CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER 01-113
NPDES PERMIT NO. CA0038768

AMENDING WASTE DISCHARGE REQUIREMENTS, ORDER NO. 00-003, FOR:

THE CITY OF AMERICAN CANYON, NAPA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region, hereinafter called the Board, finds that:

1. The Board issued the City of American Canyon (hereinafter the Discharger) a new NPDES permit, Order No. 00-003, on January 19, 2000. Order No. 00-003 regulates effluent discharge to North Slough, an existing tidally influenced wetland tributary to the Napa River.

2. The Discharger is constructing a new municipal wastewater treatment and reclamation facility (the Plant), located at the west end of Eucalyptus Road adjacent to the City of American Canyon, Napa County, California. The Plant will provide tertiary level treatment of wastewater from domestic, commercial and industrial sources within the City of American Canyon. Construction is scheduled for completion and startup in November 2001.

3. Effluent from the treatment plant will be separated into two parallel process streams to keep waste-streams with higher total dissolved solids (TDS) concentrations separate from lower TDS waste-streams. Wastewater from the North Basin, which is about 25% of the total flow, has higher TDS concentrations (2,000 mg/L) that are unsuitable for most reclamation uses (e.g., agricultural and landscape irrigation). This wastewater will be separated from the other 75% of the wastewater flow from the Main Basin, which is lower in TDS.

4. The Basin Plan prohibits discharge of treated wastewater to shallow waters (waters that do not receive 10:1 dilution), as well as any non-tidal water or dead-end slough, except where an equivalent level of environmental protection can be achieved, the discharge is approved as a part of reclamation project, or where it can be demonstrated that net environmental benefits will be derived as a result of the discharge. Exceptions to the shallow water discharge prohibition may be granted under Resolution No. 94-086, adopted on July 20, 1994, which is the Regional Board's *Policy on the Use of Wastewater to Create, Restore, and/or Enhance Wetlands*.

5. The current permit allows the Discharger to combine its two parallel process streams and discharge all of its tertiary treated effluent to the North Slough during the period of November 1 through April 30 each year. During the summer months, the current permit also allows discharges of only the higher TDS North Basin treated wastewater to North Slough. The lower TDS Main Basin treated wastewater is currently required under Order No. 00-003 to be reclaimed and used for agricultural and landscape irrigation during the summer months.

6. Wastewater flows are anticipated to be one million gallons per day (mgd) upon startup of the Plant. The treatment plant is designed to treat 2.5 mgd.

7. The discharger is currently working with local landowners to secure agreements for recycled water irrigation. However, until agreements are completed and enough reuse sites are connected to utilize all of the treated effluent, there are likely to be periods during May through October when all of the effluent cannot be reused.

8. The discharger has proposed a constructed freshwater wetland demonstration project to: 1) demonstrate the beneficial use of year-round recycled water for creation of freshwater wetlands; 2) utilize excess effluent during the period while final irrigation customer agreements are completed and conveyance systems/facilities built and 3) provide wastewater to the constructed wetlands into the future as the community grows and projected build-out conditions are achieved in order to continue demonstrating beneficial use of the reclaimed wastewater and demonstrate environmental benefit.

9. **The wetlands will not be considered part of the wastewater treatment and, therefore, must be considered waters of the State.** The wetlands must be managed, and permit limitations have been included in this amendment, to prevent vector problems, nuisance and direct toxicity to wildlife, and to minimize the occurrence of avian botulism, other infectious diseases and bioaccumulation up the food chain.

10. As the freshwater wetlands are expected to attract wildlife, the proposed project to construct the freshwater wetlands with tertiary treated water from the Discharger's treatment plant has been endorsed by the California Department of Fish and Game and the Napa County Mosquito Abatement District. The proposed project is consistent with the San Francisco Bay Area Wetlands Ecosystem Goals Project and the Baylands Ecosystem Species and Community Profiles. The constructed freshwater wetland will also provide a transition zone to the brackish wetlands of the North Slough, which are undergoing restoration by the discharger under Order 00-003.

11. This permit amendment requires that no toxic pollutants shall be present in the water column, sediment, or biota in concentrations that produce detrimental response in human, plant, animal, or aquatic life, or that bioaccumulate in concentrations that may be harmful to human health or aquatic resources.

12. The discharger has prepared a Management Plan in accordance with the Board's *Policy on The Use of Wastewater To Create, Restore, and/or Enhance Wetlands*, Resolution 94-086. The Management Plan describes the location, design features, flow to the wetland volumes, vegetation and wildlife management.

13. In July 2001, the discharger has prepared and circulated an Initial Study/Mitigated Negative Declaration addressing the potential effects of the constructed wetlands. The City approved certification of the Mitigated Negative Declaration on August 16, 2001.

14. The constructed wetland project is consistent with Resolution 94-086, which states that an exception to the discharge policy may be allowed if it can be demonstrated that net environmental benefits will be derived as a result of the discharge. The proposed project will be a "demonstration project" until such time that net environmental benefits have been successfully demonstrated. Determination of project success will be made upon reissuance of the discharger's NPDES permit in January 2005.

PURPOSE OF ORDER

15. This NPDES permit amendment establishes an additional discharge location (E-003-R), thereby permitting discharge of tertiary treated wastewater to constructed freshwater wetlands, some of which will ultimately flow to North Slough once the wetlands are established. This amendment also allows the discharger to divert up to 1.0 MGD of tertiary effluent during the period from May 1 through October 31 to the constructed wetland on an interim basis while the recycled water customer agreements are finalized and distribution facilities are constructed.

16. This permit amendment allows the discharger to use tertiary treated effluent for establishing and sustaining a new freshwater wetland as a demonstration project. The discharger must maintain the constructed wetlands in perpetuity upon successful demonstration of its beneficial uses.

17. The proposed project will consist of construction of 6 acres of freshwater wetlands, which will receive the bulk of the tertiary-treated effluent during the first several years of treatment plant operation. As effluent quantity is expected to increase with population growth in the next ten years, reclamation flows (e.g., agricultural and landscape irrigation) will increase and become roughly equal to the flows going to the wetlands.

18. The effluent compliance monitoring point for the constructed freshwater wetlands will be at the diversion structure as currently permitted by Order No. 00-003, which diverts effluent to either the North Slough directly or to the freshwater wetlands. Some unknown quantity of this reclaimed wastewater going to the wetlands will eventually flow to the North Slough. The new outfall structure, E-003-R, will deliver treated wastewater to the freshwater wetlands from the UV disinfection channel (E-001-S), which also delivers effluent to the North Slough tidal wetlands. (See Attachment B, Treatment Process Diagram.) The third outfall structure (E-002-R) will deliver chlorinated wastewater for unrestricted Title 22 reclaimed water from the chlorine contact chamber effluent.

19. Upon successful demonstration of beneficial uses, the constructed wetlands would become an integral part of the dischargers recycled water reuse program.

BASIS FOR AMENDED PERMIT

20. Discharge to the North Slough is contrary to one of the Discharge Prohibitions identified in the Basin Plan. The Basin Plan states, in part:

"It shall be prohibited to discharge:

Any wastewater which has particular characteristics of concern to beneficial uses at any point at which the wastewater does not receive a minimum initial dilution of at least 10:1, or into any non-tidal water, dead-end slough, similar confined waters, or any tributary thereof.

21. The Basin Plan states that exceptions to the above prohibition will be considered for discharges where:

- An inordinate burden would be placed on the discharger relative to the beneficial uses protected and an equivalent level of environmental protection can be achieved by alternate means, such as an alternative discharge site, a higher level of treatment, and/or improved treatment reliability; or

- A discharge is approved as part of a reclamation project; or

- It can be demonstrated that net environmental benefits will be derived as a result of the discharge."

22. The discharge of tertiary treated effluent to the constructed freshwater wetland will provide the following net environmental benefits:

- Creating a new freshwater habitat that has a long-term net environmental benefit to the San Francisco Bay Area.

- Provide an interim beneficial use of the City's recycled water, in lieu of land disposal, until its program for urban and agricultural irrigation can be fully implemented.

- Removal of approximately 10 acres of non-indigenous eucalyptus trees.

CEQA AND PUBLIC NOTICE OF ACTION

23. This Order serves as an amendment to NPDES Permit No. CA0038768, adoption of which is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code [California Environmental Quality Act (CEQA)] pursuant to Section 13389 of the California Water Code.

24. The discharger and interested agencies and persons have been notified of the Board's intent to reissue requirements for the existing discharge and have been provided an opportunity to submit their written views and recommendations.

25. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED, pursuant to the provisions of Division 7 of the California Water Code and regulations adopted thereunder, and to the provisions of the Clean Water Act and regulations and guidelines adopted thereunder, that the Discharger shall comply with the following amendments to Order No. 00-003:

A. DISHCARGE PROHIBITIONS

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5. Discharge of effluent from the Main Basin directly to North Slough through outfall E-001-S is prohibited during the dry weather period each year, from May 1 through October 31, unless the discharger submits a report, which may be initially submitted over the telephone, to the Executive Officer and the Executive Officer approves it. This report must fully explain the need for discharges and the calculated dilution the discharge may receive during this period (e.g. high flows related to late spring or early fall storm events, when reclamation is not feasible). Discharge of up to 1.0 mgd tertiary treated effluent from the Main Basin from May 1 through October 31 to the constructed freshwater wetland (E-003-R) is permitted.

...

8. Neither the discharge to North Slough nor to the constructed wetlands shall create a nuisance as defined in Section 13050 of the California Water Code.

E. PROVISIONS

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27. Constructed Wetland Management.

The constructed wetlands shall be operated and maintained in accordance with the Constructed Wetlands Demonstration Project Management Plan, dated August 2001.

28. Reporting of Constructed Wetlands

The discharger shall include in the monthly Self-Monitoring Reports monitoring results, which shall demonstrate net environmental benefit of the project as described in the Board's *Policy on The Use of Wastewater To Create, Restore, and/or Enhance Wetlands* in Resolution 94-086.

29. Fish Species Used in Constructed Freshwater Wetlands
With the approval of the Napa County Mosquito Abatement District, every attempt shall be made to stock the ponds in the constructed freshwater wetland with native fish species, such as three-spine stickleback.

