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MASTER PLAN OF STORM DRAINAGE

EXECUTIVE SUMMARY

JOINTLY FUNDED BY

THE CITY OF PEORIA

AND

THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

APRIL 1988

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

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CITY OF PEORIA, ARIZONA

MASTER PLAN OF STORM DRAINAGE

EXECUTIVE SUMMARY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
21284
THOMAS M. CALEZIENZIAN
Date Signed 4/21/88
ARIZONA, U.S.A.

Jointly Funded by

The City of Peoria

and

The Flood Control District of Maricopa County

April 1988

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

EXECUTIVE SUMMARY

INTRODUCTION

Background

The City of Peoria, Arizona has been experiencing the rapid growth common to communities throughout the Southwest United States. For the City to continue to flourish and grow, it must plan adequately for future growth and then implement the services and public facilities which are required. One of the key plans is for city-wide drainage facilities to convey runoff from storm events.

An example of the rapid growth in Peoria is the major increase in population in recent years. Population increased 75 percent between 1960 and 1970, and 200 percent between 1970 and 1980. In 1985 the population was estimated at 27,000; the City of Peoria General Land Use Plan projects a population of 75,000 for the year 2000.

Increases in population are accompanied by increases in urbanization. This urbanization has the effect of increasing storm runoff in two basic ways: (1) there is a substantial increase in impervious area (e.g. parking lots, streets, driveways, and roofs) allowing more rainfall to be converted to runoff rather than infiltrating into the ground; and (2) storms with more intense rainfall impact larger areas due to increased velocities of overland flow. To date, urbanization in the City of Peoria has occurred with virtually no storm drainage system.

Study Objective

This Master Plan of Storm Drainage presents a comprehensive drainage system and associated design criteria for the solution of local and regional flooding conditions within the City of Peoria. It is intended that by conforming to this system, agencies involved in drainage control, along with private entities involved in land development, can coordinate their efforts to achieve a regionally sound approach to the drainage problem. The material presented in this master plan will assist in the detailed design of the drainage facilities presented.

Scope of Work

The Scope of Work for the Master Plan of Storm Drainage consisted of the following primary project tasks.

Task 1: Data Collection and Review
Task 2: Aerial Photography and Mapping
Task 3: Base Map Preparation
Task 4: Field Reconnaissance
Task 5: • Hydrologic Modeling North of Pinnacle Peak Road

Task 6: Stormwater Modeling South of Pinnacle Peak Road - Existing Conditions
Task 7: Stormwater Modeling South of Pinnacle Peak Road - Future Conditions
Task 8: Alternative Stormwater Management Solutions
Task 9: Cost Estimating
Task 10: Recommend Master Plan
Task 11: Methods of Financing
Task 12: Reports
Task 13: Meetings

Much of the study effort was performed concurrently with the Area Drainage Master Study (ADMS) for the Glendale-Peoria Area.

Authorization

The City of Peoria selected the firm of James M. Montgomery, Consulting Engineers, Inc. (JMM) to perform the Master Plan of Storm Drainage. This contract was initiated on August 23, 1984. Although the contract was signed between JMM and the City of Peoria, the City issued a request to the Flood Control District of Maricopa County to provide assistance in financing the study. The Flood Control District has contributed 50 percent of the funding of the master plan study. JMM also assisted in preparation of the regional ADMS.

On August 27, 1987, JMM was contracted to revise the Master Plan of Storm Drainage to account for the effects of the Outer Loop Freeway and to update the facility cost estimates. This agreement also provided for the evaluation of the impacts of recent development based on the revised General Land Use Plan and the development of a subdivision detention plan.

SIGNIFICANT FINDINGS OF THE STUDY

Land Use

Through annexation, the City has steadily increased in size from a four-square mile town in the 1960's to approximately sixty square miles in 1986. Similarly, developed area has grown and will continue to grow. In 1983 the developed area within the City was estimated to be about 8 square miles. The General Land Use Plan estimates that ultimate development will consist of build-out in the area south of Pinnacle Peak Road (a land use plan is not presently available for the 30-square mile area north of Pinnacle Peak Road). This is the land use assumption made in this master plan for sizing and locating drainage facilities. It significantly affects the development of the master plan since all facilities have been designed to accept runoff from land use with a level of urbanization which is substantially higher than that associated with existing land use.

Existing Drainage Facilities and Regulations

The only existing major underground drainage facility in the City of Peoria is the Peoria Avenue Storm Drain. This facility, constructed in 1984, is designed to convey runoff from an area of approximately 100 acres along

Peoria Avenue. The size varies from 30 inches to 72 inches, with a capacity of 16 cfs to 250 cfs. Because of the lack of existing storm drains, the remainder of storm runoff in the City occurs as overland flow and is carried primarily in streets. This results in minor flooding and standing water throughout the City during and following virtually all storm events.

