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I, Patrick Stovall, being duly registered as a Professional Engineer under the laws of the State of New Mexico, do hereby certify that this document was prepared under my direction and is true and correct to the best of my knowledge and belief.

Patrick Stovall

Patrick Stovall, NM PE # 13830

DRAINAGE REPORT and CONCEPTUAL DESIGN
For
PROPOSED STORM DRAINAGE IMPROVEMENTS
NEAR
EL PUEBLO ROAD AND PASEO DEL NORTE
AT THE NORTH DIVERSION CHANNEL

ALBUQUERQUE, NM

Existing 30" CMP that outfalls to the North Diversion Channel
Between El Pueblo Road and the Railroad Tracks

Prepared for:
Albuquerque Metropolitan Arroyo Flood Control Authority

Prepared by:
Smith Engineering Company

January, 2007
SEC Project No. 103115C

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January 31, 2007

Mr. Bradley L. Bingham, P.E., C.F.M.
City of Albuquerque Planning Dept.
Development & Building Services Division
600 2nd Street NW
Albuquerque, NM 87102

Re: Drainage Report for El Pueblo Road at the North Diversion Channel

Dear Mr. Bingham:

I am sending you a copy of the referenced report for you files. As you are aware, AMAFCA contracted Smith Engineering Company to study the area in response to flooding from the 2006 storms. Smith has also been authorized to proceed with design plans on the Phase 1 drainage facilities from the North Diversion Channel to approximately 200 feet east to help alleviate some of the flooding.

If you have any questions, please call me at 884-2215.

Sincerely,
AMAFCA

Lynn M. Mazur

Lynn M. Mazur, P.E., C.F.M.
Project Manager

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Note – Only 2 changes were implemented in this model compared to the 2nd model.
1.Assume the 42-inch cmp under Paseo Del Norte is blocked - AP 12.91
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AHYMO_97 Summary Table
File name P1100-24.txt

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AHYMO_97 Summary Table and Input File
File name EI100-24.txt

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CD CONTAINING :

AHYMO_97 Models, Summary Tables and Full Output File
Included in a pocket at the back of this report

Z:\Projects\2003 Projects\103115C El Pueblo Drainage\report\toc.doc

EXECUTIVE SUMMARY

This executive summary presents the results from the Drainage Analyses and Conceptual Design completed for AMAFCA by Smith Engineering Company for El Pueblo Road and Paseo Del Norte between Jefferson St. and the North Diversion Channel. Please see Figures 1A and 1B located in the text for the schematic locations of drainage improvements labeled as Phases 1 through 9 as described here.

Problem Description

Severe rainfall events last summer caused significant flooding of El Pueblo Rd. between Jefferson St. and the North Diversion Channel, more specifically from the eastern most railroad crossing of El Pueblo Rd. to the North Diversion Channel. Due to undersized existing drainage structures and lack of structures, significant flow passed over the North Diversion Channel west on El Pueblo Rd. into the valley. Smaller flows also crossed the North Diversion Channel on the east and west bound lanes of Paseo Del Norte and north frontage road of Paseo Del Norte. The most severe drainage and flooding problem occurred in and along El Pueblo Rd. between the eastern most railroad crossing and the North Diversion Channel.

PROPOSED IMPROVEMENTS

Improvements were developed in phases to provide for possible funding issues and at logical break points based on the location of flooding and existing features. All improvements are based on the 100-yr. 24-hour peak discharge for full basin development (most basins are fully developed at this time).

Proposed Improvement Phase 1 (P1) (See Figure 1 A)

84" RCP and Overflow Channel at the Existing 30" CMP at the North Diversion Channel between El Pueblo Road and the Railroad Tracks

Problem -

The existing 30" CMP is deteriorating due to rust at the outfall end in the North Diversion Channel. Furthermore is has limited capacity and does not have an overflow section in case it should plug or its capacity exceeded. During many floods, flows spill into El Pueblo Rd. due to lack of culvert capacity.

Solution -

Phase 1 will consist of replacing the existing 30" CMP that outfalls to the North Diversion Channel with an 84" RCP. A culvert must remain at this location in order to collect flows from the existing 21" RCP that outfalls at this location from the existing PNM detention pond. In addition, the existing rail road tie retaining walls will be replaced with reinforced concrete walls, and the outfall from El Pueblo Rd. to the pipe inlet will be concrete lined as there is significant flow and existing erosion from El Pueblo Rd. to the pipe inlet. The emergency overflow section from the pipe headwall to the North Diversion Channel will be constructed with base course. This project will be constructed by AMAFCA is spring 2007.

In addition, please note that considerable flow now and in the future may pass across the North Diversion Channel on El Pueblo Rd. assuming none of the other proposed improvements upstream of this outfall location are built. The condition of the asphalt is very poor on El Pueblo Rd. between the railroad tracks and the North Diversion Channel and there is basically no crown to the road. The improvements will include: an asphalt overlay to provide a crowned section (between the North Diversion Channel and the rail road tracks), four catch basins and a short segment of storm drain to collect the flows in El Pueblo Rd. just east of the North Diversion Channel to outfall in front of the proposed 84" culvert. Re-design of El Pueblo Rd. may be at the discretion and decisions of the NMDOT.

The construction cost estimate of all Phase 1 improvements based on conceptual design is $192,000 and the cost of El Pueblo Rd. pavement improvements, catch basins and storm drain (conceptual design) is about $48,000 of the total $192,000.

Proposed Improvement Phase 2 (P2A) (See Figure 1A)

Concrete Channel from Existing 42" CMP Under Paseo Del Norte to the Proposed 84" RCP at the North Diversion Channel

Problem -

The existing 42" CMP under Paseo Del Norte does not have the capacity to pass the 100-yr. flow and the excess spills west between El Pueblo Road and Paseo Del Norte and floods El Pueblo Road and the railroad crossing located between the 42" CMP and the North Diversion Channel.

Solution -

P2A - a concrete channel with a 5-foot bottom width, 4 feet deep with 1V:2H side slopes is recommended in this location. Install a concrete channel from the inlet of the existing 42" CMP under Paseo Del Norte to the Inlet of the proposed 84" RCP at the North Diversion Channel. The advantage of this solution is that a channel will capture all the pipe and surface flow. The disadvantage is that it will limit future roadway development options.

Proposed Alternative Improvement Phase 2 (P2B) (See Figure 1A)

New 66-in. Storm Drain from Existing 42" CMP Under Paseo Del Norte to the Proposed 84" RCP at the North Diversion Channel

Problem -

The existing 42" CMP under Paseo Del Norte does not have the capacity to pass the 100-yr. flow and the excess spills west between El Pueblo Road and Paseo Del Norte and floods El Pueblo Road and the railroad crossing located between the 42" CMP and the North Diversion Channel.

Solution -

Install a 66" RCP from the inlet of the existing 42" CMP under Paseo Del Norte to the Inlet of the proposed 84" RCP at the North Diversion Channel. The advantage of this alternative is that all flow is underground and will not impede surface improvements. The disadvantage is that in current condition, , it will not capture remnant surface flows. A surface swale over the pipe be required.

Additional Recommendation - Future Plug of the Existing 42-inch Culvert Under Paseo Del Norte

The existing 42-inch culvert under Paseo Del Norte (the inlet is located between El Pueblo Rd. and the rail road tracks) has very low capacity should be plugged *after proposed improvements P1 and either P2A or P2B are constructed*. This will allow for additional capacity of this culvert as it continues on the north side of the north Paseo Del Norte frontage road. This is based on the recommendation that some existing flows and culvert outfalls from the north Paseo Del Norte frontage road (that now outfall into private property) be re-directed into the 48-inch culvert.

Proposed Improvement Phase 3 (P3A) (See Figure 1A)

Concrete Channel from El Pueblo Road At Eastern Most Railroad Track Crossing to Existing 42" CMP under Paseo Del Norte

Problem -

There is an existing asphalt channel in the referenced reach and this channel is failing. The erosion in this channel is within 1-foot of the concrete traffic barrier on the east bound lanes of Paseo Del Norte. This barrier and Paseo Del Norte are in need of protection because further erosion will occur at this location.

Solution -

P3A – a concrete channel with a 5-foot bottom width, 4 feet deep with 1V:2H side slopes is recommended in this location. The advantage of this solution is that a channel will capture all the pipe and surface flow. The disadvantage is that it will limit future roadway development options.

Proposed Alternative Improvement Phase 3 (P3B) (See Figure 1A)

New 66-inch RCP from El Pueblo Road At Eastern Most Railroad Track Crossing to Existing 42" CMP under Paseo Del Norte

Problem -

There is an existing asphalt channel in the referenced reach and this channel is failing and the erosion in this channel is within 1 foot of the concrete traffic barrier on the east bound lanes of Paseo Del Norte. This barrier and Paseo Del Norte are in need of protection because further erosion will occur at this location.

Solution -

P3B - a 66" RCP could be considered at this location.

The advantage of this alternative is that all flow is underground and will not impede surface improvements. The disadvantage is that in current condition, it will not capture remnant surface flows. A surface swale over the pipe be required.

Proposed Improvement Phase 4 (P4) (See Figure 1A)

El Pueblo Road At Eastern Most Railroad Track Crossing

Problem -

At present there is no outfall for the flow from the basins contributing to this location and consequently El Pueblo Road experiences frequent flooding.

Solution -

The recommended solution is to build a concrete headwall and a 66" RCP culvert under El Pueblo Road to convey the flow to the existing road side ditch between El Pueblo Road and Paseo Del Norte.

Proposed Improvement Phase 5 (P5) (See Figure 1B)

East Bound Paseo Del Norte near the North Diversion Channel

Problem -

At present there is only 1 median type inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional inlet about 20 feet east of the existing inlet and join this basin to the existing basin with a 24-inch CMP. This will collect most of the 100-yr. flow.

Proposed Improvement Phase 6 (P6) (See Figure 1B)

North Paseo Del Norte Frontage Road at Rail Road Tracks

Problem -

At present there is only 1 curb inlet in the frontage road located just east of the rail road tracks . This inlet and one inlet in west bound Paseo Del Norte and one median type inlet located in the soil north of the roadway all outfall to a 24-inch CMP that outfalls into private property. Note that due to lack of curb at the rail road track crossing that flow in excess of the road flow spills north into private property.

Solution -

The recommended solution is to add two additional inlets about 20 feet east of the existing inlet in the frontage road and join these to the existing basin with a 24-inch CMP. The connection of the 24-inch pipe from the existing basin to the median inlet basin may remain, but then the existing 24-inch CMP from the median inlet basin into private property should be abandoned. A new 24-inch CMP should be installed from the median inlet to join the manhole that is located about 200 feet west of the rail road tracks. This manhole is the junction of the 42-inch CMP under Paseo Del Norte and the 33"R x 49" S CMP that continues west just north of the frontage road. This new 24-inch CMP will eliminate nearly all runoff from draining into private property.

This report recommends plugging the 42-inch CMP on the south side of Paseo Del Norte after proposed improvements P1 and P2 are built. This will allow plenty of capacity in the 33" R x 49" S CMP that continues past the referenced manhole.