This Order expires on January 19, 2005. The discharger must file a Report of Waste Discharge in accordance with Title 23 of the California Administrative Code not later than 180 days before this expiration date as application for reissuance of waste discharge requirements.

I, Loretta K. Barsamian, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on October 17, 2001.

Loretta K. Barsamian
Executive Officer

Attachments:

A. *Constructed Wetlands Demonstration Project Management Plan, dated August 2001.*
B. Discharge Facility Treatment Process Diagram

Modifications to:
SELF-MONITORING PROGRAM
PART B

I. DESCRIPTION OF SAMPLING STATIONS

B. EFFLUENT

Station	Description
E-001-S	Effluent to North Slough Outfall At a point in the treatment facility, at which all waste tributary to the discharge outfall is present and at which point adequate disinfection is assured for discharge to the North Slough.
E-002-R	Effluent to Irrigation Reuse At a point in the treatment facility, at which point adequate disinfection is assured for irrigation.
E-003-R	Effluent to Freshwater Wetlands At a point in the treatment facility, at which all waste tributary to the discharge outfall is present and at which point adequate disinfection is assured for discharge to the constructed freshwater wetlands.

NOTE: Total Plant Effluent is the sum of flow discharged to North Slough (E-001-S), ~~and~~ to Irrigation Reuse (E-002-R) and to the Constructed Wetlands (E-003-R).

C. RECEIVING WATERS

Station	Description
C-1	At a point in North Slough directly above the center of the outfall.
C-2	At a point in the North Slough located 500 feet downstream of the center of the outfall
C-R	At a point in North Slough located 2,000 feet downstream from the diffuser.
C-W1	At a point in Constructed Wetland Pond 1.
C-W2	At a point in Constructed Wetland Pond 2.

....

VIII. Constructed Wetlands Influent and Effluent Monitoring

A monitoring station shall be established at each major inlet and outlet point for the measurement and collection of representative samples of the influent and effluent. The influent/effluent monitoring shall consist of the following:

Parameter	*Units*	*Sample Type*	*Frequency*
Flow	Million gallons	Continuous	Continuous
pH	Std. Units	Grab	Monthly
Temperature	°F	Grab	Monthly
Hardness (as mg/l CaCO3)	mg/L	Grab	Monthly

IX. Wildlife Monitoring

Wildlife monitoring shall consist of a wildlife census. The census shall be conducted on an established transect that is representative of the wetlands. The survey's focus shall be on aquatic birds, but incidental observations of other wildlife species also shall be recorded. The census shall be conducted every quarter throughout the year.

I, Loretta K. Barsamian, Executive Officer, hereby certify that the foregoing amendment to the Self-Monitoring Program in Board Order No. 00-003:

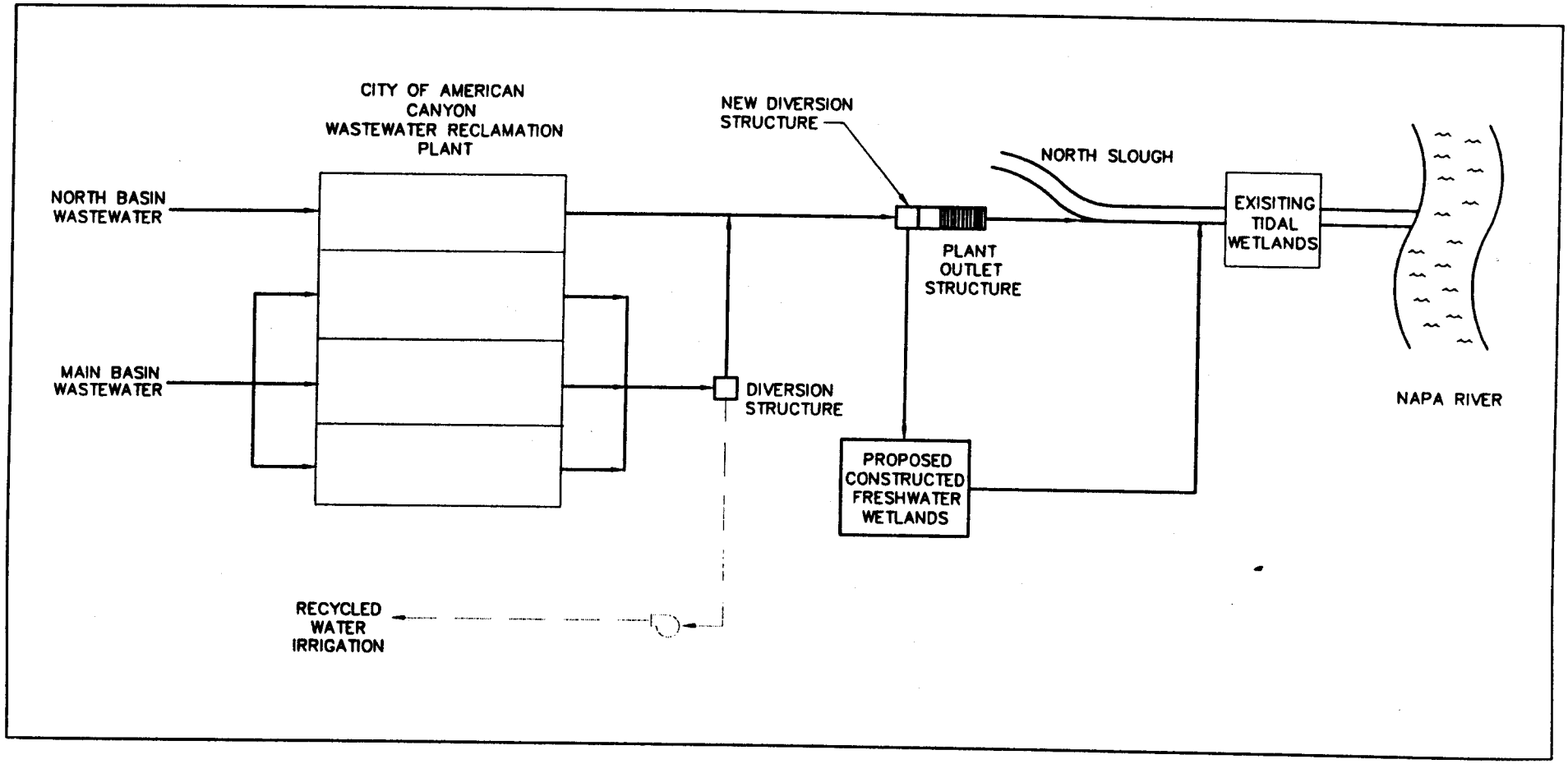
1. Has been developed in accordance with the procedure set forth in this Board's Resolution No. 73-16 in order to obtain data and document compliance with waste discharge requirements established in Board Order No. 01-113.

2. May be reviewed at any time subsequent to the effective date upon written notice from the Executive Officer or request from the discharger, and revisions will be ordered by the Executive Officer.

3. Is effective as of October 17, 2001.

Loretta K. Barsamian

LORETTA K. BARSAMIAN
Executive Officer



Source: HydroScience Engineers, 2001 : AES, 2001

Figure 3
Flow Diagram

City of American Canyon

Constructed Wetlands Demonstration Project

Management Plan

August 2001

HydroScience Engineers, Inc.

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Background

The City of American Canyon is located in southern Napa County, immediately north of the City of Vallejo along the east side of the Napa River (see Figure 1). The City was incorporated in 1992. The current population is approximately 10,000 and is projected to increase to approximately 16,000 upon build-out of the General Plan by about 2011.

The City presently contracts with the Napa Sanitation District to provide wastewater treatment and disposal services. In May 2000, the City began construction of its own wastewater treatment plant (WWTP). Upon completion of the new plant and an appropriate period of startup, during which the City will continue to discharge treated wastewater to Napa Sanitation District facilities, the new plant will begin full operation. It is expected that in approximately December 2001, the City will begin discharge of approximately 1.0 mgd of highly treated recycled water to the North Slough, which flows into tidal wetlands before entering the Napa River.

The new treatment plant is an immersed membrane bioreactor plant (MBR) that will produce very low turbidity recycled water that is also low in nitrogen. The new plant has been designed to incorporate the requirements of the California Department of Health Services (DHS) for tertiary recycled water, which permits the treated water to be used for unrestricted irrigation and discharge to the North Slough.

Project Objectives

This report describes the general design, operation and management of a constructed freshwater wetlands project to be located approximately 200 feet south of the new treatment plant. The wetlands will use recycled water from the treatment plant as its water source. The project has several objectives including, but not limited to:

- Creating a freshwater habitat that has an environmental benefit to the San Francisco Bay Area.
- Beneficial use of recycled water that is currently planned for discharge into the North Slough, a brackish water wetland subject to tidal action.
- Provide an interim beneficial use of the City's recycled water, in lieu of land disposal, until its program for urban and agricultural irrigation can be fully implemented.
- Removal of approximately 10 acres of non-indigenous eucalyptus trees.

The following sections of the report will describe in more detail general design features and plans for operation and management.