The current City of Peoria drainage code consists of two principal regulations to provide for flood and storm drainage protection. The first regulation stipulates that all building pads must be constructed a minimum of 14 inches above lot outfall to protect against damage from the 100-year flood. The second stipulates that all new developments provide on-site storage for runoff from the 10-year, 2-hour storm, and that additional runoff be conveyed safely off-site to the nearest major mile street. Many recent residential developments have provided on-site retention volume through depressed rear yards; this approach has generally proven unsuccessful over the long term due to lack of sufficient control and maintenance.

Hydrology

Peak runoff rates were computed within the City of Peoria using two different rainfall-runoff models. For the areas south of Pinnacle Peak Road where existing and future development is expected to be most intense, the Storm Water Management Model (SWMM) was used. This model is most appropriate for use in urban areas. For the area north of Pinnacle Peak Road, the unit hydrograph method in the HEC-1 Flood Hydrograph Package program was used. This method is appropriate for use in undeveloped areas. Both of these models compute full runoff hydrographs as well as peak flow rates.

Level of Protection

An analysis of drainage alternatives was performed to determine the level of protection to be provided by recommended facilities. Alternative drainage system configurations were investigated within an "Alternatives Analysis Area", bounded by Cactus Road, Olive Avenue, 67th Avenue, and 75th Avenue, and including additional subbasins draining directly to Olive Avenue; this area represents approximately one-sixth of the area in the City of Peoria. Storm drain pipes were designed to convey 100-year, 25-year, 10-year, 3-year and 2-year storm flows in conjunction with either curb-to-curb conveyance or house-to-house conveyance. Costs of providing these levels of protection for the Alternatives Analysis Area only are presented below.

Level of Protection (return period)	Capital Cost in Alternatives Analysis Area ($ million)
100-year	29.0
25-year	25.8
10-year	20.5
3-year	14.7
2-year	12.6

Based upon the extrapolated cost of providing similar facilities in the entire City, and upon consultation with the City Engineer, it was concluded that the maximum level of protection that the City could afford with a conveyance system was 2-year protection; any supplemental protection would have to be provided by a detention system designed to operate in conjunction with the conveyance system. Thus, this master plan contains storm drain facilities sized to convey the 2-year peak flow, and recommends detention sites which could be developed to increase the overall system protection to a 10-year level. The purpose of the master plan is not to protect against the severe, infrequent event, but to control local drainage in order to reduce nuisance flooding and free transportation routes during relatively common storm events.

Financial Alternatives

Of the two major assessment philosophies - "receipt of benefits" and "contribution to the problem" - the "contribution to the problem" approach is more practical from the standpoint of identifying the measures and units used to allocate costs and assess property owners. Financial alternatives deserving further evaluation include drainage service charges, system development charges, revenue bonds, and cooperative agreements with other state and local agencies. The latter could include cost sharing agreements with the State Department of Water Resources, State Department of Transportation, County Highway Department, and Flood Control District of Maricopa County. The recent Area Drainage Master Study for the Glendale-Peoria Area should be consulted for projects which may be eligible for cooperative funding by the Flood Control District.

RECOMMENDED DRAINAGE PLAN

Recommended Facilities

Recommended storm drain facilities in the City of Peoria are shown on Panels 1 through 5. They consist of major drainage systems along Thunderbird Road, Cactus Road, Peoria Avenue, Olive Avenue, Northern Avenue, and 91st Avenue/Greenway Road. The system is laid out with primary storm drain lines on the major mile streets, with networks of collector pipes draining the tributary area. In addition, several sites for regional detention basins have been indicated; these basins could be used to increase the level of protection provided by the storm drain system, as described above. In the area between Bell Road and Pinnacle Peak Road, interim open channels have also been shown (Panels 4 and 5) in addition to permanent underground drains due to the present low density of development; these channels have been located on alignments of future required storm drains. The plan recommends that the City adopt regulations which require detention facilities to be a part of all new subdivisions and developments.

Estimated Project Costs

Facility construction costs and total recommended budget costs have been estimated for each of the master plan facilities. Construction costs were estimated using unit costs from recent actual construction bids in the Phoenix area. Total budget amounts were estimated from construction costs

assuming a 20 percent increase for engineering and inspection and 20 percent for contingencies. Estimated total project costs for each of the major master plan elements are summarized below.