Proposed Improvement Phase 7 (P7) (See Figure 1B)

North Paseo Del Norte Frontage Road at Turn Lane into Private Property

Problem -

At present, approximately 80 percent of the storm runoff in the north bound frontage road at this private driveway (located about 500 feet east of the N. Div. Channel) drains into the private driveway.

Solution -

The recommended solution is to add three additional curb inlets about 20 feet east of the driveway. These inlets could be joined to the existing 33" R x 49" S CMP located just north of the north frontage road.

Proposed Improvement Phase 8 (P8) (See Figure 1B)

North Paseo Del Norte Frontage Road just east of N. Diversion Channel

Problem -

At present there is only 1 curb inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional curb inlet about 20 feet east of the existing inlet. This include could outfall into a 24-inch CMP that would outfall to the existing drainage ditch that is the outfall for the existing 33"R x 49"R CMP. This will collect most of the 100-yr. flow.

Proposed Improvement Phase 9 (P9) (See Figure 1B)

West Bound Paseo Del Norte Frontage Road just east of N. Diversion Channel

Problem -

At present there is only 1 median type inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional inlet about 20 feet east of the existing inlet and join this basin to the existing basin with a 24-inch CMP. This will collect most of the 100-yr. flow.

PROPOSED IMPROVEMENTS COST SUMMARY AND RECOMMENDATIONS

El Pueblo Road Improvements

Proposed Improvement P1 (84" RCP and overflow channel spillway section)- $192,000
(about $48,000 are improvements within El Pueblo Rd.)
will prevent flooding of El Pueblo Rd. at the North Diversion Channel.

Proposed Improvement P2A (reinforced concrete channel) - $583,000
will prevent flooding of El Pueblo Rd. at the western most railroad crossing.

Proposed Improvement P3A (reinforced concrete channel) -$220,000
will prevent failure of the Paseo Del Norte traffic barrier wall and asphalt.

Proposed Improvement P4 (66" RCP) – $328,000
will eliminate flooding of El Pueblo Rd. near the. eastern most railroad crossing.

Total Cost of Phase 1 through 4 Improvements for El Pueblo Road = $1,323,000

Paseo Del Norte and North Frontage Road Improvements

Proposed Improvement P5 (1 inlet and 24" CMP) – $20,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Proposed Improvement P6 (2 inlets and 24" CMP) – $85,000
will eliminate most 100-yr. flow from draining into private property near railroad tracks.

Proposed Improvement P7 (3 inlets and 24" CMP) – $48,000
will eliminate most 100-yr. flow from draining into private property 500 ft. east of N. Div. Channel

Proposed Improvement P8 (1 inlet and 24" CMP) – $17,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Proposed Improvement P9 (1 inlet and 24" CMP) – $20,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Total Cost of Phase 5 through 9 Improvements for Paseo Del Norte and North Frontage Road = $190,000

Total Cost of Phase 1 through 9 Improvements = $1,513,000

SECTION 1

INTRODUCTION

1.1 PURPOSE

The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) requested that Smith Engineering Company (SEC) conduct a drainage analysis, prepare a drainage report and develop conceptual design(s) to improve the existing drainage infrastructure located near El Pueblo Road and Paseo Del Norte (PDN) at the North Diversion Channel in Albuquerque, NM.

This document will summarize the hydrologic and hydraulic analyses conducted for the drainage options considered and to present conceptual plans to improve the existing storm drain system.

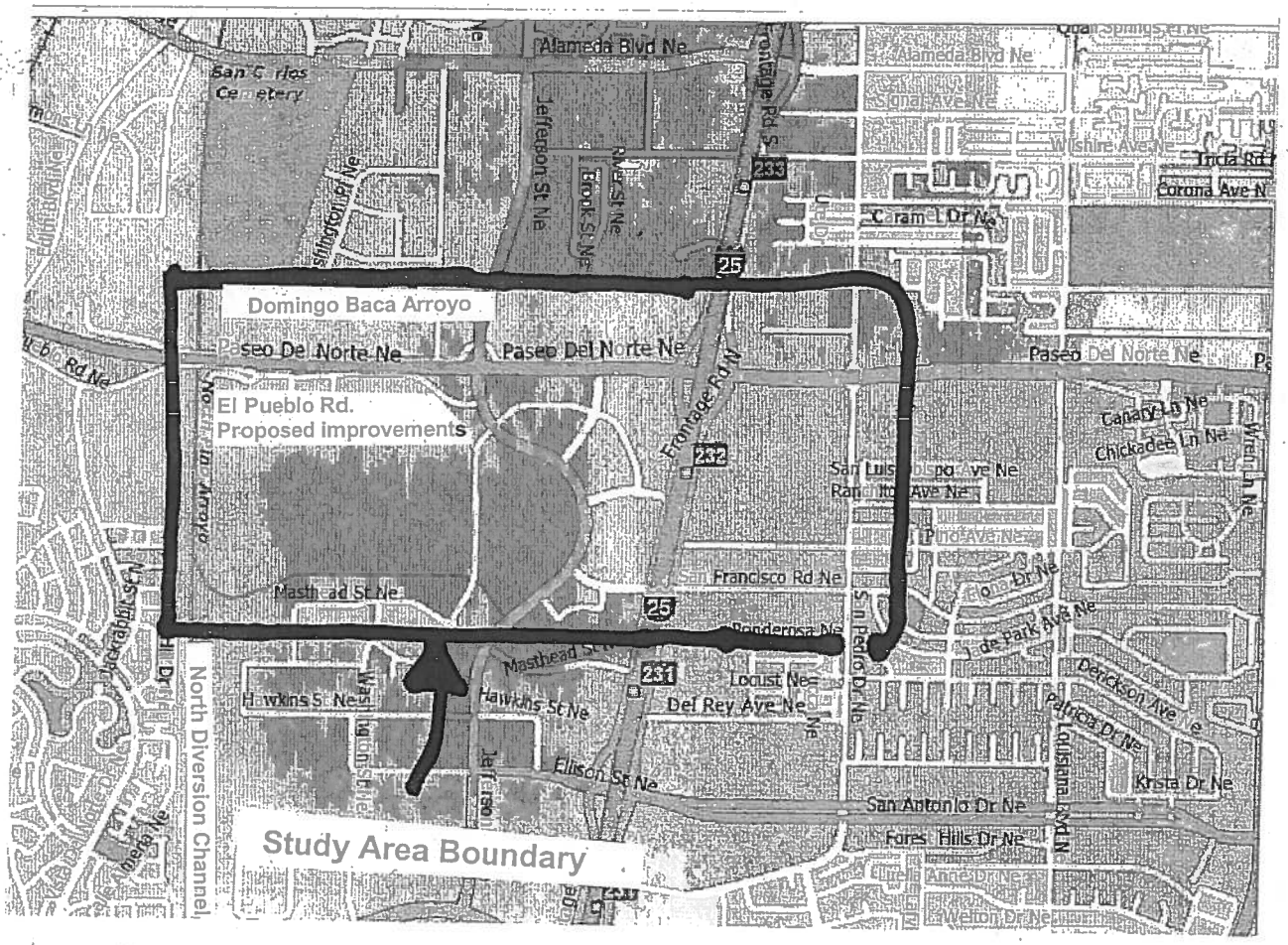
1.2 SCOPE

The scope of the drainage analysis and design plans are listed here:

- Meetings with AMAFCA
- Compile and review master drainage reports
- Compile any remaining available As-built record drawing information and identify locations for required field surveys to pick up required inverts, pipe size and slopes.
- Coordinate any field surveys investigation and topographic surveying
- Prepare a detailed drainage basin map
- Hydrologic analyses for existing, full build out and drainage options using the AHYMO_97 program
- Hydraulic analyses of storm drains and open channels
- Prepare Preliminary Hydrology and Hydraulics drainage report, submit to AMAFCA, City of Albuquerque and the New Mexico Department of Transportation (NMDOT) for review.
- Prepare Final H&H Report
- Prepare conceptual drainage options and associated quantity and cost estimates, summarize in final Report

1.3 PROJECT LOCATION

The project drainage basin area is generally between the Domingo Baca Arroyo on the north, the North Pino Arroyo on the south, the North Diversion Channel on the west and San Pedro Blvd. on the east. **Figure A** presents the generally drainage basin area and also the proposed general proposed project location that is located at El Pueblo Rd. at the North Diversion Channel.



North

Not to scale

VICINITY MAP

FIGURE A

1.4 PROBLEM DESCRIPTION AND EXISTING STORM DRAIN INFRASTRUCTURE

Problem Description

During the summer of 2006, extensive flooding occurred on El Pueblo Road at several locations just east of its crossing the North Diversion Channel. In addition, a significant quantity of storm water continued past the North Diversion Channel on El Pueblo Road. Note also that some significant erosion has occurred on the south side of Paseo Del Norte that is now a threat to the concrete barrier on the east bound lanes. Therefore, this report will provide conceptual drainage options and present recommendations to improve the drainage system along El Pueblo Road between approximately Jefferson St. and the North Diversion Channel.

Existing Storm Drain System

The existing storm drain system is presented on **Figure 1** (located in map pocket) that is the Drainage Basin Map. The storm drain systems for Paseo Del Norte were obtained from as-built drawings listed in the next section. The storm drains locations and sizes for the remainder of the study area were obtained from either the City of Albuquerque GIS system or from Drainage Plan drawings also provided by the City of Albuquerque.

SECTION 2

GENERAL BACKGROUND

2.1 PREVIOUS PLANS AND DRAINAGE REPORT INFORMATION

Storm Drain As-Built Drawings for Paseo Del Norte

New Mexico State Highway Department Construction Plans Paseo Del Norte, Section C. SP-(M)-4054(204) AMAFCA Channel to I-25. Bernalillo County. URS Corporation. (8-3-87 is Highway Dept. signature date)

Drainage Reports and Drainage Plans

Drainage Report - Paseo Del Norte Highway Project Section "C" (formerly El Pueblo River Crossing). Prepared for New Mexico Highway Department. URS Engineers.1985

A brief summary of this report follows:

Design Criteria –
- inlets - 10-yr. with one lane open in each direction
- storm sewer – 25-yr.
- depressed areas = 50-yr
- culverts – 50-yr. or greatest flood of record
- retention / detention = 100-yr.

Hydrologic Methods – rural section – USDA SCS National Engineering Handbook, Sect. 4 Hydrology
- urban section – Rational Method
- minimum Tc = 10 min.

Storm Sewers – NMSH&TD, min. velocity = 2.5 fps, flowing full with no surcharge for 10-yr. storm and with surcharge to top of grate or cover for 25-yr. storm.

Summary of Report Text –
The text description is brief and does not discuss flow divides through PDN walls, curb locations or intersection locations. There was brief discussion that storm flows could be carried directly to the North Diversion Channel within storm drains, but this option was not considered further and was not built. The 42-inch CMP under Paseo Del Norte at the railroad track crossing was described as handling the off-site flows for existing conditions, and that if the area develops, that consideration should be given that developers be required to incorporate detention ponds.