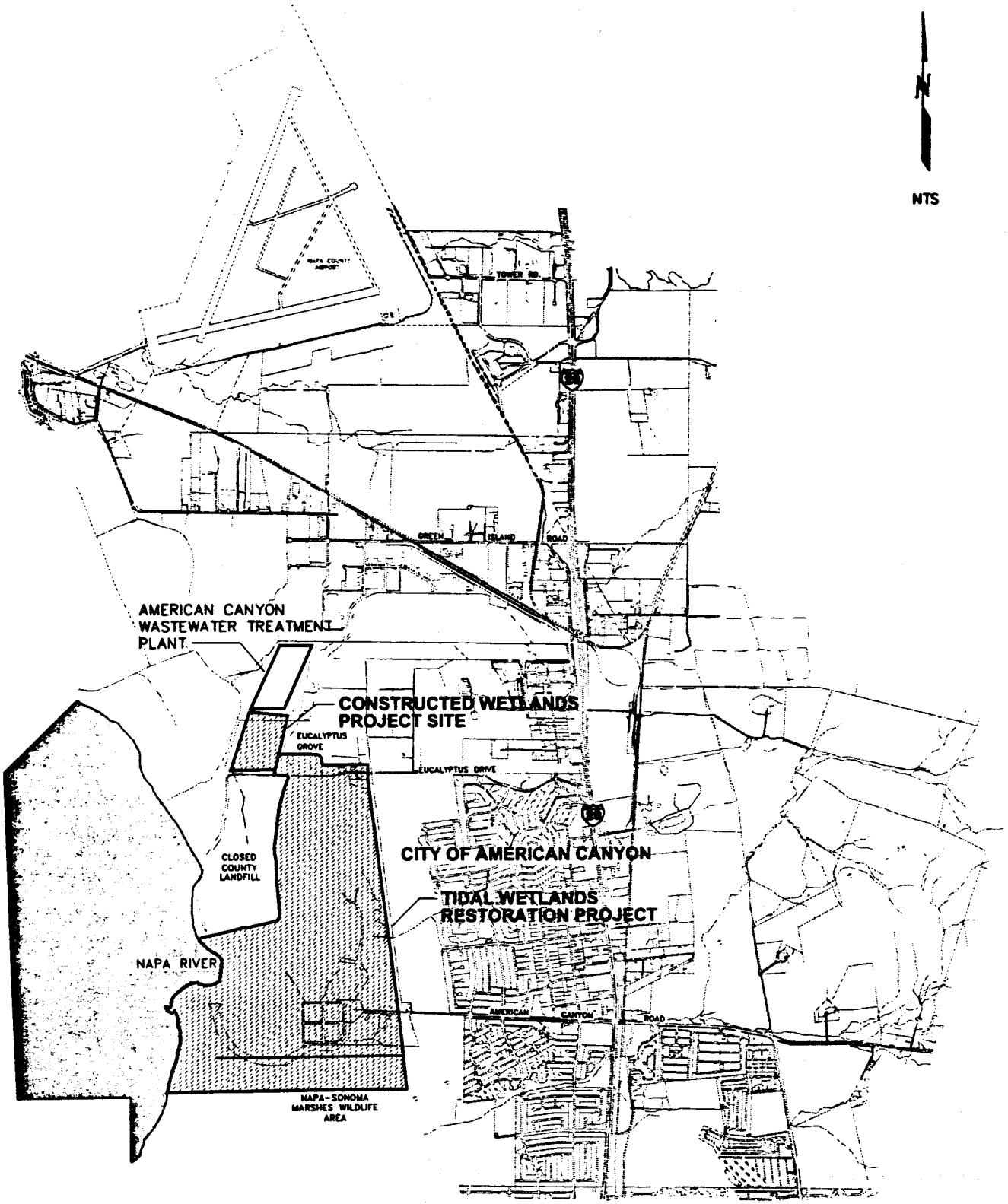

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Figure 1
Constructed Wetlands Project
Location Map

NPDES Permit Requirements

In February 2000, the City of American Canyon obtained a National Pollution Discharge Elimination (NPDES) Permit from the Regional Board for their new wastewater reclamation plant. The permit allows the City to discharge up to 2.5 mgd (average dry weather flow [ADWF]) of recycled wastewater during the winter months (from November 1 through April 30) to the North Slough. The permit also provides that from May 1 through October 31, approximately 75% of the recycled water would be used for urban and agricultural irrigation and 25% would continue to be discharged to the North Slough. The North Slough discharges into a tidal wetlands that leads to the Napa River. As a separate project, the City is working to remove some man-made impediments to tidal action within this area to restore approximately 500 acres into a tidal marsh. Figure 1 identifies the location of the treatment plant, the North Slough and the tidal marsh restoration area.

Wastewater in the southern portion of the City, the Main Basin, has total dissolved solids (TDS) levels of approximately 750 mg/l. The lower TDS wastewater from the Main Basin represents approximately 75% of the total flow. Wastewater from the area in the northern portion of the City, the North Basin, has higher TDS concentrations of approximately 2,000 mg/L (roughly 25% of the total flow), which makes it unsuitable for recycling. The NPDES permit was issued on the basis that approximately 75% of the summer month flows would be reused for urban and agricultural irrigation. The remaining 25% of summer flow will be discharged to the North Slough, tidal marsh and eventually the Napa River. During the winter months, all of the plant flow will be discharged through the tidal marsh.

The treatment plant will have two segregated wastewater treatment process streams – Process Train 1 will be used for treating the higher TDS wastewater from the City's North Basin, and Process Train 2 will be used for treating the lower TDS domestic wastewater from the City's Main Basin. The plant operators will have the flexibility of combining the two treated streams or discharging them separately after treatment. The treatment process will consist of an emergency overflow basin, screens, grit removal, secondary biological treatment using nitrifying aeration tanks with an anoxic zone for denitrification along with immersed membranes for solids separation (4 rectangular basins each treating 25% of the flow), ultraviolet (UV) disinfection for all flow discharged to the wetlands, and use of sodium hypochlorite and a chlorine contact tank for disinfection of recycled water for irrigation. The recycled water that is used for irrigation will not be de-chlorinated in order to maintain a chlorine residual in the irrigation distribution system to mitigate biological re-growth in the pipelines. The recycled water discharged to the constructed wetlands will not be disinfected with chlorine. A cascade aeration outlet structure will be used to elevate dissolved oxygen levels in effluent discharged to the North Slough.

Wastewater Flow Projections

Existing flows from the City are approximately 0.9 mgd during average dry weather (ADWF) and approximately 3.0 mgd during peak wet weather (PWWF). Upon start-up

of the plant, the flows are expected to be approximately 1.0 mgd ADWF and 3.2 mgd PWWF. The plant will have an average dry weather flow design capacity of 2.5 million gallons per day (mgd), and a peak wet weather capacity of 5.0 mgd. The treatment plant will be separated into two parallel process streams to keep waste streams with higher TDS concentrations separate from lower TDS waste streams. The disinfected tertiary treated wastewater from this lower TDS water will be recycled and used for agricultural and landscape irrigation.

Projected Effluent Quality for Reclamation and Wetlands

As previously discussed, the flow from the Main Basin within the City is expected to have a TDS concentration of 750 mg/L while the North Basin is expected to be approximately 2,000 mg/L. Initially, it is anticipated that all of the 1.0 mgd ADWF from the new WWTP would be discharged through the constructed wetlands. The TDS concentration is expected to average approximately 1,100 mg/L. At build-out, when the plant flow is expected to split during summer months between recycled water irrigation (75%) and wetlands (25%), the flow to the wetlands would be essentially all of the water from the North Basin and would contain approximately 2,000 mg/L of TDS. At build-out during the winter, the TDS discharged to the wetland would be similar to initial concentrations of 1,100 mg/L.

At this time, the concentrations of metals, ammonia and turbidity are not anticipated to vary from the Main to the North Basin. Therefore, Table 1 presents the projected turbidity, ammonia and metals concentrations for all wastewater effluent.

Table 1 • Projected Effluent Quality

Parameter	Units	Projected Average Effluent Quality to Wetlands
Turbidity	NTU	<2
Ammonia Nitrogen	mg/L	<2.0
Arsenic	µg/l	1.0
Cadmium	µg/l	1.0
Chromium	µg/l	0.1
Copper	µg/l	4.0
Lead	µg/l	0.5
Mercury	µg/l	<0.012
Nickel	µg/l	1.0
Selenium	µg/l	0.4
Silver	µg/l	0.1
Zinc	µg/l	14
PAH	µg/l	<0.049
Cyanide	µg/l	<3

Freshwater Constructed Wetlands Project

The project consists of a freshwater wetland approximately 200 feet south of the City's new wastewater reclamation plant. The new wetlands will be constructed on upland areas above the 100-year flood plain and out of delineated wetlands. The wetlands will be located on property owned by the City of American Canyon. The City will retain the property ownership of the constructed freshwater wetland.

The proposed wetland will be constructed partially in the upland area and partially within the existing eucalyptus grove. Figure 2 identifies the location of the treatment plant, constructed wetland and the limits of the delineated wetlands.[1]

The constructed wetland area will receive water from the City's new WWTP year-round with increased flows during the winter to more closely simulate natural winter flow patterns. The wetlands will create a perennial and seasonal freshwater and riparian habitat for local wildlife. Overflow from the wetlands would flow to the North Slough tidal marsh south of the new WWTP.

Figure 3 is a flow diagram illustrating the proposed project.

Wetland Design, Operation, and Management

Management Agency

The City of American Canyon will be the agency responsible for design, operation and management of the wetlands in cooperation with the Department of Fish and Game and support from the Napa County Mosquito Abatement District.

It is the intent of the design and management strategy to create a freshwater wetland that requires a minimum of operations and management. However, with projects such as this, wildlife and habitat do not always respond as expected. Therefore, a certain amount of flexibility will be built into the design to modify flow rates and water surface elevations. Further, an "adaptive management" approach will be used that will respond according to the conditions that develop. More details are included regarding the general design, operation and management in the following sections.

Wetland Design

A diversion structure will be constructed at the City's treatment plant to divert treated water to the constructed wetlands. The proposed wetlands will consist of two ponds with water conveyed to Pond 1 via a gravity pipeline from the treatment plant. A site layout of the two ponds is presented in Figure 4.

Pond 1 would provide slightly more of a water holding function, while Pond 2 would have more shallow areas for supporting perennial freshwater marsh vegetation. The

[1] The wetland delineation was identified by Environmental Science Associates, American Canyon - Port of Oakland Site, Pre-Jurisdictional Delineation of Waters of the U. S., March 26, 1999.