Northern Avenue Storm Drain East of New River	$12,440,000
Olive Avenue Storm Drain	$19,180,000
Cactus Road Storm Drain	$9,170,000
Thunderbird Road Storm Drain	$4,000,000
Northern Avenue Storm Drain West of New River	$2,580,000
Minor Drains Connected Directly to New River	$2,390,000
Peoria Avenue Storm Drain	$5,040,000
Bell Road to Pinnacle Peak Road (all facilities)	$18,490,000
Interim Channels	$1,660,000
Regional Detention Basins	$4,260,000
Right-of-Way Acquisition	$9,360,000
Grand Total	**$88,570,000**

Phased Implementation Program

Not all of the facilities included in the storm drainage master plan must be constructed immediately. A phased implementation plan has been formulated which indicates five different priorities for construction of facilities and implementation of other master plan elements. Items with the highest priority must be carried out as soon as possible to remedy existing flooding problems and lay the groundwork necessary for solving future problems. Priority I consists of the following elements:

1. Revise City drainage code to require regional detention sites for single family residential subdivisions

2. Purchase right-of-way for detention basin sites and pipe alignments for land not presently owned by the City

3. Verify open channel dimensions for the interim facilities from Bell Road to Pinnacle Peak Road, and acquire necessary right-of-way

4. Construct Olive Avenue Storm Drain and associated detention basins.

The estimated total budget cost for Priority I is $29,860,000. It is anticipated that changes to this phased program will need to be made based on future changes in priorities, timing of storm drain construction to coincide with other public works improvements, and the availability of construction funds.

SUMMARY OF RECOMMENDATIONS

1. The City of Peoria should accept and adopt this storm drainage master plan, and commit to its implementation as funding and other circumstances permit.

2. The flow patterns of stormwater runoff identified in this study should be maintained as new development occurs and new roads are constructed.

3. The level of protection provided by the storm drain system is for a storm with a 2-year recurrence interval. Protection from storms of greater magnitude should be provided through storage of stormwater in common detention basins for all types of development.

4. The size of the detention areas will need to be based on the degree of protection the City wishes to provide above the 2-year level of the storm drain system. The 100-year, 2-hour volume is presently recommended in the Uniform Drainage Policies and Standards for Maricopa County, Arizona.

5. The practice of on-lot storage of runoff in single family residential developments should be discontinued, as this method has proven to be ineffective in controlling runoff from these areas.

6. Consideration should be given by the City to allow lot size reductions to developers in exchange for common detention areas; approximately 5 percent of the land in new developments would be required to provide storage of runoff from the difference between the 100-year and 2-year events.

7. Developers should be required to connect all drainage facilities from their developments to the nearest major arterial storm drain.

8. For existing developed areas within the City, the level of protection of the proposed 2-year storm drain system should be increased through use of regional detention basins wherever feasible.

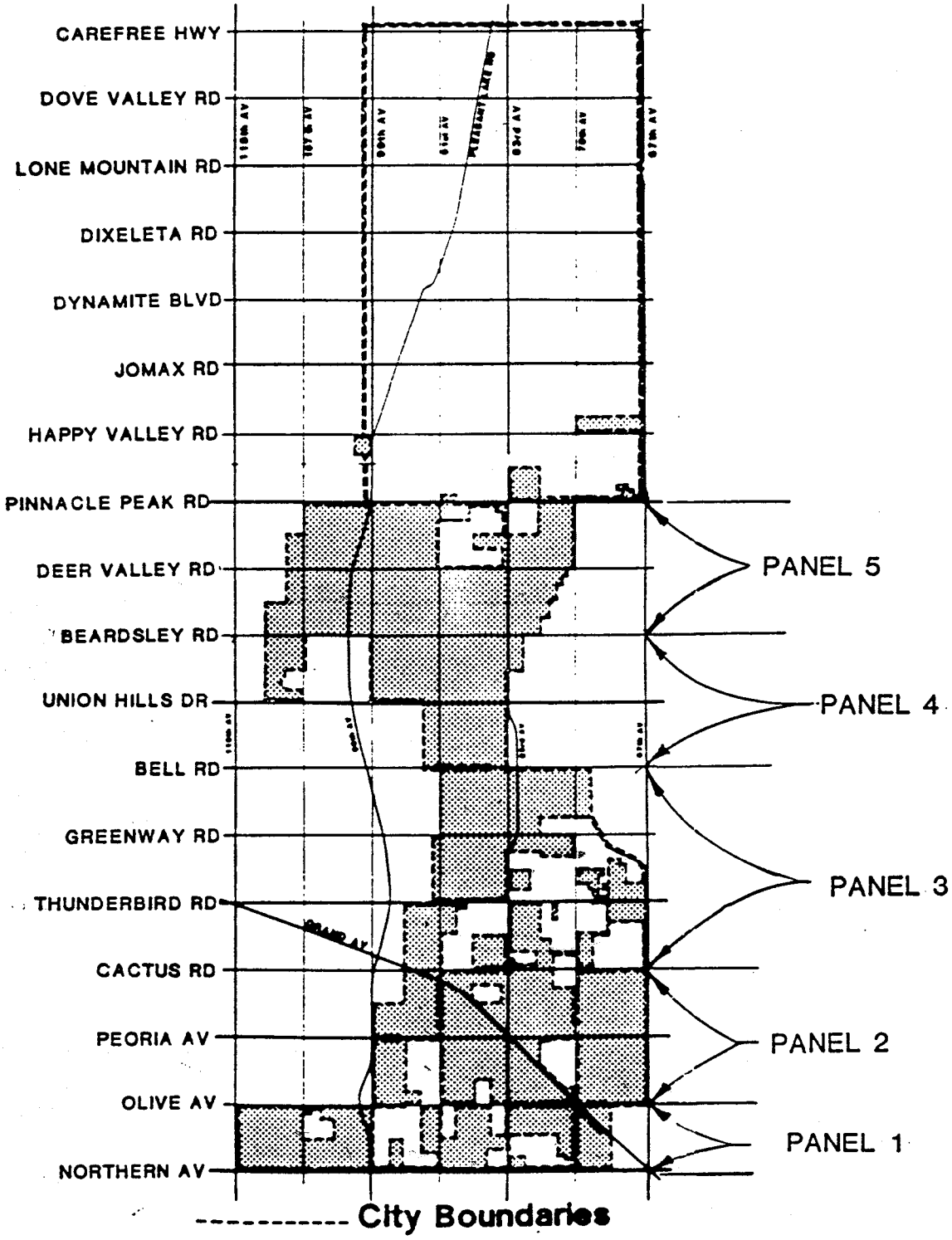
9. In general, existing and newly planned City parks should be considered as prime areas for detention basin facilities as part of a multi-use concept for the land.