Master Drainage Plan - Paseo Del Norte Industrial Park, prepared by Jeff Mortensen, 1/1999

Revised Drainage Management - Journal Center, prepared by Bohannan Huston, 12/1992

Street & Storm Drain Profile - City of Albuquerque, prepared by Bohannan Huston, 1994

Drainage Plan, Journal Center Tract 3A-1, Bohannan Huston, 8/4/94

Grading & Drainage Plan - Market Place at Journal Center Tract 3A-1C, Tierra West Development Management Services, R. Bohannan 12/17/96

Final Drainage/Grading Plan for Phase 4 - Fanning Bard Tatum, Sun Healthcare Group, Inc., Bohannan Huston, 9/1998

Final Drainage/Grading Plan for Phase 3 - Fanning Bard Tatum, Sun Healthcare Group, Inc., Bohannan Huston, 5/1997

Purposed Conditions Basin Map - Journal Center, Tract 3A-1A, Fanning Bard Tatum, Sun Healthcare Group, Inc., Bohannan Huston, 12/21/96

Final Drainage/Grading Plan for Tracts 3A-1A - Journal Center, Tract 3A-1A, Fanning Bard Tatum, Sun Healthcare Group, Inc., Bohannan Huston, 1/95

Journal Center, Phase II, Bohannan Huston, 2000

2.2 PROPOSED PROJECTS

AMAFCA

This report summarizes AMAFCA's efforts to eliminate flooding problems along El Pueblo Rd. and Paseo Del Norte generally located between the North Diversion Channel and Jefferson St. Subsequent sections of this report present conceptual level proposed drainage improvement options.

NMDOT

The NMDOT is in the very preliminary planning stages to improve Paseo Del Norte and/or provide alternate or additional roadways. This Drainage Report and the proposed recommendations may be usefull

SECTION 3

HYDROLOGIC AND HYDRAULIC ANALYSES FOR EXISTING CONDITIONS AND PROPOSED IMPROVEMENTS

3.1 HYDROLOGIC DATA AND ASSUMPTIONS

Design Criteria

The 100-yr.- 24-hr. storm was selected for the design return period. Rainfall data was obtained from NOAA Atlas 14 on the internet and that data is included in **Appendix A**. **Table 1** presents a summary of the rainfall data.

Future Basin Development Conditions

Please see the Drainage Basin Map **Figure 1** (map pocket) and note that the aerial photograph used as the base does not represent additional development that has occurred since the date of the photograph. Most of the basin is developed at this time and therefore the analysis will only be conducted for full future basin development conditions. Please see the footnotes on the bottom of **Table 2** for those basins that have mostly undeveloped conditions for existing conditions.

Basin Delineations

The watershed was divided into drainage basins as shown on **Figure 1**. All storm drain locations, storm drain inlets, culverts, drainage divides and land use types were verified with field observation.

Land Treatment Assumptions

The land treatment type assumptions were based on field observations and mostly the aerial photograph (**Figure 1**). For those basins with some undeveloped land, the assumption was that the land would be developed as the current development which is all commercial or industrial. **Table 2** presents a summary of all land treatment type assumptions for all basins.

Time of Concentration (Tc) and Time to Peak (Tp)

The longest flow path in each basin was delineated and measured on **Figure 1**. The Upland Method was applied as all basins have a total flow length of less than 4000 feet. The conveyance factors were selected based on recommendations in the COA DPM and referenced in **Table 2** which presents a summary of all Tc and Tp data, formulas and unit hydrograph Tp results required for the AHYMO model.

Flow Divide Assumptions

Surface Flow Divide Assumptions - There are many locations particularly along Paseo Del Norte and El Pueblo Road that storm runoff spills in or out of a basin due to breaks in the Paseo Del Norte traffic barrier walls and curb cuts due to the railroad track crossings. Flow divide assumptions were developed based on experience and visual observation.

Storm Drain Inlet Divide Assumptions – The location of storm drain inlets and storm drains were used to determine analysis point locations for flow divides.

Hydrograph Routing

Due to the relatively short routing reaches, and due to the assumptions developed to simulate the drainage basin and its complex series of flow divides and hydrograph combinations, hydrograph routing was determined to be unnecessary. This is also based on experience with short routing reaches because these result in very small attenuation of hydrograph peaks and time delay.

3.2 AHYMO MODEL DEVELOPMENT

Surface Flow Divide Assumptions
There are many street intersections and other locations such as breaks in the concrete traffic barrier walls along Paseo Del Norte where flow will divide into 2 directions. All such locations were observed in the field and the percentage flow split was estimated based on field conditions and experience. **Table 3** presents a summary of all flow divide assumptions.

Storm Drain Inlet Combination
A group or location of one or more inlets were combined into one Analysis Point to represent a location where the combined capacity of those inlets could be modeled. **Figure 2** (located in map pocket) presents a graphical annotation of the inlet types and combinations of inlets combined for a given analysis point.

Existing Structure Hydraulics

Storm Drain Inlets - The Flow Master output and the other hydraulic computations to determine the capacities of the storm drain inlet and storm drain pipes are included in **Appendix A**. **Table A1** located in **Appendix A** presents a summary of the discharges computed for all Analysis Points which represent storm drain inlets.

Storm Drain Pipes – The non-pressure full pipe flow capacity of all existing storm drains was computed with the Flow Master program and the output is also included in **Appendix A**. **Table A2** locate in **Appendix A** includes a summary of the storm drain capacities.

Inlet Capacity Versus Storm Drain Non-Pressure Full Pipe Flow Capacity

The smallest value of either the inlet capacities at a given Analysis Point or the non-pressure full pipe flow capacity was assumed for the value to be applied to divide the hydrograph. Hydrographs were divided at Analysis Point to differentiate pipe flow from street or surface flow. **Table 3** presents a summary of all flow divide values.

Culvert Hydraulics - The existing culverts that were modeled are the following:

One 42" CMP under Paseo Del Norte at the railroad track crossing collects some flow from the south side of Paseo Del Norte. This culvert joins a 33" rise by 49" span on the north side of Paseo Del Norte and then outfalls just east of the North Diversion Channel.

One 30" CMP between El Pueblo Rd. and the railroad track crossing the North Diversion Channel. This pipe outfalls to the North Diversion Channel.

One 21" RCP that begins in the PNM detention pond and outfalls at the inlet to the 30" CMP as describe above.

The culvert hydraulics were modeled with the Culvert Master program and the input assumptions, data and program output are included in **Appendix A**. The maximum culvert capacities were applied at the corresponding analysis points to represent the hydrograph volume that would be divided by the culvert capacity. The culvert discharge capacities are summarized in **Table 3.**

AHYMO Modeling Schematic

The order of basin hydrograph computation, flow divide locations and assumptions, hydrograph combination locations are summarized in the AHYMO_97 modeling schematic as shown in **Figure 3** (located in map pocket). This schematic is crucial to understanding the model development, hydrograph and analysis point locations and flow divide locations and assumptions. **Table 3** presents a summary of all flow divide assumptions and discharge values for the "divide hydrograph" analysis point locations.

3.3 AHYMO_97 FULL DEVELOPMENT CONDITIONS WITHOUT and WITH PROPOSED IMPROVEMENT P1 OUTPUT AND SUMMARY

AHYMO_97 Model Without Proposed Improvements

Due to the complexity of the AHYMO_97 model and numerous locations where a hydrograph will leave the watershed, a continuity check is crucial to ensure that a modeling error has not occurred. **Table 4** presents a summary of that continuity check that proves the model has accounted for all basins through a comparison of areas of individual basins.

Table 5 presents a summary of the AHYMO_97 Model Output for the full development conditions 100-yr. 24-hour return period storm only for the problem locations evaluated for the purpose of this analysis. Please see **Appendix B** for a full AHYMO_97 model summary table for all analysis point locations and for the input file. The digital AHYMO_97 model input file, summary table and output file are included on a CD in a map pocket.

AHYMO_97 Model With Proposed Improvement P1 (Replacement of the existing 30-inch CMP at N. Diversion Channel with an 84-inch RCP

A model was developed to simulate proposed improvement P1 for the following reason. Improvement P1 assumes that the 42-inch CMP under Paseo Del Norte will be plugged in the future, and that all flow from El Pueblo Rd. will be collected so that none will pass over the North Diversion Channel. The result of this change at the location of the 30" CMP follows: existing conditions Qp 100yr. = 277 cfs, and with Proposed Improvement P1 assumptions as described, Qp 100yr. = 364 cfs.

Table 5 presents a summary of the AHYMO_97 Model Output for the full development conditions 100-yr. 24-hour return period storm only for the problem locations evaluated for the purpose of this analysis. Please see **Appendix B** for a full AHYMO_97 model summary table for all analysis point locations and for the input file. The digital AHYMO_97 model input file, summary table and output file are included on a CD in a map pocket.

3.4 PROPOSED IMPROVEMENTS CONCEPTUAL DESIGN

Improvements were developed in phases to provide for possible funding issues and at logical break points based on the location of flooding and existing features. All improvements are based on the 100-yr. 24-hour peak discharge for full basin development (most basins are fully developed at this time).

Appendix C includes the quantity and cost estimates, assumptions, hydraulic data and results for the proposed drainage improvements as described in this section. Please see **Figure 1A** for a schematic view of the El Pueblo Road Phase 1 through 4 existing conditions and proposed improvements. Please see **Figure 1B** for a schematic view of the Paseo Del Norte and north frontage road Phase 5 through 9 existing conditions and proposed improvements. The actual locations of the proposed drainage

improvements are illustrated on **Figure 4** (located in map pocket) and descriptions of those improvements are described here.

PROPOSED IMPROVEMENT PHASE 1 (P1)
84" RCP and Overflow Channel at the Existing 30" CMP at the North Diversion Channel between El Pueblo Road and the Railroad Tracks

Problem
The existing 30" CMP is deteriorating due to rust at the outfall end in the North Diversion Channel. Furthermore is has limited capacity and does not have an overflow section in case it should plug or its capacity exceeded. During many floods, flows spill into El Pueblo Rd. due to lack of culvert capacity.

Solution
Phase 1 will consist of replacing the existing 30" CMP that outfalls to the North Diversion Channel with an 84" RCP. A culvert must remain at this location in order to collect flows from the existing 21" RCP that outfalls at this location from the existing PNM detention pond. In addition, the existing rail road tie retaining walls will be replaced with reinforced concrete walls, and the outfall from El Pueblo Rd. to the pipe inlet will be concrete lined as there is significant flow and existing erosion from El Pueblo Rd. to the pipe inlet. The emergency overflow section from the pipe headwall to the North Diversion Channel will be constructed with base course. This project will be constructed by AMAFCA in spring 2007.

In addition, please note that considerable flow now and in the future may pass across the North Diversion Channel on El Pueblo Rd. assuming none of the other proposed improvements upstream of this outfall location are built. The condition of the asphalt is very poor on El Pueblo Rd. between the railroad tracks and the North Diversion Channel and there is basically no crown to the road. The improvements will include: an asphalt overlay to provide a crowned section (between the North Diversion Channel and the rail road tracks), four catch basins and a short segment of storm drain to collect the flows in El Pueblo Rd. just east of the North Diversion Channel to outfall in front of the proposed 84" culvert. Re-design of El Pueblo Rd. may be at the discretion and decisions of the NMDOT.