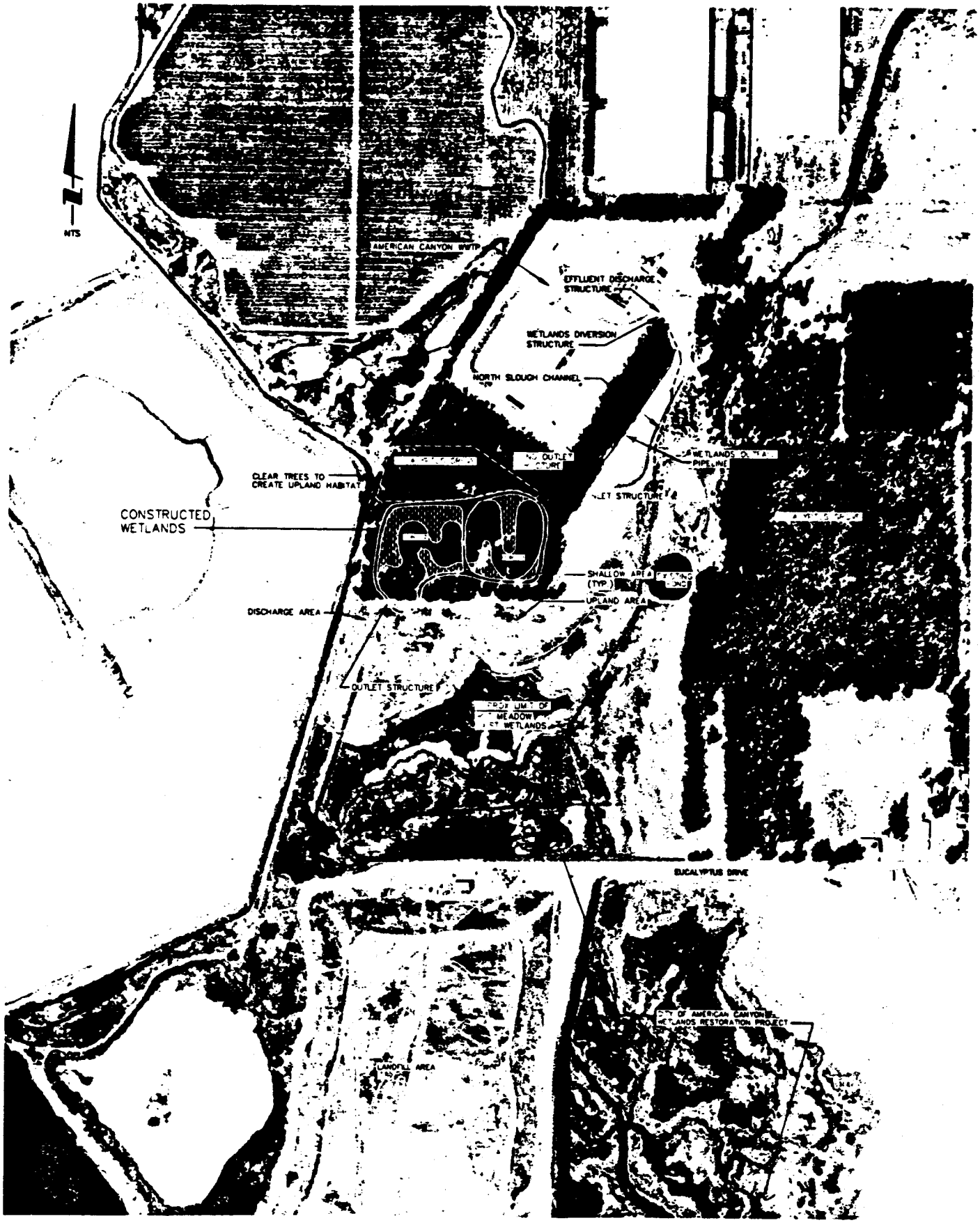

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Figure 2
Constructed Wetlands Project
Site Map

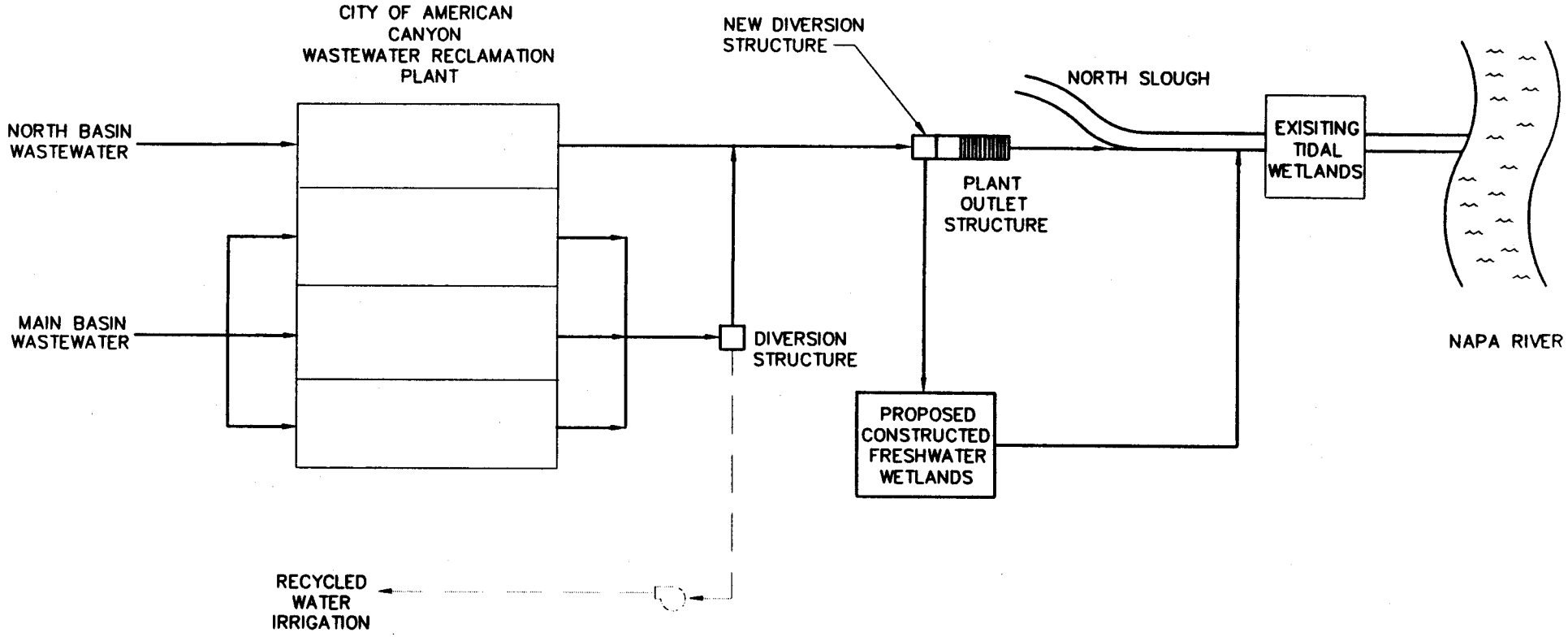

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Figure 3
Constructed Wetlands Project
Flow Diagram

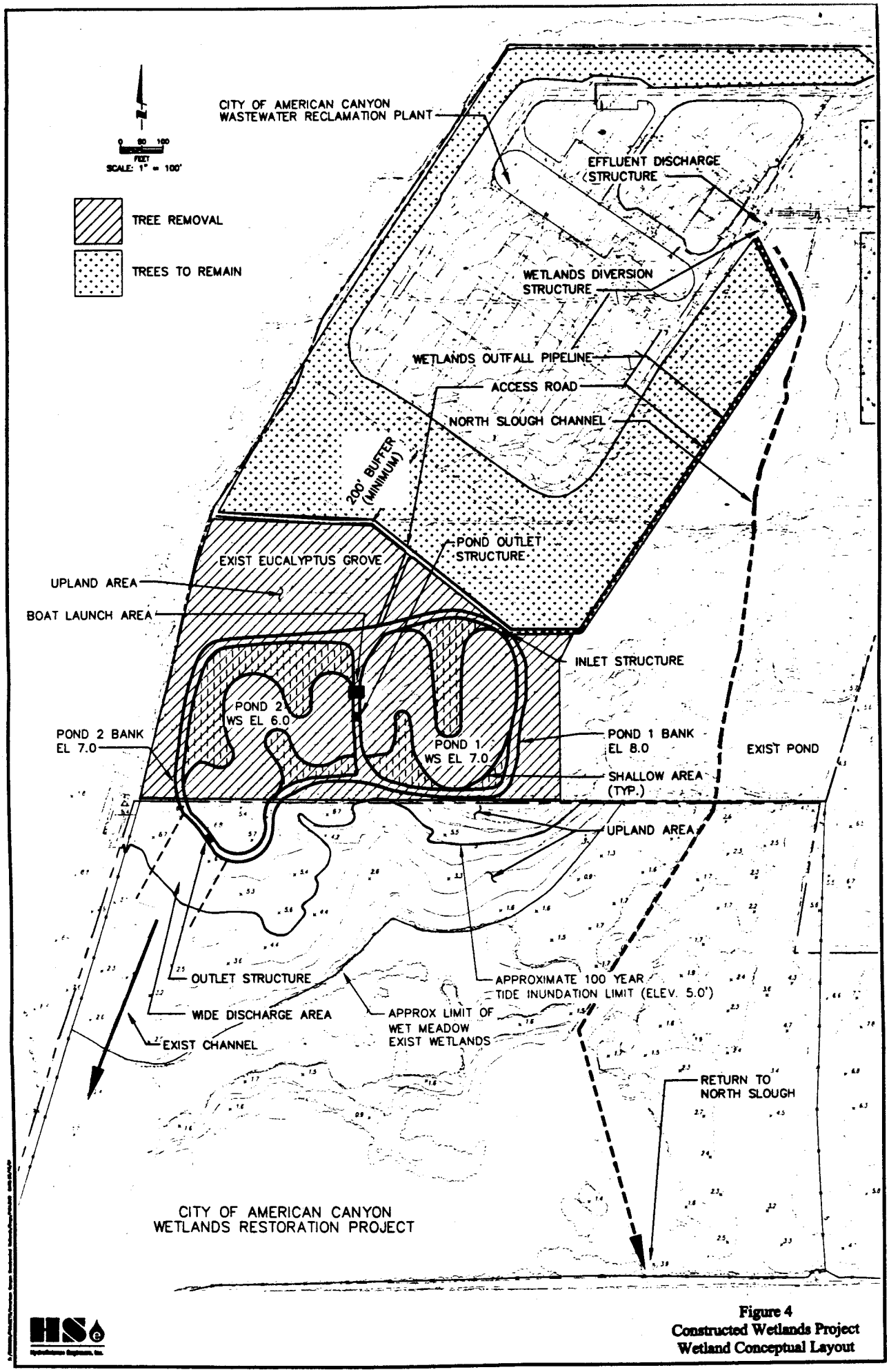

Figure 4
Constructed Wetlands Project
Wetland Conceptual Layout

deeper water sections will be approximately 8 feet deep to prevent emergent vegetation from taking over the ponds and provide open water habitat. Based on the pond wetland configuration shown in Figure 4, Pond 1 will be approximately 3 acres, 2.2 acres in open water (70%) and 0.8 acres in wetland (30%). Pond 2 will be 3.5 acres, 1.75 acres each in open water and wetland (50% each). The edge of the ponds will slope up to the top of the pond rim. The combination of the two ponds will have approximately 50 percent open water and 40 percent wetland vegetation. Figure 5 is a typical cross-sectional view illustrating typical pond depths and bank slopes. Bank slopes will be approximately 3:1 or 4:1 to minimize erosion potential. The shallow areas designed for wading birds and emergent vegetation will slope up from a water depth of approximately 4 feet at approximately 25:1 (see Figure 5).