10. Sites designated in the report as potential detention basin locations which are not currently owned by the City should be obtained as a top priority in the implementation of this master plan.

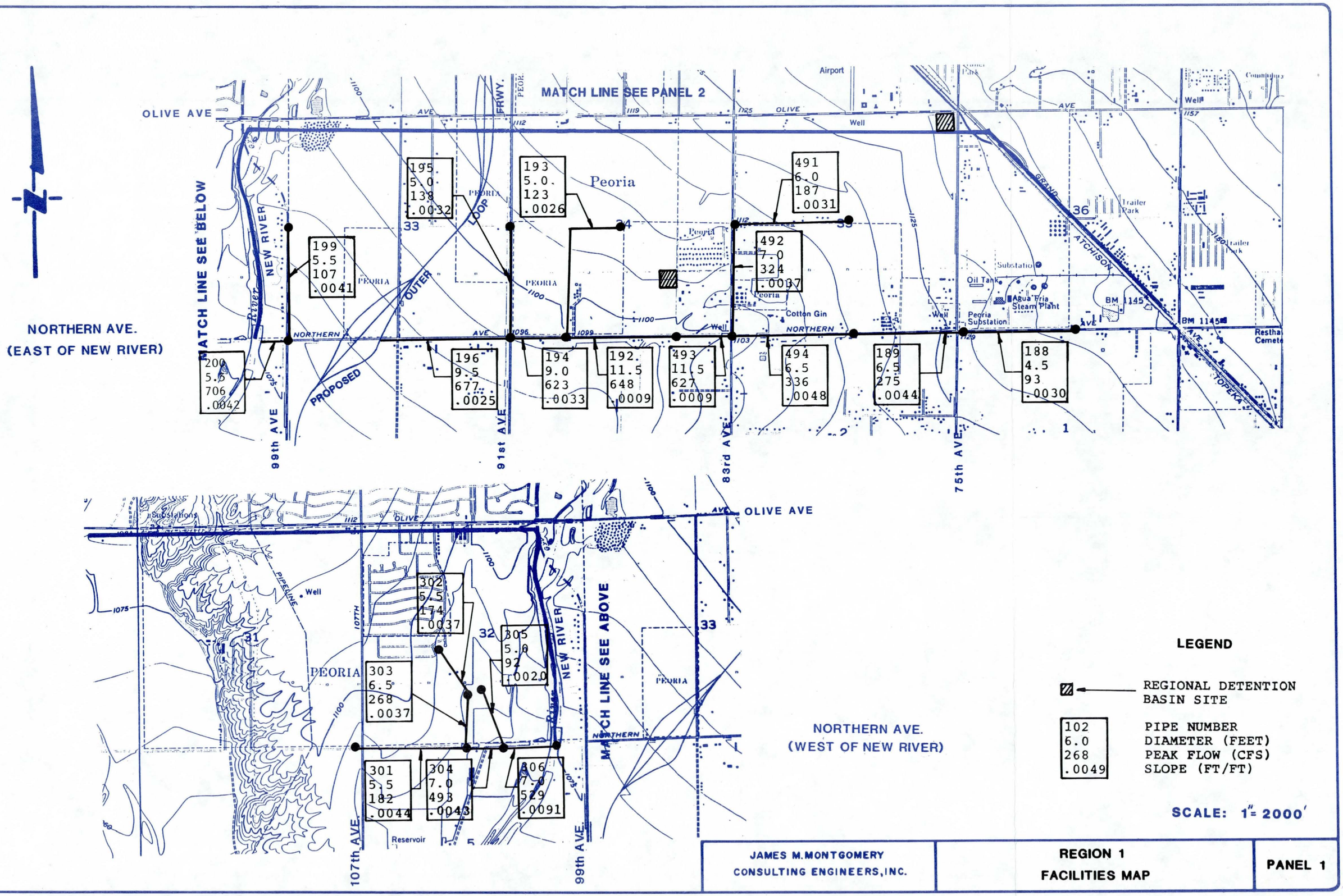
11. Construction of storm drain improvements should be incorporated with planned road improvement projects to reduce costs and minimize community inconveniences.

