Final Concept Drainage Report

South Mountain Freeway
I-10 Papago to I-10 Maricopa
Volume I: Main Report

Contract 88-24
Price Expressway
General Consultant
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Prepared for :

Arizona Department of Transportation

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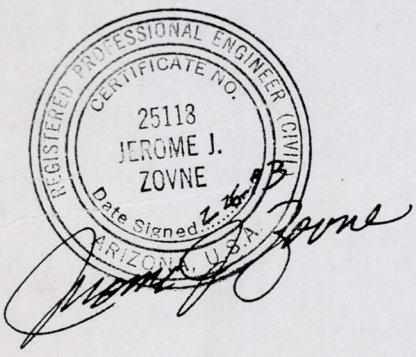

February, 1993

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SECTION 1.0
INTRODUCTION

1.1 Project Description

In 1990 HDR Engineering, Inc. (HDR) entered into a General Engineering Consultant (GEC) agreement with the Arizona Department of Transportation (ADOT) to develop conceptual design for the Loop 202 - South Mountain Freeway (SMF) from the I-10 Papago Freeway to the I-10 Maricopa Freeway in Maricopa County, Arizona. Figure I.1 is a project location map and Figure I.2 gives an aerial perspective of the proposed freeway system. As part of that agreement, HDR was to review and refine previous hydrologic analysis, refine the drainage concepts and prepare new design concept drainage plans. Conceptual design was performed using guidelines from the ADOT Urban Highways **Design Procedures Manual** (DPM), 1990 Edition. The original design location concept reports were prepared by HDR in September, 1988.

Loop 202 was divided into five study segments and evaluated separately. The segments, which are hydrologically independent, are shown on Figure I.1 and defined as follows:

Segment I. I-10 Papago to the Salt River, including the proposed Salt River Bridge.

Segment II. Salt River south bank to 51st Avenue (includes the Champion Drain watershed).

Segment III. 51st Avenue to 19th Avenue.

Segment IV. 19th Avenue to 1500 feet east of 40th Street.

Segment V. 1500 feet east of 40th Street to 56th Street (includes SMF/I-10 Maricopa TI and the Maricopa Road TI).

This report will discuss hydrology, hydraulics and concept plans for each segment, distinguishing between on-site (within the right-of-way) storm water and off-site storm water.

1.2 General Drainage Concepts

1.2.1 Segment I Discussion

The north to south orientation of Segment I's roadway (see Figure I.1) almost follows the natural slope of the land which gently falls southwesterly to the Salt River. However, the proposed

freeway will be constructed on embankment and will obstruct some surface runoff coming overland from the east-northeast. To the north, storm runoff is prohibited from reaching Segment I by the I-10 Papago Channel which parallels the existing Papago Freeway. This channel controls a large watershed north of I-10 and conveys storm water west to the Agua Fria River. A drainage area map showing Segment I's watershed limits and other details is provided in a map pocket at the end of this report.

Due to the absence of natural waterways or outfalls (obliterated by agriculture and industry) into which intercepted surface flow might be discharged, the major feature of Segment I's proposed drainage plan is a lined channel along the freeway alignment's east side which will intercept off-site flows and provide an outfall for on-site runoff. This channel would parallel the freeway southward, discharging at the north bank of the Salt River.

The concept design contains a proposed interchange to link the South Mountain Freeway (SMF) and I-10 Papago Freeway. This interchange will impact the existing freeway drainage by the addition of directional ramps and collector roads and by the reconfiguration of entrance and exit ramps at 43rd, 51st, 59th and 67th Avenues. The existing I-10 storm drain system will require significant modification in order to serve the entrance and exit ramp realignments and those sections of the I-10 mainline pavement which shall require widening. I-10's rolling profile is fully depressed with sag points at each of the crossing avenues which are drained by existing on-site pump stations into the I-10 Papago Channel. The proposed improvements are not anticipated to adversely impact the operation of those pump stations; however, a section of the Papago Channel between 51st and 59th Avenues is proposed to be reconstructed due to the introduction of a collector road on the north side of I-10.

A new bridge crossing of the Salt River is proposed as a part of the South Mountain Freeway. Discussion and drawings of this bridge are part of a draft bridge selection report prepared by HDR in April, 1992 (Reference 29). The current concept is for the bridge to span the existing 3350 foot wide floodway.

The study utilized the 1984 FEMA/Maricopa County Flood Insurance Study (FIS) HEC-2 hydraulic model as the basis for this evaluation. However, the Flood Control District of Maricopa County is having the Salt River FIS restudied and this restudy will be completed in about two years. The results of this restudy will be to establish new regulatory elevations for the river. After the model results for this restudy are accepted by FEMA, the proposed South Mountain Freeway Bridge should be reevaluated using this newer hydraulic model.

Because the bridge will have to be restudied before implementation, the analysis for this bridge was not as detailed as would normally be done. However, it appears that the South Mountain Freeway Bridge could be shortened as much as 850 feet to a length of 2500 feet without any

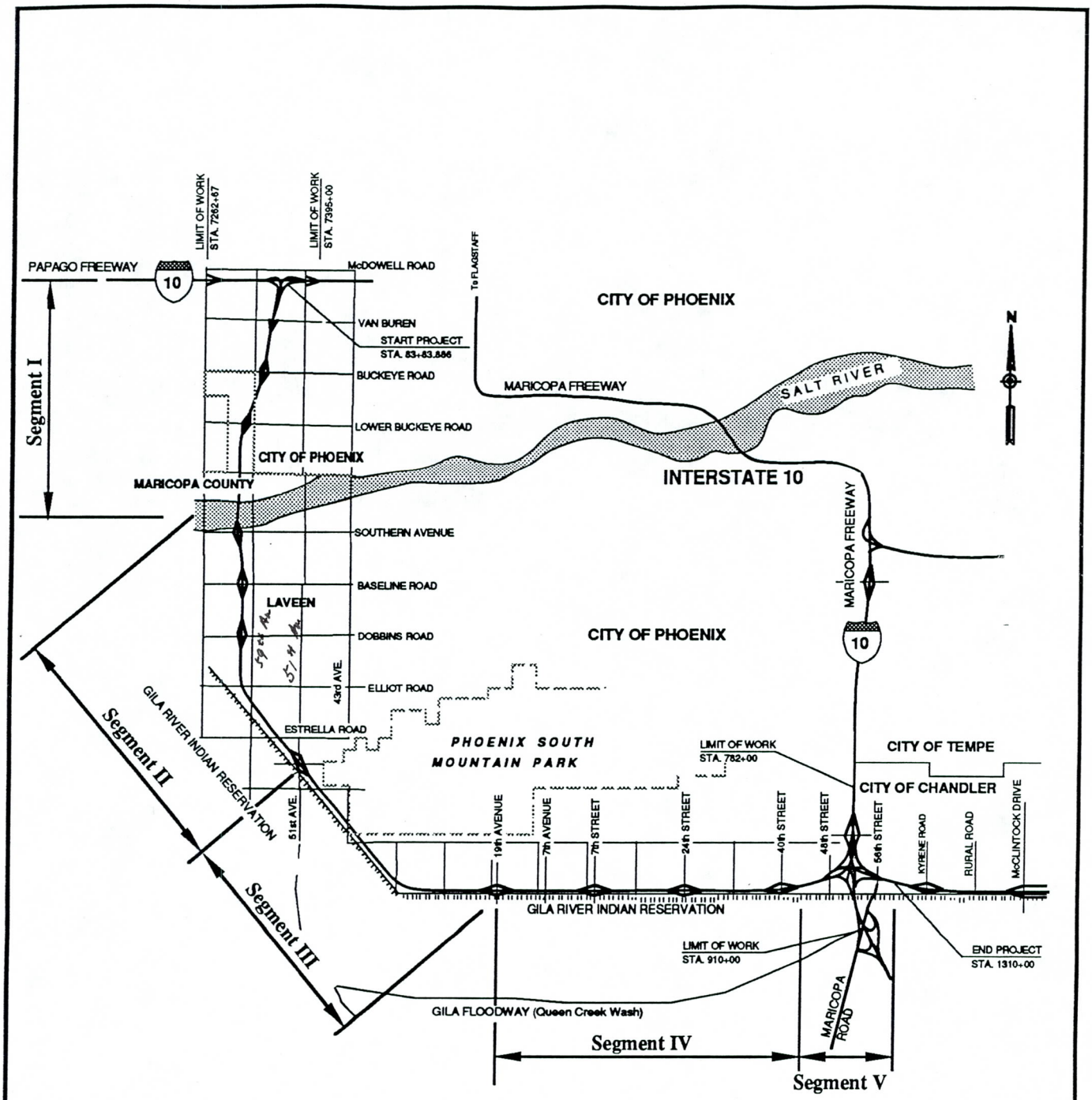

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FIGURE I.1
PROJECT LOCATION MAP

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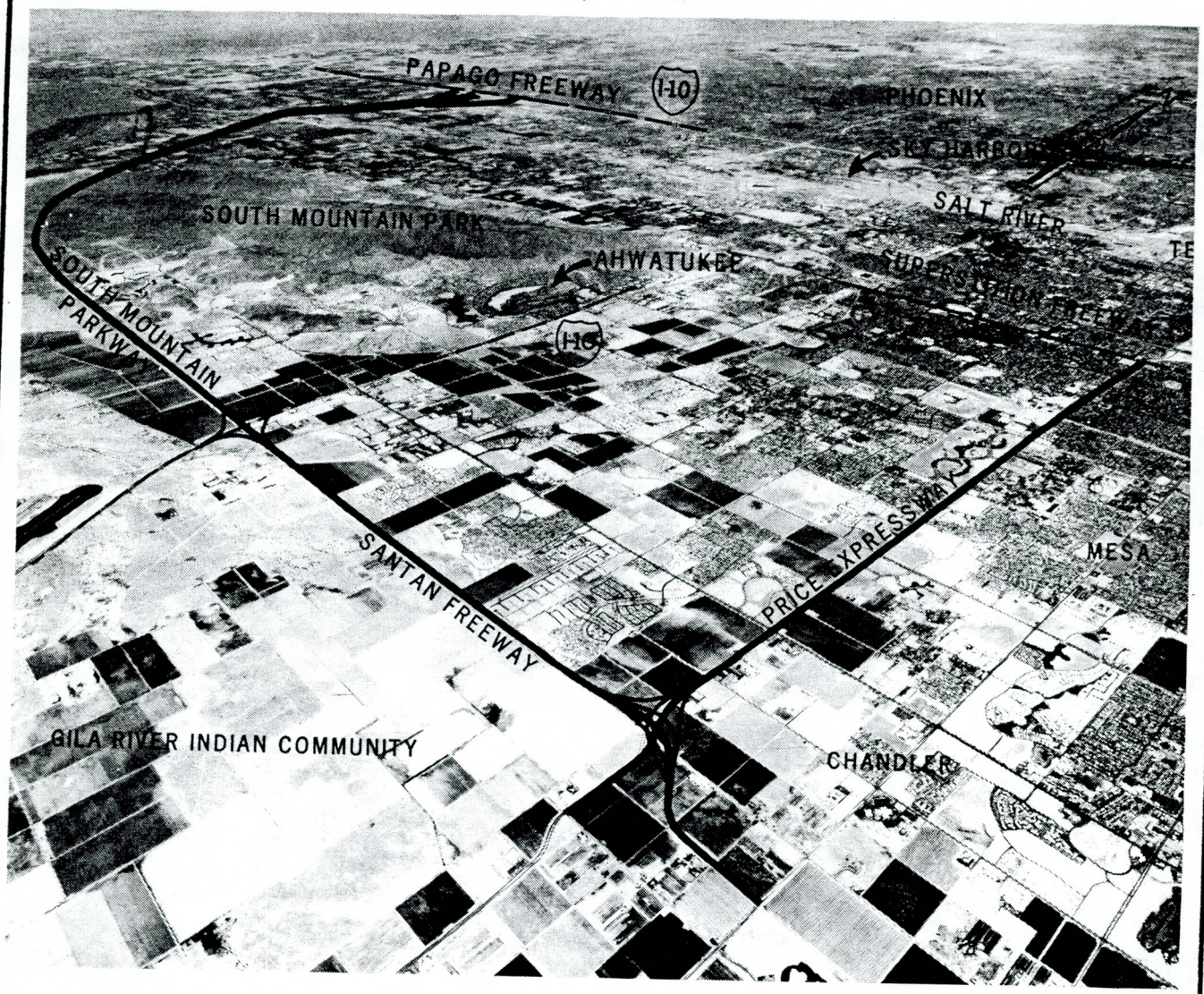


CONTRACT 88-24 SOUTH MOUNTAIN FREEWAY GENERAL CONSULTANT TRACS NO. H-2222-01D	CONCEPT DRAINAGE REPORT FIGURE 1.2 PROJECT OVERVIEW	HDR HDR Engineering, Inc.

channel modifications. The average velocities through the bridge would be less than 10 feet per second. Further reductions in bridge length could be possible by channelization of the river reach. This could produce another 500-700 foot reduction in the proposed Salt River bridge length.

The hydraulic (HEC-2) analysis referred to in this memo is not included in the Technical Appendices because of the on-going restudy which will provide new cross-sectional data and result in the development of a new hydraulic model. A scour analysis will be required at the time of detail design and hydraulic information will be used from the restudy model. A conceptual cost estimate set the bridge construction cost at $15,000,000. This cost is considered a roadway cost and is not included in the drainage cost estimate.

1.2.2 Segment II Discussion

The Segment II portion of South Mountain Freeway, running north to south from the south bank of the Salt River to 51st Avenue, will also be on embankment with the exception of a depressed section at Dobbins Road. This alignment severs east to west flow patterns from the Champion (or Maricopa) Drain watershed. (Discussion of this watershed is contained in Subsection 2.1.2.2). Natural water courses have long been obliterated by agricultural development and runoff is now conveyed through this watershed in various ways, such as irrigation ditches, depressed roads and sheet flow. HDR's previous investigation and analysis for the 1988 **Drainage Design Concept Report** concluded the impracticality of passing flows through the freeway embankment in any existing or natural pattern. This review concludes the same and the proposed solution continues to be the interception of runoff in a lined channel which will collect flow at the street crossings, from overflowing irrigation tailwater ditches and from a system of area drains or spillway structures at low points along the alignment. One exception is an estimated 255 cfs assumed in the hydrologic model to be diverted west through the freeway embankment at the Estrella Drive underpass. This is the approximate capacity of an improved future Estrella Drive, through the freeway opening, flowing one foot deep.

One detention basin (185 acre-feet volume) is proposed in Segment II's north-south leg and serves to attenuate the high peak flow coming off of the mountainous drainage areas at the west end of the South Mountain Park Preserve. This basin's outflow continues north adjacent to the freeway and meets the flow generated by the much larger Champion Drain watershed at Baseline Road. The alternatives of handling these flows are discussed in Subsection 2.3.3.3.

1.2.3 Segment III Plan Discussion

The Segment III roadway follows the Gila River Indian Community boundary as the freeway corridor turns east at the southwest end of South Mountain Park. The alignment contains stretches of roadway both on embankment and through deep rock cuts. The drainage area is largely mountainous. Primary natural flow paths were identified from aerial and topographic mapping and proposed cross culverts were located in the major washes and gullies. Downstream level spreader/detention structures have been proposed at locations where the natural topography did not tend toward defined waterways, but toward sheet flow or rivulet flows too numerous and shallow to drain with cross culverts through the embankment. Level spreaders are, in general, linearly shaped earthen basins, shallow in depth (a few feet), which upon filling with storm water evenly discharge the excess over the top of the downstream edge of the basin. This edge, being graded at an equal overtopping elevation and above natural ground, can be constructed as long or as short as necessary to redistribute the flow in a sheet flow fashion which is less erosive than a concentrated flow. This top edge, or berm, and the spillway side will require protection to maintain the integrity of that edge. If possible, low flow pipes should be used to fully drain the level spreader basin, but if a discharge point for a gravity drain is not attainable, then the basins are drained by percolation, evaporation and/or drywells. Level spreaders also possess minor detention properties, providing limited flood protection downstream.

1.2.4 Segment IV Plan Discussion

Extending from 19th Avenue to east of 40th Street, the Segment IV alignment is to be constructed on embankment and will lie roughly perpendicular to stormwater runoff patterns, again tending to impound and concentrate stormwater runoff. Much of the drainage area lying between the freeway and South Mountain Park is developed, however, and the runoff is already concentrated in existing channels and culverts. In those areas where development master drainage plans exist, HDR proposes to perpetuate the existing systems. Cross culverts will be sized and located to preserve conformity to the drainage systems from the north and the existing level spreaders along Pecos Road will be used to outlet runoff as sheet flow onto the Gila River Indian Community lands. Many of these level spreaders are located within a Salt River Project (SRP) transmission line easement. SRP verbally approved the drainage concepts in January 1992, but final plans are subject to their review.

1.2.5 Segment V Plan Discussion

The rapidly developing area between 40th Street and I-10 Maricopa Freeway, in the northwest quadrant of the SMF/I-10 Maricopa interchange, drains in a southeasterly direction and runoff will be collected with an interceptor channel which crosses south beneath the freeway alignment, ultimately outfalling to the Gila Floodway. The Gila Floodway is an existing watercourse within the Gila River Indian Community and additional information regarding the proposed development of the Gila Floodway can be found in **Gila Drain Alternative Concept Drainage Report** (Draft), April 1992.

The lightly developed industrial area between I-10 Maricopa Freeway and 56th Street, in the northeast quadrant of the interchange, also drains southeasterly, to the existing Gila Drain outfall. This area was studied in a separate Price/Santan hydrology study, also prepared by HDR. Implementation of the off-site collection system and improvement of the Gila Drain as described in HDR's **Concept Drainage Report, Price Expressway and Santan Freeway from 56th Street to Dobson Road, Gila Drain Alternative, Final Report** (Draft) April 1992, is part of this plan.

The SMF/I-10 interchange drainage system is separate from the off-site drainage and consists of infield detention areas, cross culverts and an on-site pump station needed to evacuate pavement drainage from the depressed portion of the South Mountain Freeway. All on-site drainage, as well as off-site drainage, is ultimately discharged to a proposed outfall pipe (54-inch) running south along the west side of I-10 to the planned Gila Floodway.

1.3 Concept Plan Drawings

Drainage concept plan drawings have been prepared for the project limits covered in this report. These plans will be integrated into a comprehensive set of General Plans covering the South Mountain/Price/Santan alignments. The plans prepared for this study supersede the 1988 concept plans.