Upon completion of the City's tidal wetland restoration project, which will remove some of the existing levees that restrict some of the tidal action, the limit of inundation will occur at a slightly higher elevation than currently exists. The ponds have been located about 100 feet north of the 100-year inundation limit (elevation 5 feet). The constructed wetland project will preserve existing upland area south of the proposed ponds and north of the ponds within the existing eucalyptus grove. The eucalyptus trees will be removed and the upland area restored with native shrubs and trees. A buffer of 200 feet (minimum) will be maintained between the treatment plant and the upland area.

The pond water surface and bank elevations have been established to keep them out of tidal influence. Flow from the pipeline would first enter Pond 1. The outlet devices from each pond would be designed to allow operations personnel to regulate the water surface elevation within a range of approximately two feet in the event that some adjustment is desirable, as may be identified as part of the wetland "adaptive management" approach. The wetlands will be essentially a flow though system and water surface elevations will not fluctuate more than approximately 0.1 to 0.2 feet. Water would flow from Pond 1 to Pond 2 where it would overflow to an existing tidal marsh north of Eucalyptus Drive.

Discharge from Pond 2 will be allowed to spread out over a large area to encourage more shallow wetland transition from a brackish to salt water environment. Grading for the pond construction will be designed so as to create a gradually sloping topography from existing ground to the top of the levees in order to blend and not create abrupt changes in slope.

WATER DIVERSIONS TO THE CONSTRUCTED WETLAND

Tables 2 and 3 below present potential monthly water balance estimates of diversions to irrigation vs. wetlands at startup of the new treatment plant and at build-out of the City's General Plan. Initially it is anticipated that all of the 1.0 mgd will be diverted to the proposed constructed freshwater wetlands. As the City develops its recycled water distribution system and customers are connected, the amount of flow to the wetlands will gradually decrease during the summer months.

When the City reaches build-out and the WWTP flow is 2.5 mgd, a portion of the recycled water produced in the winter will flow through the proposed wetland and a portion will be discharged into the North Slough. At this time, it is anticipated that the

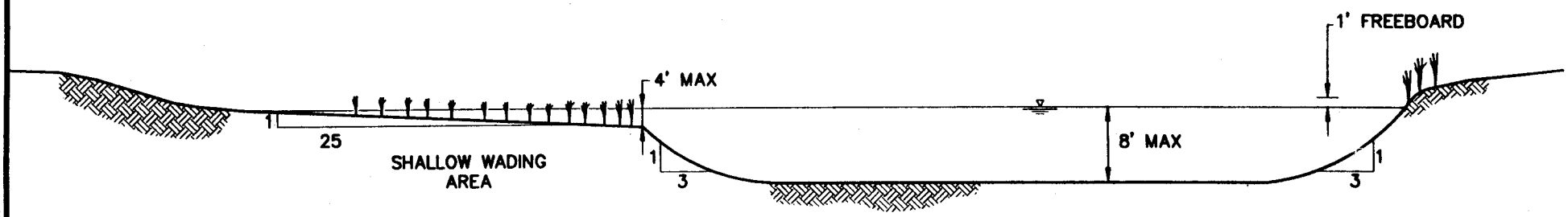

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Figure 5
Constructed Wetlands Project
Typical Pond Cross-Section

constructed wetlands would receive no more than 95 AF during a winter month (approximately 1 mgd), the maximum amount proposed upon startup (see Table 2). Table 3 includes estimates of the flow at build-out to be discharged to the North Slough (i.e. that portion not being recycled to irrigation or diverted to the proposed wetlands).

Table 2 • Projected Flow to Wetlands at Initial WWTP Flows (Approximately 1 MGD ADWF)

Month	% of Annual Irrigation	Irrigation Demand (AF)	Total Plant Effluent (AF)	Water to Irrigation (AF)	Water to Wetland (AF)	Water to North Slough (AF)
January	0%	0	95	0	95	0
February	0%	0	86	0	86	0
March	0%	0	95	0	95	0
April	5%	55	92	0	92	0
May	10%	109	95	0	95	0
June	15%	164	92	0	92	0
July	20%	218	95	0	95	0
August	20%	218	95	0	95	0
September	15%	164	92	0	92	0
October	10%	109	95	0	95	0
November	5%	55	92	0	92	0
December	0%	0	95	0	95	0
Total	100%	1,092	1,120	0	1,120	0

Table 3 • Projected Flow to Wetlands at Build-out Flow (Approximately 2.5 MGD ADWF)

Month	% of Annual Irrigation	Irrigation Demand (AF)	Total Plant Effluent (AF)	Water to Irrigation (AF)	Water to Wetland (AF)	Water to North Slough (AF)
January	0%	0	238	0	95	143
February	0%	0	215	0	95	120
March	0%	0	238	0	95	143
April	5%	140	230	140	90	0
May	10%	279	238	178	60	0
June	15%	419	230	173	57	0
July	20%	559	238	178	60	0
August	20%	559	238	178	60	0
September	15%	419	230	173	57	0
October	10%	279	238	178	60	0
November	5%	140	230	140	90	0
December	0%	0	238	0	95	143
Total	100%	2,794	2,801	1,338	914	549

Actual flows will vary due to wet weather increases from infiltration and inflow into the sanitary sewers.

Figure 6 presents estimates of yearly summer time flows to the wetlands and irrigation from the initial startup of the WWTP in 2001 through build-out in approximately 2011. Similarly, Figure 7 illustrates the flows to the wetlands and discharge to the North Slough from the initial startup through build-out. When wastewater flow reaches the projected build-out of 2.5 mgd ADWF, and allowing for discharge of a portion of the effluent directly to the North Slough, flow to the freshwater wetland is likely to range from approximately 57 AF (0.62 mgd) during typical summer months to 95 AF (1.0 mgd) during typical winter months.

WETLANDS EVAPORATION AND EVAPOTRANSPIRATION

Water balances have been adjusted to account for evaporation that would occur in the open water portion of the ponds and the evapotranspiraton (ET) from the wetland vegetation. During the summer, a portion of the water would be lost through evaporation and evapotranspiration. However, it is anticipated that most will pass through the wetlands. Because of the naturally occurring impermeable clay soils in the area, percolation losses are expected to be minor. Tables 4 and 5 below provide estimates of evaporation, evapotranspiration and rainfall in inches for each month during the year. Evaporation estimates are included for the open water areas as well as an allowance for evaporation that would occur in the flooded wetland areas around emergent vegetation.

Table 4 • Evaporation, Evapotranspiration and Rainfall (Inches)

Month	Open Water Evaporation Rate[2]	Wetland Area Evaporation Rate[3]	Wetland ET Rate[4]	Rainfall
January	0.96	0.48	0.91	4.8
February	1.28	0.64	1.21	3.8
March	2.48	1.24	2.34	2.7
April	3.52	1.76	3.32	1.1
May	5.12	2.56	4.83	0.6
June	6.08	3.04	5.74	0.1
July	7.28	3.64	6.87	0
August	6.4	3.2	6.04	0
September	4.8	2.4	4.53	0.3
October	2.88	1.44	2.72	0.8
November	1.28	0.64	1.21	2.2
December	0.8	0.4	0.76	3.9
Total	42.88	21.44	40.47	20.30

[2] Based on pan evaporation rates from DWR Bulletin No 113-3 for North Coast – Interior Valleys and a pan coefficient of 0.8.
[3] Assumed 50% of open water evaporation.
[4] Based on formula Wetland ET=(034+6.8/√Salinity+0.04 x Stem Density) x Pan Evaporation. Stem Density assumed to be 5 stems per square foot.