12. The City should agree to construct the proposed regional drainage facilities identified in the Glendale-Peoria Area Drainage Master Study (Northern Avenue, Olive Avenue, and Cactus Road storm drain systems) in lieu of the "Peoria-only" facilities outlined in this master plan.

13. The issue of storm drainage system funding should be studied in more detail, both for ongoing financial obligations and for specific projects. Of specific importance will be cost sharing opportunities with County and State agencies.



JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	INDEX TO MAP PANELS	



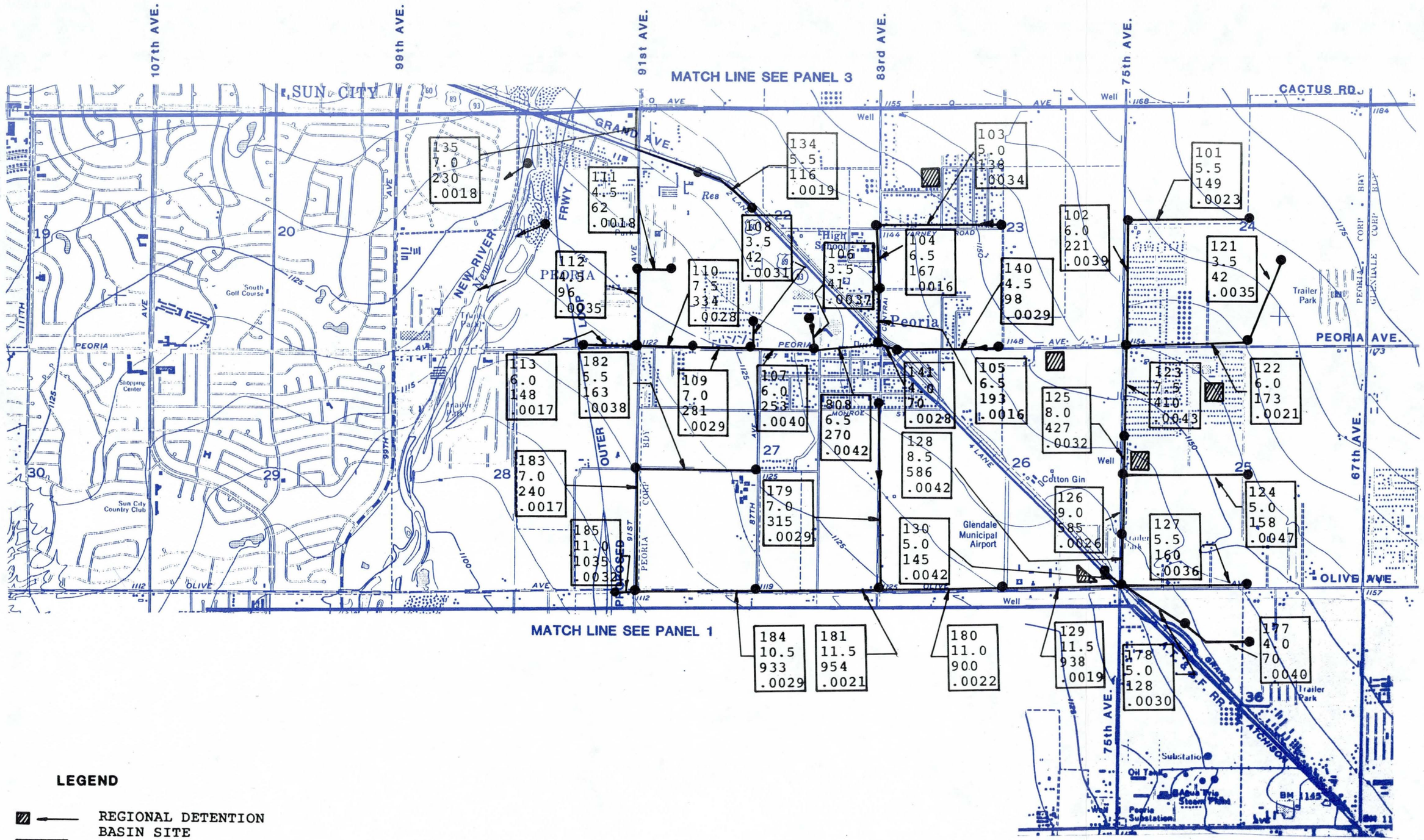
LEGEND

REGIONAL DETENTION BASIN SITE

102	PIPE NUMBER
6.0	DIAMETER (FEET)
268	PEAK FLOW (CFS)
.0049	SLOPE (FT/FT)

SCALE: 1" = 2000'

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	REGION 1 FACILITIES MAP	PANEL 1



LEGEND

▨ ——— REGIONAL DETENTION BASIN SITE

102	PIPE NUMBER
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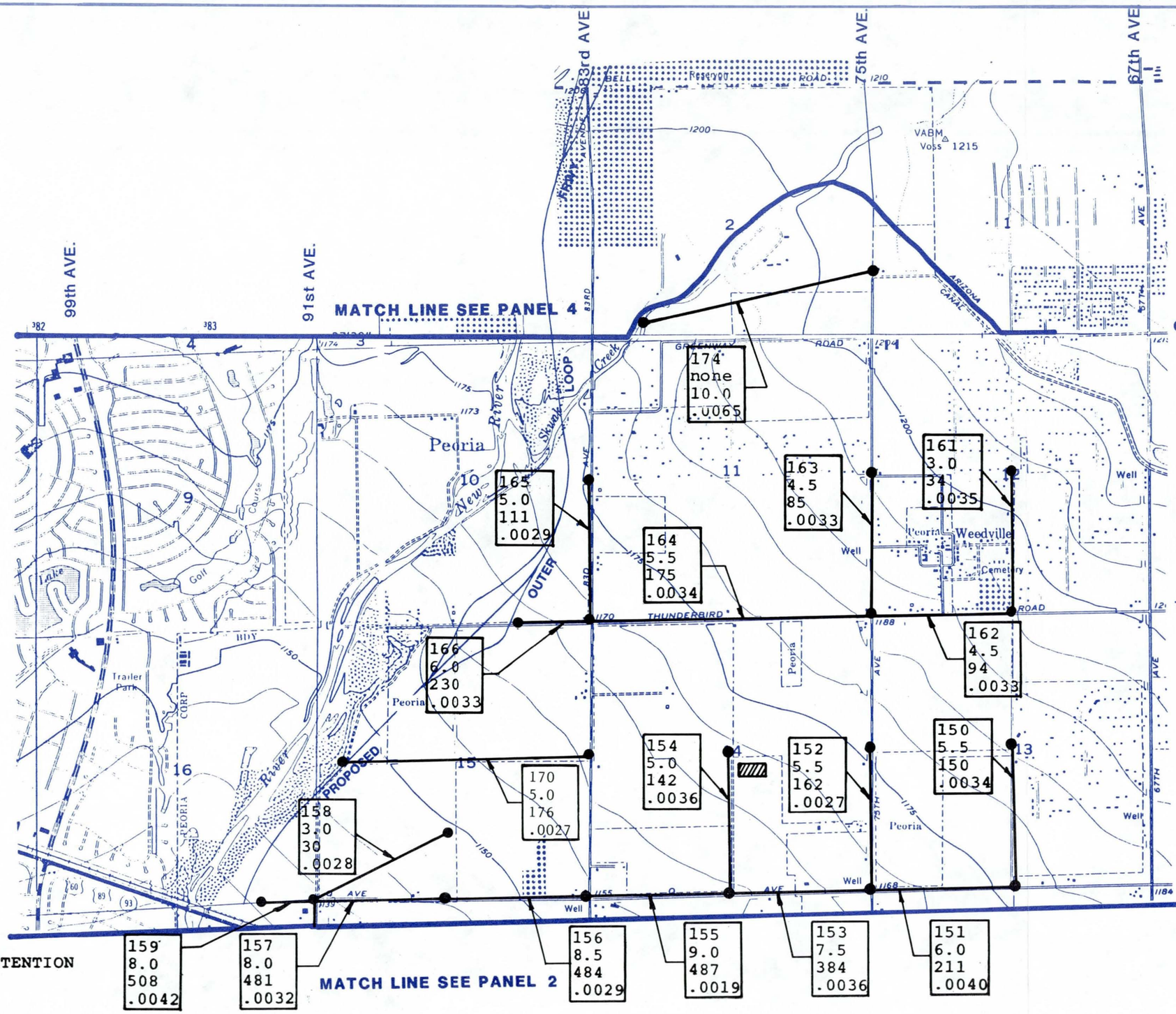
268	PEAK FLOW (CFS)
.0049	SLOPE (FT/FT)

