment facilities.

During the technical session process, session attendees including City staff, outside experts, NRC members, and the project team reviewed each of the existing treatment processes as part of a brainstorming exercise. One goal of the exercise was to determine the applicability and potential of the existing facilities to meet the existing regulatory requirements as outlined in the 2001 remanded NPDES permit as well as other potential future requirements. Based on these discussions during the technical session and the findings of a capacity and performance analysis, findings and recommendations are summarized for the existing WPCP in Table 5.

Figure 2 - Existing WPCP Facilities Treatment Schematic

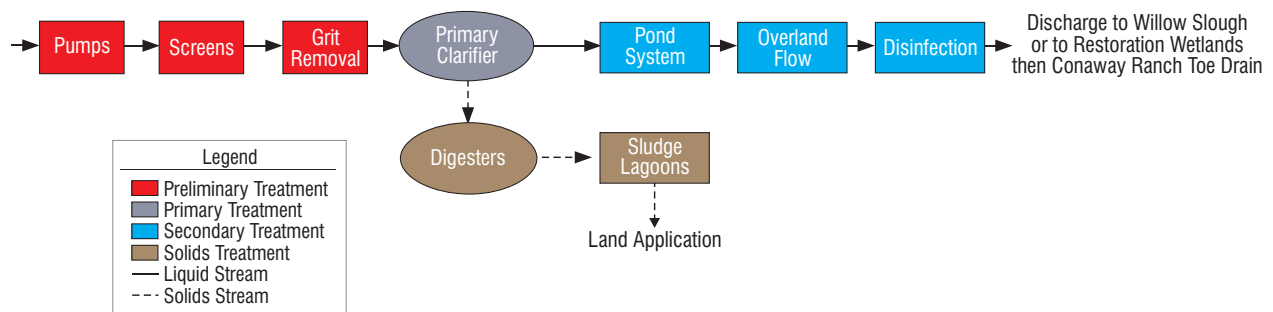


Table 5 - Summary of Findings/Recommendations on Existing WPCP Treatment Facilities

- ▶ Existing headworks' screening needs improvement.
- ▶ Existing primary clarifier capacity is sufficient.
- ▶ Existing secondary system produces variable effluent quality that is not conducive to meeting the strict effluent limits required by the 2001 NPDES permit and potential requirements anticipated in the future:
 - Oxidation/aerated ponds offer inadequate treatment performance for meeting potential NPDES permit requirements. The ponds produce significant algal solids (TSS) during summer months and provide low ammonia reduction during the winter months.
 - Overland flow will not be considered in the future due to inadequate treatment performance for meeting potential NPDES permit requirements, poor water quality during winter months (high TSS), and vector issues (i.e., mosquitoes) that result in employee exposure and elevated abatement costs with limited benefit.
 - Lemna pond will not be considered in the future due to little added treatment benefit for meeting potential NPDES permit limits and due to the failing grid system which requires continued maintenance.
- ▶ Existing disinfection system would need to be expanded to meet stricter disinfection requirements outlined in the 2001 NPDES permit.
- ▶ Existing primary solids digestion and drying capacity sufficient.
- ▶ Restoration wetlands provide a community benefit and are to be maintained for all alternatives.

In general, the preliminary/primary facilities, including influent pumping, screening, grit removal and primary sedimentation have adequate capacity and are in good condition for future use. The solids process, consisting of anaerobic digestion and solids drying, also has adequate capacity. The solids handling facilities are considered to be in good condition for future use as well.

The secondary system, consisting of oxidation/aerated ponds, Lemna ponds, and overland flow system, often produces variable water quality and is impacted by climatic conditions. Because of these factors and the stringent regulatory requirements that are assumed based on the 2001 remanded NPDES permit as well as other, recent permitting activity by the Regional Board, the consensus of the technical session attendees was that the secondary process, in its current configuration, had reached the end of its useful life. However, the physical facilities could still serve in other treatment capacities depending upon the alternative secondary treatment considered.