Figure 6 Summer Flow to Wetlands

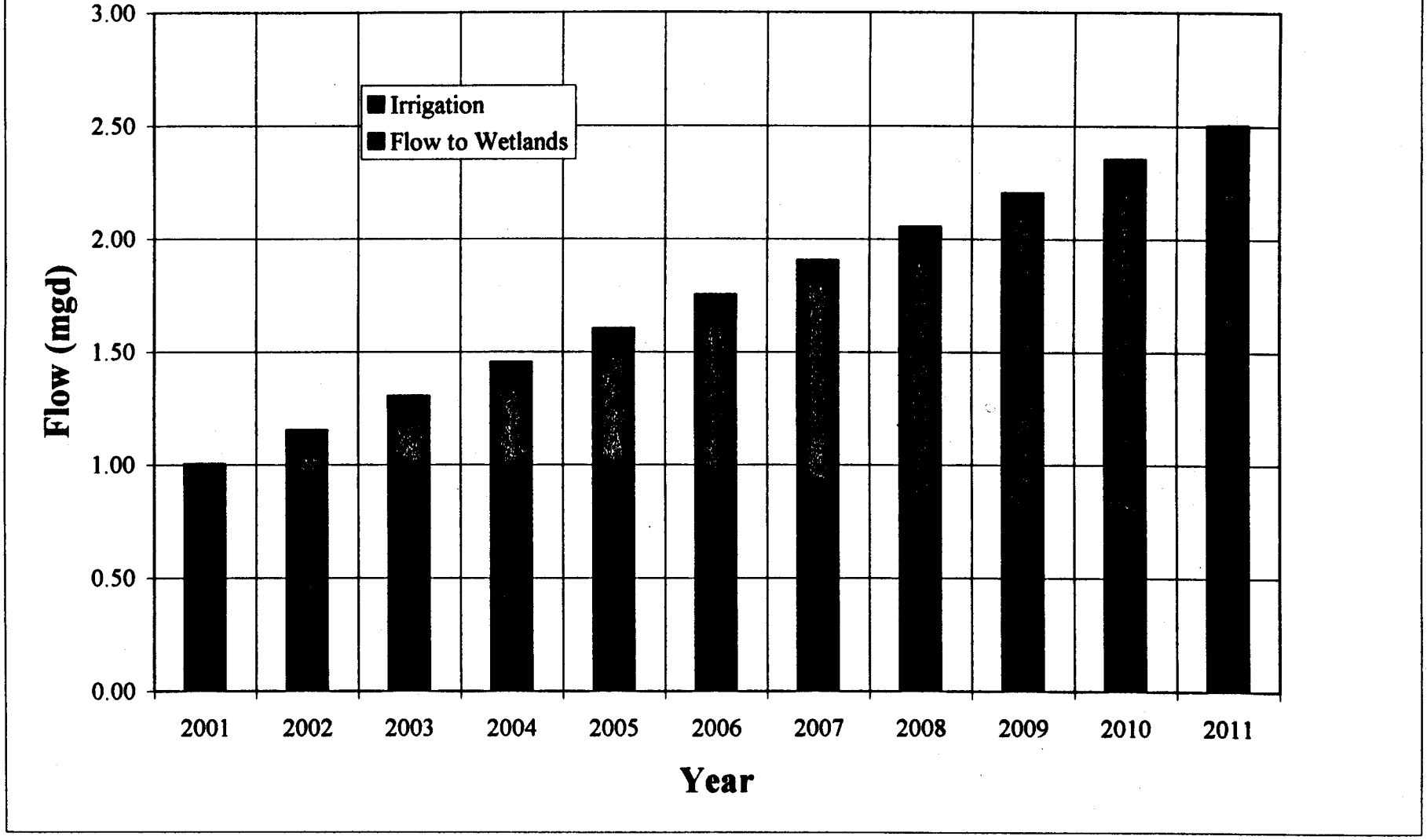


Figure 7 Winter Flow to Wetlands

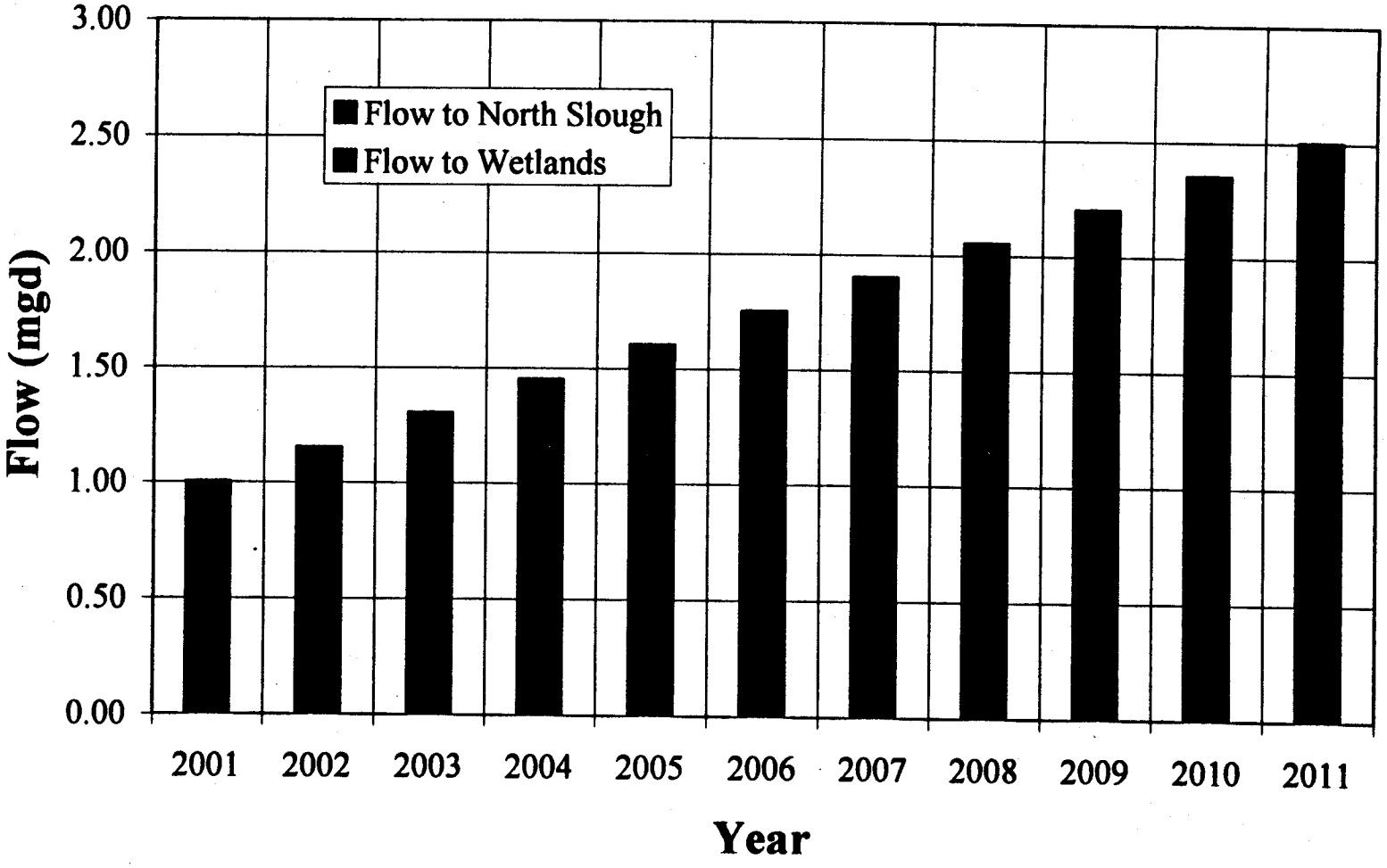


Table 5 • Monthly Net Gain/Loss From Wetland[5]

Month	Total Evaporation (AF)	Wetland Evapotranspiration (AF)	Rainfall Volume Added to Wetland (AF)	Net Gain/Loss from Wetland (AF)
January	0.42	0.20	2.60	1.99
February	0.55	0.26	2.06	1.24
March	1.07	0.51	1.46	-0.12
April	1.53	0.72	0.60	-1.65
May	2.22	1.05	0.33	-2.94
June	2.63	1.24	0.05	-3.82
July	3.15	1.49	0.00	-4.64
August	2.77	1.31	0.00	-4.08
September	2.08	0.98	0.16	-2.90
October	1.25	0.59	0.43	-1.40
November	0.55	0.26	1.19	0.38
December	0.35	0.16	2.11	1.60
Total	18.58	8.77	11.00	-16.35

WETLAND RETURN FLOWS

Flow from the freshwater wetland will be discharged into the existing channel located near the southwest portion of the wetland and ultimately to the North Slough and the existing tidal wetland. Figure 4 illustrates the proposed wetland configuration, discharge location and return flow pattern to the North Slough. Tables 5 and 6 below present estimates of return flow from the constructed wetland to the North Slough after the effects of evaporation, evapotranspiration and rainfall are included when treatment plant flow is 1.0 mgd (initial wetland operation) and plant flow of 2.5 mgd (when American Canyon is built-out).

[5] Based on 3.9 acres of Open Water area and 2.6 acres of Wetland.

Table 6 • Monthly Net Gain/Loss From Wetland at Initial Operation

Month	Initial Flow To Wetland (AF)	Net Gain/loss from Wetland (AF)	Flow from Wetland (AF)
January	95	1.99	97.0
February	86	1.24	87.2
March	95	-0.12	94.9
April	92	-1.65	90.4
May	95	-2.94	92.1
June	92	-3.82	88.2
July	95	-4.64	90.4
August	95	-4.08	90.9
September	92	-2.90	89.1
October	95	-1.40	93.6
November	92	0.38	92.4
December	95	1.60	96.6
Total	1,119	-16.35	1,103

Table 7 • Monthly Net Gain/Loss From Wetland When Fully Developed

Month	Initial Flow To Wetland (AF)	Net Gain/loss from Wetland (AF)	Flow From Wetland (AF)
January	95	1.99	97.0
February	95	1.24	96.2
March	95	-0.12	94.9
April	90	-1.65	88.4
May	60	-2.94	57.1
June	57	-? 82	53.2
July	60	-4.64	55.4
August	60	-4.08	55.9
September	57	-2.90	54.1
October	60	-1.40	58.6
November	90	0.38	90.4
December	95	1.60	96.6
Total	914	-16.35	898

MINIMUM FLOW TO WETLAND

The estimates provided above are based on an initial summer time flow (July) to the wetland of 1 mgd (95 AF) and a flow of 0.6 mgd (60 AF) after the City has fully implemented its recycled water system master plan. However, the City of American

Canyon may, at some time, want to increase recycled water irrigation beyond the amounts included in the above assumptions. It is also possible that the actual flow from the North Basin may not reach 0.6 mgd as projected during the summer months. Therefore, for purposes of wetland management, some provision should be made for reduced flow to the wetland. It is assumed for the purpose of this management plan that a minimum flow to the constructed wetlands could be as low as 0.25 mgd (or 23 AF during a typical July) at some time.

Some literature suggests that ET from wetland vegetation can vary up to approximately 3 times open water evaporation rates. Table 5 above projects that the summer month evaporation from the ponds could be as high as 3 AF. If the wetland ET rate actually occurs at a higher rate (i.e. 3 times the evaporation), ET losses could be as high as 9 AF bringing total ET and evaporation losses from the wetland to 12 AF (9 AF for ET and 3 AF for Evaporation) during a summer month. If that should occur in combination with reduced flow to the wetland, flow from the wetland could be as low as 11 AF during a typical July (23 AF – 12 AF).

Even under the most conservative estimates of flow to the wetlands and evaporation/ET losses, a net positive flow will always be moving through the wetland. Table 8 below provides a summary of flow estimates through the wetlands with estimated and maximum evaporation/ET rates for a typical July.