The major changes to previous drainage concepts have been adjustments to the design storm frequency for various drainage elements, checking of contributing drainage areas, reevaluation of detention basins and redefinition of right-of-way requirements.

One notable change is that the 1988 plan and report recommended upsizing of the Champion Drain (Champion Drain discussion follows in Subsection 2.1.2), assuming future coordination with the Flood Control District of Maricopa County and Salt River Project. At the time of this report, there are no indications from the Flood Control District of plans to improve the Champion Drain nor plans to make appreciable improvements in the upper watershed. This report therefore discusses alternative solutions for the outfall which do not involve collaborative improvement of the Champion Drain. Discussion of those alternatives is found in Subsection 2.3.3.3. Following consultation with ADOT, one of these alternatives was selected to be depicted on the concept plans.

1.4 Concept Drainage Report and Technical Appendices

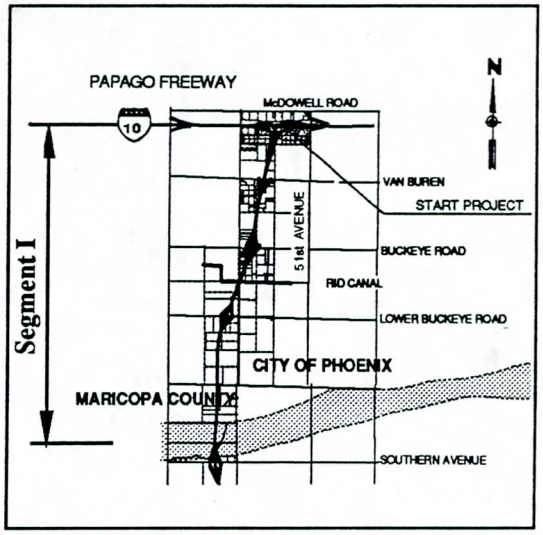
This concept drainage report contains narrative and other material covering the five segments comprising the Loop 202 South Mountain Freeway system. Two separately bound volumes, **Volume II: Technical Appendix Segments I, II and III and Volume III: Technical Appendix Segments IV and V**, contain hydrologic and hydraulic calculations and other documentation.

SECTION 2.0
OFF-SITE DRAINAGE

2.1 Description of Drainage Areas

2.1.1 Segment I Drainage Area

The I-10 Papago Channel and the Papago Freeway are barriers on the north preventing 100-year storm runoff from reaching the SMF Segment I alignment. Of Segment I's contributing drainage area 1.65 square miles lies north of the Roosevelt Irrigation District (RID) Canal and is bounded on the east by 51st Avenue. The 51st Avenue boundary is partly created by the street itself, but also influenced by the considerable development along the east side of the 51st Avenue where a combination of stormwater retention policies, physical barriers (such as north-south railroad lines) and the southerly fall of the land have the effect of creating a drainage boundary at 51st Avenue. The RID Canal is a barrier to the south-southwesterly overland path of runoff, creating a major concentration point at the intersection of the SMF and the canal. This portion of the total watershed lying above the RID Canal is a mix of land use but is largely industrial in nature, containing an extensive gasoline distribution center (tank farm), the Freeport Center (an industrial/warehousing complex) and numerous smaller facilities. Some of these facilities are subject to 100 year retention policies and others are not. The City of Phoenix has had a 100-yr., 2-hr. storm retention policy since 1985. An allowance for existing retention within the HEC-1 hydrologic model was applied sparingly and subject to field verification. Areas within protection berms, which ring large areas within the tank farm, were assumed to be noncontributing.



The remaining 0.60 square mile drainage area south of the RID Canal remains primarily agricultural. The land's general fall is south-southwesterly at a mild 0.2% slope. Field observation was used to establish 59th Avenue, which is higher than existing ground from the RID Canal to Broadway Road, as an east drainage boundary.

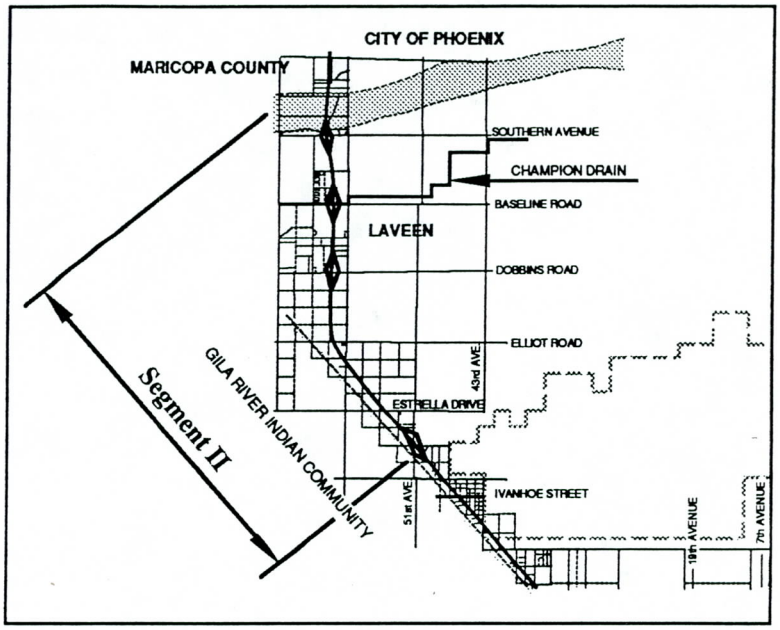
With the exception of a small area in the southeast quadrant of Buckeye Road and 59th Avenue intersection, there is no significant contributing drainage area on the west side of the alignment as those lands slope to the southwest, away from the freeway.

The hydrologic soil group for this watershed was determined to be type B (moderate infiltration rate) from Soil Conservation Service published soil surveys.

2.1.2 Segment II Drainage Area

2.1.2.1 Watershed Description

The drainage area limits for the Segment II portion of the project are the proposed SMF on the west, a low ridge line paralleling the Salt River to the north, Central Avenue to the east and the ridge line of the South Mountain Park to the south. The largest single runoff concentration point is the freeway crossing at the Champion Drain (also referred to as Maricopa Drain) irrigation waste ditch. The alignment of the Champion Drain follows the east-west course of a broad swale that runs south of and roughly parallel to the Salt River. Where the freeway alignment intersects this drain the contributing drainage area is approximately 24 square miles. Further discussion of the Champion Drain channel follows in Subsection 2.1.2.2.



Topography of the Champion Drain watershed ranges from rugged mountains at the southeastern and southern portions of the watershed to level farm fields in the western portions of the watershed. There is sporadic residential development within western parts of the watershed and substantial parcels of residential development in the north and east areas of the watershed. However, most of the Champion Drain contributing area is in agricultural use. Drainage area maps are included in a map pocket at the end of this report.

Hydrologic soil groups for the watershed contributing to Segment II range from type D soils (high runoff potential) to type A soils (high infiltration rate). Generally type D soils were encountered in the upper areas of the South Mountain range and type A soils were located at or near the base of the mountains. Soils within the agricultural and residential areas were predominantly type B soils.

There are few major barriers to the east-west surface movement of stormwater runoff in the Champion Drain watershed. A detention area (developed in the 1970's) near the Central Avenue entrance to South Mountain Park does however provide control of a large mountainous drainage area (4.1 square miles) within the park. Downstream of that point there are minor, albeit numerous, obstructions to overland flow. Irrigation canals, such as the Western Canal, may have some delaying effect upon the storm runoff but field inspection suggests that numerous crossings over or under the irrigation canals reduce the impact of this barrier. The canals, as well as other minor obstacles have more effect upon frequent storm events (2-year, 10-year, etc.) than on large scale, infrequent events (50-year and 100-year).

In the absence of natural water courses throughout the Champion Drain watershed, flow paths follow streets, irrigation ditches and field slopes. Extensive shallow ponding is expected throughout the watershed, but historical flooding information is limited. One neighborhood, 1/4 mile south of Southern Avenue on 43rd Avenue experiences periodic street and yard flooding due to the elevated grade of 43rd Avenue acting as a barrier. This area will probably be targeted by the Flood Control District for storm water flooding relief. Laveen, an unincorporated community at Dobbins Road and 51st Avenue, also experiences significant street flooding and lot flooding, but many of the lots are bermed and the area historically retains water. This area is reported to be served by old subsurface drain lines.

Neighborhoods of irrigated lots throughout the Champion Drain watershed were visited and those determined to have significant on-site storage were delineated on the mapping and deemed to be hydrologically noncontributing. Also considered noncontributing were El Prado Park at 19th Avenue south of Southern Avenue, and Alvord Park at 35th Avenue and Baseline Road because of on-site retention. Other smaller areas, most identified as earth borrow sites, were also designated noncontributing.

2.1.2.2 Champion Drain (Maricopa Drain)

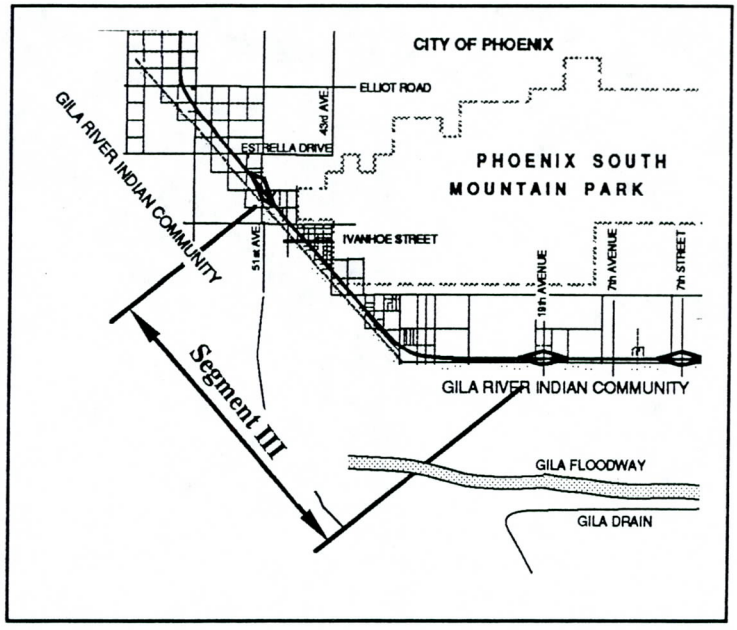
The Champion Drain is an irrigation waste water ditch which follows the course of a historical water supply ditch first dug in the late 1800's. This ditch also follows the alignment of a broad swale which is thought to convey Salt River breakout flow originating between 35th Avenue and 19th Avenue. This swale is not, however, designated in the Salt River 100-year floodplain.

Over the years, changes in irrigation practices have converted the Champion Drain into a waste ditch. Salt River Project obtained management of the ditch in the late 1960's, but Maricopa County routinely performs maintenance of the ditch from approximately 1/8 mile east of 67th Avenue to 1/8 mile east of 51st Avenue. The 1988 **Drainage Design Concept Report** reports the capacity of the ditch to be from 46 cfs to a maximum of 666 cfs near its outfall at the Salt River. These capacities were not substantiated for this report.

The Champion Drain has for many years been considered to be a potential source of flooding relief, but substantial enlargement and improvement to the ditch would be required. The Flood Control District of Maricopa County has completed (in conjunction with a private engineering consultant) a hydrologic and floodplain study referred to as the Laveen Area Drainage Master Study which includes the Champion Drain watershed. Recommendations as to flood control measures will be presented in a future phase of that study.

2.1.3 Segment III Drainage Area

Segment III receives runoff from drainage areas which contribute to the freeway alignment between 51st Avenue and 19th Avenue. The total watershed encompasses some 9 square miles and is bounded by the South Mountain range to the north and the freeway alignment along the Gila River Indian Community (GRIC) on the south.



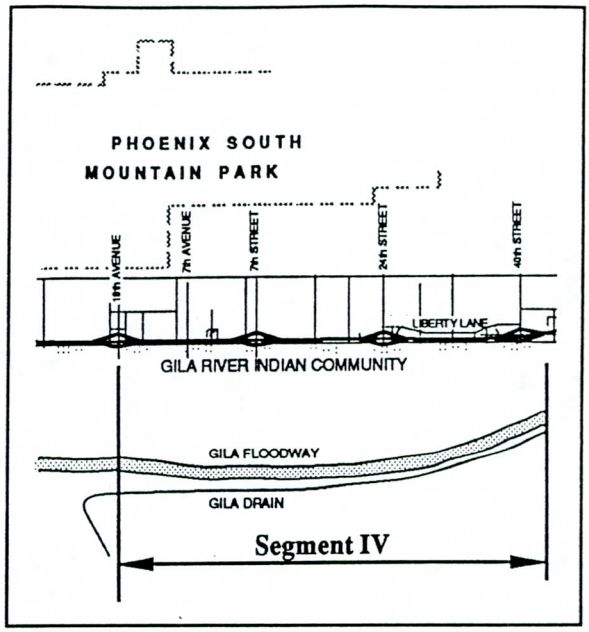
Watershed topography ranges from steep rugged mountains with slopes of around 50% to alluvial fan areas of around 2% slope at the GRIC boundary. The flow direction of runoff ranges from a near westerly direction at 51st Avenue to an almost southerly direction at 19th Avenue. Storm runoff concentrating in the lower portions of the mountainous slopes is conveyed by many small washes and gullies as it approaches the freeway alignment. Storm water flows onto and across GRIC land in these washes until it reaches the Gila Floodway and then outlets at the Gila River.

Hydrological soil groups range from type D in the upper mountainous areas of the watershed through types A, B and C at the foot of the mountains and in the alluvial fan areas.

At present the watershed is largely undeveloped with a large area being part of the South Mountain Park. The remainder consists of a small pocket of sparsely populated residential land near Ivanhoe Street, and other undeveloped land. Drainage area maps are included in a map pocket at the end of this report.

2.1.4 Segment IV Drainage Area

The watershed contributing to Segment IV is approximately 18 square miles in area and is bounded by the South Mountains range to the north, the GRIC lands to the south, 19th Avenue to the west and approximately 40th Street to the east.



The upper areas of the watershed form part of the South Mountain range and are rugged and steep with slopes up to 50%. Topography at the freeway alignment ranges from steep ridges with well defined washes and gullies to alluvial fan type areas.

The remainder of the watershed not within South Mountain Park is nearly all developed residential land and delineation of drainage sub-areas is largely dependent upon the locations of cross-culverts and man-made channels previously installed or planned by various development engineers. Development within the proposed freeway corridor itself has been curtailed in recent years due to advance public information and the cooperation of local government agencies. Drainage area maps are included in a map pocket at the end of this report.

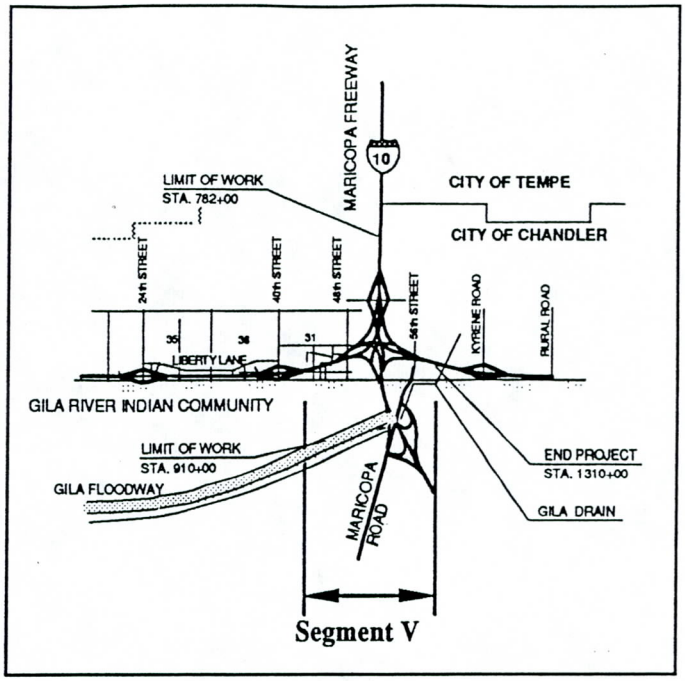
2.1.5 Segment V Drainage Area

2.1.5.1 40th Street to I-10 Maricopa (NW Quadrant of TI)

A 4 square mile watershed, currently 60 percent developed, contributes to the SMF alignment. The remaining 40 percent is virtually all in agricultural use with a small portion of the upper watershed forming part of South Mountain Park. The watershed slopes range from 50% in the upper areas to around 1% at the freeway alignment, although in general, this segment has far milder slopes than Segment IV. Hydrologic soil groups for areas contributing to this segment are predominantly type B soils with a small percentage of type D soils (rock outcrops) in the upper watershed.

The developments within this segment are mainly residential with some commercial, and due to the time span over which development has occurred the individual stormwater retention policies vary. In general, any future development will be subject to City of Phoenix storm drainage requirements including 100-year, 2-hour retention. There are many man-made channels in the upper watershed, but these waterways terminate at development boundaries and stormwater is more or less dispersed back into a pre-development flow pattern as it approaches the SMF alignment. The overland flow

pattern is generally southeasterly towards the SMF/I-10 Maricopa traffic interchange with some flow moving directly south in 48th Street and the adjacent irrigation channel.



2.1.5.2 I-10 Maricopa to 56th Street (NE Quadrant of TI)

This area (NE 1/4 of Section 32) slopes mildly at 0.4% and is partially developed with scattered industrial sites. This watershed is within the corporate boundaries of the City of Chandler and is thus subject to a 100-year, 2-hour stormwater retention policy. The land slopes evenly and southeasterly towards the Santan Freeway alignment. The open areas are either in agricultural use or fallow pending development. The hydrologic soil group is type B for the entire area contributing to this section. A drainage area map covering Segment V is included in a map pocket at the end of this report.

2.1.6 Mapping

The necessary data for the development of a hydrologic model requires many types of input and resources. Discussion of those types of input and resources (CN selection, lag times, soil types, etc.) is presented in other sections of this report. Most important of these required resources is adequate topographical mapping. The flatter the terrain, the more critical the mapping becomes in order to determine drainage boundaries and flow paths. Also, recent aerial photography is important in establishing accurate land use. For this project an area determined to have been platted or under development was assumed to be fully developed for modeling purposes. Following is a summary of the primary mapping resources that were used to execute the off-site hydrological analysis.