SCALE: 1" = 2000'

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	REGION 1 FACILITIES MAP	PANEL 2



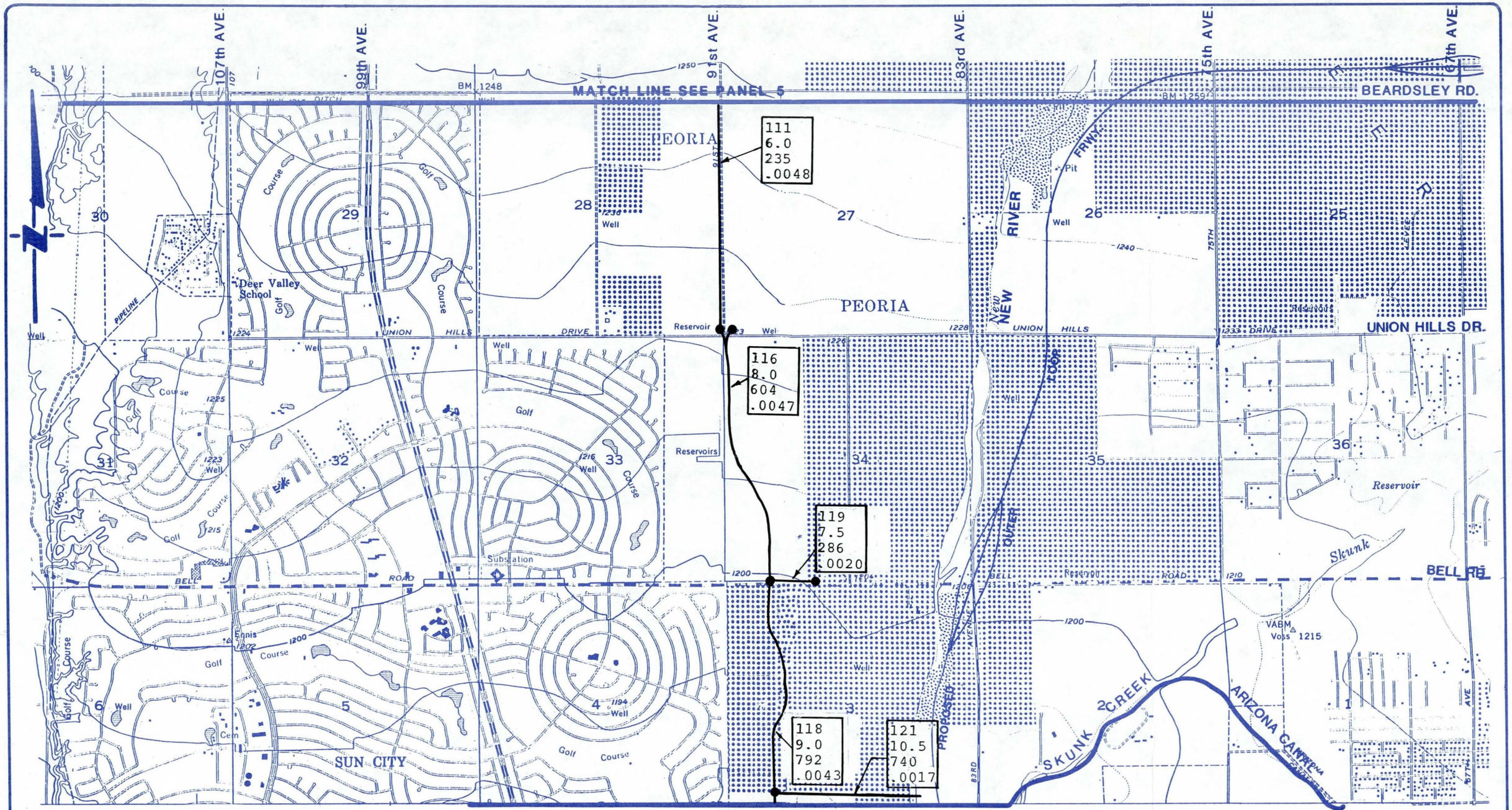
LEGEND

REGIONAL DETENTION BASIN SITE

102	PIPE NUMBER
6.0	DIAMETER (FEET)
268	PEAK FLOW (CFS)
.0049	SLOPE (FT/FT)

SCALE: 1" = 2000'