Table 8 • Flow Estimates Through Wetlands During a Typical July

Flow to Wetland (AF)	Evaporation/ET		Flow Through Wetland	
	Estimated (AF)	Maximum (AF)	Estimated (AF)	Maximum (AF)
95	5	12	90	83
60	5	12	55	48
23	5	12	18	11

WATER LEVEL MANAGEMENT

The amount of flow through the wetland is expected to vary initially from approximately 1.0 mgd during the winter months to possibly as low as 0.25 to 0.62 mgd in the summer, depending on ultimate irrigation demands As the recycled water distribution system develops and irrigation customers are connected, flow through the wetland would likely decrease during summer months but likely not increase beyond about 1 mgd during the winter. The remainder of the winter flow from the wastewater treatment plant would be discharged to the North Slough. With the variations in flow through the wetland expected, some minimum level of water surface elevation for management of the wetland may be desirable. The adaptive management plan may determine, for example, five years after beginning operation, that the ponds may produce a more desirable ecosystem if

water surface elevations are modified. Therefore, the facilities are planned to include inlet and outlet structures with overflow weirs for each of the ponds so the water surface elevation can be adjusted by up to as much as 2 feet in each pond, depending on conditions that may develop within the wetland. Figure 8 presents a typical inlet and outlet that will be used to adjust the water surface.

Even though the weirs will provide the flexibility to adjust water surface elevations, the pond elevations will be maintained at a fixed level. The variations in flow rates identified will only affect the water surfaces in the order of 0.1 to 0.2 feet. Maintaining constant water surface elevations in the ponds is intended to help protect nesting areas. Flow rates are expected to be the highest during the winter and any decrease would occur during the summer months when flow though the wetlands is reduced due to water diversion for irrigation.

WETLAND VEGETATION

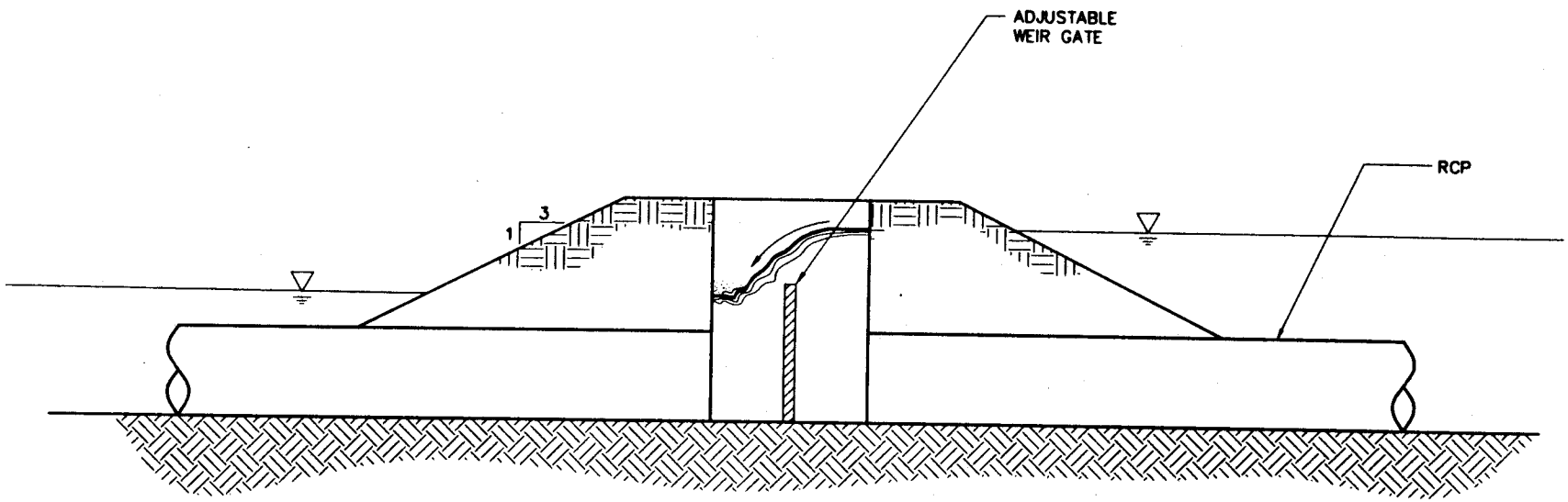
It is anticipated that the wetland vegetation will be dominated by tules in the portion of the wetlands that will support perennial freshwater marsh. The perennial freshwater marsh that will occur at depths of 2 to 4 feet will occur along the outer edge of the marsh as well as along shallow (2 to 4 feet) ridges that will extend into the open water area. Along the bank gradient the wetland vegetation that will grade from perennial freshwater marsh to seasonal marsh in the zone where water levels will fluctuate seasonally (see Figure 9). Above the seasonal marsh zone a riparian vegetation zone will be established with arroyo willow and elderberry. The upland part of the ponds, above the riparian zone, short shrubs of coyote bush will be planted. The restoration along the slopes and rim of the ponds will provide diverse native habitat that will promote native wildlife use and help reduce establishment of non-native invasive weeds such as fennel and pepper weed.

Below the outlet of Pond 2 and above the zone of tidal influence a grove of about 10 to 15 willows will be planted. The eucalyptus trees will be removed and the upland area restored with native shrubs and trees. An adaptive management approach has been be developed to monitor and respond to developing conditions to ensure the native upland plants become established and non-native plants do not become established.

More information is included below describing the type of vegetation, waterfowl likely to be attracted and aquatic life that will be established.

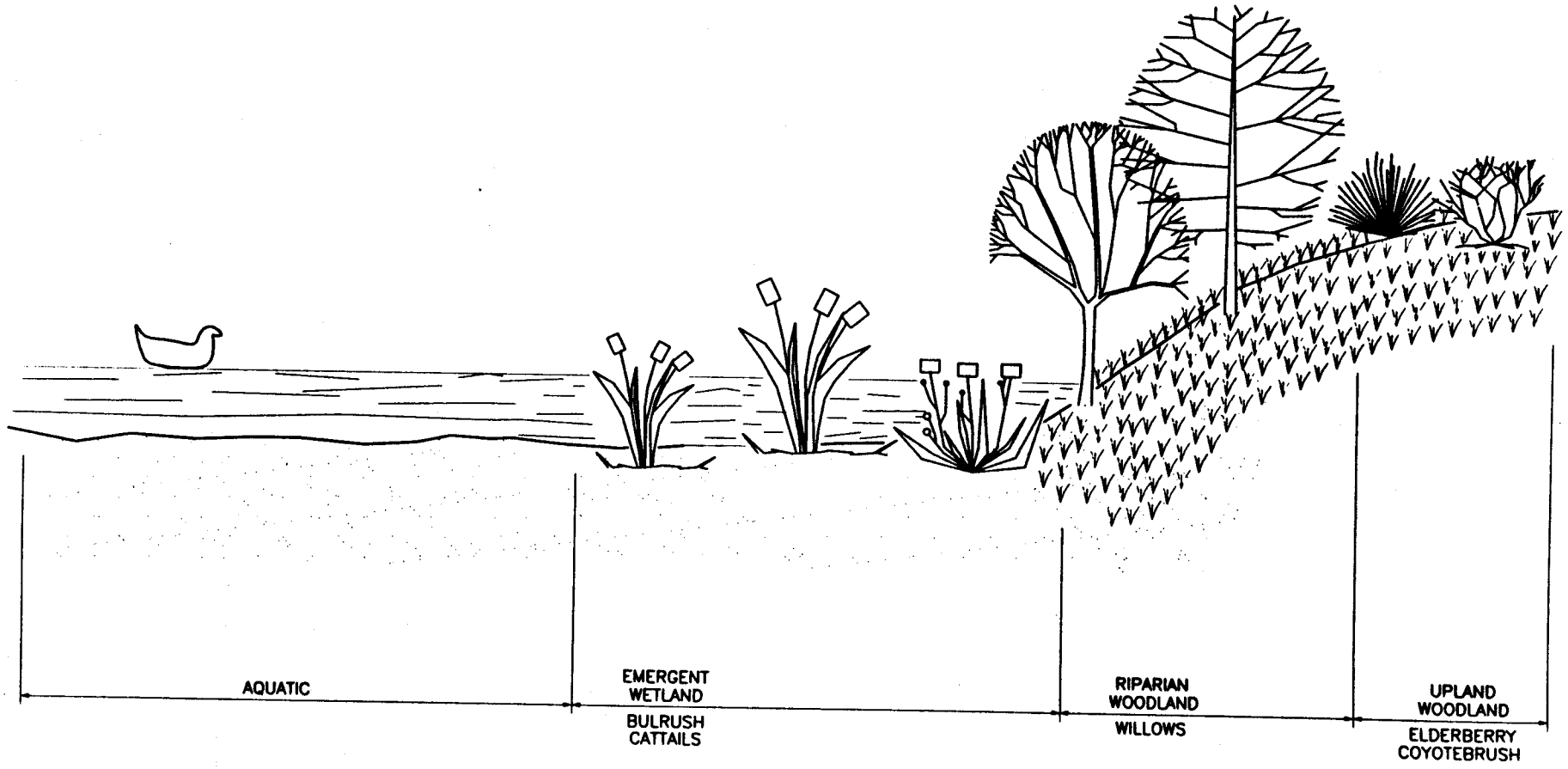
Plants

The wetland will be planted with native freshwater marsh species including tule (*Scirpus californicus*). It is expected that other native vegetation will become established as the wetland matures. This native vegetation will provide additional habitat similar to existing North Slough habitat in the immediate vicinity. Vegetation in the seasonal wetland zone of the pond banks will become established on it own without the need for planting. The riparian vegetation will include arroyo willow (*Salix lasiolepis*). The upland vegetation on the upper bank and rim of the ponds will include coyote brush



HydroScience Engineers, Inc.

Figure 8
Constructed Wetlands Project
Typical Inlet/Outlet Structure



HydroScience Engineers, Inc.

Figure 9
Constructed Wetlands Project
Habitat Types

(*Baccharis pilularis*) and elderberry (*Sambucus mexicana*). Arroyo willows also will be planted below the discharge outlet of Pond 2.

The upland south and north of the ponds will include creeping wild rye (*Lemus triticoides*) to provide understory and grassland vegetation and help prevent establishment of non-native invasive weeds. Shrubs in the upland area will include coyote brush, eldeberry, and toyon (*Heteromeles arbutifolia*). Coast live oak (*Quercus agrifolia*) will be planted in the upland area to provide an open tree canopy layer.

Wildlife

The ponds will be stocked with Three-Spined Stickleback initially as an attempt to control mosquitoes with native species in lieu of non-native mosquito fish as part of the vector control program. Please see the section on mosquito abatement for more information. No other wildlife species will be introduced into the ponds. Rare or endangered species will not be stocked or transplanted to the wetlands. It is expected that ducks, geese, egrets, blue heron and other shore birds will inhabit the wetland. Invertebrate species including snails and crustaceans will also likely inhabit the wetlands as well as aquatic insects.