ALTERNATIVES ANALYSIS

Using the project requirements as a basis, alternatives for disposal, reuse, and treatment were considered, discussed, and screened during the technical session process. Attendees at these meetings included City staff, NRC members, legal and regulatory experts, the project team (including internal process experts), and outside wastewater experts including George Tchobanoglous (professor emeritus from UC Davis College of Engineering), Robert Gearheart (professor emeritus and wetlands specialist from California State University at Humboldt) and Joe Middlebrooks (professor emeritus and pond specialist from Utah State University at Logan). After the first three of four technical sessions, the project team evaluated and developed the alternatives in more detail. The team reassembled at Technical Session No. 4 to discuss and screen the alternatives further and to develop recommendations.

Because the level of treatment required depends on the disposal/reuse alternative being considered, some treatment processes were better suited than others for certain disposal alternatives. To simplify the alternatives discussion, the disposal and reuse alternatives are discussed first followed by a discussion of the treatment alternatives evaluated.

Disposal/Reuse Alternatives

The following disposal and reuse alternatives were evaluated on both an economic and non-economic basis:

- ▶ Surface Water Discharge:
 - Willow Slough/Conaway Ranch Toe Drain (existing discharge)
 - Tule Canal
 - Sacramento River
- ▶ Year-Round Land Disposal/Reuse
 - Seasonal agricultural reuse/storage
 - Seasonal agricultural reuse/percolation basins
 - Year-round percolation basins
- ▶ Seasonal Reuse
 - Urban reuse through a satellite treatment facility separate from the WPCP
 - Urban reuse from WPCP facility
 - Reuse at Yolo Basin Foundation/Department of Fish and Game (DFG) Wetlands
 - Demonstration reuse on City owned lands
- ▶ Export raw wastewater to Sacramento Regional County Sanitation District (SRCSD)

During Technical Session No. 4, the group discussed the economic and non-economic merits of each disposal/reuse alternative. The seasonal reuse alternatives could be added to any disposal alternative and therefore, were considered separately.

Based on group discussion, the Tule Canal alternative was determined to offer no benefit for consistent dilution with added cost over the existing discharge location; therefore, this option was eliminated. The seasonal reuse alternative with winter percolation did not save any land requirement over that of year-round percolation and therefore, was

more expensive. This alternative was also eliminated from further consideration. The remaining disposal/reuse alternatives are compared in Table 6.

Table 6 - Summary of Disposal/Reuse Alternatives Evaluation

| | Existing Discharge | Sacramento River | Export to SRCSD | Land Percolation | Storage/Reuse |
|------------------------------|--------------------|------------------|-------------------------------|------------------|---------------|
| Relative Cost ⁽¹⁾ | 1.00 | 1.8 | 1.6 | 1.1 - 1.3 | 2.0 - 3.0 |
| Level of Treatment Assumed | Tertiary | Tertiary | Secondary (provided at SRCSD) | Secondary | Secondary |
| Risk of Implementation | Low | High | Medium | High | Low |

Note:

(1) Relative cost = cost of alternative divided by cost of existing discharge alternative.

While the Sacramento River may offer dilution for discharge, at least in the immediate future, the facilities needed to discharge to the Sacramento River are expensive. The reliability of obtaining long-term dilution credit in the Sacramento River is very uncertain for some water quality constituents. In addition, downstream water purveyors would potentially have strong objections to a new discharge in the Sacramento River, which might impact implementation for an extended period.

Export to SRCSD is also costly and there is no certainty that SRCSD will be able to continue secondary discharge, as they are currently receiving pressure to add tertiary treatment. The addition of tertiary treatment at SRCSD would further increase the cost to the City for this alternative.

The year-round land percolation option is the second lowest cost alternative, next to continuing with the existing discharge. However, several unknowns are associated with this alternative, such as the ability to maintain long-term percolation rates in this part of the Central Valley, where heavy clays persist. In addition, regulations for percolation operations are becoming more prohibitive and this will likely increase as degradation of groundwater continues to be evaluated.

The storage and reuse option is very costly due to the large area of storage ponds required to hold the water through the winter, and due to the large amount of land that must be purchased for reliable reuse application in the summer.