Segment I

1. C.O.P topographic 1/4 section maps
   1" = 200', 2' contour interval
   Flown in late 1970's
2. USGS 7 1/2 minute quadrangle map
   1" = 2000', 10' contour interval
   1982
3. Aerial photos
   May, 1990

Segments II and III

1. Cooper Aerial contour mapping on aerial base
   1" = 400', 2' contour interval
   1990
2. USGS 7 1/2 minute quadrangle mapping
   1" = 2000', 10' contour interval
   1971
3. Aerial Photos
   1991

Segment IV

1. USGS 7 1/2 minute quadrangle mapping
   1" = 2000', 10' contour interval
   1971
2. Various development mapping provided by development engineers
3. Aerial Photos
   1991

Segment V

1. USGS 7 1/2 minute quadrangle mapping
   1" = 2000', 10' contour interval
   1971
2. Various development mapping provided by development engineers
3. Aerial Photos
   1991

While much of the USGS mapping appears out-of-date, when used in conjunction with recent aerial photos and field observation, it was generally adequate for hydrological purposes.

2.2 Hydrology

2.2.1 Methodology

The U.S. Army Corps of Engineers **Flood Hydrograph Package**, HEC-1, (either Haestad Version 4.0, Sept. 1990 or West Consultants Version 4.01E-2000 Ordinate, May 1991) was utilized to model the flood hydrology of drainage areas contributing to the South Mountain Freeway segments. A current version of HEC-1 was used for the hydrological analysis and a recent version which has an expanded capacity for 2000 hydrograph ordinates was also used by HDR. Most versions allow a maximum number of 300. The advantages of the 2000 ordinate version are that longer storms (48 hour, 72 hour, etc.) can be analyzed without sacrificing accuracy by having to increase the computational interval time step. Also, small drainage areas which may violate an allowable ratio of model time step to an area's lag time can be modeled more confidently using a shorter computation interval, say 1 or 2 minute, while performing a standard 24-hour storm analysis. The selection of HEC-1 version, either 2000 ordinate or 300 ordinate, was based upon the requirements of the segment and the size of the drainage areas.

The SCS runoff and unit hydrograph options were applied to generate 50- and 100-year, 24-hour design hydrographs. Stormwater detention areas were modeled using the Modified-Puls routing option. Excess runoff is calculated based upon the drainage characteristics of the land surface as represented by the curve number (CN) assigned to a given area and upon the initial abstraction (IA), the initial surface storage capacity. Without sufficient data to set an IA value (depth, in inches), a default value was used which is a direct function of the CN value. Times of concentration were calculated using formulae and guidelines from SCS **Urban Hydrology for Small Watersheds** (TR-55),1986.

The CN values are based upon land use and soil types. Land use was determined from available aerial mapping and field observation. Soil types were determined from SCS soil survey mapping. Table 2.1 is a listing of the SCS runoff curve numbers used for these studies. These values reflect an Antecedent Moisture II condition, an average wetted soil condition.

Table 2.1 Runoff Curve Number (CN) Values

Cover Description	A	B	C	D
Row Crop (straight row)	72	81	88	91
Mountain	-	-	98	98
Desert Shrub (poor cover)	63	77	85	88
Fallow	74	83	88	90
Industrial	81	88	91	93
Schools	63	77	85	88
Single Family Residential	-	84	88	-

These values were either taken directly or interpolated from SCS **Urban Hydrology for Small Watersheds** (TR55), 1986.

The design storms used in the off-site hydrology were the 50- and 100-year, 24-hour duration rainfall events. These design storms yielded total point precipitation depths which were determined from ADOT's **Hydrologic Design for Highway Drainage in Arizona** (1968). The 'balanced' storm procedure was used which creates a triangular shaped hyetograph from 5 and 15-minute and 1, 2, 3, 6, 12 and 24-hour rainfall depths. The 1, 6 and 24-hour rainfall values are given in Tables 2.2 through 2.4. These values vary slightly from segment to segment because the project limits cover 23 miles, sufficient distance for anomalies in measured rainfall to occur. Hydrologic calculations and documentation are contained in the accompanying Technical Appendices.

Table 2.2 Segment I Precipitation Values (inches)

	50-Year	100-Year
1-Hour	2.30	2.68
6-Hour	3.00	3.40
24-Hour	3.55	4.00

Table 2.3 Segment II and III Precipitation Values (inches)

	50-Year	100-Year
1-Hour	2.37	2.72
6-Hour	3.05	3.45
24-Hour	3.60	4.05

Table 2.4 Segment IV and V Precipitation Values (inches)

	50-Year	100-Year
1-Hour	2.31	2.64
6-Hour	2.97	3.37
24-Hour	3.52	4.00

Aerial reduction of rainfall may also be applied in the HEC-1 analysis. This option automatically reduces the point precipitation amount (those found in the tables above) to an average depth of precipitation for large watersheds, based upon recommendations in Weather Bureau **TP-40** (1961).

2.2.2 Segment I Hydrology

Segment I's sub-area drainage boundaries were set at half-section and section lines, from north to south, all adding to a cumulative runoff hydrograph at critical concentration points along the freeway alignment. The resulting flow values were used to size the collector channel and

crossroad drainage structures. Design flows were channel routed, using a HEC-1 normal depth routing routine, to achieve reasonable timing for hydrograph combining.

Initial abstractions for several drainage sub-areas were manually input to the model to allow for on-site retention policies. No amount more than the 100-year, 2-hour precipitation value of 2.93 inches was abstracted from any area.

The Segment I HEC-1 model was structured to accumulate contributing runoff hydrographs for outfall at two locations. First, runoff from areas north of Van Buren Street were summed and detention routed for proposed bleed off into a City of Phoenix storm drain within Van Buren Street. Second, runoff from areas south of Van Buren Street were accumulated for ultimate discharge into the Salt River. This model, filenamed SMFNORTH.DAT, is contained in the Technical Appendix. Table 2.5 contains a summary of discharges at design concentration points along Segment I's proposed drainage system.

Table 2.5 Summary of Discharges - Segment I

Location	Model Filename	HEC-1 I.D. No.	Drainage Area (sq. mi.)	Flow(cfs) Q50	Q100
Basins 1 and 2 (inflow)	SMFNORTH.DAT	ADD99	0.02	-	66
Basins 1 and 2 (outflow)	"	RTSE	0.02	-	7
Van Buren St. Basin 3 (inflow)	"	AD101	0.18	-	114
Van Buren St. Basin 3 (outflow)	"	RTVBN	0.18	-	9
Southern Pacific Railroad	"	AD103	0.47	-	386
Buckeye Road	"	AD103	0.47	-	386
RID Canal Basin 4 (inflow)	"	AD106	1.32	-	527
RID Canal Basin 4 (outflow)	"	RTRID	1.32	-	372
Culvert No. C341	"	SM109	0.04	52	63
59th Avenue	"	RT109	1.36	-	379
Lower Buckeye Road	"	AD107B	1.44	-	391*
Broadway Road	"	ADBDWY	1.96	-	571

* 411 cfs - 20 cfs from D.A. SM107B

2.2.3 Segment II Hydrology

2.2.3.1 General Discussion

Topographically, the Champion Drain watershed ranges from level farm land to mountains. The study area is partially urbanized and while urban development has slowed significantly in the 1980's, the area still has potential for significant residential and commercial growth. The hydrologic modeling and the design are based upon existing conditions which will be conservative compared to on-site retention requirements imposed upon new development. The mountain preserve area is protected and will remain in a natural condition.

In addition to HDR's 1988 design location study and this study, there has been a hydrologic analysis, mentioned previously, performed on the same area by the Flood Control District's private consultant. The consultant applied new Flood Control District of Maricopa County hydrologic design procedures, from **Hydrologic Design Manual for Maricopa County, Arizona** (1990), which differ from the Soil Conservation Service (SCS) methods used by HDR.

HDR, as part of its contract with ADOT, reviewed the analysis performed for the County and will report on procedural and technical differences to account for differing results. No discussion is incorporated in this report.

2.2.3.2 HEC-1 Model

An aerial reduction factor was used in this analysis and reduced 100-year rainfall depths from 4.05 inches to 3.94 inches within the 24-square mile Champion Drain watershed.

Drainage subareas were inspected in the field to verify accuracy; however, in flatter areas the mapping was heavily relied upon. The drainage subareas in the agricultural and partially developed areas are generally correct, but because of flow splitting at street intersections, overtopping of ditch levees resulting in partial diversions, overland flow paths altered by development and other variables found in the field, the definition of drainage boundaries was subjective. The drainage boundaries were found to be in overall agreement with boundaries delineated in the Laveen ADMS. Because this study's primary interest was in a design concentration point where the SMF crosses the Champion Drain, the precise delineation of drainage boundaries in the upper watershed is less critical than for the ADMS, which is attempting to identify and mitigate flooding problems throughout the watershed. The north-south streets, 59th Avenue, 51st Avenue and 43rd Avenue, were observed to be fairly good physical boundaries used in delineating the drainage areas. The HEC-1 model, filenamed PRICE2, for this watershed is contained in the Technical Appendix. Table 2.6 contains a summary of discharges at design concentration points along Segment II's off-site collector system.

Table 2.6 Summary of Discharges - Segment II

Location	Model Filename	HEC-1 I.D. No.	Drainage Area (sq. mi.)	Flow (cfs) Q50	Q100
51st Avenue	PRICE2	-	0.03	-	224
Estrella Drive	"	ESTREL	0.97	-	1019
Elliot Road	"	AD190	5.99	-	2380
Basin 5 (inflow)	"	AD190	5.99	-	2380
Basin 5 (outflow)	"	DET08	5.99	-	1151
Dobbins Road	"	AD240	6.28	-	1206
S. Mtn. Freeway @ channel X-ing	"	AD260	6.46	-	1237
Baseline Road	"	AA260	6.46	-	1237
Southern Avenue	"	AD270	6.68	-	1331
Champion Drain @ SMF	"	AD250	24.26	-	6092

2.2.3.3 Flood Routing

Flood routing in HEC-1 is used to simulate flood wave movement through the watershed and to simulate reservoir routing. For this study various techniques of routing stream flows or overland flows were utilized. Where applicable, methods of storage routing (for channels) such as Muskingum-Cunge, Modified-Puls and normal depth storage were used. In routing reaches where precise paths of flows were indeterminate, kinematic wave routing was used. While the storage routing techniques will simulate peak discharge attenuation due to storage volume in areas of overbank flows, the kinematic wave method translates an unattenuated flood hydrograph from one point to another over a travel time interval. Rather than overestimate the attenuation based upon highly subjective physical definition of the routing channel, the kinematic wave method was used selectively in areas where flow paths were less definable and flows less concentrated. This approach undoubtably results in a conservative estimate of flow values.

The storage methods of channel routing were used in areas where the streets or swales were primary conveyors of runoff. The Champion Drain swale was a readily applicable reach for storage routing. HEC-2, a stream profiles computer program, was used to

compute a volume-discharge relationship for Modified-Puls input for the Champion Drain.

For any situation the choice of channel routing methods was dependent upon input requirements and what information was available to fit those requirements.

The Modified-Puls reservoir routing technique was used in areas of natural or man-made detention ponding. This level-pool routing was typically accomplished with storage-elevation data. As examples, the South Mountain Park detention area and the new detention basin No. 5 (discussed later) were modeled in HEC-1 using this technique. It was determined that the South Mountain Detention Basin near Central Avenue and Mineral Road is unable to contain the 100-year 24-hour storm event. In this study's analysis the storm runoff volume was calculated to be 740 acre-feet. An analysis performed in 1976 for the City of Phoenix estimated the 100-year runoff volume to be 644 acre feet. The volume of the basin at the spillway elevation was estimated to be 495 acre-feet. As-built plans for the pit were available from the City of Phoenix, but newly acquired 2-foot contour mapping (1990) was considered more accurate for determining volumes and stage-discharge relationships used in this study. The HEC-1 analysis determined a 100-year discharge of 997 cfs which overtops the emergency spillway (elev. 1318.0). A portion of this flow (approximately 104 cfs) is discharging through a 36-inch RCP low flow pipe set 6 to 8 feet above the invert of the basin. This pipe was modeled as being under outlet control, due to the extreme length of the pipe.

2.2.4 Segment III Hydrology

2.2.4.1 General Discussion

Proposed culvert locations (concentration points) were determined from the available mapping and aerial photography through this segment. Drainage sub-basins were then delineated and the area contributing to each concentration point defined. Due to the alluvial fan type terrain through the majority of this segment not all drainage boundaries are well defined and in these situations allowances have been made for the possibility that runoff could break out into an adjacent drainage area. Details on how estimates of flow splits were handled is addressed in Subsection 2.2.4.2.

Normal depth storage routing with assumed representative channel sections has been used through this segment where applicable. Refer to HEC-1 model filenames PRICE3 and PRICE4 in the Technical Appendix. In addition to the HEC-1 modeling, sub-basins with areas of less than 80 acres have been checked for peak discharges using the Rational Method. A comparison of results from the two analysis methods is also contained in the Technical Appendix. Table 2.7 summarizes the contributing subareas and their peak runoff. The locations of these subareas are shown on Map 3 of 5 located in the map packet at the end of this report.

Table 2.7 Summary of Drainage Areas and Discharges - Segment III

D.A. and HEC-1 No.	Model Filename	Drainage Area (sq. mi.)	SCS Curve Number	Flow (cfs) Q50	Q100
SW90AB	PRICE4	0.05	91.5	138	161
SW90C	"	0.07	91.5	205	240
SW90D	"	0.03	91.5	95	111
SW100	"	1.15	88.5	1853	2209
SW110	"	0.09	85	134	162
SW120	"	0.12	85	149	180
SW130	"	0.28	83.1	337	411
SW140A	"	1.94	92.6	3551	4160
SW140B	"	0.22	63.0	78	110
SW150	"	0.39	87.8	605	723
SW160	PRICE3	0.49	89.7	1043	1238
SW170	"	0.97	90.4	1763	2087
SW180	"	0.04	98.0	140	160
SW190	"	0.10	88.8	261	311
SW200	"	0.11	82.0	229	281
SW210	"	0.03	79.5	48	60
SW220	"	0.06	82.8	109	134
SW230	"	0.06	84.7	110	133
SW240	"	0.81	85.9	1339	1616
SW250	"	0.21	70.0	149	197
SW260	"	0.12	72.8	119	155
SW270	"	1.09	90.0	1922	2274
SW280	G50/G100	0.26	-	311	372

2.2.4.2 Development of Design Discharges

Design discharges for the culverts and channels through this area are based on the HEC-1 models included in the Technical Appendix. In areas where detailed mapping was available (51st Ave. to 39th Ave. and 27th Ave. to 19th Ave.) the discharges from the HEC-1 model were modified, if required, to account for flow splits identified within the sub-basin. In general the method used was to calculate the discharge at the split, estimate the percentage diverted by a normal depth analysis of the washes through the split and then determine the design discharge at the culvert. To allow for uncertainties in these design flow estimates, discharges were increased 25-50% at some locations.

2.2.4.2.1 SW90ab, SW90c, SW90d (Culverts C101, C102, C103 respectively)

Design discharges for the sizing of the three culverts in this area are the unadjusted values obtained from the HEC-1 model, filenamed PRICE4. All three sub-basins have an area of less than 80 acres and peak flows have been checked using the Rational Method. Refer to the Technical Appendix for the summary table.

2.2.4.2.2 SW100 (Culverts C104, C105, C106)

Sub-basin SW100 is drained by one significant wash until about 100 ft. upstream of the proposed SMF alignment, where the main channel splits into three separate washes. To match existing flow patterns as closely as possible three culverts are proposed to drain this sub-basin. Cross sections of the wash, through the split area, were plotted from 2' contour mapping, and using a normal depth analysis, the distribution of runoff from SW100 conveyed in each of the three washes was estimated. Results of this analysis are as follows: For the 50-year event, culverts C104, C105 and C106 are designed for 43%, 42% and 15% of the total Q50 = 1853 cfs respectively. For the 100-year event the split is: Culverts C104 and C105, 40% each, and C106, 20% of the total Q100 = 2209 cfs.

These design discharges have not been increased to allow for uncertainties due to the fact that there is significant relief capacity through Ivanhoe Street underpass in addition to the culverts. However, it may be prudent to provide more than 100 percent design capacity in the culverts for the final design.

2.2.4.2.3 SW110 & SW120 (Culverts C107 & C108 respectively)

No significant flow splits were identified within these sub-basins. Design discharges were obtained directly from the HEC-1 model, filenamed PRICE4, without adjustment.

2.2.4.2.4 SW130 (Culverts C109, C110, C111)

Three significant washes were identified as outlets to sub-basin SW130. Culvert C109 is located in the major wash and is sized for the full runoff flow from sub-basin SW130

as per the HEC-1 model, filenamed PRICE4. The design discharges used for sizing culverts C110 & C111 were estimated by using ADOT's **DPM** formula for estimating discharges within a HEC-1 sub-basin. Areas contributing to C110 & C111 were delineated from 2' contour mapping.

2.2.4.2.5 SW140a & SW140b (Culvert C112)

Culvert C112 is sized for the full discharge from combined sub-basins SW140a & SW140b. From inspection of the mapping it can be seen that a portion of flow exiting SW140b does get diverted into SW150 but the alluvial fan in this area is so complex and the drainage pattern so undefined that no reduction in design flows at culvert C112 could be quantified. Design discharges have been obtained from the HEC-1 model, filenamed PRICE4.

2.2.4.2.6 SW150 (Culvert C113 & C114)

As stated in Subsection 2.2.4.2.5 a percentage of flow leaving sub-basin SW140a will be diverted through the alluvial fan and could possibly get to culverts C113 or C114. Culvert C114 has been sized for the full flow from sub-basin SW150 and 25% of the flow from sub-basin SW140a. Culvert C113 has been sized for 50% of the design discharge at C114; this is to allow for the flow split approximately 1000 ft. upstream of the proposed freeway alignment.

2.2.4.2.7 Sub-basins SW160 to SW240 (Culverts C115 to C123)

Drainage sub-basins through this segment have been delineated from USGS quad maps as no detailed mapping was available for this area at the time of this report. All culverts were designed for the discharges obtained directly from the HEC-1 model, filenamed PRICE3, with no adjustment.

Further investigation of this area should be made when more detailed mapping is available, and at that time flow splits could be identified and evaluated.

2.2.4.2.8 SW250 (Culvert C124)

Inspection of the detailed mapping and aerial photographs of the area identified the possibility that significant additional run-off could reach Culvert C124 due to a diversion from the main wash in sub-basin SW240, located approximately 2400 ft. north of the proposed freeway alignment. The discharge at the diversion was estimated using ADOT's **DPM** formula for estimating discharge within a HEC-1 sub-basin and by using a normal depth analysis of wash cross-sections through the split, a percentage flow-split was evaluated. For the design of culvert C124, it was estimated that 50% of the flow entering the diversion in SW240 could possibly enter sub-basin SW250.