The construction cost estimate of all Phase 1 improvements based on conceptual design is $192,000 and the cost of El Pueblo Rd. pavement improvements, catch basins and storm drain (conceptual design) is about $48,000 of the total $192,000.

Figure 4 illustrates the proposed locations and conceptual level plan view. Due to an existing sanitary sewer line near the location of the proposed 84" CMP, SEC opened the manhole to take a depth measurement, and also measured basic horizontal and vertical dimensions of the surrounding features. That information is presented in **Figure 5** and was used as the basis for conceptual design of the proposed solution as described. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 6**.

PROPOSED IMPROVEMENT PHASE 2 (P2A)
Concrete Channel from Existing 42" CMP Under Paseo Del Norte to the Proposed 84" RCP at the North Diversion Channel

Problem
The existing 42" CMP under Paseo Del Norte does not have the capacity to pass the 100-yr. flow and the excess spills west between El Pueblo Road and Paseo Del Norte and floods El Pueblo Road and the railroad crossing located between the 42" CMP and the North Diversion Channel.

Solution

P2A - a concrete channel with a 5-foot bottom width, 4 feet deep with 1V:2H side slopes is recommended in this location. Install a concrete channel from the inlet of the existing 42" CMP under Paseo Del Norte to the Inlet of the proposed 84" RCP at the North Diversion Channel. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 7**.

The advantage of this solution is that a channel will capture all the pipe and surface flow. The disadvantage is that it will limit future roadway development options.

PROPOSED ALTERNATE IMPROVEMENT PHASE 2 (P2B)

New 66-in. Storm Drain from Existing 42" CMP Under Paseo Del Norte to the Proposed 84" RCP at the North Diversion Channel

Problem

The existing 42" CMP under Paseo Del Norte does not have the capacity to pass the 100-yr. flow and the excess spills west between El Pueblo Road and Paseo Del Norte and floods El Pueblo Road and the railroad crossing located between the 42" CMP and the North Diversion Channel.

Solution

Install a 66" RCP from the inlet of the existing 42" CMP under Paseo Del Norte to the Inlet of the proposed 84" RCP at the North Diversion Channel. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 7**.

The advantage of this alternative is that all flow is underground and will not impede surface improvements. The disadvantage is that in current condition, it will not capture remnant surface flows. A surface swale over the pipe be required.

Additional Recommendation - Future Plug of the Existing 42-inch Culvert Under Paseo Del Norte

The existing 42-inch culvert under Paseo Del Norte (the inlet is located between El Pueblo Rd. and the rail road tracks) has very low capacity should be plugged *after proposed improvements P1 and either P2A or P2B are constructed*. This will allow for additional capacity of this culvert as it continues on the north side of the north Paseo Del Norte frontage road. This is based on the recommendation that some existing flows and culvert outfalls from the north Paseo Del Norte frontage road (that now outfall into private property) be re-directed into the 48-inch culvert.

PROPOSED IMPROVEMENT PHASE 3 (P3A)

Concrete Channel from El Pueblo Road At Eastern Most Railroad Track Crossing to Existing 42" CMP under Paseo Del Norte

Problem

There is an existing asphalt channel in the referenced reach and this channel is failing. The erosion in this channel is within 1 foot of the concrete traffic barrier on the east bound lanes of Paseo Del Norte. This barrier and Paseo Del Norte are in need of protection because further erosion will occur at this location.

Solution
P3A – a concrete channel with a 5-foot bottom width, 4 feet deep with 1V:2H side slopes is recommended in this location. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table8**.

The advantage of this solution is that a channel will capture all the pipe and surface flow. The disadvantage is that it will limit future roadway development options.

PROPOSED ALTERNATE IMPROVEMENT PHASE 3 (P3B)
New 66-inch RCP from El Pueblo Road At Eastern Most Railroad Track Crossing to Existing 42" CMP under Paseo Del Norte

Problem
There is an existing asphalt channel in the referenced reach and this channel is failing and the erosion in this channel is within 1 foot of the concrete traffic barrier on the east bound lanes of Paseo Del Norte. This barrier and Paseo Del Norte are in need of protection because further erosion will occur at this location.

Solution
P3B - a 66" RCP could be considered at this location. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 8**.

The advantage of this alternative is that all flow is underground and will not impede surface improvements. The disadvantage is that in current condition, it will not capture remnant surface flows. A surface swale over the pipe be required.

PROPOSED IMPROVEMENT PHASE 4 (P4)
El Pueblo Road At Eastern Most Railroad Track Crossing

Problem
At present there is no outfall for the flow from the basins contributing to this location and consequently El Pueblo Road experiences frequent flooding.

Solution
The recommended solution is to build a concrete headwall and a 66" RCP culvert under El Pueblo Road to convey the flow to the existing road side ditch between El Pueblo Road and Paseo Del Norte. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 9**.

Proposed Improvement Phase 5 (P5) (See Figure 1B)
East Bound Paseo Del Norte near the North Diversion Channel
Problem -
At present there is only 1 median type inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional inlet about 20 feet east of the existing inlet and join this basin to the existing basin with a 24-inch CMP. This will collect most of the 100-yr. flow. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 10**.

Proposed Improvement Phase 6 (P6) (See Figure 1B)

North Paseo Del Norte Frontage Road at Rail Road Tracks

Problem -

At present there is only 1 curb inlet in the frontage road located just east of the rail road tracks . This inlet and one inlet in west bound Paseo Del Norte and one median type inlet located in the soil north of the roadway all outfall to a 24-inch CMP that outfalls into private property. Note that due to lack of curb at the rail road track crossing that flow in excess of the road flow spills north into private property.

Solution -

The recommended solution is to add two additional inlets about 20 feet east of the existing inlet in the frontage road and join these to the existing basin with a 24-inch CMP. The connection of the 24-inch pipe from the existing basin to the median inlet basin may remain, but then the existing 24-inch CMP from the median inlet basin into private property should be abandoned. A new 24-inch CMP should be installed from the median inlet to join the manhole that is located about 200 feet west of the rail road tracks. This manhole is the junction of the 42-inch CMP under Paseo Del Norte and the 33"R x 49" S CMP that continues west just north of the frontage road. This new 24-inch CMP will eliminate nearly all runoff from draining into private property.

This report recommends plugging the 42-inch CMP on the south side of Paseo Del Norte after proposed improvements P1 and P2 are built. This will allow plenty of capacity in the 33" R x 49" S CMP that continues past the referenced manhole.

Figure 4 illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 11**.

Proposed Improvement Phase 7 (P7) (See Figure 1B)

North Paseo Del Norte Frontage Road at Turn Lane into Private Property

Problem -

At present, approximately 80 percent of the storm runoff in the north bound frontage road at this private driveway (located about 500 feet east of the N. Div. Channel) drains into the private driveway.

Solution -

The recommended solution is to add three additional curb inlets about 20 feet east of the driveway. These inlets could be joined to the existing 33" R x 49" S CMP located just north of the north frontage road. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 12**.

Proposed Improvement Phase 8 (P8) (See Figure 1B)

North Paseo Del Norte Frontage Road just east of N. Diversion Channel

Problem -

At present there is only 1 curb inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional curb inlet about 20 feet east of the existing inlet. This include could outfall into a 24-inch CMP that would outfall to the existing drainage ditch that is the outfall for the existing 33"R x 49"R CMP. This will collect most of the 100-yr. flow. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 13**.

Proposed Improvement Phase 9 (P9) (See Figure 1B)

West Bound Paseo Del Norte Frontage Road just east of N. Diversion Channel

Problem -

At present there is only 1 median type inlet at this location that outfalls to a 24-inch CMP into the North Diversion Channel. Some flow escapes this inlet and passes west across the North Diversion Channel.

Solution -

The recommended solution is to add one additional inlet about 20 feet east of the existing inlet and join this basin to the existing basin with a 24-inch CMP. This will collect most of the 100-yr. flow. **Figure 4** illustrates the proposed locations and conceptual level plan view. **Table 5** presents a summary description of the existing problem and proposed solution(s), 100-yr. peak discharge and the conceptual level cost estimate. The quantity and cost estimates and hydraulic data and results are included in **Appendix C** and the cost total is summarized in **Table 14**.

SECTION 4

RECOMMENDATIONS

4.1 PROPOSED IMPROVEMENTS COST SUMMARY AND RECOMMENDATIONS

Table 5 presents a summary of the existing drainage problems and proposed drainage improvements and cost estimates based on conceptual design. Please see **Figures 1A and 1B** for a schematic representation of the existing conditions and proposed improvements.

PROPOSED IMPROVEMENTS COST SUMMARY AND RECOMMENDATIONS

Proposed Improvement P1 (84" RCP and overflow channel spillway section)- $192,000
(about $48,000 are improvements within El Pueblo Rd.)
will prevent flooding of El Pueblo Rd. at the North Diversion Channel.

Proposed Improvement P2A (reinforced concrete channel) - $583,000
will prevent flooding of El Pueblo Rd. at the western most railroad crossing.

Proposed Improvement P3A (reinforced concrete channel) -$220,000
will prevent failure of the Paseo Del Norte traffic barrier wall and asphalt.

Proposed Improvement P4 (66" RCP) – $328,000
will eliminate flooding of El Pueblo Rd. near the. eastern most railroad crossing.

Total Cost of Phase 1 through 4 Improvements for El Pueblo Road = $1,323,000

Paseo Del Norte and North Frontage Road Improvements

Proposed Improvement P5 (1 inlet and 24" CMP) – $20,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Proposed Improvement P6 (2 inlets and 24" CMP) – $85,000
will eliminate most 100-yr. flow from draining into private property near railroad tracks.