Based on these considerations, the conclusion from Technical Session No. 4 was to carry forward the disposal alternative for continued discharge at the existing location (Willow Slough and Conaway Ranch Toe Drain). It is assumed that discharge at this location requires tertiary treatment based on the 2001 NPDES permit and discussion above. All treatment alternatives considered included tertiary treatment. Tertiary treatment also allows greater use of the water for reuse, if desired, and provides more flexibility for moving to a new discharge location at some point in the future.

Treatment Alternatives

During the technical session process, attendees were broken into smaller, brainstorming groups and were charged with developing treatment alternatives that would meet, at a minimum, the 2001 NPDES permit and potential future regulatory requirements identified by the regulatory experts. Each of these groups suggested a variety of treatment train alternatives. The entire group then reviewed all the alternatives to discuss the merits of each. The following treatment alternatives remained after an initial screening and discussion of the advantages and disadvantages of various treatment processes:

1. **Extended Aeration and Filtration Alternative**
(Screening→Grit Removal→Primary Clarification→Extended Aeration→Secondary Clarification→Filtration→Disinfection)
2. **Membrane Bioreactor (MBR) Alternative**
(Screening→Grit Removal→Primary Clarification→Membrane Bioreactor {Aeration Basin→Membrane Filtration}→Disinfection)
3. **Modified Ponds and Filtration Alternative**
(Screening→Grit Removal→Primary

Clarification→Enhanced Aerated Ponds→Nitrifying Rock Filter→Vegetated Treatment Wetlands→Filtration→Disinfection)

These three treatment alternatives were developed in more detail to determine unit process sizing requirements and conceptual level costs. The conceptual level costs for the three alternatives are separated by approximately 15 percent. At Technical Session No. 4, the advantages and disadvantages of each alternative were discussed and are summarized in Table 7 on the following page.

Findings on Alternatives

At the conclusion of Technical Session No. 4, the recommended disposal alternative was continued discharge at the existing location (Willow Slough and Conaway Ranch Toe Drain). It is assumed that discharge at this location will require tertiary treatment. Reliably meeting the effluent requirements for tertiary treatment requires a stable and consistent secondary effluent.

During Technical Session No. 4, process experts expressed reservations about the ability of the modified pond / filtration alternative to consistently meet discharge requirements due to the climatic dependency of the processes. Therefore, group consensus was to eliminate the modified pond / filtration alternative. Of the two remaining alternative treatment trains, MBR and extended aeration coupled with filtration, the MBR system would be the preferred alternative. An MBR system will, in general, produce a better quality effluent and exceed the tertiary treatment standards as well as many of the other effluent limits. Also, an MBR will provide greater reliability and flexibility to meet current and future requirements.

With either the MBR or the extended aeration/ filtration alternative, the question of compliance with *all* potential permit requirements remains, specifically for metals and salts. Both treatment processes are anticipated to remove metals to some degree, but it is difficult to say with certainty to what level.

Table 7 - Comparison of Non-Economic Considerations for Treatment Alternatives

| Criteria | MBR | Extended Air/Filtration | Modified Ponds/Filtration |
|---|---|--|--|
| Water Quality <ul style="list-style-type: none"> Conventional Pollutants (BOD, TSS, Turbidity, Coliform, Ammonia) Metals/Organics | Highest Quality Likely good - need data for selenium and other metals of concern | Good Quality Likely good - need data for selenium and other metals of concern | Variable Quality Land systems are generally good for metals reduction- but will methylate mercury and bioaccumulate selenium. |
| Adaptability/Flexibility to meet future regulations | Best - Easier to add on reverse osmosis, also effectively reduces pathogens | Fairly good | Fair |
| Reliability to consistently meet or exceed process performance (NPDES requirements) | Good - Exceeds many of the NPDES requirements | Good | Variable |
| Public Health/Vectors | None | None | Mosquitoes |
| Operational Simplicity | Moderate | Moderate | More intensive |
| Community Benefit/Addition of Habitat | None additional | None additional | Vegetated Wetlands - but no public access |