NOTE: Culvert C123 has been sized for the full discharge from sub-basin SW240 due to the fact that the percentage split at the diversion identified is judgmental.

2.2.4.2.9 SW260 & SW270 (Culverts C125, C126 respectively)

A diversion from the main wash in sub-basin SW270 into SW260 was identified approximately 3200 ft. north of the proposed freeway alignment. The flow entering the split was estimated using the ADOT **DPM** formula, as previously mentioned, and by employing a normal-depth analysis of cross-sections through the washes in the diversion area. It was estimated that 50% of the flow in the wash at the diversion could break-out into sub-basin SW260 and culvert C125 has been designed to allow for this. Culvert C126 has been designed to convey the total flow from sub-basin SW270.

2.2.4.2.10 SW280 (Culvert C127)

The majority of sub-basin SW280 is part of the Foothills Phase III development, which is covered by a **Master Drainage Report for the Foothills Phase 3** (Revised), 1990. The HEC-1 model, filenamed G, from Foothills Phase III, was expanded to include a small area not part of their study area. The design discharges were obtained directly from the model with no adjustment.

2.2.5 Segment IV Hydrology

2.2.5.1 General Discussion

Hydrology through Segment IV has been investigated and reported upon by various development engineering consultants (refer to reference list). Specifics on where design discharges for freeway culverts and channels have been obtained are detailed in the following subsections. Where existing HEC-1 models were available (Foothills) they were re-run with HDR storm data. Through other developments, design discharges were obtained from master drainage reports and plans.

The only development not covered by a drainage report through this segment is the "Goldman Ranch" property (approximately 0.25 square miles immediately east of 24th Street, between "The Foothills" and "Lakewood" developments) and this area has been modeled by HDR. The model covers the Goldman "onsite" land and further discussion on determination of design discharges for the freeway culvert can be found in Subsection 2.2.5.2.3 of this report.

Table 2.8 Summary of Discharges - Segment IV

HDR Culvert No.	50yr-24hr Design Discharge	100yr-24hr Design Discharge	Consultant Culvert Designation	Consultant 100yr-2hr Discharge	Development Name
C200	338	402	F	387	Foothills Ph III
C201	122	147	E	122	Foothills Ph III
C202	1975	2349	D	2040	Foothills Ph III
C203	1129	1335	C	1231	Foothills Ph III
C204	535	624	B	651	Foothills Ph III
C205	257	300	C8	303	Foothills Ph I&II
C206	297	313	C9	314	Foothills Ph I&II
C207	77	88	C10	96	Foothills Ph I&II
C208	1567	1818	C16	1708	Foothills Ph I&II
C209	49	56	C19	104	Foothills Ph I&II
C210	374	447	C20	379	Foothills Ph I&II
C211	431	521	C21	436	Foothills Ph I&II
C212	598	725	C22	614	Foothills Ph I&II
C213	173	201	C22	614	Foothills Ph I&II
C214*	992	1072	-	-	Goldman Ranch
C215	2200	2500	28th St.	-	Lakewood
C216	244	284	32nd St.	-	Lakewood
C217	770	926	Central Spine	-	Lakewood
C218	1172	1238	40th St.	-	Pecos Rd. PCD

* Modeled by HDR with HEC-1 (filenamed GOLDMAN)

2.2.5.2 Development of Design Discharges

2.2.5.2.1 Foothills Phase III (Culverts C200 to C204)

Hydrologic information throughout this segment of freeway is contained in the **Master Drainage Report for the Foothills Phase 3**, (February 1990). The report contains offsite and onsite drainage area delineations for the development, HEC-1 models for each

outlet location at the Gila River Indian Community (GRIC) boundary, 10-, 25- and 100-year 2-hour peak discharges and the development's proposed drainage system. Detention has been proposed as part of the development to ensure that estimated post development flows leaving the site do not exceed estimated historical flows.

No additional hydrology was done by HDR through this segment except to re-run the existing HEC-1 models with 50-year and 100-year, 24-hour storm data to obtain the required ADOT design discharges.

2.2.5.2.2 Foothills Phase I & II (Culverts C205 to C213)

The hydrology for this segment of SMF was taken from the **Master Drainage Report for the Foothills** (April 1988). The report contains offsite and onsite drainage areas, 10-, 25- and 100-year, 2-hour design discharges at each of the culvert locations and the proposed master drainage system. HEC-1 models were supplied by the Engineer and were re-run to obtain 50-year and 100-year, 24-hour peak discharges for sizing of culverts.

2.2.5.2.3 Goldman Ranch (Culvert C214)

No master drainage report was available for the Goldman property as a whole. Information for offsite hydrology has been gathered from "Mountain Park Ranch" and "Lakewood" reports and **The Channelization of Offsite Flows on Goldman Ranch** (1989). Goldman 'Onsite' (i.e. Goldman property) has been modeled as part of this report and hydrology is based on historic natural desert land use. This was considered conservative as post development peaks should not exceed historical flows. Refer to the Technical Appendix for HEC-1 model, filenamed GOLDMAN and subarea parameter sheets. In addition to runoff from the Goldman property, an additional flow of 600 cfs from Mountain Park Ranch West watershed is included in the design discharge for Culvert C214. The diversion historically entered the site near the northeast corner of the property but has now been moved south to approximately 250 feet north of the freeway alignment at 28th Street. Design discharges for culvert design were developed by adding the 600 cfs directly to the peaks from the HEC-1 model.

2.2.5.2.4 Lakewood (Culverts C215, C216, C217)

The upstream drainage system for these three culverts is existing and complete and the hydrology for these watersheds is contained in three reports: **Phase IV Flood Control Facilities, Western Watershed Mountain Park Ranch Development** (1985), **Master Drainage Report - Lakewood** (1985), **Lakewood Phase II Update** (1985). The 50 year and 100 year, 24 hour design flows used were taken directly from the respective drainage reports and no additional hydrology was done by HDR.

2.2.5.2.5 Pecos Road PCD (Culvert C218)

Information for the design of this culvert has been obtained from **Master Drainage Report for Pecos Road PCD** (1985). The report uses 50-year and 100-year, 24-hour storms for the hydrological analyses and drainage design. The resulting peak flows were used directly by HDR for sizing Culvert C218.

2.2.6 Segment V Hydrology

The areas to the west of I-10 that contribute to Segment V of SMF were analyzed in a single HEC-1 model, filenamed PRICE5, contained in the Technical Appendix. No master drainage report or plan for this area as a whole exists at present, although portions of the watershed have been addressed in various drainage reports as part of residential developments. The most recent and comprehensive report on this is the **48th Street and Chandler Boulevard Master Drainage Report**, (July 1991), which covers approximately the northwest half of the watershed for Segment V.

This report contains a TR-20 model and the input parameters (CN's and times of concentration) were duplicated in HDR's model. Information for flood routing was obtained from site visits, photographs and mapping. Areas not covered by this report were added to the model by HDR. Input parameters for HDR's model have been obtained from the USGS quad maps supplemented with available development plans, and as a result of this, detailed information required for evaluation and quantification of flow paths and splits was not always available. The City of Phoenix has plans to prepare an Area Drainage Master Study (ADMS) for the entire watershed. Results of that study and its recommendations should be integrated into the SMF off-site drainage plan.

A separate HEC-1 model, filenamed SPUMP100, was assembled for the on-site analysis in the proposed SMF/I-10 Maricopa Traffic Interchange. Further discussion of that analysis will follow in subsequent sections. Resulting hydrographs from this model were input manually (QI data in HEC-1) to the model discussed in the previous paragraph. All of the runoff from the west side of I-10 and in the SMF/I-10 TI itself discharges at the same location, Detention Basin No. 15, before ultimately outfalling to the Gila Floodway via a proposed discharge line. Table 2.8 contains a summary of discharges for the major design concentration points for Segment V's off-site drainage system.

Areas on the east side of I-10 Maricopa and west of 56th Street were modeled under the separate Price/Santan hydrology study. That HEC-1 analysis, filename GILADRY.DAT, is found in the Price/Santan report.

Table 2.9 Summary of Discharges - Segment V

Location	Model Filename	HEC-1 I.D. No.	Drainage Area (sq. mi.)	Flow (cfs) Q50	Q100
SMF @ 48th Street	PRICE5	AD519B	3.92	1347	1995
Basin 15 (inflow)	"	ADPMP	4.08	-	2006
Basin 15 (outflow)	"	DET	4.08	-	111
Gila Drain @ Maricopa Road	GILADRY.DAT	CGILAB	30.86	-	1750
56th Street	"	SECT32	0.33	-	130

See Table 3.2 for summary of interchange detention cell discharges.

2.3 Offsite Systems

2.3.1 Design Criteria and Methodology

Design criteria related to hydrologic design is found in current editions of ADOT's Urban Highways **Design Procedures Manual (DPM)**. Off-site hydrology for the South Mountain Freeway has been primarily performed using the HEC-1 computer program and typically, the 50-year and 100-year storms were the frequencies analyzed. Due to the extensive use of storm water detention and interceptor flood channels a considerable portion of the drainage facilities are designed for the 100-year storm criteria. The HEC-1 analyses and related data are contained in the separate appendices.

2.3.1.1 Culverts

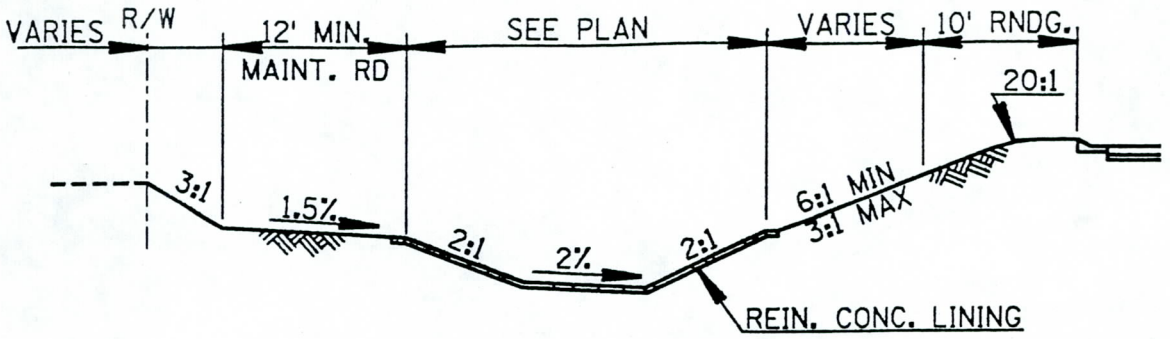
Culverts have been designed to comply with the ADOT **DPM** (1990). The design has been based on 50-year and 100-year, 24-hour duration peak discharges. HY-8 Culvert Analysis Version 2.0 computer software was used for culvert design calculations in this report. The software package utilizes the design methods described in **HDS No. 5 Hydraulic Design of Highway Culverts** (September 1985), FHWA-IP-85-15. Headwater elevations were calculated assuming zero inlet velocity head given that the incoming flow approaches generally at right angles to the culvert and often from two opposing directions. The maximum allowable headwater criteria is that the 50-year headwater elevation not exceed two feet below the lowest pavement elevation and that the 100-year check flood not increase flood damage potential outside of ADOT right-of-way. A 6-foot minimum barrel height was applied for all box culverts as requested by ADOT. HY-8 culvert design summary sheets are included in the respective Technical Appendices.

2.3.1.2 Collector Channels

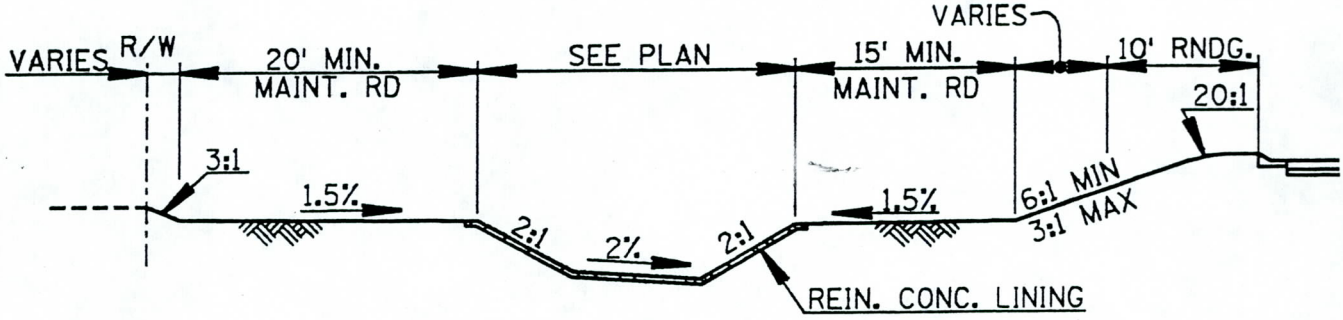
Throughout all of the segments collector channels have been proposed as a means of intercepting off-site flows reaching the freeway alignment. The flow paths of off-site runoff were often difficult to discern and quantifying flow splits among numerous flow paths was additionally difficult. Developmental changes such as street improvements and burial of irrigation facilities could also alter the distribution of surface runoff as time passes. The use of open channels, particularly in agricultural or non-developed areas, offers some flexibility as to where runoff can enter the system and how it can enter. In mountainous areas, as in Segments III and IV, flow paths are distinct and cross culverts were more frequently proposed, but collector channels were still applied as a measure against slope erosion and as a means of draining isolated pockets created by the freeway. Also, unless right-of-way costs were unusually high, lined open channels were generally determined to be less expensive than buried conduit.

The **DPM** contains extensive guidelines for design of flood channels (those conveying more than 100 cfs) for 100-year design discharge. Throughout the SMF, the concept plans call for concrete-lining, 2:1 sideslopes, minimum 8-foot bottom width and minimum 0.1% longitudinal slope. The depth of lining was not less than 3 feet and nearly all of the channels are at least 4 feet deep. None of the channels were proposed to be constructed within a 30-foot roadway recovery zone, as illustrated in ADOT Std. C-03.20. In segments of freeway embankment, the channel was generally placed at the toe of a 3:1 or 4:1 embankment slope. For maintenance purposes, the **DPM** proposes a 20-foot strip on each side. This criteria was not always met, particularly in those areas where right-of-way could be costly or difficult to acquire. As a minimum, a 12-foot maintenance road was provided for on the outside, or right-of-way side, of the channel. Guidelines for the configuration of a channel in relation to the embankment slope, maintenance road, or right-of-way limits are not standardized, therefore the designer will have some latitude in their design. Typical sections are shown in Figure I.3. Generally, conservative right-of-way limits were set for this stage of design.

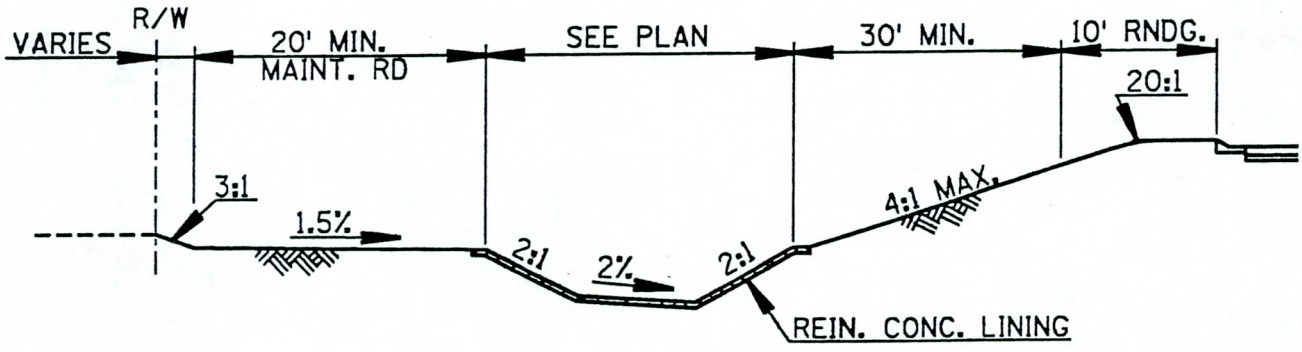
The channels were sized using a computer program, Haestad Methods' **Flowmaster Open Channel Flow Module**, that calculates normal depth flow characteristics and those calculations are included in the respective Technical Appendices. A minimum one foot of freeboard was allowed and capacity for 120% of the design flow was also checked. Culverts that lie in the collector channel system were generally sized to not unduly increase the water surface profile upstream of the structure beyond the channel criteria limits. However, for economy there may be occasional short stretches of channel lining where the lining height should be increased a foot or so, in order to contain a higher than normal flow depth induced by culvert hydraulic losses. A HEC-2 analysis, filenamed SALTZ.DAT, was performed as a check on the lengthy channel reach and numerous crossings encountered in Segment II.



SEGMENT I TYPICAL CHANNEL SECTION



SEGMENT II AND IV TYPICAL CHANNEL SECTION



SEGMENT III TYPICAL CHANNEL SECTION

CONTRACT 88-24 SOUTH MOUNTAIN FREEWAY GENERAL CONSULTANT TRACS NO. H-2222-01D	CONCEPT DRAINAGE REPORT FIGURE 1.3 TYPICAL CHANNEL SECTIONS	HDR HDR Engineering, Inc.

2.3.1.3 Detention Basins and Spreader Basins

Detention basins have been provided for attenuation of both onsite and offsite peak discharges. Basins are sized based upon 100-year 24-hour hydrographs and have been coded within the HEC-1 models. Criteria for the layout of detention basins is contained in the ADOT **DPM** (1990) and a minimum freeboard of 4 feet (a desired, but not standard ADOT criteria) was applied to the 100-year water surface elevation, where practical. It was often difficult to provide an added 4 feet of depth to a shallow basin which is proposed to be gravity drained, but 2 feet of that may be above ground. Salt River Project design guidelines for the spreader basins are contained in the Segment IV Section of the Technical Appendix.