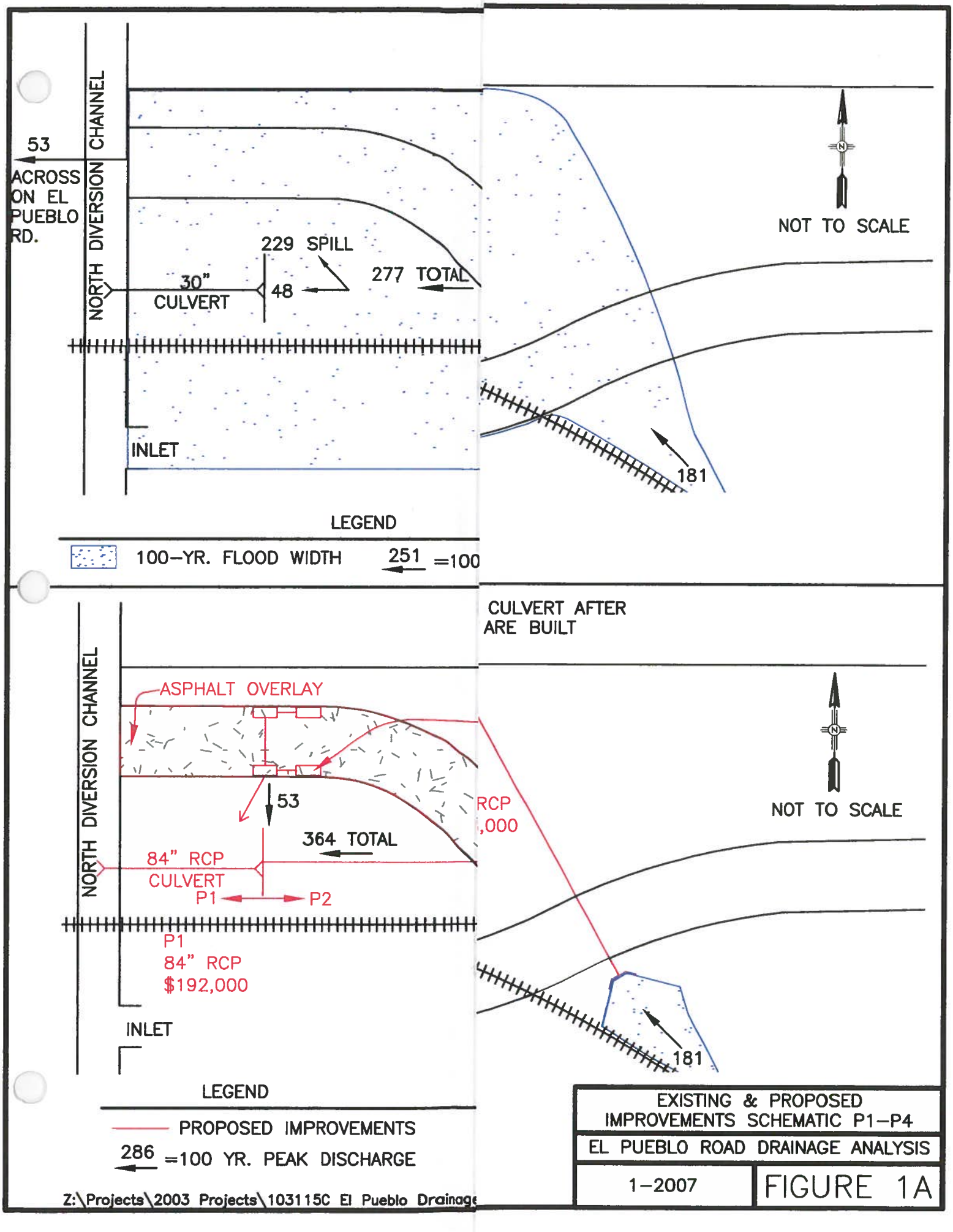
Proposed Improvement P7 (3 inlets and 24" CMP) – $48,000
will eliminate most 100-yr. flow from draining into private property 500 ft. east of N. Div. Channel

Proposed Improvement P8 (1 inlet and 24" CMP) – $17,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Proposed Improvement P9 (1 inlet and 24" CMP) – $20,000
will eliminate most 100-yr. flow from crossing the N. Diversion Channel.

Total Cost of Phase 5 through 9 Improvements for Paseo Del Norte and North Frontage Road = $190,000

Total Cost of Phase 1 through 9 Improvements = $1,513,000


NORTH DIVERSION CHANNEL
53
ACROSS ON EL PUEBLO RD.
30" CULVERT
229 SPILL
48
277 TOTAL
INLET
NOT TO SCALE
181
LEGEND
100-YR. FLOOD WIDTH
251 =100
CULVERT AFTER ARE BUILT
ASPHALT OVERLAY
53
364 TOTAL
84" RCP CULVERT
P1
P2
P1
84" RCP
$192,000
INLET
RCP
,000
NOT TO SCALE
181
LEGEND
PROPOSED IMPROVEMENTS
286 =100 YR. PEAK DISCHARGE
Z:\Projects\2003 Projects\103115C El Pueblo Drainage
EXISTING & PROPOSED IMPROVEMENTS SCHEMATIC P1-P4
EL PUEBLO ROAD DRAINAGE ANALYSIS
1-2007
FIGURE 1A

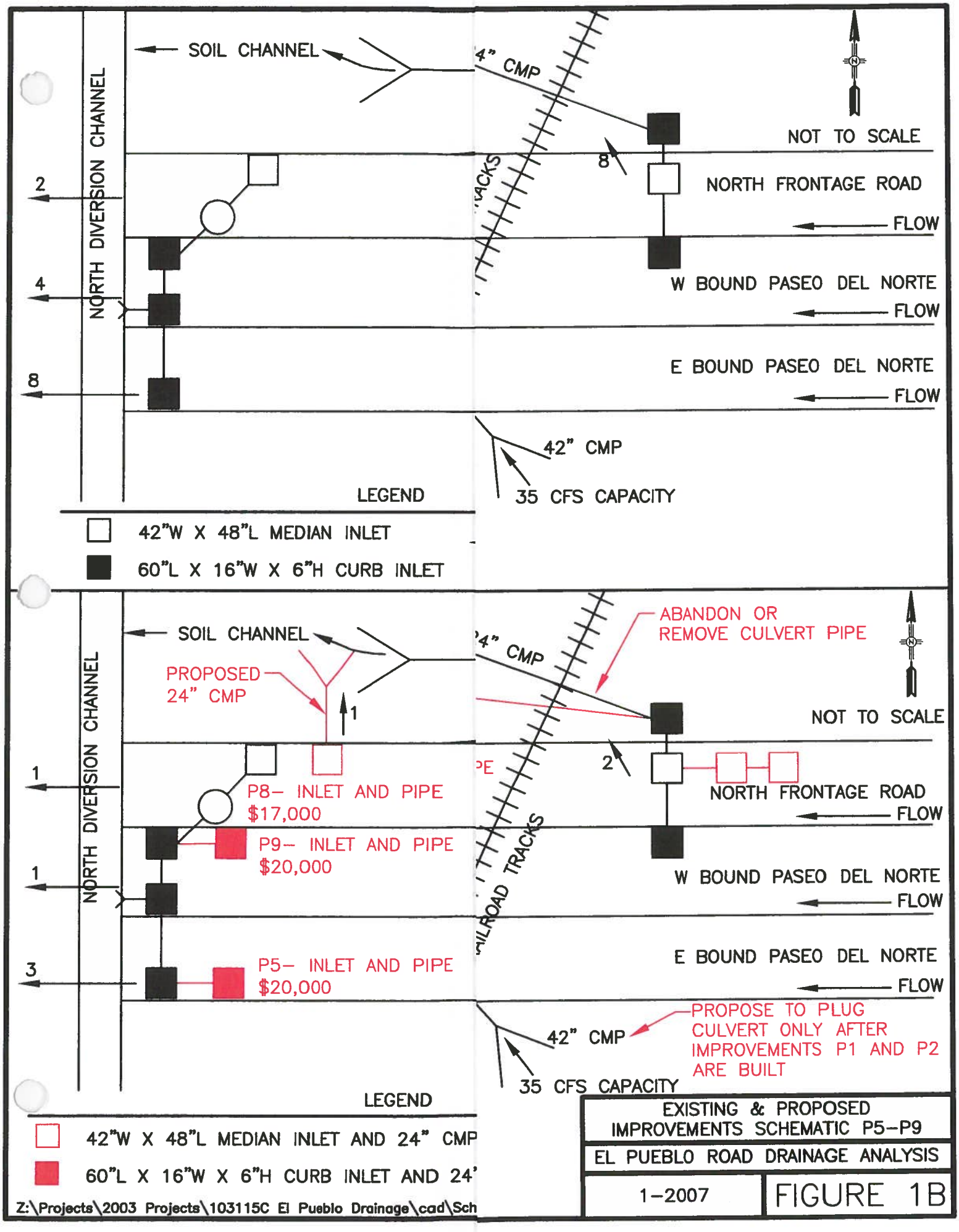

SOIL CHANNEL
NORTH DIVERSION CHANNEL
4" CMP
NOT TO SCALE
NORTH FRONTAGE ROAD
FLOW
W BOUND PASEO DEL NORTE
FLOW
E BOUND PASEO DEL NORTE
FLOW
42" CMP
35 CFS CAPACITY
LEGEND
42"W X 48"L MEDIAN INLET
60"L X 16"W X 6"H CURB INLET
SOIL CHANNEL
NORTH DIVERSION CHANNEL
PROPOSED
24" CMP
ABANDON OR
REMOVE CULVERT PIPE
NOT TO SCALE
P8- INLET AND PIPE
$17,000
P9- INLET AND PIPE
$20,000
P5- INLET AND PIPE
$20,000
NORTH FRONTAGE ROAD
FLOW
W BOUND PASEO DEL NORTE
FLOW
E BOUND PASEO DEL NORTE
FLOW
PROPOSE TO PLUG
CULVERT ONLY AFTER
IMPROVEMENTS P1 AND P2
ARE BUILT
42" CMP
35 CFS CAPACITY
LEGEND
42"W X 48"L MEDIAN INLET AND 24" CMP
60"L X 16"W X 6"H CURB INLET AND 24'
EXISTING & PROPOSED
IMPROVEMENTS SCHEMATIC P5-P9
EL PUEBLO ROAD DRAINAGE ANALYSIS
1-2007
FIGURE 1B
Z:\Projects\2003 Projects\103115C El Pueblo Drainage\cad\Sch

TABLE 1

RAINFALL DATA
El Pueblo Road Drainage Analysis

Return Period	Rainfall Areal Reduction Factor	1-Hour Rainfall	**1-hour Rainfall with Areal Adjustment**	Rainfall Areal Reduction Factor	6-Hour Rainfall	**6-Hour Rainfall with Areal Adjustment**	Rainfall Areal Reduction Factor	24-Hour Rainfall	**24-Hour Rainfall with Areal Adjustment**
(year)		(inches)	**(inches)**		(inches)	**(inches)**		(inches)	**(inches)**
	(b)	(a)		(b)	(a)		(b)	(a)	
2.00	1.00	0.69	**0.69**	1.00	1.01	**1.01**	1.00	1.24	**1.24**
10.00	1.00	1.11	**1.11**	1.00	1.54	**1.54**	1.00	1.81	**1.81**
50.00	1.00	1.56	**1.56**	1.00	2.11	**2.11**	1.00	2.42	**2.42**
100.00	1.00	1.77	**1.77**	1.00	2.38	**2.38**	1.00	2.69	**2.69**
200.00	1.00	2.00	**2.00**	1.00	2.65	**2.65**	1.00	2.97	**2.97**
500.00	1.00	2.30	**2.30**	1.00	3.03	**3.03**	1.00	3.35	**3.35**

(a) (NOAA Atlas 14 - See Appendix A for printouts from internet
(b) No areal reduction factor applied to very small drainage basin size

TABLE 4

CONTINUITY VERIFICATION OF AHYMO MODEL OUTPUT
(El Pueblo Road Drainage Analysis)

AHYMO Analysis Point Number	Analysis Point Description	Drainage Area	Runoff Volume	Peak Discharge
		(sq mi)	(ac-ft)	(cfs)
(a)	(a)	(b)	(b)	(b)
35.91	to existing retention pond in basin 35	0.07331	8.702	173
27.96	total in Jefferson St. storm drain that outfalls to Domingo Baca Arroyo	0.15362	18.432	265
18.92	excess flow that will flow W. on W. bound PDN that will pass the N. Div. Channel	0.00022	0.028	4
24.97	total Q in 24" SD that leaves basin at Frontage Rd. just west of RR tracks	0.00420	0.535	18
24.93	assume 50% of Frontage Rd. Q spills out of basin at RR tracks	0.00031	0.040	4
23.91	assum 80% spills from Frontage Rd. to private driveway	0.00127	0.164	11
22.93	assum 75% spills out of Frontage Rd. due to curb opening	0.00008	0.010	1
16.92	excess Q that will flow W. on E. bound PDN across the N. Div. Channel	0.00033	0.042	8
16.94	total Q in PDN SD that oufalls to the N. Div. Channel under PDN median	0.00535	0.691	19
12.91	is the Q that will pass through the 42" SD under PDN at RR tracks	0.06354	6.880	35
1.92	excess El Pueblo Rd. Q that will flow across the N. Div. Channel	0.01361	1.468	53
1.96	total Q to the ex. 30" CMP that outfalls to N. Div. Channel between El Pueblo Rd. and the RR tracks	0.05379	5.280	48
1.97	Q in excess of ex. 30" CMP that outfals to N. Div. Channel - will spill over top of channel	0.06165	6.051	229
4.92	assume flow in excess of 21" RCP capacity from existing PNM pond remains in pond	0.03314	2.385	80
3.97	total Q to N. Div. Chanenl inlet just south of RR tracks	0.05791	3.635	93
	TOTAL AREA	**0.52233**		

NOTE - This is the total area of all analysis points that either represent flow that leaves the basin, or flow that remains within a closed basin. The sum of all basin areas as shown in Table 2 is 0.51373 sq mi.