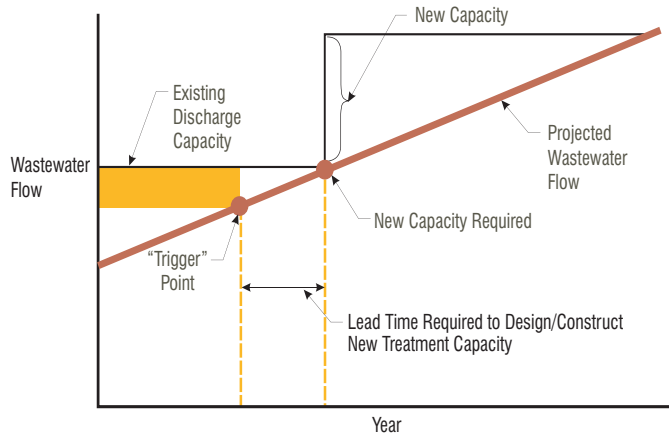
To address the metals compliance question, a strategy was identified to assist the City with the treatment alternative decision. The first component in the strategy is to pilot a bench-scale MBR system on the City’s influent to better determine the metals removal capability. If the MBR pilot provides consistent metals removal, the City can proceed into preliminary design on this process. However, if the pilot does not achieve consistent metals removal, the adjustment of operational parameters and alternate processes will be evaluated as potential methods of achieving metals reduction. Simultaneous to pilot testing, the City has also initiated studies or work plans for studies that would determine the actual toxicity of various metals in the specific effluent and receiving water conditions of the discharge. The results of these studies may affect ultimate permit requirements.

RECOMMENDED PROJECT / STRATEGIC PLAN

Recommended Project

The recommended project is continued discharge to Willow Slough and Conaway Ranch Toe Drain with tertiary treated water, based on the factors discussed above. A phased reuse program could also be implemented including: providing demonstration agricultural reuse on City-owned lands south of the plant, providing reuse water to the Department of Fish and Game for use in supplementing water supplies in the northern areas of the Yolo Wildlife Area lands, and potentially implementing urban reuse for golf courses, parks, and/or Covell Village. Recycled water for all potential users of this phased reuse program would be provided from the WPCP treatment facility.

Figure 3 - Expansion “Trigger” and Timing of New Facilities



Future expansion of the plant beyond the existing discharge capacity of 7.5-mgd ADW flow will not be required for many years and would not occur until certain flow “triggers” are reached indicating that the plant capacity will be exceeded within a five-year period. This flow-trigger concept is illustrated in Figure 3. However, for master planning purposes, consideration of future facilities is prudent to ensure adequate space is available. The recommended treatment process schematic is shown in Figure 4. The layout for the recommended project and future facilities is shown in Figure 5 on the following page.

The conceptual level costs for the recommended project are shown in Table 8 on the following page. The treatment facility costs include construction of the following major elements:

- ▶ Preliminary/primary modifications: screens, gates and chemical addition facilities.
- ▶ Secondary/tertiary treatment - aeration basins, membrane tanks, pumps, blowers, chemical cleaning facilities.
- ▶ Solids handling facilities - sludge lagoons.
- ▶ Disinfection facilities - ultraviolet light.
- ▶ Energy/power systems.
- ▶ Auxiliary systems - potable water, storm water pumps, boiler upgrades.
- ▶ Operations building and laboratory upgrades.

Strategic Plan

A strategic planning meeting was held in May 2005 with City staff, the project team, and regulatory and legal consultants to the City. At that meeting, the recommended project and other disposal options were discussed. The discussions centered on the capacity of the recommended project with respect to CEQA issues, regulatory issues and strategies concerning level of treatment and constituents of concern, and the effect of water supply on those constituents. The purpose of the restoration wetlands was also discussed, including how the wetlands fit with the future treatment and discharge.