2.3.1.4 Culvert Outlet Protection

Culvert outlet protection requirements have been evaluated at a preliminary level as part of this report. Specific details, such as type of protection and extent and size of rip-rap, are considered part of the final design and are not included as part of this report or in the General Plans. Guidelines for determining the appropriate outlet protection to be used is contained in ADOT Structures Section **Drainage Manual Volume 1 - Policy** (1987), and is summarized as follows:

Ratio of Outlet Velocity to Natural Stream Velocity:	Type of Protection
less than 1.5	No protection required
1.5 to 2.0 with outlet velocity less than 10 fps	Dumped rock riprap
1.5 to 2.5 with outlet velocity between 10 and 15 fps	Wire tied rock riprap
Greater than 2.5 or outlet velocity greater than 15 fps	Energy Dissipator

Outlet protection requirements for Segments III & IV are summarized in Subsection 2.3.4.2 and 2.3.5.6 respectively.

2.3.2 Segment I - I-10 Papago to the Salt River (Off-Site System)

The Segment I section of the South Mountain Freeway is entirely upon embankment. This causes storm water runoff to be either impounded or to flow along the toe of the east embankment. It is proposed to provide an interceptor channel to collect the 100-year runoff and

convey it south to the Salt River. Runoff collected north of Van Buren Street is proposed to be significantly attenuated by detention storage (Basin No. 3) to a 100-yr. outflow rate of 9 cfs. The 10-year design outflow rate would be 6 cfs. A connection to a City of Phoenix storm drain (48-inch) is desired in order to bleed off this detention basin. This proposed connection to the storm drain has been submitted for approval to the C.O.P. The 1988 **Southwest Loop Highway (S.R. 218) Drainage Design Concept Report** states that this 48-inch storm drain was installed between 51st Avenue and 59th Avenue to pick up runoff from between I-10 and Van Buren Street. The primary advantage to this connection is the avoidance of utility conflicts within Van Buren Street and avoidance of a rather wide, deep irrigation ditch running along the south side of Van Buren Street. In the event of emergency overflow from Basin No. 3, excess flow will be directed into Van Buren Street, which is basically the existing flow path for flood events.

From Van Buren Street south to the RID Canal cumulative drainage areas add peak runoff to the interceptor channel which empties into another proposed detention area (Basin No. 4), located above the RID Canal. The 100-year volume of runoff contributing to this basin is rather large at 92 acre-feet. This basin is restricted in capacity to the most volume that can be graded within the confines of specific property takings. The result is a 548 cfs attenuation to 372 cfs, enough to result in cost savings downstream. The basin is located on land for which future access is a problem. The basin would be drained by a three 60-inch RCP inverted "siphon" structure beneath the RID Canal. In the event of emergency overflow from Basin No. 4, excess flow will enter the RID Canal which borders the south end of the basin.

Continuing downstream there would be additional structure crossings at 59th Avenue, Lower Buckeye Road and Broadway Road. The concrete-lined collector channel would be trapezoidal with an 8 to 10 foot bottom width and flow depths from 3 to 4 feet. A 12'X9' RCB is proposed for the RID Canal conveyance beneath the SMF. The size and type of structure was based upon normal operating depth data (not bank full) contained in a recent canal study, see Ref. 10, and current cross-sectional survey data from the site. Calculation sheets for the sizings of both channels and structures are included in the Technical Appendix.

A wedge-shaped drainage area (No. 109) on the west side of the freeway between Buckeye Road and the RID Canal will be drained across the mainline with a proposed 36-inch RCP. This cross culvert should be designed for a 50-year design flow (52 cfs).

2.3.3 Segment II - Salt River to 51st Avenue (Off-Site System)

2.3.3.1 Collector Channel

A concrete lined channel is proposed along the upstream side of Segment II's freeway alignment, beginning approximately 1000 feet southeast of 51st Avenue and continuing north to its outfall to the Salt River. This channel will collect off-site flows (with the exception of flow potentially escaping through the Estrella Drive underpass, see Subsection 1.2.2) and any on-site runoff.

The channel will cross under major streets in box culverts which should be designed to pass 100-year channel design flows. The channel empties into a proposed detention basin (No. 5) north of Elliot Road and emerges from the basin continuing north where it will ultimately cross under the freeway alignment near Sta. 419+00. Downstream of the culvert is a short section of open channel before the channel discharges into a long inverted siphon box culvert structure which crosses beneath the Champion Drain tailwater ditch and Baseline Road. The use of the inverted siphon was necessary in order to not disrupt the Champion Drain (Maricopa Drain) waterway and to avoid introducing Champion Drain flows into the ADOT system. Also the shallowness (distance from flowline to existing ground) of the proposed downstream channel makes it difficult to grade a cross culvert of any practical height under Baseline Road. From Baseline Road the channel continues north along the west side of the alignment, crossing under Southern Avenue, then west along the north side of Southern Avenue to 67th Avenue, then north to the Salt River. A HEC-2 run, filenamed SALT2.DAT, models the entire channel system. This drainage scheme represents a selected alternative which is discussed in section 2.3.3.3.

The proposed channel slopes are necessarily very mild, influenced by three factors: 1) the shallow natural fall of the land; 2) a 10-year frequency tailwater elevation of 989.0 (Salt River) is a controlling constraint on channel hydraulics and; 3) a high groundwater table present in the proximity of the channel alignment near Baseline Road.

USGS groundwater level maps (1983) indicate a groundwater elevation of 990 at 59th Avenue and Baseline Road. This would indicate a depth to water of 10 to 12 feet from the surface. A local farmer interviewed by HDR in 1986 verified this information, stating that during a recent excavation at 59th Avenue and Baseline Road, water was observed at 12 feet, and at 67th Avenue and Baseline Road it was at 11 feet. Although ground water levels across the valley are in general decline, it seems probable that, given the proximity to the Salt River, levels in this area may still be near the surface.

2.3.3.2 Basin No. 5 (Between the Salt River and 51st Avenue)

In previous reports to ADOT, the drainage concepts had proposed a series of detention basins paralleling the Segment II freeway alignment on the east side. These basins would attenuate high peak runoff flows from drainage subareas covering mountainous portions at the west end of South Mountain Park. Upon further analysis of the hydrologic model and experimentation with different scenarios, only one detention area is now recommended. Basin No. 5, a long narrow basin running north from Elliot Road, reduces the 100-year peak flow from 2380 cfs to 1151 cfs, thus substantially decreasing the size of downstream channels. Model testing showed that basins located further upstream were economically unjustified because their delayed outflow peaks (from the quickly peaking mountainous subareas) aligned closely in time with the peak discharges of slower peaking downstream areas. The benefit derived from detention storage was thus largely offset by the later peaking times of hydrographs adding in downstream.

Testing also showed that basins located downstream of Basin No. 5 were not economically justified because Basin No.5 already controlled most of the drainage area and produced a relatively flat outflow hydrograph which, if routed through another basin, would have required an inordinate amount of storage and surface area in order to produce significant peak flow reduction. The results of this evaluation leave the concept plan with slightly larger channels, but reduce overall construction and land costs. Emergency overflows from Basin No. 5 can be directed into the mainline sump at Dobbins Road.

2.3.3.3 Outlet Alternatives at Champion Drain

As part of the scope of this study, HDR was to develop Champion Drain crossing alternatives where the freeway alignment intersects the Champion Drain waterway. The freeway impacts the location in two ways; 1) the roadway embankment is concentrating runoff with flows being diverted northward along the alignment; and 2) the roadway crossing of the Champion Drain potentially increases flooding depths by acting as a constriction to the floodwaters. The 1988 drainage concept report recommended cooperative funding to improve the Champion Drain ditch through the freeway to the Salt River along the drain's current alignment. Champion Drain improvement was one of the concepts evaluated in this study, but the idea of cooperative funding is not a viable option at this time as the Flood Control District of Maricopa County has not indicated a plan to upgrade the Champion Drain.

Three alternatives were developed and are summarized in the following paragraphs. They are all based upon the premise that ADOT would be acting unilaterally in its handling of all flood-waters at the Champion Drain location. The costs of each of the three alternatives should be used for comparison purposes only. Actual total costs may be higher or lower and are dependent upon land costs, inflation and other undetermined design factors.

The first alternative is a combination of a detention basin to intercept all flow converging at the freeway and Baseline Road with a new outfall channel constructed northward to Southern Avenue, west to 67th Avenue, then discharged to the Salt River. The detention basin would be located directly in the Champion Drain floodplain and its size would dictate the outfall channel's size. There are many problems associated with this alternative including a shallow groundwater table, prohibitive land costs and conflicts with local roadways; 59th Avenue and Baseline Road must pass through the basin. Cost: $18,000,000. Not recommended.

The second alternative is to construct a smaller detention cell south (or upstream) of Baseline Road, on the east side of the freeway. This basin would further attenuate the peak flow from the south before discharging the flow into an inverted siphon beneath Champion Drain and Baseline Road. The siphon would discharge into a lined channel section leading north to the Salt River, as described in the first alternative. The separate Champion Drain floodwaters would pass unobstructed through an enlarged bridge

opening at the freeway overpass of Baseline Road. The key concept in this alternative is to handle only the diverted flows from the south. The Champion Drain flows, which naturally traverse this section of the proposed roadway, would not be significantly affected. The major drawback associated with this alternative is the enlarged bridge structures required to avoid an adverse floodplain encroachment. Cost: $13,000,000. Recommended. (Subsequent analysis has shown that it is more economical to upsize the siphon and downstream channel rather than provide a detention basin).

The third alternative is to combine flows both from the south and from the Champion Drain watershed and channelize them either in a northerly route, similar to the two preceding alternatives or a westerly route, basically along the existing drain alignment. The westerly route is considered to be more expensive since it is longer and the gradient is slightly flatter. The major drawback to this alternative is the channel width requirement (approximate 200' bottom width) which would be both costly to construct and maintain, and aesthetically displeasing. Cost: $13,000,000. Not recommended.

Rough sketches and cost estimates of the three alternatives were presented to ADOT prior to this report and are included in the Technical Appendix. Alternative No. 2 is presented on the drainage concept plans. The chosen Alternative No. 2 will have a significant effect on the Baseline Road Interchange. To implement the chosen concept of passing the Champion Drain (Maricopa Drain) flows with minimal obstruction, adequate conveyance across the ramps and under the mainline had to be provided to ensure that no significant increase in upstream water surface elevations or velocities resulted. This produced a mainline structure of approximately 1550 ft. (950 ft. north of Baseline Road and 600 ft. to the south), short structures on Ramps A and B, and ramp profiles that will be overtopped in the 100-year event and may be impassable for a few hours. (This was not considered a major problem as access to South Mountain Freeway is available one mile north, and one mile south, at Southern & Dobbins respectively). The Baseline Road profile has been set at an elevation which will keep one lane in each direction open during the 100-year flood event.

2.3.4 Segment III - 51st Avenue to 19th Avenue (Off-Site System)

2.3.4.1 Cross-Drainage Design

The underlying concept to the drainage design through Segment III was to simulate existing downstream flow patterns by outletting runoff flows in a similar manner in which they reached the South Mountain Freeway alignment. This was achieved by:

(1) Cross-culverts with level spreader basins at locations where the implementation of 0these structures is practical.

(2) In areas where level spreader basins were impractical or the sheet outflow from the level spreader did not match the existing flow pattern (i.e. areas with more defined

washes) a culvert was located in each major wash. Suitable outlet erosion protection for these culverts will be required. Refer to Subsection 2.3.4.2.

Concrete-lined collector channels are proposed along the upstream side of the freeway alignment throughout this entire segment. The design calculations for these channels are contained in the Technical Appendix.

The major departure made from the **Southwest Loop Highway (SR218) Drainage Design Concept Report** (1988) is the addition of more cross culverts and the reduction in number of the level spreaders. The level spreaders were removed because the slope of the ground along the Gila River Indian Community boundary would not enable them to function as conceived, and because the addition of more culverts with suitable outlet structures would more closely match the existing flow patterns. The recent availability of detailed mapping through this area enabled the identification of the required locations of these additional culverts. In addition to the removal of level spreaders, three culverts (C101, C102, C103) have been added at the western end of this segment to drain an area which was part of the Segment II system in the HDR 1988 Concept report. This change was made to reduce the amount of stormwater being conveyed to the north.

2.3.4.2 Outlet Protection

Table 2.10 is a summary of culvert locations in Segment III which require further evaluation and investigation during final design to determine suitable outlet protection measures.

Table 2.10 Segment III Outlet Protection Summary

Culvert No.	Discharge (cfs) Q50	Outlet Velocity (fps) V50	Outlet Protection Required
C101	138	24.9	yes
C102	205	15.6	"
C103	95	17.0	"
C104	797	10.8	"
C105	778	10.8	"
C106	278	9.6	"
C107	134	9.3	"
C108	149	10.2	"
C109	337	9.7	"

C110	128	11.8	yes
C111	140	11.4	"
C112	3116	12.9	"
C113	747	12.8	"
C114	1493	10.6	"
C115	1043	12.8	Level Spreader
C116	1763	10.4	yes
C117	140	9.2	"
C118	261	7.7	Level Spreader
C119	229	3.2	"
C120	48	3.7	"
C121	109	7.6	"
C122	110	7.6	"
C123	1339	8.9	"
C124	556	7.6	yes
C125	1014	9.3	"
C126	1922	10.7	"
C127	311	10.8	"

2.3.5 Segment IV - 19th Avenue to 40th Street (Off-Site System)

2.3.5.1 Culverts C200 to C204 (Foothills Phase III)

Freeway cross culverts have been designed to pass 50-year, 24-hour peak flows and checked for the 100-year, 24-hour peak flow as per ADOT **DPM** (1990). In addition to this criteria all culverts were checked for the 100-year, 2-hour peak flows specified in the Foothills Phase III report. Culverts have been located to match proposed drainage improvements exiting the development, and discharge into relatively defined washes. Level spreaders are not proposed for these culverts and outlet protection will be required. Refer to Subsection 2.3.5.6 for outlet protection summary.

2.3.5.2 Culverts C205 to C213 (Foothills Phase I & II)

Culverts through this section of SMF have been sized for 50-year and 100-year peak discharges as per ADOT criteria. In addition culverts were checked for the 100-year, 2-hour peak discharges as per the Foothills Phase I & II report and to ensure that proposed headwater elevations would not negatively impact existing culverts at Liberty Lane. The positions of freeway culverts are generally the same as proposed culverts under Pecos Road with the exception of Culverts C212 and C213 which replace proposed Pecos Road Culvert C22. Two culverts are proposed for this drainage area because of insufficient right-of-way to relocate the proposed channel as per the Foothills plan. Level spreaders will be used at Culverts C210 to C213 in keeping with concepts set forward in the Foothills Master Drainage Plan. Refer to General Plan sheets for level spreader details at these locations. Other culverts in this area will require outlet protection. Refer to Subsection 2.3.5.6.

2.3.5.3 Culvert C214 (Goldman Ranch)

One culvert is proposed to drain the Goldman Ranch area (24th St. to 28th St.) and will discharge into an existing wash approximately 700 ft. east of 24th Street. A level spreader is proposed at the culvert outlet to match existing flow patterns as closely as possible.

At the time of writing this report, the site has been partially developed. A diversion structure from the 28th Street channel has been constructed approximately 250 ft. north of the freeway alignment at 28th Street. The existing channel from the diversion, to approximately 700 ft. east of 24th Street, is located in conflict with the freeway alignment and will be relocated to the north as part of the freeway General Plan.

It is recommended that, if at the time of final design drainage improvements have been completed within the Goldman property, a re-evaluation of the freeway drainage design should be performed to ensure compatibility with the development's drainage system.

2.3.5.4 Culverts C215, C216, C217 (Lakewood)

At all three locations there are existing culverts under Pecos Road; these will be removed and replaced by the proposed freeway culverts. The proposed culverts have been sized for the 50-year and 100-year, 24-hour peak flows as per the ADOT **DPM** criteria and in addition, headwater elevations were checked to ensure that they will not exceed existing culvert and channel water surface elevations. At present the existing culverts discharge into level spreaders within the SRP easement adjacent to the freeway. HDR proposes to perpetuate the system by outletting the proposed freeway culverts to the same spreader basins.

2.3.5.5 Culvert C218 (Pecos Road PCD)

Culvert C218 is located approximately 600 ft. east of 40th Street and will be connected to the existing 40th St. channel. The major drainage facilities within the Pecos Road PCD are mostly in place and at present a portion of an existing detention basin/level spreader is located within the freeway corridor. The existing level spreader/detention cell will remain and be enlarged to the south to replace lost volume due to freeway encroachment.

2.3.5.6 Outlet Protection

Table 2.10 is a summary of culvert locations in Segment IV which require further evaluation and investigation during final design to determine suitable outlet protection measures.

Table 2.11 Segment IV Outlet Protection Summary

Culvert No.	Discharge (cfs) Q50	Outlet Velocity (fps) V50	Outlet Protection Required
C200	338	10.3	yes
C201	122	8.0	"
C202	1975	11.6	"
C203	1129	8.6	"
C204	535	10.5	"
C205	257	13.8	"
C206	297	10.6	"
C207	77	8.0	"
C208	1567	11.9	"
C209	49	10.5	"
C210	374	8.3	Level Spreader
C211	431	2.2	"
C212	598	-	"
C213	173	3.6	"
C214	992	8.3	"

C215	2200	8.9	Level Spreader
C216	244	4.3	"
C217	770	-	"
C218	1172	9.8	"

2.3.6 Segment V - 40th Street to I-10 Maricopa (Off-Site System)

2.3.6.1 40th Street to the SMF/I-10 Maricopa Interchange

Collector channels are proposed along the north side of SMF west of 48th Street and on the north side of Ramp N-W and S-W east of 48th Street. A drop inlet box culvert under the depressed SMF profile, approximately 300 feet west of 48th Street, will convey the 100 year design flow into Basin No. 15 (approximately 300 acre-feet) south and west of the interchange. A 54-inch diameter outlet pipe will drain the basin at a peak rate of approximately 100 cfs into the proposed Gila Floodway.

An emergency overflow weir can be provided on the southeast boundary of Basin No. 15, which would allow excess flow to sheetflow out onto the underdeveloped natural terrain and resume a natural flow path.

2.3.6.2 SMF/I-10 Maricopa Interchange to 56th Street

The off-site drainage area contributing to the freeway lies in the northeast quarter of Section 32. I-10 is a barrier to flow coming from the west, leaving a small drainage area sloping southeast toward the interchange facilities, specifically Ramp W-N. The proposed plan is to place a collector channel along the toe of the ramp slope beginning at Frye Road and 54th Street and continuing it east to join the Santan Collector Channel at 56th Street. The maximum design 100-year flow is 130 cfs and a concrete-lined channel with 8-foot bottom width and 3-foot lining depth is proposed.