(0.52233 sq mi - 0.51373 sq mi) (640 ac/sq mi) = 5.5 acres
0.51313 sq mi (640 ac/sq mi) = 329 acres
(5.5 acres / 329 acres) (100) = approx. 1% error

CONCLUSION - The AHYMO model has accounted for all basin area.

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
Total flow at existing 30" CMP that outfalls to N. Div. Chan. between El Pueblo Rd. and railroad tracks	NA	1.98	364 (assumes 42" culvert under PDN is plugged - and collect all flow from El Pueblo Rd.)	**NA** (This is *TOTAL FLOW* at proposed improvement 1 as described below)	NOTE - Existing Conditions Peak Discharge = 277 cfs. Some flow passes through existing 30" CMP culvert to N. Div. Chan. and excess spills over soil top to N. Div. Chan. and El Pueblo Rd.	------
Total Capacity of either the existing 30" CMP at N. Div. Chan. or Proposed 84" RCP replacement pipe	E	1.96 (flow to cuvlert)	48	NA	Existing 30" CMP is very rusted and should be replaced and enlarged to increase capacity	
	P	1.96 (flow to cuvlert)	364	**P1** - Replace rusted 30" CMP at N. Div. Chan. with an 84" RCP	Proposed Improvement 1 - 84" RCP will provide 100-yr. capacity	
Total Capacity of the existing soil overflow section at N. Div. Chan. or reinforced concrete overflow section	E	1.97 (overflow section)	228	NA	Existing soil overflow section at existing 30" CMP N. Div. Chan. and runoff from El Pueblo Rd. east of culvert headwall is causing severe erosion	

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
	P	1.97 (overflow section)	98	**P1** - Replace soil overflow section above proposed 84" RCP at N. Div. Chan. with an emergency overflow section (lined with base course) - also includes reinforced concrete channel lining just east of culvert headwall to provide rundown for El Pueblo Rd. flow to proposed 84" RCP pipe inlet and emergency overflow section	Proposed Improvement 1 - reinforced concrete channel section will eliminate erosion from El Pueblo Rd. flows just east of cuvlert headwall and provide emergency overflow spill capacity above 84" RCP to the N. Div. Chan.	$192,000

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
Flow in El Pueblo Rd. at the east side of the N. Div. Chan. that will pass west past the N. Div. Chan. in El Pueblo Rd.	E	1.92 (excess flow in El Pueblo Rd. that passes west past N. Div. Chan.)	53	NA	Signicant flows pass west across the N. Div. Chan. in El Pueblo Rd.	
	P	1.92 (excess flow in El Pueblo Rd. that passes west past N. Div. Chan.)	53	**P1** - Asphalt is very poor in El Pueblo Rd. from N. Div. Chan. east to rail road tracks and the road has no crown. Therefore, build an asphalt overlay to provide a crowned section (between the N. Div. Chan. and rail road tracks), four catch basins and a short segment of storm drain to collect flows and outfall in front of the proposed 84" cuvlert.	**P1** will provide 100-yr. collection of flows and will prevent flows from spilling west across the N. Div. Chan. in El Pueblo Rd.	

TABLE 3

SUMMARY OF DIVIDE HYDROGRAPH VALUES

FOR: EXISTING - STORM DRAIN CAPACITY, STORM DRAIN INLET CAPACITY, CULVERT CAPACITY AND INTERSECTION FLOW DIVIDE ASSUMPTIONS

El Pueblo Road Drainage Analysis.

AHYMO Model Analysis Point	Street or Intersection Divide Assumption	Cuvlert Size	Culvert Capacity	Storm Drain Capacity (non-pressure full pipe flow) (Table A2	Total Inet Capacity (Table A1)	Storm Drain Discharge to Use for Divide Hyd (smaller of pipe capacity or inlet capacity)	**FINAL Divide Hyd Value used in AHYMO Model**
	(%)		(cfs)	(cfs)	(cfs)	(cfs)	(cfs) or (%)
(a)	(a)	(a)	(b)	(c)	(c)	(d)	
35.91	100						100
30.91				71	58	58	58
31.91				146	37	37	37
32.91				230	40	40	40
28.91				9	9	9	9
27.91				33	10	10	10
26.91				33	34	33	33
28.71	25						25
21.91				17	14	14	14
19.91				13	13	13	13
19.93	50						50
18.91				13	9	9	9
25.91				17	24	17	17
24.91				13	5	5	5
24.93	50						50
23.91	80						80
22.91				13	2	2	2
22.93	75						75
20.91				17	30	17	17
17.91				13	18	13	13
17.93	70						70
16.91				13	8	8	8
15.91	25						25
14.91				16	20	16	16
9.92	100						100
14.81	80						80
7.91				22	6	6	6
6.91				22	22	22	22
12.91		ex. 42" CMP joins with 33" R x 49" S arch pipe @ PDN	35				35
11.91	30						30
11.93	60						60
2.91				26	47	26	26
1.91	80						80

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
Total flow in excess of the 42" CMP under PDN (just east of railroad track crossing PDN El Pueblo Rd.) that will spill west between PDN concrete traffic barrier and El Pueblo Rd.	E	12.92	238	NA	flows in excess of 42" CMP capacity under PDN flood railroad tracks and spill into El Pueblo Rd.	------
	P	12.92	238	**P2A** - build a small reinforced concrete trapezoidal shaped channel to convey flow in excess of existing 42"CMP under PDN to Proposed Improvement P4 - 84" RCP at N. Div. Chan. (assume 66" RCP under rr tracks and El Pueblo Rd.)	Proposed Improvement 2A will eliminate the flooding across the railroad tracks and prevent spill into El Pueblo Rd.	$583,000
Total flow in excess of the 42" CMP under PDN (just east of railroad track crossing PDN El Pueblo Rd.) that will spill west between PDN concrete traffic barrier and El Pueblo Rd.	E	12.92	238	NA	Flows in excess of 42" CMP capacity under PDN flood railroad tracks and spill into El Pueblo Rd.	------
	P	12.92	238	**P2B** - Build a 66" RCP storm drain pipe to convey water under railroad tracks and El Pueblo Rd. and outfall in the open channel just east of the N. Div. Chan. (between El Pueblo Rd. and railroad tracks)	Proposed Improvement 2B will eliminate the flooding across the railroad tracks and prevent spill into El Pueblo Rd.	$600,000
Total flow to the existing asphalt channel located east of the 42" CMP under Paseo Del Norte	E	12.99	273	NA	Significant erosion will cause failure of PDN concrete traffic barrier and shoulder asphalt along this existing open channel	------

TABLE 2

SUMMARY OF BASIN HYDROLOGIC DATA
APPLIED WITHIN THE AHYMO_97 MODEL
El Pueblo Road Drainage Analysis

