DRAFT

DESIGN ANALYSIS REPORT

FOR THE

ALBUQUERQUE METROPOLITAN ARROYO FLOOD CONTROL AUTHORITY

UNSER DIVERSION

SEPTEMBER 1993

PREPARED FOR:

SUNWEST BANK SPECIAL ASSETS DEPARTMENT AND THE BELL GROUP

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I, Charles M. Easterling, do hereby certify that this report was prepared by me or under my direction and that I ~~am a~~ duly registered Professional Engineer under the laws of the State of New Mexico.

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PURPOSE

The purpose of this report is to demonstrate the adequacy of the proposed storm water diversion and retention facilities. Principal issues evaluated in this report include the following:

- Hydrology and Pond Routing
- Sediment Issues
- Emergency Spillways
- Storm Drain Pipe Class
- Outlet Structure Design

PROJECT DESCRIPTION

The proposed project consists of six excavated ponds, storm drain connections, minor collection and diversion dikes, and a storm drain outfall. The proposed ponds are to be located along the western boundary of the Atrisco Business Park, Unit 2 between the platted rights-of-way for Avalon Road and Daytona Road. Storm drains are proposed to connect the proposed ponds. A storm drain is proposed to be constructed from the lowest pond to the planned Tierra Bayita Storm Drain at Unser Boulevard to provide for future developed conditions in the watershed.

The project is expected to provide flood protection for the downstream area under a variety of watershed conditions. The expected watershed conditions include the following extremes and possibly several intermediate conditions.

- The design condition — The design condition assumes the watershed is in its existing, primarily undeveloped condition. In this condition, the project watershed is approximately 478 acres in size. This watershed, as shown on Plate 1, extends northwest from the project to the Ladera Diversion System. The project facilities are designed to intercept and retain all of the water and sediment runoff produced in the watershed in the design storm (100–year, 10–day). The focus of this report is on the design condition.

- Future fully developed condition — The developed condition watershed boundaries were identified in the West Bluff Drainage Plan Phase III (Reference 1). The watershed in the fully developed condition is expected to be much smaller than the existing one due to a proposed diversion project (The I–40 Interceptor), which is expected to be constructed along the north side of Interstate 40. OK

The intent of this design is to provide some flexibility for future drainage planning in the fully developed watershed. The project retention facilities were designed to be converted to detention and conveyance facilities to serve the watershed as it develops in the future. The basis for sizing storm drain outfalls and pond connections for this future developed condition was the AHYMO Modeling done for the Master Drainage Plan for the Atrisco Business Park (Reference 3).

The connection of the ponds together in series adds importance to good estimates of inflow timing. Because it is impossible at this time to predict how drainage will be treated and conveyed within the fully developed watershed, it is recommended that further system modeling be required as a part of future drainage planning in the watershed. Allowable discharge from the fully developed watershed should be based on the capacity of the system given a specific drainage plan for the watershed.

This constraint is consistent with the City of Albuquerque Drainage Ordinance Section 12, Paragraph G which states, "The City Engineer shall not approve any plan or report pertaining to proposed construction, platting or other development where the proposed activity or change in the land affected would result in downstream capacity being exceeded."

SYSTEM OPERATION

The following is an explanation of how the system is designed to function in the design condition watershed:

- Pond 6 is designed to retain all of the runoff which reaches it in the design storm. A 36″ storm drain will connect Pond 6 to downstream Pond 4 to provide for the future developed condition. In the event that Pond 6 receives more runoff than predicted, the additional volume will overtop the weir on the outlet structure and be passed through the 36″ storm drain to Pond 4.

- Pond 5 is designed to function primarily as a sedimentation basin to clean up flows from Mirehaven Arroyo "C" before they are conveyed via a 48″ storm drain to downstream Pond 4. Pond 5 is not expected to be required in the fully developed watershed so it was designed to be relatively small in size. Therefore, much of the flow that enters Pond 5 in the design storm will overtop the weir on the outlet structure and will be conveyed via the 48″ storm drain to Pond 4.

- Pond 4 is designed to function as a detention and retention pond for flows passed through Pond 5. It will not receive flow directly from the watershed. Runoff which exceeds the retention volume provided in Pond 4 will overtop the weir on the outlet structure and be conveyed to downstream Pond 3 via a 42″ diameter storm drain.

- Pond 3 is designed to function as a detention, retention and sedimentation pond for flows received directly from the watershed and flows from upstream ponds. The flow from the watershed will be collected and conveyed to the pond along an earthen berm. This berm will extend from the northern edge of the pond to the southern edge of Mirehaven Arroyo "C." Flows which exceed the retention volume in the pond will overtop the weir on the outlet structure and be conveyed through a 42″ storm drain to downstream Pond 2.

- Pond 2 is designed to function as a detention and retention pond for flows passed through Pond 4. This pond will retain the bulk of the flows conveyed to it. A small volume of the design flow will overtop the weir on the outlet structure and be conveyed downstream to Pond 1 via a 48″ storm drain.

- Pond 1 is designed to function as a retention pond for flow conveyed directly from the watershed as well as flows which pass through Pond 2. A 42″ diameter storm drain outfall is being constructed from this pond to the planned Tierra Bayita Storm Drain in Unser Boulevard to provide for the future developed condition.