ADAPTIVE MANAGEMENT PLAN

Annual monitoring of the vegetation will determine whether the goals of the wetland and upland components are being met. No regularly schedule management of vegetation is proposed. However, monitoring will determine the following: 1) whether non-native invasive weeds are invading the wetland or upland zones, 2) whether the wetland and upland vegetation continues to remain in the areas identified or whether it is invading the open water to a greater or lesser extent than proposed in the design, and 3) whether the wetland and upland vegetation is in a good state of growth.

It is possible that the wetland vegetation may produce areas of dead tule leaves in which new re-sprouts cannot grow through during the growing season. Annual monitoring will evaluate the re-growth status of the tules and determine whether the vegetation should be excavated and allowed to become reestablished. Similarly, upland vegetation may die-off or grow into areas that limit monitoring and management activities. In those cases, it will be determined that vegetation thinning will need to occur. The potential need for vegetation management cannot be established as a regularly scheduled activity. Instead, the annual field monitoring will determine the need for any vegetation management.

The Napa County Mosquito Abatement District will monitor non-native plant species such as cordgrass, fennel and peppergrass and implement treatment as appropriate. Refer to the section regarding "Mosquito Abatement" for more information.

Wildlife Monitoring

Monitoring of wildlife using or residing in the wetlands will be performed quarterly and in association with the monitoring of the tidal wetland program south of the ponds. Monitoring will include the establishment of a marked single point located between the

two ponds. Bird and other wildlife will be surveyed from the point for a period of 10 minutes for each pond. The data recorded will include the species observed, number of each species, and any courtship or nesting behavior.

Vegetation Monitoring

The ponds and the upland areas will be monitored for plant growth. For all vegetation, including natives, non-natives, and the wetland and planted upland or riparian vegetation, will be monitored yearly to include percent cover, height, and overall health or vigor. Measurements will be taken at a spatial frequency that adequately represents the populations. The percentage of open water and wetland plant life will change as the emergent plants become established. When the wetland area reaches full maturity, the percentage in pond 1 is expected to be maintained at 70% open water and 30% emergent plants while Pond 2 will be maintained at 50% open water and 50% emergent plants. Since the wetlands will constructed as a demonstration project, goals have not been established beyond a three-year period, which is approximately when the City's existing NPDES permit expires. The following are general goals for plant growth.

Table 9 • Goals for Plant Growth

		January 2002	January 2003	January 2004
Wetland Vegetation				
	Percent Cover	25%	75%	100%
	Height (feet)	1	3	6
Upland Area				
	Percent Cover	25%	75%	100%
	Height	25%	50%	100%

Facility Maintenance

The diversion structure flow control gate and flow monitoring facilities at the wastewater treatment plant will be operated and maintained in accordance with the operation and maintenance (O&M) manual for the treatment plant. The pipeline, pond banks and inlet/outlet structures that serve the wetlands will receive maintenance and operation according to the following schedule:

Pipeline: Yearly Inspection

Pond Banks: Biannual Inspection

Inlet/Outlet Structures and Weir Gates: Annual Inspection and Operation of Gates

The access road will be maintained as needed to assure all weather access.

As the wetlands mature and more information is developed on the operation and maintenance, the O&M manual will be updated with the operation and maintenance

requirements of the constructed wetlands. Treatment plant personnel will perform all work at the wetlands.

Mosquito Abatement

During the planning of the constructed wetlands, the Napa County Mosquito Abatement District was consulted. The District has indicated that there are currently five species of mosquitoes that routinely breed in the wetlands on both sides of the western end of Eucalyptus drive. They are: the Summer Salt Marsh Mosquito (*Aedes dorsalis*), the Winter Salt Marsh Mosquito (*Aedes squamiger*), the Winter Marsh Mosquito (*Culiseta inornata*), the Banded Foul Water Mosquito (*Culex stigmatosoma*) and the Western Encephalitis Mosquito (*Culex tarsalis*). Each species is seasonal in habit (*Aedes dorsalis and Culex stigmatosoma* - April thru October; *Culiseta inornata* and *Aedes squamiger*, depending on rainfall patterns, breed from October thru April; and *Culex tarsalis* breeds and feeds from February through October). There are other species of mosquitoes found in the City of American Canyon, that could breed as a result of the wetlands including: the Tule Mosquito (*Culex erythrothorax*) and the Little House Mosquito (*Culex pipiens*). The District anticipates that the Little House mosquitoes will most likely breed in water sites at the treatment plant while the Tule Mosquito will move into the constructed ponds that are projected to have Bullrush and Cattails.

As the result of the discharge of fresh water from the wetlands, a brackish wetland area may also develop immediately south of the ponds. This brackish wetland could result in the production of Encephalitis (*Culex tarsalis*), Winter Marsh (*Culiseta inorata*), or Summer Salt Marsh (*Aedes dorsalis*) mosquitoes.

For all of the species of mosquitoes discussed above, only two are known/proven carriers of disease to humans (*Culex tarsalis* – vectors encephalitis viruses, while the Little House Mosquito vectors the Saint Louis Encephalitis and West Nile Virus). The most aggressive species are the marsh mosquitoes. Both species of *Aedes* marsh mosquitoes are aggressive day species that will also travel upwards of 10 or more miles. The Winter Marsh Mosquito, which as a rule travels less than two miles, will bite during the day, but prefers to bite in the late afternoon and early evening hours until about one hour after sunset. The other species of mosquitoes tend not to travel more than a mile from their breeding sites and are not as aggressive.

Because of the biting and traveling behavior of these mosquitoes the District has set some population criteria levels. These criteria are based on what the residents in the American Canyon area will tolerate, as well as the District's ability to maintain environmentally sound cost effective control measures. The District strives to prevent adult emergence, and therefore targets the immature stages in the water. Sampling is performed for the immature stages using a 1 pint dipper, taking samples of the water and counting the numbers of immature stages in each dip sample (x number of dips per acre and then averaging the number of immature per dip). Therefore, the following immature mosquito population criteria, that will trigger a response from the District, are as follows:

Aedes dorsalis and *Aedes squamiger* - less than 1 immature per dip

Culiseta inornata - 1 to 2 immatures per dip
Culex tarsalis and *Culex pipiens* - 3 immatures per dip
All other species 3 to 5 immatures per dip

When these thresholds are reached, the breeding site will be treated with either biological or chemical control agents. The material of selected is determined by the age of the average age of the immature stages as well as available equipment, staff time and most cost effective control measure.

The District prefers long-term control measures and therefore prefers vegetation management (providing effective drainage and open water areas with minimal vegetation) or the use of mosquitofish. Mosquitofish are non-native fish to California, although they have been a mainstay of California mosquito control programs since 1922. The recent experimentation with the native Three-Spined Stickleback has had mixed results. In many applications thay have failed to provide effective control (Sacramento-Yolo MAD (pers comm) and Offill and Walton (1999)). The District has indicated a willingness to experiment with these native fishes although there is a chance that they may not be effective. Should they prove ineffective, mosquitofish would be planted or chemical control measures used. Therefore a three tiered approach is proposed - Native fish first, followed by a combination of mosquitofish and chemical control measures if the native fish do not work, followed by vegetation management and chemical control measures if that proves ineffective (or some combination of the above). The assessment of the effectiveness will be based on immature population data and chemical control measures will be employed to prevent any adult emergence.

Should midges begin to hatch in the wetland areas. Sacramento Blackfish (*Orthodon microlepidotus*) will be placed in the ponds for control.

Chemical treatment, if necessary, would most likely occur on a regular 10-day cycle performed by the District using a sand granule application of BTI (*Bacillus thuringiensis* var. *israelensis*), which will be cast into the wetland areas of the ponds. The distance for casting is limited to a maximum of 50 feet; therefore, a boat will be used to reach the finger shaped wetland areas. Access for launching the boat will be incorporated into design at a point in between the two ponds.

The Mosquito Abatement District currently treats the existing wetland area southwest of the treatment plant site treated for mosquito production. Access to this area will be cut off as the result of the pond construction. Therefore the access road will be extended to the west to provide access to the existing wetland area.

The Mosquito Abatement District will also monitor for exotic non-native invasive plants. Currently there are three species that are of concern, peppergrass (*Lepidium latifolium*), fennel (*Foeniculum vulgare*), and cordgrass (*Spartina* spp.- three different invasive species within S.F. Bay)). Cordgrass only occurs in brackish to saltmarsh habitats and has not been a problem near the wetlands site. Both peppergrass and fennel occur along the levees south of the site and west of the dump. Therefore, there is a small chance that in the future it could invade the upper margins of the wetlands and upland areas of the

ponds. If cordgrass or peppergrass begin to invade the constructed wetlands, the District will apply spot treatment of an approved herbicide for control.

Contingency/Emergency Plan

The City's wastewater treatment plant includes a 5 million gallon emergency holding pond. Should a plant upset or equipment failure occur resulting in the inability of the plant to provide adequate treatment, the wastewater would be diverted to the emergency pond. Once the problems have been resolved, the stored wastewater would be returned for full treatment.

Reporting

An annual report will be prepared and submitted to the Regional Board along with the annual report for the self monitoring plan required as part of the NPDES permit. The annual report will include summaries of the following:

- Monthly flow to the wetlands
- Periodic inspections
- Wildlife and vegetation monitoring
- Vector control actions
- Maintenance work performed
- Unusual events or work performed
- Changes to the Adaptive Management Plan
- Scheduled activities for the upcoming year

Water Quality Monitoring

Water quality entering the wetland will meet all DHS Title 22 requirements for an unrestricted recreational impoundment and other requirements of the City's NPDES permit. Comprehensive water quality monitoring will be performed in accordance with the City's NPDES permit. Sampling and measuring for accumulation of metals, organics and other constituents in the sediments, vegetation and wildlife is not proposed at this time.

Information Sources

AGENCIES

California Department of Fish and Game, Fred Botti and Larry Wyckoff

Napa County Mosquito Abatement District, Wes Maffei

Sacramento Yolo Mosquito Abatement District, Werner Schon (Personal Communication with Wes Maffei) 26 June 2001.

San Francisco Bay Regional Water Quality Control Board, Shin-Roei Lee, Tobi Tyler and Andree Breaux.

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