…)		Land Treatment Types (c)						Time of Concentration Data *Upland Method (a)																			Time to Peak
		Future Development Conditions						Upper Reach						Middle Reach					Bottom Reach								
…Area	Basin Area	A	B	C	D	Total	Length of Longest Water-course	Top Elevation at beginning of water-course	Bottom Elevation	Length (L_1)	Slope	K_1	V_1	Elevation at lower end of water-course	Length (L_2)	Slope	K_2	V_2	Elevation at lower end of water-course	Length (L_3)	Slope	K_3	V_3	Actual T_C	Final T_C	T_P
…es)	(sq mi)	(%)	(%)	(%)	(%)	(%)	(ft)	(ft)	(ft)	(ft)	(ft/ft)		(ft/sec)	(ft)	(ft)	(ft/ft)		(ft/sec)	(ft)	(ft)	(ft/ft)		(ft/sec)	(hours)	(hours)	(hours)
	(a)	(c)	(c)	(c)	(c)							(b)	(e)				(b)	(e)				(b)	(e)	(f)	(g)	(h)
…9	0.00218			60	40	100	640	5077	5075	400	0.0050	1.0	0.71	5070	240	0.0208	2.0	2.89	0	0	0	0	0.00	0.18	0.20	0.13
…3	0.00176			5	95	100	520	5083	5078	400	0.0125	1.0	1.12	5077	120	0.0083	2.0	1.83	0	0	0	0	0.00	0.12	0.20	0.13
…3	0.00520			75	25	100	1,090	5084	5079	400	0.0125	1.0	1.12	5070	690	0.0130	2.0	2.28	0	0	0	0	0.00	0.18	0.20	0.13
…32	0.06456		5	70	25	100	2,570	5108	5098	400	0.0250	1.0	1.58	5081	1600	0.0106	2.0	2.06	5074	570	0.0123	3.0	3.32	0.33	0.33	0.22
…73	0.05271			95	5	100	2,070	5108	5097	400	0.0275	1.0	1.66	5077	1600	0.0125	2.0	2.24	5072	70	0.0714	3.0	8.02	0.27	0.27	0.18
…16	0.00853			5	95	100	710	5094	5086	400	0.0200	1.0	1.41	5084	310	0.0065	2.0	1.61	0	0	0	0	0.00	0.13	0.20	0.13
…75	0.00586			5	95	100	780	5100	5094	400	0.0150	1.0	1.22	5091	380	0.0079	2.0	1.78	0	0	0	0	0.00	0.15	0.20	0.13
…58	0.07904			70	30	100	2,800	5138	5128	400	0.0250	1.0	1.58	5101	1600	0.0169	2.0	2.60	5093	800	0.0100	3.0	3.00	0.32	0.32	0.21
…47	0.01792			20	80	100	2,190	5138	5128	400	0.0250	1.0	1.58	5108	1600	0.0125	2.0	2.24	5107	190	0.0053	3.0	2.18	0.29	0.29	0.20
…11	0.00690			95	5	100	900	5130	5115	400	0.0375	1.0	1.94	5106	500	0.0180	2.0	2.68	0	0	0	0	0.00	0.11	0.20	0.13
…34	0.00053				100	100	540	5085	5080	400	0.0125	1.0	1.12	5077	140	0.0214	2.0	2.93	0	0	0	0	0.00	0.11	0.20	0.13
…32	0.00128			95	5	100	440	5088	5084	400	0.0100	1.0	1.00	5082	40	0.0500	2.0	4.47	0	0	0	0	0.00	0.11	0.20	0.13
…28	0.00043				100	100	440	5091	5085	400	0.0150	1.0	1.22	5085	40	0.0125	2.0	2.24	0	0	0	0	0.00	0.10	0.20	0.13
…03	0.00162			10	90	100	1,050	5107	5100	400	0.0175	1.0	1.32	5091	650	0.0138	2.0	2.35	0	0	0	0	0.00	0.16	0.20	0.13
…50	0.00094				100	100	820	5130	5116	400	0.0350	1.0	1.87	5107	420	0.0214	2.0	2.93	0	0	0	0	0.00	0.10	0.20	0.13
…17	0.00183				100	100	1,020	5081	5078	400	0.0075	1.0	0.87	5070	620	0.0129	2.0	2.27	0	0	0	0	0.00	0.20	0.20	0.14
…28	0.00200				100	100	1,090	5098	5090	400	0.0200	1.0	1.41	5081	690	0.0130	2.0	2.28	0	0	0	0	0.00	0.16	0.20	0.13
…14	0.00226				100	100	1,200	5082	5079	400	0.0075	1.0	0.87	5070	800	0.0113	2.0	2.12	0	0	0	0	0.00	0.23	0.23	0.16
…23	0.00192				100	100	900	5098	5090	400	0.0200	1.0	1.41	5082	500	0.0080	2.0	1.79	0	0	0	0	0.00	0.16	0.20	0.13
…09	0.00327				100	100	1,400	5124	5116	400	0.0200	1.0	1.41	5098	1000	0.0180	2.0	2.68	0	0	0	0	0.00	0.18	0.20	0.13
…31	0.00298				100	100	1,400	5124	5116	400	0.0200	1.0	1.41	5098	1000	0.1800	2.0	8.49	0	0	0	0	0.00	0.11	0.20	0.13
…28	0.00044				100	100	500	5077	5075	400	0.0063	1.0	0.79	5070	100	0.0090	2.0	1.90	0	0	0	0	0.00	0.16	0.20	0.13
…53	0.00082				100	100	900	5084	5079	400	0.0125	1.0	1.12	5077	500	0.0065	2.0	1.61	0	0	0	0	0.00	0.19	0.20	0.13
…42	0.00066				100	100	710	5097	5090	400	0.0175	1.0	1.32	5084	310	0.0059	2.0	1.54	0	0	0	0	0.00	0.14	0.20	0.13
…48	0.01168			5	95	100	1,410	5122	5116	400	0.0150	1.0	1.22	5098	1010	0.0113	2.0	2.12	0	0	0	0	0.00	0.22	0.22	0.15
…47	0.02574			10	90	100	2,140	5165	5153	400	0.0300	1.0	1.73	5123	1600	0.0188	2.0	2.74	5122	140	0.0071	3.0	2.54	0.24	0.24	0.16
…11	0.00641				100	100	2,830	5190	5183	400	0.0175	1.0	1.32	5140	1600	0.0269	2.0	3.28	5124	830	0.0193	3.0	4.17	0.27	0.27	0.18
…39	0.00624				100	100	2,820	5190	5183	400	0.0175	1.0	1.32	5141	1600	0.0263	2.0	3.24	5124	820	0.0207	3.0	4.32	0.27	0.27	0.18
…52	0.04144		15	35	50	100	2,800	5167	5156	400	0.0275	1.0	1.66	5136	1600	0.0125	2.0	2.24	5130	800	0.0075	3.0	2.60	0.35	0.35	0.23
…02	0.03753		5	25	70	100	1,680	5190	5182	400	0.0200	1.0	1.41	5155	1280	0.0211	2.0	2.90	0	0	0	0	0.00	0.20	0.20	0.13
…48	0.02262		10		90	100	1,340	5158	5146	400	0.0300	1.0	1.73	5135	940	0.0117	2.0	2.16	0	0	0	0	0.00	0.18	0.20	0.13
…81	0.02313			10	90	100	2,050	5159	5150	400	0.0225	1.0	1.50	5124	1600	0.0163	2.0	2.55	5123	50	0	0	0.00	0.25	0.25	0.17
…53	0.00864			10	90	100	530	5200	5199	400	0.0025	1.0	0.50	5198	130	0.0077	2.0	1.75	0	0	0	0	0.00	0.24	0.24	0.16
…72	0.02144		5	15	80	100	1,450	5221	5214	400	0.0175	1.0	1.32	5199	1050	0.0143	2.0	2.39	0	0	0	0	0.00	0.21	0.21	0.14
…67	0.04323		5	50	45	100	1,930	5194	5180	400	0.0350	1.0	1.87	5156	1530	0.0157	2.0	2.50	0	0	0	0	0.00	0.23	0.23	0.15
…78	0.51373																									

…ned from the Drainage Basin Map
…e City of Albuquerque DPM, Chapter 22, pg. 22-22.
…lbuquerque DPM, Chapter 22, page 22-10.
…ormula
…)3600 sec/hour DPM formula
…less than 0.2 hours, then use 0.2 hours per DPM
…PM

NOTE ABOUT EXISTING LAND TREATMENTS - Most basins are developd under existing conditions. However, a few basins have the following existing land treatements shown here for comparision to the full development condition assumption for those basins

Basin	A	B	C	D
3			75	25
8			70	30
26			10	90
29		15	35	50
30		5	25	70
32			10	90
35		5	50	45

…xls

			…	…o replace existing asphalt channel that is failing	ensure the PDN concrete traffic barrier and asphalt will remain	$304,180
Total flow that approaches the s. side El Pueblo Rd.at east side of railroad tracks (eastern most railroad crossing of El Pueblo Rd.)	E	8.99	181	NA	Storm water floods over the top of El Pueblo Rd. as no provisions were built to pass flow under road	------
	P	8.99	181	**P4** - build concrete headwall and 60" RCP storm drain pipe under El Pueblo Rd.	Proposed Improvement 4 will eliminate the flooding across El Pueblo Rd. at this location	$328,000
Total flow on E. bound Paseo Del Norte that flows west past N. Div. Channel	E	16.92	8	NA	Some water flows past N. Div. Channel	------
	P	16.92	3	**P5** - build 1 new median type inlet 20 ft. e. of existing median inlet, connect with 24-in. cmp	Proposed Improvement 5 will reduce flow past the N. Div. Channel	$20,000

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
Total flow that spills into private property from N. Paseo Del Norte frontage road at rail road tracks and from 24-inch CMP that outfalls to private property	E	24.92	8	NA	Significant flow enters private property from frontage road	------
	P	24.92	2	**P6** - build 2 new curb inlets 20 ft. e. of existing curb inlet, connect with 24-in. cmp, also redirect ex. 24-in. CMP to join 33"R x 49"S CMP	Proposed Improvement 6 will nearly eliminate flow into private property	$85,000
Total flow that spills into private driveway from N. Paseo Del Norte frontage road (500 ft. e. of N. Div. Chan.)	E	23.99	14	NA	Significant flow enters private property from frontage road	------
	P	23.99	2	**P7** - build 3 new curb inlets 20 ft. e. of ex. private driveway, connect with 24-in. CMP to join 33"R x 49"S CMP	Proposed Improvement 7 will nearly eliminate flow into private property	$48,000
Total flow on N. Paseo Del Norte frontage road that flows west past N. Div. Channel	E	22.92	2	NA	Some water flows past N. Div. Channel	------

TABLE 5
SUMMARY OF EXISTING PROBLEMS AND PROPOSED IMPROVEMENTS - 100-YR. PEAK DISCHARGE AND COST SUMMARY
AHYMO_97 Model Output for future full basin development conditions
El Pueblo Rd. Drainage Analysis

Description of Analysis Point Location	E - Existing Conditions Infrastructure or P - Proposed Conditions Infrastructure	Analysis Point Number	Peak Discharge (100-yr. 24-hr.)	**Proposed Improvement Number and Description**	Comment on Existing Problems and Proposed Solutions	Conceptual Level Design Cost Estimate
			(cfs)			($)
(a)		(b)	(c)	(d)		(e)
Total flow on W. bound Paseo Del Norte that flows west past N. Div. Channel	P	22.92	1	**P8** - build 1 new curb inlet 20 ft. e. ex. Curb inlet, outfall with 24-in. CMP to ex. Soil channel that is at outfall of 33"R x 49"S CMP	Proposed Improvement 8 will reduce flow past the N. Div. Channel	$17,000
	E	18.92	4	NA	Some water flows past N. Div. Channel	------
	P	18.92	1	**P9** - build 1 new median type inlet 20 ft. e. of existing median inlet, connect with 24-in. cmp	Proposed Improvement 9 will reduce flow past the N. Div. Channel	$20,000

(a) See Figures 1 and 4 for existing locations and proposed improvemets
(b) See Figure 3 for Analysis Point locations
(c) See Appenix B for AHYMO_97 model output
(d) See Figure 4 for Proposed Improvement locations and Figure 5 for Conceptual Level Design Details of Proposed Improvement 4
(e) See Appendix C for quantity and cost calcs and hydraulic analyses

TABLE 6

PROPOSED IMPROVEMENT P1

84" RCP at the North Diversion Channel
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	1.0	2,000	2,000
2		NPDES	LS	1.0	2,000	2,000
3		Reseeding	LS	1.0	2,000	2,000
4		Grading < 2'	SY	410.0	8	3,280
5	a	Section "A" Structural Reinforced Concrete Headwall, Retaining walls and conc. Rundown from El Puebo Rd.	CY	82.0	600	49,200
6	a	Section "B" Concrete Channel Lining 8" thick with reinforcement (this item was removed and replaced with only base course)	SF	0.0	15	0
7		Base course as overflow weir	SY	248.0	10	2,480
8		Structural Concrete Water Quality Weir	CY	12.0	600	7,200
9		84" RCP Class IV (furnish & place in open trench, cip)	LF	58.0	475	27,550
10		Trenching backfill & compaction, over 60" sewer pipe, over 8' to 12' in depth, pipe not incl., compl.	LF	58.0	150	8,700
11		Sawcut, Remove & Dispose Concrete Channel	CY	4.0	100	400
12		Remove & Dispose Concrete Headwall & RxR Ties	LS	1.0	2,000	2,000
13		Remove & Dispose 30" CMP includes trenching	LF	58.0	40	2,320
14	b	Cold milling asphalt cement pavement overlay, 2.5' thickness(includes disposal of millings comp.) From N. Div. Channel to railroad tracks)	SY	1,413.0	5	7,065
15	b	Type Double A catch basin, cip.	EA	4.0	5,000	20,000
16	b	18" RCP Class IV (furnish & place in open trench, cip)	LF	60.0	36	2,160
17	b	Trenching backfill & compaction for 18" RCP, 18-36' sewer pipe up to 8 ft. depth, pipe not incl., compl.	LF	60.0	25	1,500
18	b	24" RCP Class IV (furnish & place in open trench, cip)	LF	50.0	40	2,000
19	b	Trenching backfill & compaction for 24" RCP, 18-36' sewer pipe up to 8 ft. depth, pipe not incl., compl.	LF	50.0	25	1,250
20	b	Traffic Control (includes, signs, flagman, maintenance, etc.)	LS	1.0	3,000	3,000
21	b	Misc. items (striping, concrete cutting and disposal (for new inlets, etc.)	LS	1.0	3,000	3,000
		Sub-Total				**149,105**
22		Mobilization/Demobilization (assume % of all bid items)	%	7.0	10,437	10,437
		Sub-Total				**159,542**
		Contingency and soft costs	%	20.0	31,908	31,908
		TOTAL				**191,451**
	a	See Figure 5 in map pocket for locations of Sections A and B				
	b	**Cost Items for Construction in El Pueblo Rd.**				**39,975**