This section of channel, from Frye to 56th Street, may also serve to collect SRP irrigation tailwater currently collecting in three existing north-south ditches which are adjacent to I-10, 54th Street and 56th Street. The ditch running parallel to I-10 will require relocation. This plan is subject to approval by SRP, but if approved, eliminates dual facilities and freeway crossings for irrigation water which is now discharged into the Gila Drain, the same proposed outfall for the collected storm water.

SECTION 3.0
ON-SITE DRAINAGE

3.1 Hydrology

The on-site pavement drainage design requirement is 50-year frequency for depressed roadway sections. Median drainage is 50-year design for depressed or non-depressed sections. The Rational Method was applied for all on-site drainage. The Rational Method was developed for use in small urban areas, and the **Design Procedures Manual (DPM)** recommends use be limited to watersheds of 80 acres or less. The Rational Method requires three types of data for peak discharge computation. They are the runoff coefficient (C) which represents the ratio of runoff to rainfall; the rainfall intensity (I) which is the intensity of rainfall, in inches per hour, for a storm duration equal to the time of concentration and; the drainage area (A) in acres. For the on-site analysis three principal values of C were applied as recommended in the DPM:

Paved Surfaces	0.95
Highway Slopes 3:1	0.70
Highway Slopes 5:1	0.60

A runoff coefficient value of 0.60 should be applied for roadway median surfaces. Where the freeway is depressed, as at Dobbins Road in Segment II, the median was conservatively assumed paved, in anticipation of ultimate pavement widening.

The rainfall was determined using the standard ADOT method. A one-hour precipitation depth was derived from precipitation maps in the ADOT hydrology manual, **Hydrologic Design for Highway Drainage in Arizona** (1969). These values are given in Tables 2.2 through 2.4. Using the appropriate value, intensity values were selected by entering the Rainfall Intensity Curves (**DPM**, Fig. 3.7-1) for a storm duration equal to the drainage area's time of concentration. Due to the typically small drainage area size and the short runoff response time, the estimated time of concentration rarely exceeded the minimum recommended value of 10 minutes for any individual subarea.

The conceptual design of on-site drainage systems was performed using guidelines from the ADOT's **DPM**. The depressed roadway criteria was applied to the depressed sections of the South Mountain Freeway found in Segments II and V.

3.2 On-Site Systems

3.2.1 Segment I On-Site

3.2.1.1 I-10 Existing System

The existing I-10 Papago Freeway, within the project limits from 43rd Avenue to 67th Avenue, is depressed and has an extensive on-site storm drain system. Each of the crossroads, 43rd, 51st, 59th and 67th Avenues, has an on-site pump station which lifts collected runoff into the adjacent I-10 Papago Channel. Drainage calculations for this system (constructed in the mid 1980s) were not reviewed as part of this study. The existing system is presumed to function adequately. An effort has been made to minimize any increase of runoff or of contributing area to the depressed mainline.

Extensive modifications to the on-site system will be required, such as the relocation of catch basins to new curb locations and the replacement or relocation of storm drain lines to the outside of new pavement. A minimum 24-inch pipe size is advised for any replacement work. Otherwise, in-kind replacements are generally advised. The drainage concept plans will show the existing pipe network and new pipes, manholes, catch basins, etc., in conjunction with proposed action codes which suggest what structural modifications may be necessary.

3.2.1.2 Interchange Drainage

The addition of directional ramps will create infield drainage areas from which runoff must be collected and drained. These areas could either be drained to the I-10 mainline system or to the SMF off-site collector system, discussed later. The proposed plan is to drain the interchange areas to the new off-site collector system, in order to not overtax the I-10 Papago System. Two small detention basins (100-year design) within the interchange are proposed to substantially reduce the peak discharge from the interchange area. These areas are to be used to receive as much directional ramp pavement drainage as can be directed into them. While physically separated, the two cells were modeled as one cell for purposes of HEC-1 storage routing. It is intended that they be connected by an equalization pipe rather than by a controlled outlet structure from the upper cell. The attenuated peak discharge will outfall to a minor ditch (less than 100 cfs) paralleling Ramp N-E. In the event of basin emergency overflow, excess flow is directed into the South Collector Road, where it drains into the I-10 mainline system.

3.2.1.3 Mainline Drainage

The SMF mainline pavement is on embankment and, per the **DPM**, the pavement drainage design frequency is 10-year where curb is in place. Where the embankment height exceeds 16 feet, which is most of the alignment, an ADOT Type "C" curb (3-inch high) is required. This curb will not contain much flow and flows in excess of the 10-

year event will overtop the curb and sheet down the embankment slope. Flows overtopping the west curb in this way will be allowed to flow freely away overland in much the same fashion as they would without the freeway present. Flows captured by inlets in the west curb line, median inlets and east curb inlets will be discharged into the proposed collector channel. Flows overtopping the east curb line will sheet down the embankment directly into the collector channel.

3.2.2 Segment II On-Site

A portion of the north-south leg of South Mountain Freeway, extending from Station 424+00 to Station 479+00 is depressed as it passes beneath Dobbins Road. The 50-year design storm drain system proposed as shown in the concept plans is controlled vertically by the shallow gradients, a low point in the Dobbins Road sag curve and limited points of outfall. The system discharges into the adjacent channel. Dual pipes were used in order to remain below allowable hydraulic grade line limits and to maintain a flowline gradient which would allow gravity discharge into the channel.

The main trunk line is shown on the plans. Inlets and pipe lateral locations were not determined and are considered part of the detailed design. An allowance for those items was included in the cost estimate (Section 5.0) as a lump sum value. Hydrologic and hydraulic calculations related to the system are located in the Technical Appendix.

3.2.3 Segment III and IV On-Site

Most of the mainline pavement is on embankment through Segments III and IV, from 51st Avenue to 40th Street. There are a few stretches of rock cut at the southwest end of South Mountain Park and several locations between 19th Avenue and 7th Street, where a special roadway template is employed. A broad, shallow swale is created behind the shoulder as a buffer against falling rocks. This swale also collects runoff from the uncurbed pavement.

Where there is roadway embankment with side slopes greater than 5:1 (generally true in this segment) a Type "C" curb (3-inch high) is installed and a 10-year design criteria is applicable. This curb will not contain much flow, but catch basins placed in these curb lines can be either down drained into the north side collector ditches or into natural washes on the south side. Median drainage (50-year design frequency) should be drained to the north side collector ditches or if possible, connected directly to cross culverts. Flows exceeding the 10-year design are not intercepted and will overtop the top of curb, sheeting down the embankment slopes.

3.2.4 Segment V On-Site

3.2.4.1 I-10 Maricopa Mainline System (North Section)

The proposed new profile of existing I-10 and the addition of directional ramps extended as far north as Chandler Blvd. generally disrupts the existing I-10 drainage system in that

area. According to as-built drawings the Chandler Blvd. (formerly Williams Field Road) interchange is drained at two locations into an SRP irrigation lateral running south along the east side of I-10, to an ultimate outfall at the Gila Drain. This is one of the SRP laterals mentioned in Subsection 2.3.6.2 and it will require relocation due to roadway improvements. Field examination of this system, particularly the portion north of Chandler Blvd., indicates that some of the existing culverts and storm drains may not be fully functional due to poor maintenance.

Therefore, a new drainage system, to be installed at the Chandler Blvd. interchange, is proposed for four reasons. 1) the existing system does not appear to function effectively; 2) the existing system may be overloaded due to increased on-site drainage area; 3) the outfall is an irrigation facility, which is undesirable; and 4) a new outfall is available as part of the proposed off-site drainage plan. A series of interconnected area catch basins, collecting mainline flow and runoff from areas between ramps, will convey 50-year runoff south to a point on the west side of I-10 (approximate Station 840+00) where the collected runoff can be discharged into a proposed off-site drainage channel. This channel, which is also collecting 100-year off-site flow from areas northwest of the SMF/I-10 Maricopa interchange, continues south beneath the South Mountain Freeway via box culvert to a proposed detention area (No. 15).

In addition, a storm drain is proposed at I-10 Station 851+00, which will also collect mainline runoff and runoff from areas between new ramps. This system, running west to east beneath I-10, will intercept surface flows from the north (not captured by the system described in the previous paragraph) before these flows can enter the depressed SMF roadway. This system will discharge into a detention cell located in a NE quadrant infield area.

3.2.4.2 South Mountain Freeway Storm Drain at I-10 Maricopa

A depressed section of SMF roadway, extending from Station 1222+00 to Station 1283+00, is proposed to be drained by a storm drain system culminating at a sag point at Station 1268+05. A concept layout is shown on the general plan. From that location the total runoff (257 cfs, 50 year-24 hour storm) is conveyed southwesterly in an oversized conduit. A 96-inch pipe is proposed which will provide a small amount of buffer storage, 54,000 cubic feet, to enable the pump station to operate at an attenuated 200 cfs maximum. The pump station would discharge into the off-site Detention Basin No. 15, located in the southwest quadrant of the interchange. The pump station is positioned away from the sag point and closer to the detention area in order to provide easier and safer maintenance access.

Calculations, including a sewer calculation spreadsheet and a HEC-1 run, are provided in the Technical Appendix. Manhole losses were computed using formulae from **Design of Urban Highway Drainage - The State-of-the-Art** (August 1979).

The Rational Method was used to size the on-site storm drain lines which will drain to the pump station. However, the Rational Method is inappropriate for analyzing pump station operation and for analyzing required on-site detention routing. HEC-1 was therefore applied to assist in the analysis, using a HEC-1 routine which can simulate pumping.

Because the Rational Method and a unit hydrograph method were being applied to the same area use, correlative results were needed for both runoff volumes and peak discharges between the Rational Method and a 1-hour storm synthesis. This was achieved by establishing a comparable CN value for each Rational C value.

3.2.4.3 Detention Cells and Interchange Drainage

Five minor detention cells are proposed to be located in the east half and southwest quarter of the SMF/I-10 Maricopa interchange. These cells are indirectly formed by the embankment grading of the ramps and mainlines and with some additional shaping provide excellent storm water storage capability. The volume of runoff contributing to these cells is fairly small, at 10 acre-feet (50-year), and storage depths are shallow. HEC-1 was used to model a detention storage routing operation which linked these detention cells. This routing begins in the NW infield area where on-site runoff is conveyed clockwise from quadrant to quadrant (and cell to cell), accumulating runoff volume, to ultimate discharge into a final off-site detention area. Direct crossings (say, from the NW infield) would require very deep inverted siphons to pass beneath the depressed portion of the SMF. Table 3.2 provides a summary of hydraulic data for the cells.

Table 3.2 Summary of Detention Cell Data (Segment V)

Cell No.	Bottom Elev.	Water Surface 50-Yr	Water Surface 100-Yr	Storage (ac-ft) 50-Yr	Storage (ac-ft) 100-Yr	Outlet Pipe	Outflow (cfs) Q50	Outflow (cfs) Q100
16	1157.0	1159.5	1160.1	2	3	24"	11	16
17	1157.9	1159.6	1160.3	2	2	24"	7	11
18	1158.0	1160.6	1160.9	4	5	18"*	7	8
19	1159.0	1161.9	1162.2	4	5	24"	10	12
20	1160.0	1163.8	1164.2	5	6	30"	16	20

* For basin outlet structures, pipes less than 24-inch diameter may be used or a suitable orifice restriction on a larger pipe may be substituted.

The storage routing through these cells was performed using the 2000 ordinate HEC-1 model which allowed for shorter computational time periods (in this case, 1 minute increments) which achieves better accuracy in watersheds having short lag times.

The downstream cell, Cell No. 16, discharges to the off-site Detention Basin No. 15, which is located southwest of the interchange. The 100-year design highwater in that basin (No. 15) is 1159.1, which will surcharge the interchange cells during the 100-year storm. Therefore, in the 100-year model, cells 16 through 18 were coded such that no storage was presumed available below elevation 1159.1.

The detention cells are to be graded with 3:1 or 4:1 side slopes, whichever is the natural extension of the roadway embankment slopes. Low flow swales should be placed in the cell bottoms, connecting inlet to outlet. Bottom elevations are one-half to one foot below the outlet pipe inverts to allow for sediment entrapment, although excessive sediment is not expected to be a problem considering the limited size and the nature of the contributing drainage area.

In the event of emergency overflow, excess flow can be graded to or piped to the Santan mainline roadway sump.

SECTION 4.0
DRAINAGE STRUCTURE SUMMARIES

Following are tables containing information regarding the major drainage structures on this project. Minor structures, such as median drains and irrigation structures are not listed here although they may be indicated on the General Plan. The culvert sizes and lengths are approximate only and subject to final design determination.

Table 4.1 provides a summary of the culverts but does not contain summary data for on-site storm drain pipes. Detailed information on those systems is contained in the corresponding Technical Appendix. Table 4.2 summarizes the detention basins and level spreaders data. Outflow values for the level spreaders are not provided because these facilities are not intended to attenuate peak flow. They are intended as a device to redistribute concentrated flow.

Table 4.1
Culvert/Pipe Summary

Culvert No.	Location	Type	Length (feet)	Design Q (cfs) 50 Yr. (Design)	100 Yr. (Design or Check)
C6	419+00	3-10'x8' RCB	500'	-	1237
C7	365+80	36" RCP	330'	41	50
C8	378+00	36" RCP	280'	41	50
C9	390+00	42" RCP	330'	41	50
C10	351+65	5-10'x6' RCB	170'	-	1331
C11	405+00	3-10'x8' RCB	2310'	-	1237
C12	457+83	3-10'x8' RCB	220'	-	1206
C13	471+20	4-8'x6' RCB	80'	-	1151
C14	510+54	7-10'x6' RCB	112'	-	2380
C15	Not Used	-	-	-	-
C16	Not Used	-	-	-	-
C17	575+75	4-10'x6' RCB	175'	-	1019
C18	604+20	2-8'x6' RCB	240'	-	765
C101	627+10	72" RCP	330'	138	161
C102	641+70	72" RCP	260'	205	240
C103	648+30	48" RCP	200'	95	111
C104	656+50	2-10'x6' RCB	500'	797	884
C105	660+10	2-10'x6' RCB	470'	778	884
C106	663+20	10'x6' RCB	370'	278	442
C107	669+00	66" RCP	270'	134	162
C108	673+05	60" RCP	250'	149	180
C109	678+00	2-6'x6' RCB	210'	337	411
C110	684+00	72" RCP	215'	128	157
C111	688+00	54" RCP	255'	140	171
C112	691+60	9-10'x6' RCB	230'	3116	3685
C113	702+00	2-10'x6' RCB	210'	747	882

Table 4.1-Continued

Culvert No.	Location	Type	Length (feet)	Design Q (cfs) 50 Yr. (Design)	100 Yr. (Design or Check)
C114	707+20	4-10x6' RCB	210'	747	882
C115	737+20	16 'x14' RCB	220'	1043	1238
C116	740+40	5-10'x6' RCB	230'	1763	2087
C117	777+50	72" RCP	290'	140	160
C118	782+50	3-6'x6' RCB	250'	261	311
C119	789+00	2-8'x6' RCB	250'	229	281
C120	794+25	2-30" RCP	245'	48	60
C121	798+25	8'x6' RCB	220'	109	134
C122	801+20	8'x6' RCB	220'	110	133
C123	807+10	6-10'x6' RCB	280'	1339	1616
C124	824+30	4-10'x6' RCB	225'	556	685
C125	846+90	4-10'x6' RCB	200'	1014	1211
C126	860+00	5-10'x6' RCB	190'	1922	2274
C127	870+25	8'x6' RCB	250'	311	372
C200	889+45	10'x6' RCB	850'	338	402
C201	905+50	2-48" RCP	260'	122	147
C202	923+25	5-10'x6' RCB	235'	1975	2349
C203	932+90	3-10'x6' RCB	270'	1129	1335
C204	942+30	2-8'x6' RCB	255'	535	624
C205	958+55	6'x6' RCB	230'	257	300
C206	968+20	8'x6' RCB	300'	297	313
C207	976+15	60" RCP	370'	77	88
C208	997+10	3-10'x6' RCB	530'	1567	1818
C209	1005+50	60" RCP	275'	49	56
C210	1028+00	10'x6' RCB	290'	374	447

Table 4.1-Continued

Culvert No.	Location	Type	Length (feet)	Design Q (cfs) 50 Yr. (Design)	100 Yr. (Design or Check)
C211	1047+85	2-8'x6' RCB	305'	431	521
C212	1067+70	2-10'x6' RCB	400'	598	725
C213	1083+80	8'x6' RCB	575'	173	201
C214	1092+45	3-10'x6' RCB	470'	992	1072
C215	1113+50	7-10'x6' RCB	230'	2200	2500
C216	1138+20	2-6'x6' RCB	220'	244	284
C217	1164+60	4-8'x6' RCB	260'	770	926
C218	1198+05	4-10'x6' RCB	475'	1172	1238
C219	1241+85	3-10'x6' RCB	875'	1347	1995
C227	1298+77	2-54" RCP	170'	-	130
C331	NW 31+64	24" RCP	160'	-	7
C332	NE 10+40	24" RCP	180'	-	7
C333	NE 3+00	42" RCP	114'	-	60
C334	127+00	12" RCP	120'	-	9
C335	153+20	4-54" RCP	180'	-	386
C336	180+15	3-60" RCP	200'	-	386
C337	206+70	3-60" RCP	155'	-	372
C338	214+00	3-60" RCP	170'	-	379
C339	239+60	8'X6' RCB	180'	-	391
C340	292+52	4-60" RCP	136'	-	571
C341	206+35	36" RCP	340'	52	63
C342	157+52	4-54" RCP	80'	-	386

Table 4.2
Basin and Level Spreader Summary

Detention Basin No.	Location	Peak Storage (acre - ft.)	100 Year Q (cfs) Peak Inflow	Peak Outflow
1	90+00	-	40	7
2	90+00	2 **	25	7
3	120+00	12	114	9
4	200+00	18	527	372
5	471+60 to 510+00	185	2380	1151
6*	724+50 to 738+30	-	1238	-
7*	775+00 to 795+50	-	2414	-
8*	1028+30 to 1036+10	-	447	-
9*	1047+25 to 1055+50	-	521	-
10*	1068+00 to 1073+30	-	725	-
11*	1081+50 to 1083+65	-	201	-
12*	1086+40 to 1092+50	-	1072	-
13*	1110+70 to 1118+30	-	2500	-
14*	1197+70 to 1206+80	-	1238	-
15	1245+00 to I-10	312	1995	111
16	1267+00	3	105	16
17	1274+00	2	80	11
18	1278+00	5	44	8
19	1280+00	5	82	12
20	1285+00	6	212	20

*Level Spreader/Detention Structure
**Combined Storage of Basins 1 and 2

SECTION 5.0
CONSTRUCTION COST ESTIMATES

5.1 General Discussion

Estimates of probable construction costs for each segment have been prepared and are included here. Costs of on-site versus off-site facilities are distinguished in the estimates, but each segment's costs are summed and factors applied to those totals to account for unidentified and unspecified costs. With the exception of Segment II, specific land (right-of-way) costs for off-site drainage facilities, such as detention basins and channels, have not been included. Detailed costs for storm drain lines smaller than 36-inch are not fully developed because the level of design did not reach that detail. In Segments II and V, where a depressed pavement storm drain system is proposed, a lump sum value (referred to as "Other Drainage Items") has been added to account for manholes, catch basins, connector pipes, etc. not shown on the General Plans. Also, in consideration of the level of design, an additional 15 percent of total costs (not including land) is allowed for to account for all the minor items, possible upsizings and undetermined special problems that will undoubtably be revealed during a detail design process. An added 12 percent is allowed for contingencies and engineering costs.