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	REGION 1 FACILITIES MAP	PANEL 3



LEGEND

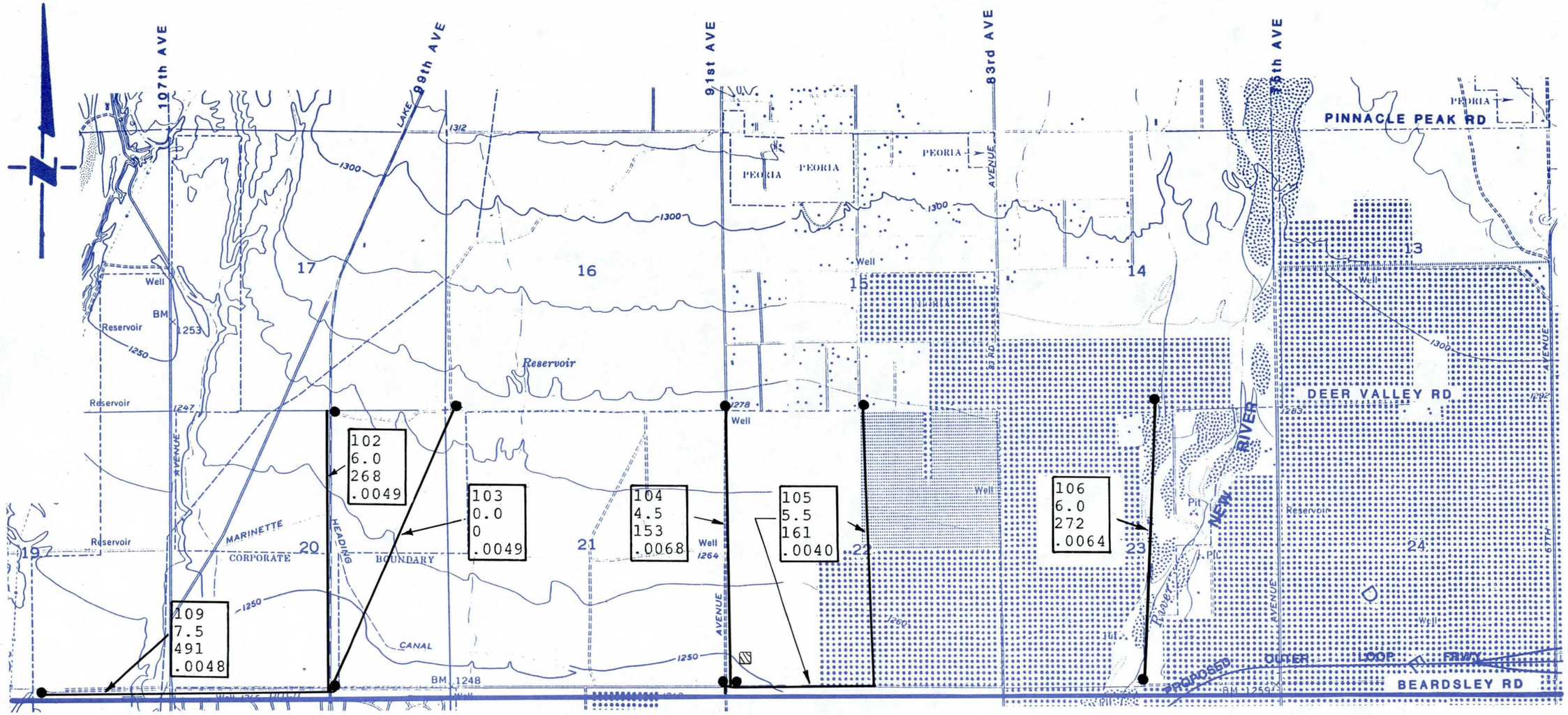
▨ ← REGIONAL DETENTION BASIN SITE

102
6.0
268
.0049

PIPE NUMBER
DIAMETER (FEET)
PEAK FLOW (CFS)
SLOPE (FT/FT)

SCALE: 1" = 2000'

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	REGION 2 FACILITIES MAP	PANEL 4



MATCH LINE SEE PANEL 4

LEGEND

REGIONAL DETENTION BASIN SITE

102	PIPE NUMBER
6.0	DIAMETER (FEET)
268	PEAK FLOW (CFS)
.0049	SLOPE (FT/FT)

SCALE: 1" = 2000'

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.	REGION 2 FACILITIES MAP	PANEL 5