TABLE 7

PROPOSED IMPROVEMENT P2A

Reinforced Concrete Channel
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost ($/unit)	Cost ($)
1		Construction Staking	LS	1.0	2,000	2,000
2		Reseeding	LS	1.0	2,000	2,000
3		NPDES	LS	1.0	2,000	2,000
4		Grading <2'	SY	2,217.0	8	17,736
5		Excavation and disposal of soil for channels	CY	1830.0	6	10,980
6		Excavation backfill & compaction for channels	CY	1478.0	8	11,824
7		Concrete Channel Lining 8" thick with reinforcement	SF	19,950.0	15	299,250
8		Structural Concrete, Headwall and Railroad Crossing	CY	26.0	600	15,600
9		Bore Under Railroad	LF	20.0	400	8,000
10	a	66" RCP (including installation and trenching < 6')	LF	190.0	400	76,000
11		Sawcut, Remove, Dispose & Replace Asphalt Pavement, 6" thick, includes C&G	SY	62.0	36	2,232
12		Gabion Aprons	CY	25.0	250	6,250
		subtotal				**453,872**
13		Mobilization/Demobilization (assume % of all bid items)	%	7.0	31,771	31,771
		SUB TOTAL				**485,643**
		Contingency	%	20.0	97,129	97,129
		TOTAL				**582,772**

a- assume that a 66" RCP will convey channel flow under railroad tracks and El Pueblo Rd.

PROPOSED IMPROVEMENT P2B

66-in. RCP Storm drain Pipe
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost ($/unit)	Cost ($)
1		Construction Staking	LS	1.0	2,000	2,000
2		NPDES	LS	1.0	2,000	2,000
3		Reseeding	LS	1.0	2,000	2,000
4		Grading <2'	SY	3,166.0	8	25,328
5		Excavation and disposal of soil	CY	844.0	6	5,064
6		Structural Concrete, Headwall & Railroad Crossing	CY	35.0	600	21,000
7		Bore Under Railroad	LF	20.0	400	8,000
8		66" RCP (including installation and trenching < 6')	LF	940.0	400	376,000
9		Manhole Type C-8' diameter, 0' to 6' deep	EA	2.0	10,000	20,000
10		Gabion Aprons	CY	25.0	250	6,250
		subtotal				**467,642**
11		Mobilization/Demobilization (assume % of all bid items)	%	7.0	32,735	32,735
		SUB TOTAL				**500,377**
		Contingency	%	20.0	100,075	100,075
		TOTAL				**600,452**

TABLE 8

PROPOSED IMPROVEMENT P3A

Reinforced Concrete Channel
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost ($/unit)	Cost ($)
1		Construction Staking	LS	1.0	2,000	2,000
2		NPDES	LS	1.0	2,000	2,000
3		Reseeding	LS	1.0	2,000	2,000
4		Grading <2'	SY	1,100.0	8	8,800
5		Excavation and disposal of soil for channels	CY	0.0	6	0
6		Excavation backfill & compaction for channels	CY	700.0	8	5,600
7		Concrete Channel Lining 8" thick with reinforcement	SF	9,450.0	15	141,750
8	a	Structural Concrete, Headwall	CY	15.0	600	9,000
		subtotal				**171,150**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	11,981	11,981
		SUB TOTAL				**183,131**
		Contingency	%	20.0	36,626	36,626
		TOTAL				**219,757**

a- assume headwall required at beg. & end of channel - assume voume from P1 = 15 cy for 1 headwall

PROPOSED IMPROVEMENT P3B

66-in. RCP Storm drain Pipe
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost ($/unit)	Cost ($)
1		Construction Staking	LS	1.0	2,000	2,000
2		NPDES	LS	1.0	2,000	2,000
3		Reseeding	LS	1.0	2,000	2,000
4		Grading <2'	SY	1,100.0	8	8,800
5		Backfill select material over pipe	CY	1925.0	12	23,100
6		66" RCP (including installation and trenching < 6')	LF	450.0	400	180,000
7	a	Structural Concrete, Headwall	CY	15.0	600	9,000
8		Manhole Type C-8' diameter, 0' to 6' deep	EA	1.0	10,000	10,000
		subtotal				**236,900**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	16,583	16,583
		SUB TOTAL				**253,483**
		Contingency	%	20.0	50,697	50,697
		TOTAL				**304,180**

a- assume headwall required at beg. & end of channel - assume voume from P1 = 15 cy for 1 headwall

TABLE 9

PROPOSED IMPROVEMENT P4

66-in. RCP Storm drain Pipe
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	1.0	2,000	2,000
2		NPDES	LS	1.0	2,000	2,000
3		Reseeding	LS	1.0	2,000	2,000
4		Grading <2'	SY	3020.0	8	24,160
5		Excavation and disposal of soil	CY	1324.0	6	7,944
6	a	Remove and Dispose 24" CMP, includes Trenching	LF	200.0	50	10,000
7	a	Remove and Dispose Manhole, all diameters	EA	1.0	600	600
8		66" RCP (including installation and trenching < 6')	LF	230.0	400	92,000
9		Structural Concrete, Headwall	CY	15.0	600	9,000
10		Manhole Type C-8' diameter, 0' to 6' deep	EA	1.0	10,000	10,000
11		Gabion Aprons	CY	182.0	250	45,500
12	b	Purchase of 0.5 acres of ROW	AC	0.5	100,000	50,000
		subtotal				**255,204**
11		Mobilization/Demobilization (assume % of all bid items)	%	7.0	17,864	17,864
		SUB TOTAL				**273,068**
		Contingency	%	20.0	54,614	54,614
		TOTAL				**327,682**

a - Final design may lead to removal of existing 24" CMP and manhole to ex. Asphalt channel.

b - Triangular piece of ground need to build and maintain inlet to proposed culvert

TABLE 10

PROPOSED IMPROVEMENT P5

New Median Type Inlet and Pipe in East Bound Paseo Del Norte at N. Div. Channel
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	1.0	0	0
2		Traffic Control (includes, signs, flagman, maintenance, etc.)	LS	1.0	3,000	3,000
3		NPDES	LS	1.0	0	0
4		Reseeding	LS	1.0	0	0
5		Grading <2'	SY	3020.0	0	0
6		Excavation and disposal of soil	CY	5.0	10	50
7		42-in. x 48-in. median inlet, materials and installation c.i.p.	EA	1.0	6,000	6,000
8		24" CMP (including installation and trenching < 6')	LF	20.0	200	4,000
9		Asphalt cut (20 ft. length, disposal and repaving)	LS	1.0	2,500	2,500
		subtotal				**15,550**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	1,089	1,089
		SUB TOTAL				**16,639**
		Contingency	%	20.0	3,328	3,328
		TOTAL				**19,966**

TABLE 11

PROPOSED IMPROVEMENT P6

2 Curb Inlets and Pipe N. Paseo Del Norte Frontage Road at Railroad Tracks
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	1.0	1,000	1,000
2		Traffic Control (includes, signs, flagman, maintenance, etc.)	LS	1.0	3,000	3,000
3		NPDES	LS	1.0	0	0
4		Reseeding	LS	1.0	0	0
5		Grading <2'	SY	30.0	10	300
6		Excavation and disposal of soil	CY	10.0	10	100
7		Curb Inlet - 60 in. L, 16 in. W x 6" H (c.i.p.)	EA	2.0	6,000	12,000
8		24" CMP (including installation and trenching < 6')	LF	230.0	200	46,000
9		Asphalt cut (40 ft. length, disposal and repaving)	LS	1.0	3,500	3,500
		subtotal				**65,900**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	4,613	4,613
		SUB TOTAL				**70,513**
		Contingency	%	20.0	14,103	14,103
		TOTAL				**84,616**

TABLE 12

PROPOSED IMPROVEMENT P7

3 Curb Inlets and Pipe N. Paseo Del Norte Frontage Private Turn Lane
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	1.0	1,000	1,000
2		Traffic Control (includes, signs, flagman, maintenance, etc.)	LS	1.0	3,000	3,000
3		NPDES	LS	1.0	0	0
4		Reseeding	LS	1.0	0	0
5		Grading <2'	SY	0.0	10	0
6		Excavation and disposal of soil	CY	7.0	10	70
7		Curb Inlet - 60 in. L, 16 in. W x 6" H (c.i.p.)	EA	3.0	6,000	18,000
8		24" CMP (including installation and trenching < 6')	LF	60.0	200	12,000
9		Asphalt cut (40 ft. length, disposal and repaving)	LS	1.0	3,500	3,500
		subtotal				**37,570**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	2,630	2,630
		SUB TOTAL				**40,200**
		Contingency	%	20.0	8,040	8,040
		TOTAL				**48,240**

TABLE 13

PROPOSED IMPROVEMENT P8

1 Curb Inlets and Pipe N. Paseo Del Norte Frontage Rd. Near N. Div. Channel
Conceptual Level Cost Estimate
El Pueblo Road Drainage Analysis

No.		Item	Unit	Quantity	Unit Cost	Cost
					($/unit)	($)
1		Construction Staking	LS	0.0	1,000	0
2		Traffic Control (includes, signs, flagman, maintenance, etc.)	LS	1.0	3,000	3,000
3		NPDES	LS	1.0	0	0
4		Reseeding	LS	1.0	0	0
5		Grading <2'	SY	0.0	10	0
6		Excavation and disposal of soil	CY	4.0	10	40
7		Curb Inlet - 60 in. L, 16 in. W x 6" H (c.i.p.)	EA	1.0	6,000	6,000
8		24" CMP (including installation and trenching < 6')	LF	20.0	200	4,000
9		Asphalt cut (40 ft. length, disposal and repaving)	LS	1.0	400	400
		subtotal				**13,440**
9		Mobilization/Demobilization (assume % of all bid items)	%	7.0	941	941
		SUB TOTAL				**14,381**
		Contingency	%	20.0	2,876	2,876
		TOTAL				**17,257**