Unit costs were drawn from ADOT summaries of construction bids and from ADOT and HDR staff members and are subject to some minor variance. These values are considered to be 1992 dollars.

5.2 Estimates

See the following pages for detailed listings of the construction cost estimates for drainage work. Table 5.1 summarizes the total costs for each segment.

Table 5.1 Summary of Costs

Segment	Total Costs	
I	$ 13,200,000	
II	13,920,000	
III	8,670,000	
IV	5,570,000	
V	9,320,000	
	$ 50,680,000	Grand Total South Mountain Freeway

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report	
PROJECT	Loop 202 South Mountain Freeway	ESTIMATED	ETL	South Mountain Freeway	
SECTION	Segment I - I-10 Papago to the Salt River	CHECKED			
STATIONS	90+00 to 335+00	DATE	5-28-92		
LENGTH	4.6 miles	REVISED	8-4-92		

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	Drainage (On-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 12"	120	LF	$25	$3,000
	Pipe, Rein. Concrete, 18"	370	LF	$35	$12,950
	Pipe, Rein. Concrete, 24"	12,700	LF	$40	$508,000
	Pipe, Rein. Concrete, 30"	30	LF	$50	$1,500
	Pipe, Rein. Concrete, 36"	3,550	LF	$60	$213,000
	Pipe, Rein. Concrete, 42"	470	LF	$75	$35,250
	Pipe, Rein. Concrete, 48"	1,400	LF	$85	$119,000
	Special Junction Box	2	EA	$10,000	$20,000
	Catch Basins	141	EA	$1,500	$211,500
	Manholes	41	EA	$2,500	$102,500
	Reconstruct Catch Basin	6	EA	$1,000	$6,000
	Remove Catch Basin or Manhole	105	EA	$500	$52,500
	Pipe Plug	60	EA	$150	$9,000
	Pipe Collar	37	EA	$200	$7,400
	Removal of Pipe	2,970	LF	$14.50	$43,065
	Drainage Excavation (basins)	30,070	CY	$2	$60,140
	I-10 Channel Relocation	1	LS	$6,829,450	$6,829,450
				Subtotal (1)	$8,234,255
2	Drainage (Off-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 36"	340	LF	$60	$20,400
	Pipe, Rein. Concrete, 42"	114	LF	$75	$8,550
	Pipe, Rein. Concrete, 54"	720	LF	$100	$72,000
	Pipe, Rein. Concrete, 60"	2,115	LF	$135	$285,525
	8'x6' Box Culvert	180	LF	$235	$42,300
	12'x10' Box Culvert	420	LF	$434	$182,280
	Structural Excavation	720	CY	$8	$5,760
	Channel, Conc. Lined	50,898	SY	$18	$916,164
	Drainage Excavation (channel)	100,944	CY	$2	$201,888
	Drainage Excavation (basins)	96,240	CY	$2	$192,480
	Rail Bank Protection	370	LF	$182	$67,340
	Concrete Headwalls	10	EA	$1,900	$19,000
				Subtotal (2)	$2,013,687

continued

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report	
PROJECT	Loop 101 South Mountain Freeway	ESTIMATED	ETL	South Mountain Freeway	
SECTION	Segment I - I-10 Papago to the Salt River	CHECKED			
STATIONS	90+00 to 335+00	DATE	5-28-92		
LENGTH	4.6 miles	REVISED			

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
	Subtotal A (Items 1 and 2)				$10,247,942
3	Other Misc. Items	(15% of Subtotal A)			$1,537,191
	Subtotal B (Items 1 - 3)				$11,785,133
4	Contingency and Engineering	Construction (12% of Subtotal B)			$1,414,216
	Est. Construction Total (Items 1 - 4)				$13,199,349
5	Detention Basin Land Costs				
			SF	$1.25	$0
			SF	$1.25	$0
	South Mountain Freeway (Salt River to 51st Ave.) Combined Total Cost (not including land)				$13,199,349

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report		
PROJECT	Loop 202 South Mountain Freeway	ESTIMATED	ETL	South Mountain Freeway		
SECTION	Segment II - Salt River to 51st Avenue	CHECKED				
STATIONS	350+00 to 625+00	DATE	5-27-92			
LENGTH	5.2 miles	REVISED	8-4-92			

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	Drainage (On-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 24"	2,590	LF	$40	$103,600
	Pipe, Rein. Concrete, 30"	200	LF	$50	$10,000
	Pipe, Rein. Concrete, 36"	1,290	LF	$60	$77,400
	Pipe, Rein. Concrete, 42"	545	LF	$75	$40,875
	Pipe, Rein. Concrete, 48"	4,440	LF	$85	$377,400
	Pipe, Rein. Concrete, 54"	1,510.00	LF	$100	$151,000
	Special Junction Box	4	EA	$10,000	$40,000
	Catch Basins	25	EA	$1,500	$37,500
	Manholes	5	EA	$2,500	$12,500
	Other Drainage Items	1	LS	$306,700	$306,700
				Subtotal (1)	$1,156,975
2	Drainage (Off-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 36"	610	LF	$60	$36,600
	Pipe, Rein. Concrete, 42"	330	LF	$75	$24,750
	Pipe, Rein. Concrete, 48"	520	LF	$85	$44,200
	2-8'x6' Box Culvert	240	LF	$390	$93,600
	4-8'x6' Box Culvert	80	LF	$664	$53,120
	4-10'x6' Box Culvert	175	LF	$886	$155,050
	5-10'x6' Box Culvert	170	LF	$1,095	$186,150
	7-10'x6' Box Culvert	112	LF	$1,415	$158,480
	3-10'x8' Box Culvert	3,030	LF	$750	$2,272,500
	Channel, Conc. Lined	132,400	SY	$18	$2,383,200
	Drainage Excavation (channel)	372,900	CY	$2	$745,800
	Drainage Excavation (basin no.5)	564,500	CY	$2	$1,129,000
	Structural Excavation	59,550	CY	$8	$476,400
				Subtotal (2)	$7,758,850

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report		
PROJECT	Loop 101 South Mountain Freeway	ESTIMATED	ETL	South Mountain Freeway		
SECTION	Segment II - Salt River to 51st Avenue	CHECKED				
STATIONS	350+00 to 625+00	DATE	5-27-92			
LENGTH	5.2 miles	REVISED				

		Subtotal A (Items 1 and 2)				$8,915,825
3	Other Misc. Items	(15% of Subtotal A)				$1,337,374
		Subtotal B (Items 1 - 3)				$10,253,199
4	Contingency and Engineering	Construction (12% of Subtotal B)				$1,230,384
		Est. Construction Total (Items 1 - 4)				$11,483,583
5	Detention Basin Land Costs					
	Basin No.5	1,546,500	SF		$1.25	$1,933,125
	Channel Land Costs (Salt River to Southern Ave.)	403,000	SF		$1.25	$503,750
	South Mountain Freeway (Salt River to 51st Ave.)	Combined Total Cost				$13,920,458

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report		
PROJECT	Loop 202 South Mountain Freeway	ESTIMATED	SMc	South Mountain Freeway		
SECTION	Segment III - 51st Avenue to 19th Avenue	CHECKED				
STATIONS	625+00 to 887+00	DATE	5-27-92			
LENGTH	5.0 miles	REVISED	8-4-92			

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	Drainage (Off-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 24"	450	LF	$40	$18,000
	Pipe, Rein. Concrete, 30"	490	LF	$50	$24,500
	Pipe, Rein. Concrete, 48"	200	LF	$85	$17,000
	Pipe, Rein. Concrete, 54"	225	LF	$100	$22,500
	Pipe, Rein. Concrete, 60"	250	LF	$135	$33,750
	Pipe, Rein. Concrete, 66"	270	LF	$160	$43,200
	Pipe, Rein. Concrete, 72"	1,095	LF	$180	$197,100
	2-6'x6' Box Culvert	210	LF	$305	$64,050
	3-6'x6' Box Culvert	250	LF	$425	$106,250
	8'x6' Box Culvert	690	LF	$235	$162,150
	2-8'x6' Box Culvert	250	LF	$390	$97,500
	10'x6' Box Culvert	370	LF	$275	$101,750
	2-10'x6' Box Culvert	1,180	LF	$485	$572,300
	4-10'x6' Box Culvert	635	LF	$886	$562,610
	5-10'x6' Box Culvert	420	LF	$1,095	$459,900
	6-10'x6' Box Culvert	280	LF	$1,298	$363,440
	9-10'x6' Box Culvert	230	LF	$1,970	$453,100
	16'x14' Box Culvert	220	LF	$587	$129,140
	Channel, Conc. Lined	95,050	SY	$18	$1,710,900
	Drainage Excavation (channel)	102,400	CY	$2	$204,800
	Drainage Excavation (basins)	233,350	CY	$2	$466,700
	Structural Excavation	24,650	CY	$8	$197,200
	Riprap, Dumped	14,500	CY	$50	$725,000
				Subtotal (1)	$6,732,840
		Subtotal A (Item 1)			$6,732,840
2	Other Misc. Items	(15% of Subtotal A)			$1,009,926
		Subtotal B (Items 1 & 2)			$7,742,766
3	Contingency and Engineering	Construction (12% of Subtotal B)			$929,132
		Est. Construction Total (Items 1 - 3)			$8,671,898

South Mountain Freeway (51st Ave to 19th Ave) Combined Total Cost (not including land) $8,671,898

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report	
PROJECT	Loop 202 South Mountain Freeway	ESTIMATED	SMc	South Mountain Freeway	
SECTION	Segment IV - 19th Avenue to 40th Street	CHECKED			
STATIONS	887+00 to 1207+00	DATE	5-27-92		
LENGTH	6.1 miles	REVISED			

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	Drainage (Off-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 48"	520	LF	$85	$44,200
	Pipe, Rein. Concrete, 60"	645	LF	$135	$87,075
	6'x6' Box Culvert	230	LF	$190	$43,700
	2-6'x6' Box Culvert	220	LF	$305	$67,100
	8'x6' Box Culvert	875	LF	$235	$205,625
	2-8'x6' Box Culvert	560	LF	$390	$218,400
	4-8'x6' Box Culvert	260	LF	$664	$172,640
	10'x6' Box Culvert	1,140	LF	$275	$313,500
	2-10'x6' Box Culvert	400	LF	$485	$194,000
	3-10'x6' Box Culvert	1,270	LF	$690	$876,300
	4-10'x6' Box Culvert	475	LF	$886	$420,850
	5-10'x6' Box Culvert	235	LF	$1,095	$257,325
	7-10'x6' Box Culvert	230	LF	$1,512	$347,760
	Channel, Conc. Lined	10,900	SY	$18	$196,200
	Drainage Excavation (channel)	20,000	CY	$2	$40,000
	Drainage Excavation (basins)	50,600	CY	$2	$101,200
	Structural Excavation	32,050	CY	$8	$256,400
	Riprap, Dumped	9,600	CY	$50	$480,000
				Subtotal (1)	$4,322,275
		Subtotal A (Item 1)			$4,322,275
2	Other Misc. Items	(15% of Subtotal A)			$648,341
		Subtotal B (Items 1 & 2)			$4,970,616
3	Contingency and Engineering	Construction (12% of Subtotal B)			$596,474
		Est. Construction Total (Items 1 - 3)			$5,567,090
	South Mountain Freeway (19th Ave to 40th Street)	Combined Total Cost (not including land)			$5,567,090

CLIENT	Arizona Department of Transportation	JOB NO.	173-39-44	Concept Drainage Report	
PROJECT	Loop 202 South Mountain Freeway	ESTIMATED	SMc	South Mountain Freeway	
SECTION	Segment V - 40th Street to 56th Street	CHECKED			
STATIONS	1207+00 to 1299+50 SMF & 822+00 to 914+00 I-10	DATE	6-8-92		
LENGTH	3.5 miles	REVISED	8-4-92		

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
1	Drainage (On-site):				
	Pumpstation	1	LS	$1,500,000	$1,500,000
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 18"	200	LF	$35	$7,000
	Pipe, Rein. Concrete, 24"	2,065	LF	$40	$82,600
	Pipe, Rein. Concrete, 30"	1,490	LF	$50	$74,500
	Pipe, Rein. Concrete, 36"	450	LF	$60	$27,000
	Pipe, Rein. Concrete, 42"	735	LF	$75	$55,125
	Pipe, Rein. Concrete, 48"	2,435	LF	$85	$206,975
	Pipe, Rein. Concrete, 54"	650	LF	$100	$65,000
	Pipe, Rein. Concrete, 60"	600	LF	$135	$81,000
	Pipe, Rein. Concrete, 90"	1,090	LF	$270	$294,300
	Special Junction Box	1	EA	$10,000	$10,000
	Catch Basins	7	EA	$1,500	$10,500
	Manholes	9	EA	$2,500	$22,500
	Other Drainage Items	1	LS	$283,750	$283,750
				Subtotal (1)	$2,720,250
2	Drainage (Off-site):				
	Gravity Storm Drain				
	Pipe, Rein. Concrete, 54"	6,230	LF	$100	$623,000
	3-10'x6' Box Culvert	850	LF	$1,270	$1,079,500
	Structural Excavation	23,650	CY	$8	$189,200
	Channel, Conc. Lined	38,450	SY	$18	$692,100
	Drainage Excavation (channel)	118,800	CY	$2	$237,600
	Drainage Excavation (basins)	831,200	CY	$2	$1,662,400
	Manholes	12	EA	$2,500	$30,000
				Subtotal (2)	$4,513,800
	Subtotal A (Items 1 - 2)				$7,234,050
3	Other Misc. Items	(15% of Subtotal A)			$1,085,108
	Subtotal B (Items 1 - 3)				$8,319,158
4	Contingency and Engineering	Construction (12% of Subtotal B)			$998,299
	Est. Construction Total (Items 1 - 4)				$9,317,456
	South Mountain Freeway (40th St. to 56th St.)	Combined Total Cost (not including land)			$9,317,456

SECTION 6.0
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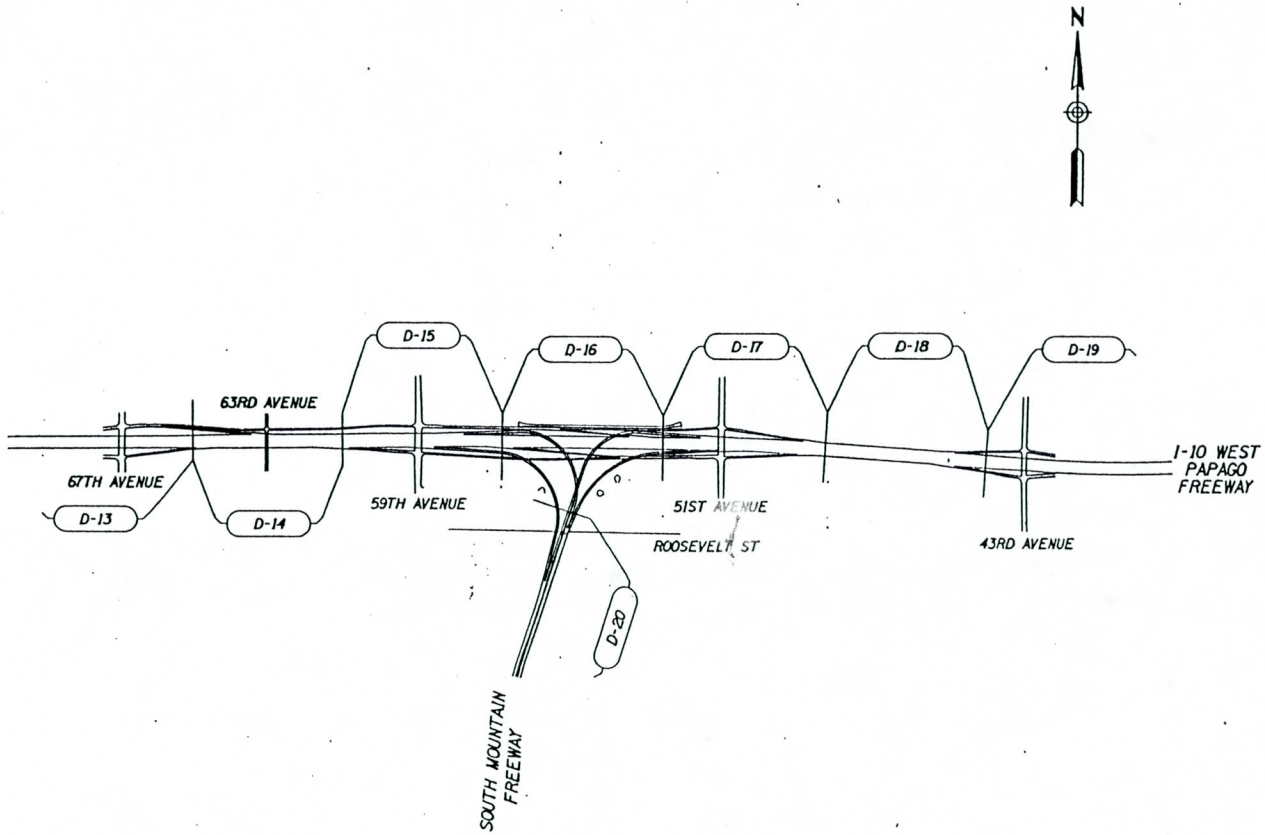
F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



PRELIMINARY

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HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