Over 0.4 acre feet of storage volume is available in Pond 1 between the calculated design storm maximum water surface and the crest of the outlet weir. If a storm larger than the design storm occurs and the outlet weir is overtopped, the excess flow will enter the Unser Diversion Storm Drain and be conveyed to Unser Boulevard. If the Tierra Bayita Storm Drain has been completed in Unser Boulevard at the time of this occurence, the flow will outfall to the Tierra Bayita Storm Drain. If the Tierra Bayita Storm Drain is not in place, the flow would likely exit the Unser Diversion Storm Drain manhole located adjacent to Unser Boulevard and flow into Unser Boulevard.

If the excess flow is somehow prevented from entering the Unser Diversion Storm Drain, over 3 acre feet of additional storage volume is available between the crest of the emergency spillway and the crest of the outlet weir. If the emergency spillway is overtopped, flows will be released to a portion of the historic flow path from the watershed.

GENERAL OPERATION NOTES

If downstream outfalls become available before development occurs in the watershed, it may be desirable to convert the system from full retention to an extended detention system. This can be accomplished by relatively simple modifications to the pond outlet structures. For water quality purposes, it is recommended that the outflow rate from the system be kept very low and detention times long. The average discharge rate required from the system to drain it in 96 hours is approximately 2.75 cfs. Given this small outflow rate, design storm system operation will be nearly the same in the full retention or extended detention mode.

What modification?

The runoff retained in each of the ponds will leave the ponds through evaporation and percolation through the natural soil lining the bottom and sides of the ponds. Reference 8 lists permeability of the soils in which the ponds will be constructed as 2″ to 20″ per hour. If the low estimate of 2″ per hour is assumed, Ponds 1 and 2 with the largest storage depths, will drain in less than two days.

It is expected that fine sediments collected in the ponds will reduce the natural permeability of the soils over time. But, due to the fact that the existing condition watershed does not generate runoff in the frequent events, and the watershed does not contain much road surface area (a source of oils and other soil sealing contaminants), it is not expected that the ponds will contain water for extended periods of time.

HYDROLOGY AND POND ROUTING

The AHYMO 392 hydrologic computer model was utilized to model runoff from the watershed, as well as perform stormwater routing through the proposed ponds. Modeling was done per the guidelines provided in the City of Albuquerque, Development Process Manual, Volume 2, Section 22.2, January 1993 Edition, City of Albuquerque Development Process Manual (COADPM).

Because the system is designed to function without an outfall in the initial condition, the 100–year 10–day storm was utilized as the design storm. Per the COADPM, the 10–day storm runoff is calculated by adding the runoff predicted for the 24–hour storm and the runoff which results from the rainfall falling on impervious areas between the first 24–hour period and the tenth day. Because the subject watershed has very little impervious area, runoff after the 24–hour storm is very limited. Due to this fact, flow rates from this extended runoff period were not considered important. Additional volume produced by this runoff was however utilized for proper sizing of the ponds. The 10–day storm was modeled per the following:

- The model was run using the 24–hour rainfall as the base storm.

- The volume of runoff generated on impervious areas between the 24–hour storm and the 10–day storm was calculated using the following equation:

  $V_{\Delta} = \text{Impervious Area} * (P_{10} \text{ days} - P_{1440})/12.$

- The additional volume was added to the inflow hydrographs of the ponds accepting runoff from the impervious areas. This runoff volume was added to the hydrographs after the peak of the storm had passed so that peak flow rates were not distorted.

Due to the fact that the existing condition watershed is mostly undeveloped, relatively high sediment content is expected in the inflow to the system. In order to model the effect of sediment content, sediment yields were predicted and pond inflow hydrographs were bulked accordingly. Further discussion of sediment issues is included in the next section.

Plate 1 of this report shows the existing condition watershed of the project, the subbasins utilized for modeling, and peak flow rates and volumes for various points in the system. Plate 1 also includes pond routing data.

Appendix "A" contains a print out of the AHYMO model input file and a summary table containing output data. A 3½″ computer disk located inside the back cover of this report contains the input, output, and summary table files for the model.

SEDIMENT ISSUES

Sediment is expected to impact the proposed system in the following ways:

- Create the need for periodic cleaning of the ponds to maintain capacity and infiltration.

- Add to inflow rates and volumes to be stored in the design storm.

- Potentially deposit in storm drain connections between ponds.

In order to evaluate the impact of sediment on the proposed system, a sediment analysis was performed to predict the following:

- Average annual sediment yield from the watershed.

- Sediment yield from the watershed in the design storm.

- Trap efficiency of ponds that directly receive water from the watershed and discharge outflow through a storm drain.

- Sediment transport capacity of storm drains expected to transport significant volumes of sediment.

The following text contains discussion of the methods used and the results of this analysis:

SEDIMENT YIELD

The delivery of sediment to the Unser Diversion System will be limited by the sediment transport capacity of the immediate upstream reaches of the conveyances to the

System. Based on this, sediment yield was estimated as the maximum transport capacity in the various conveyances based on the AHYMO simulated clear water runoff into the ponds. Sediment transport capacity consists of two major components. Sediment which is transported as bed load and sediment transported as wash load.

The method used to estimate transport capacity/sediment yield to the system included the following steps:

Step 1 — <u>Estimate the Wash Load Sediment Concentration</u>. Wash load was estimated using the Modified Universal Soil Loss Equation (MUSLE). The equation is:

$$Ys = \alpha \, (Qp * Vw)^{\beta} \; KLSCP$$

Where:

Ys = Event sediment yield in tons

α = A constant usually 95

Qp = Event peak flow rate in cfs

Vw = Event runoff volume in acre-feet

β = A constant usually 0.56

K = Soil erodibility factor

LS = Topographic factor

CP = Erosion control factor