Figure 4 - Recommended Alternative Treatment Schematic

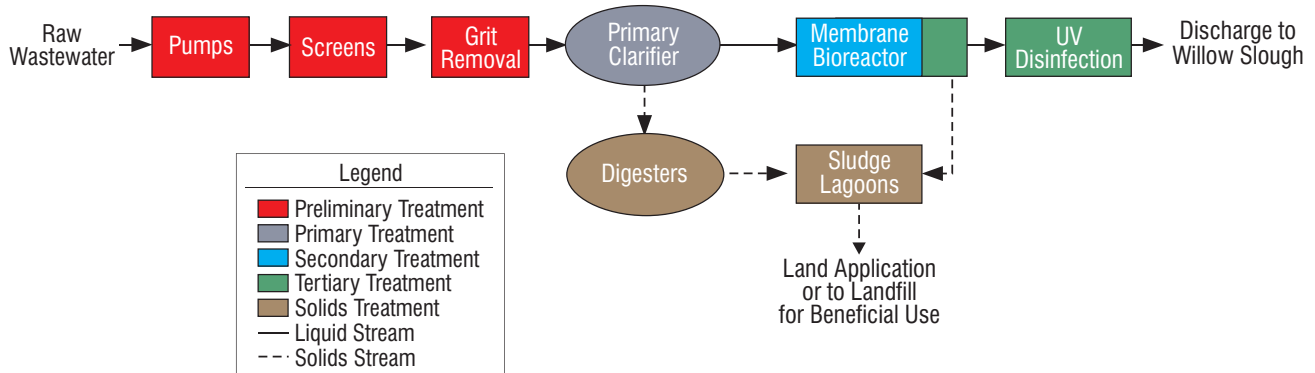
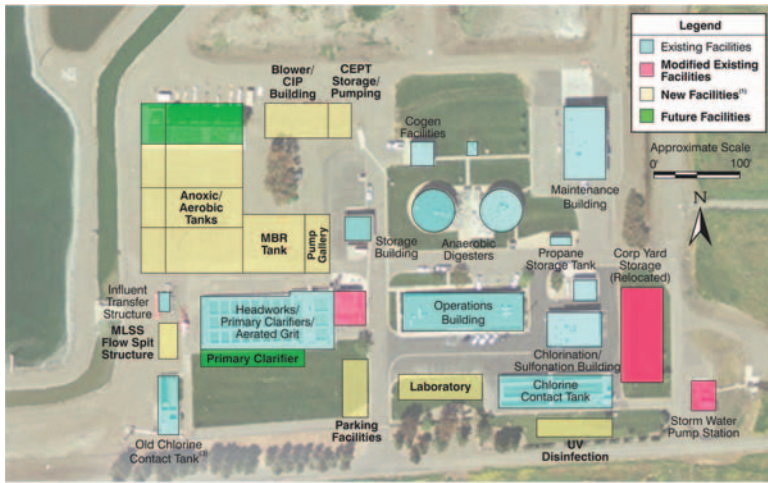


Figure 5 - Conceptual Layout of Recommended Project



Note:
(1) Facilities needed to meet project flow and load conditions and anticipated NPDES requirements.

established by the General Plan. However, the recommended project to be carried forward into CEQA and design will be designed to meet the current permitted discharge capacity of 7.5-mgd ADW flow and to meet anticipated stricter regulatory requirements. Although the project does not add treatment capacity, the existing capacity exceeds development levels allowable in the 2010 General Plan. Growth inducement will need to be considered during CEQA review, but because capacity would not be added, the growth-inducement considerations are less of a concern than if capacity were added.

Table 8 - Recommended Conceptual Level Project Costs

| Costs, millions ⁽¹⁾ | Construction Costs | Project Costs ⁽²⁾ |
|------------------------------------|--------------------|------------------------------|
| Treatment Facilities | \$100 | \$140 |
| Reuse Options | | |
| Demonstration Agricultural | \$10-15 | \$15-20 |
| Yolo Basin Foundation/DFG | \$5-10 | \$7-14 |
| Urban Reuse | \$35-45 | \$50-64 |
| Total Reuse Options ⁽³⁾ | \$50-70 | \$72-98 |

Note:
(1) Costs based on ENR = 9200 (mid-point of construction, June 2010).
(2) Project Costs = 1.4 x construction costs to account for engineering, legal, administrative and construction management costs.
(3) The reuse options are in addition to the cost for treatment facilities.

CEQA Issues

The 2010 General Plan build-out creates unusual issues for developing a wastewater master plan and moving forward with a project. If the project results in capacity that exceeds general plan development levels, the project’s growth-inducing impacts must be evaluated during the CEQA review. This triggers the need to evaluate impacts due to growth (e.g., traffic, schools, etc.) as part of the Environmental Impact Report (EIR).

As a necessity for completeness, this Master Plan evaluated treatment plant needs past the 2010 date

Level of Treatment

At the start of the master planning process, there was discussion about the justification for a permit requirement of adding tertiary treatment. As discussed in the Regulatory Requirements section, the City appealed this part of its 2001 NPDES permit. While the City’s NPDES permit has not yet been acted upon, a recent court decision upheld an NPDES permit requiring that the City of Woodland (the City’s neighbor to the north) meet

effluent limitations based on tertiary treatment. The Regional Board must consider the costs and circumstances of any individual discharge before imposing tertiary treatment. The consensus of the regulatory and legal experts consulted on this issue was that the likely environmental benefit of meeting Title 22 tertiary standards would be quite marginal, but that tertiary treatment is likely to be required in the next permit, based on the 2001 permit and other permitting actions of the Regional Board. Facilities meeting tertiary treatment requirements may also provide metals reduction as described previously. Therefore, it is the

recommendation of the project team and City staff that the City plan for the construction of tertiary treatment. Overall, the process of development of the new NPDES permit and further efforts on the Master Plan will interrelated.

Constituents of Concern

As discussed under the Regulatory Requirements section, several constituents currently have regulatory goals more stringent than existing effluent concentrations. Several constituents arrive at the WPCP in high concentrations due to the City's drinking water source. The City currently relies entirely on groundwater wells for public water supply. A combination of intermediate and deep wells extract groundwater from underlying aquifers. Studies have shown that if the City either replaced intermediate aquifer wells with deep aquifer wells and/or developed a surface water supply from the Sacramento River, the WPCP influent concentrations would decrease for TDS, EC, and selenium.

EC/TDS

In several of the technical sessions, the issue of salinity, in particular TDS and EC, was discussed. It was determined at these meetings that adding treatment to meet strict TDS and EC goals at the WPCP would be cost prohibitive. Rather, improvements to the water supply would be first priority as these measures would improve the general drinking water quality as well. Therefore, the first strategy for TDS/EC reduction will be to continue efforts to import Sacramento River water for water supply. In the interim, the City will continue converting wells to deep aquifer wells as intermediate aquifer wells reach the end of their useful life. If the deep aquifer is unable to support all the water demands, wellhead treatment in the form of RO could be implemented to improve water quality, if justified. Finally, as a last resort, RO facilities could be added to the WPCP to reduce effluent TDS/EC concentrations to meet discharge requirements.

The degree of implementation or timing of the above measures cannot be determined with certainty. Given that, for the WPCP, such measures would primarily relate to salinity reduction, a significant question is what levels of salinity are acceptable. The City has joined the Agricultural Salt Study currently underway for the City of Woodland and UC Davis to determine the appropriate TDS/EC levels for crops grown in the area. The City will also begin working on investigating high-strength dischargers and develop a program to educate users about the use of water softeners.

Selenium

The City's drinking water supply has relatively high levels of selenium similar to the issue of TDS/EC. Selenium is a naturally occurring substance in the area soils. The influent selenium is primarily in dissolved form and filtration processes do not significantly reduce dissolved metals. Selenium is currently reduced by the overland flow process, which acts in the same way as a wetlands in that the selenium is bound to soils and taken up by biota, plants, and algae. The selenium then bioaccumulates in birds and aquatic life that consume the selenium rich food. With the elimination of the overland flow process, the bioaccumulation issues in the overland flow are resolved; however, it is unknown if new treatment processes will be able reduce the influent selenium levels to meet discharge limits.

As with TDS/EC, conversion to an alternate water supply will decrease the selenium concentrations in the influent. Since the selenium is naturally occurring in the soils, the concentrations in the receiving water are also elevated above water quality objectives. The EPA has released draft regulations changing selenium to a fish tissue-based criteria. It is unknown if this new criteria will be easier or more difficult for WPCP compliance. The City could begin studies to determine selenium accumulation in key indicator organisms in Willow

Slough and the Yolo Bypass, which may lead to developing site-specific standards for the discharge.

Aluminum

Aluminum is another substance that is naturally high in the surrounding soils. Interestingly, the water supply does not have high concentrations of aluminum (<50 ug/l), although the influent wastewater is very high (over 1,300 ug/l). This would indicate that aluminum is either being added through use or by infiltration into the sewer lines. The background concentrations in the receiving stream exceed the water quality criteria that has been relied on by the Regional Board in recent permits. It is recommended that discussions with the RWQCB be held to evaluate the appropriateness of the such limits for this discharge. In addition, it is recommended that the City begin water quality studies to develop a water effects ratio that may ultimately lead to regulatory relief on this issue.

Discharge Location

While remaining at the existing discharge location is recommended for wastewater disposal, strategies for the future include evaluating potential future changes in discharge locations. If, in the future, continued discharge to an effluent-dominated water body becomes prohibitive due to the level of treatment required, the City could still pursue the Sacramento River as an alternative discharge location, or move toward a zero discharge with reuse and storage. Tertiary treatment would provide the City more flexibility in moving its discharge (required in a new discharge location) or in the ability to implement unrestricted reuse (requires tertiary treatment). If the City implements a demonstration reuse project, as recommended, the surrounding farmers and public may more readily accept the use of recycled water, in case a more aggressive reuse program is ever necessary.

Restoration Wetlands

The restoration wetlands were put in service in 1999, with funding from the US Army Corp of Engineers to restore wetland habitat in the area. The primary goal of the wetland design was to provide habitat for waterfowl. A secondary goal was to provide treatment benefits to the community's wastewater and storm water. Of the almost 400 acres, only 77 acres are dedicated to wastewater treatment, with the rest being used for storm water treatment and detention.

There are several issues with the current configuration of the wastewater wetlands. The long detention times and lack of vegetated zones lead to algal growth and a rise in pH, making compliance with existing discharge requirements difficult. If the wetlands are kept in the process in the future, tertiary standards would be impossible to meet. Also, selenium in the effluent bioaccumulates in the wetland food chain and requires regular monitoring. Sampling performed over the last five years has indicated a steady rise of selenium in the invertebrates and bird eggs, indicating that continued use of the wetlands may be problematic.

At the strategic planning session, a couple options for the wetlands were discussed. The wastewater wetlands could be converted to storm water wetlands, with the potential to add wastewater occasionally providing habitat water in the summer and fall months. Another option is to use the wetlands as part of the reuse program and run the tertiary treated water through them on the way to reuse sites. Turbidity and coliform sampling would have to occur before the wetlands. Running the water through the wetlands before sending it to the Yolo Basin/DFG wetlands may offer a level of comfort to the DFG wetland managers about safety of the water for use on wetlands. Finally, the wetlands could be kept in the treatment process to provide a temperature adjustment prior to discharge to ensure the thermal plan requirements are met. All discharge requirements would have to be met prior to the wetlands to ensure compliance.

The configuration of the wetlands and how to use them in the future will be evaluated in more detail during preliminary design of the new facilities. Discussions with the RWQCB about the issue of compliance points would be required for any of the options discussed above.

SUMMARY/RECOMMENDATIONS

The next step is to move forward with preliminary design for the new treatment facilities and begin the CEQA documentation (preparation of an EIR). The first step of the preliminary design will include process confirmation with the MBR pilot, as discussed earlier, to confirm compliance with effluent limits. Simultaneously, regulatory permitting must move forward. The project team has been in contact with the RWQCB regarding the Master Plan, and communications will continue with the RWQCB through the CEQA and preliminary design process. The 2001 NPDES permit is up for renewal in 2006. As such, permitting documents will be prepared and meetings held with the RWQCB as part of the permit renewal process. An implementation schedule for all these activities is shown in Figure 6 on the following page.

Recommended follow-up studies and next steps are as follows:

- ▶ Process confirmation and performance determination through piloting.
- ▶ Preliminary design of recommended alternative, once process confirmation is complete.
- ▶ CEQA review/EIR preparation of recommended alternative, once process confirmation is complete.
- ▶ Financial rate analysis.
- ▶ Water quality studies and permitting studies, as necessary.
- ▶ Continue permit negotiations and discussions with RWQCB.

Figure 6 - Proposed Implementation Schedule for Design, CEQA, Permitting/Legal