SOUTH MOUNTAIN FREEWAY
KEY MAP

LOCATION
I-10 PAPAGO/SMF TI

DWG NO. G-3.12 OF

TRACS NO. H-2222-01D | KMPAPA02 | ___ OF ___

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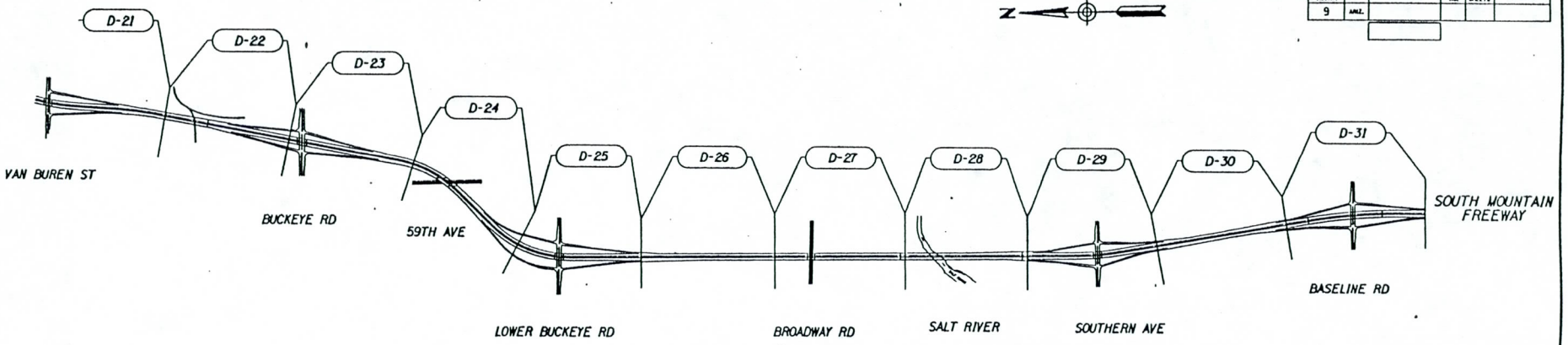

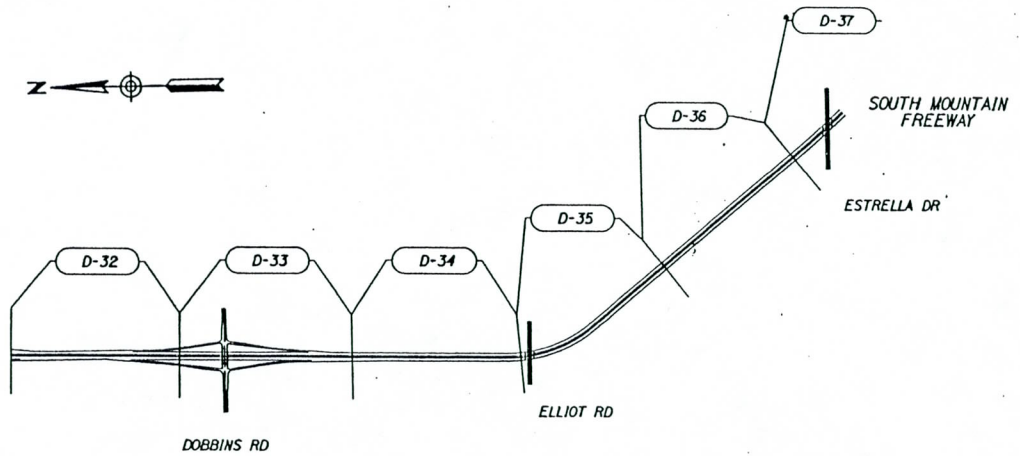

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ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

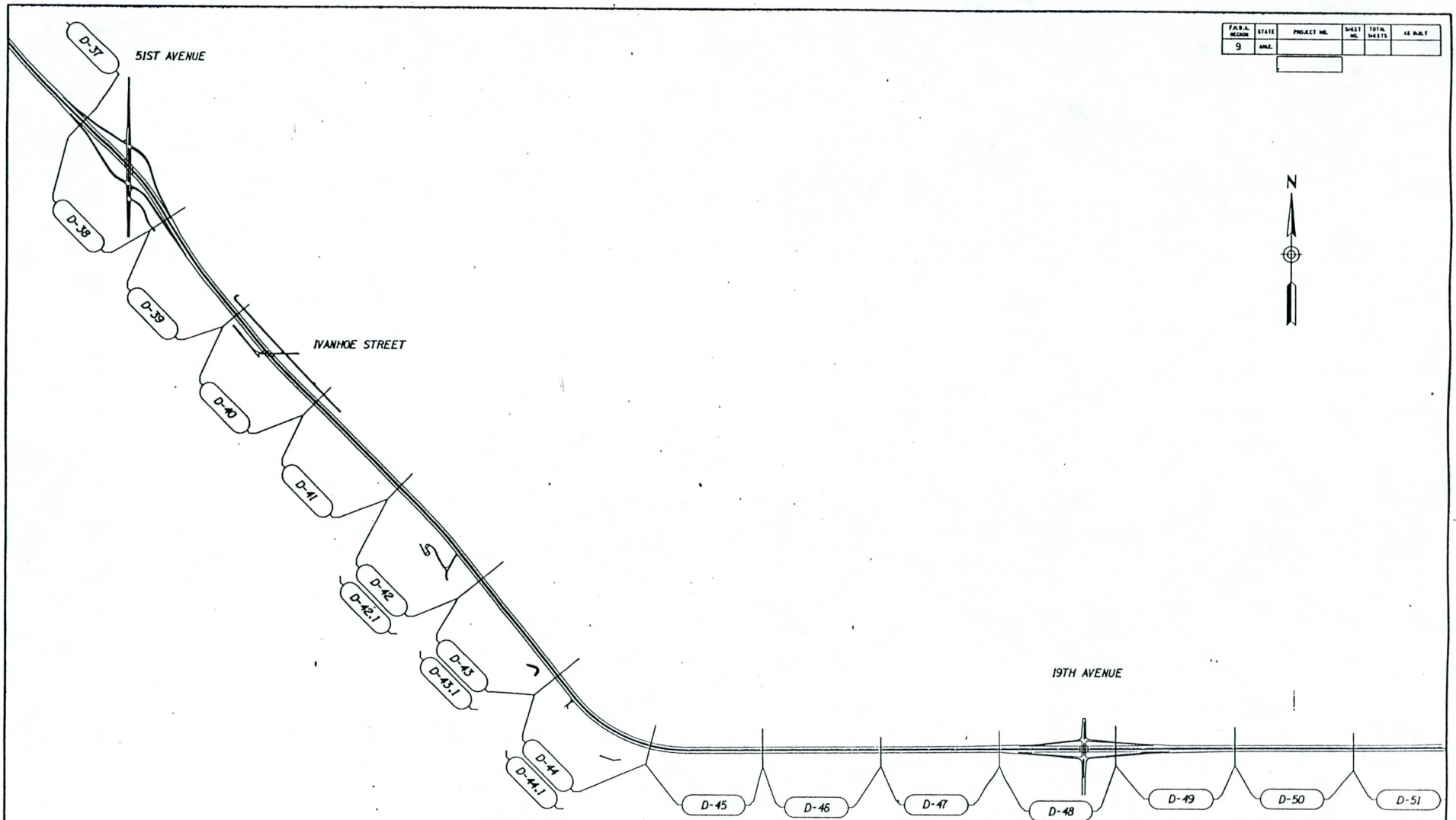
SOUTH MOUNTAIN FREEWAY
KEY MAP

ROUTE | MILEPOST

LOCATION
ROOSEVELT ST TO 51ST AVE

DWG NO. G-3.13 OF

TRACS NO. H-2222-01D | KMNSMF02 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

PRELIMINARY

NOT FOR CONSTRUCTION

SOUTH MOUNTAIN FREEWAY

	NAME	DATE
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CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

SOUTH MOUNTAIN FREEWAY
KEY MAP

LOCATION: 51ST AVENUE TO 7TH STREET

DWG NO. C-3.14 OF

TRACS NO. H-2222-01D | KMSWLP03 | ___ OF ___

F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
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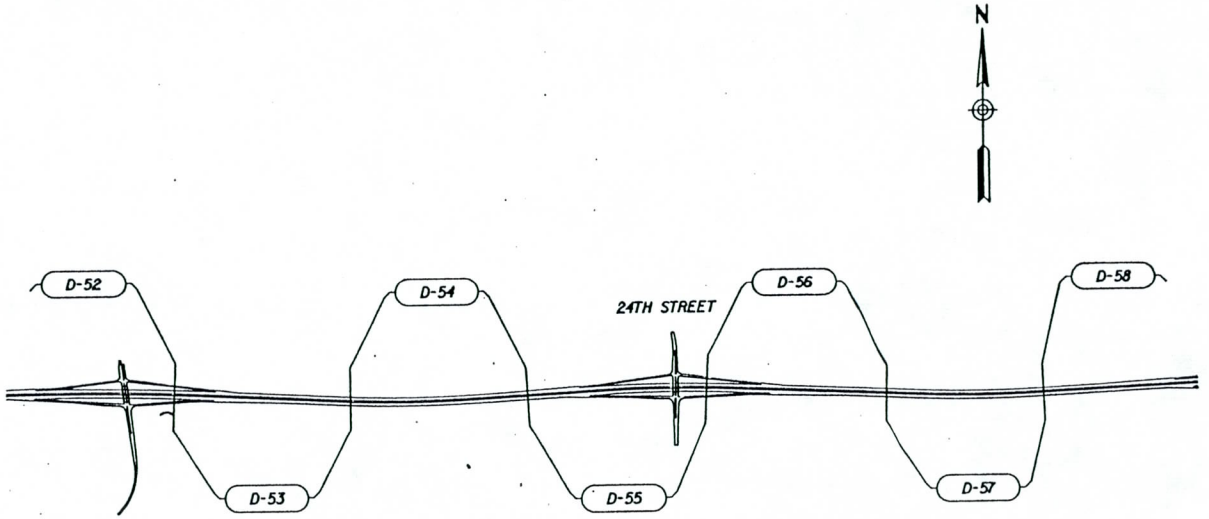

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HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

SOUTH MOUNTAIN FREEWAY
KEY MAP

LOCATION
7TH STREET TO 40TH STREET

DWG NO. G-3.15 OF

TRACS NO. H-2222-010 | KMSMFW02 | ___ OF ___

-----HIGHWAY SPECIFICATION-----
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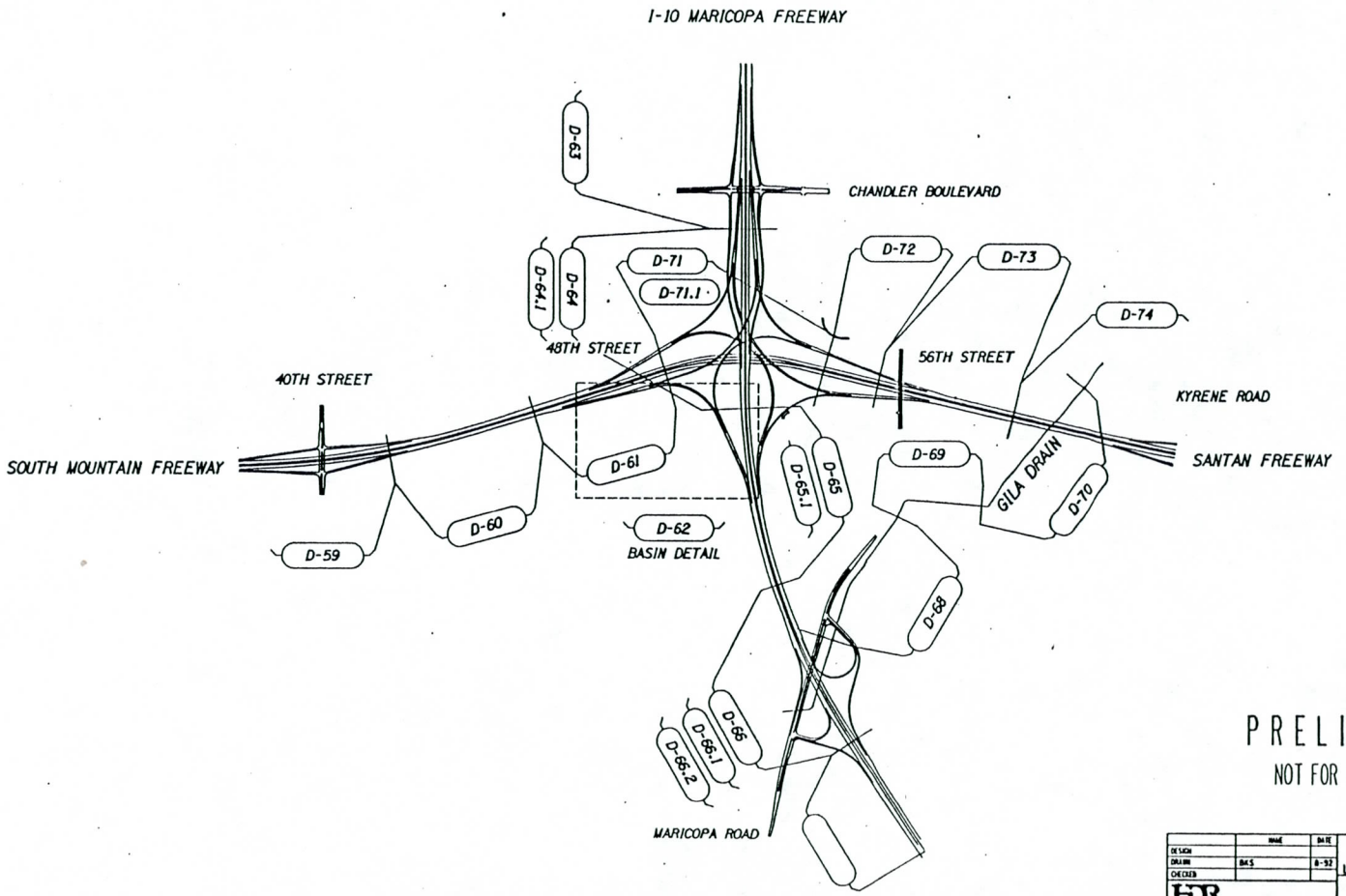
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



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NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN		
DRAWN	BAS	8-92
CHECKED		

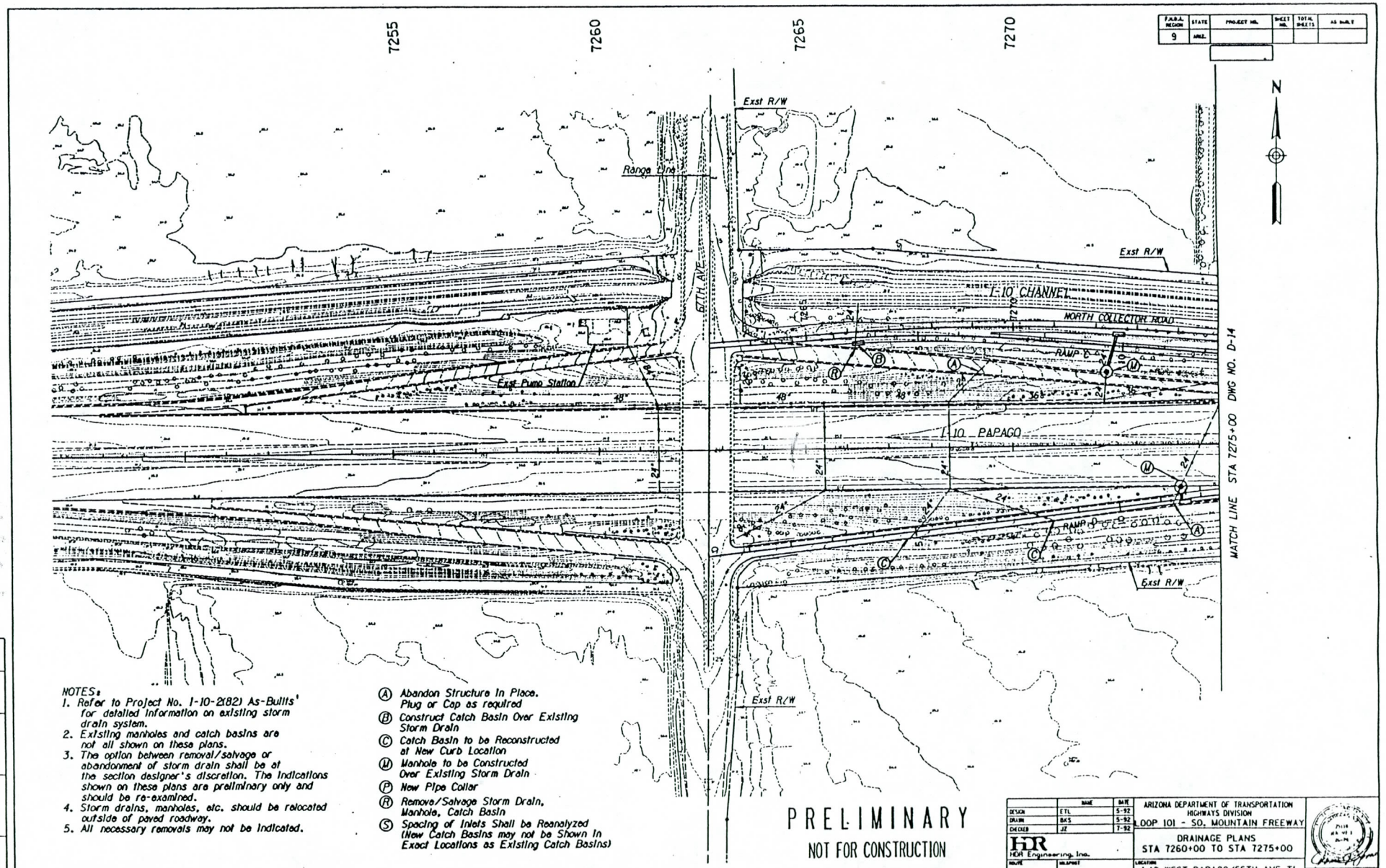
HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO MOUNTAIN FREEWAY
SOUTH MOUNTAIN FREEWAY
KEY MAP
LOCATION
40TH STREET TO KYRENE ROAD

DWG NO. G-3160F

TRACS NO. H-2222-013 | KWSWLP04 | ___ OF ___



NOTES:

1. Refer to Project No. I-10-2(82) As-Builts' for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown In Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	5-92
DRAWN	BKS	5-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

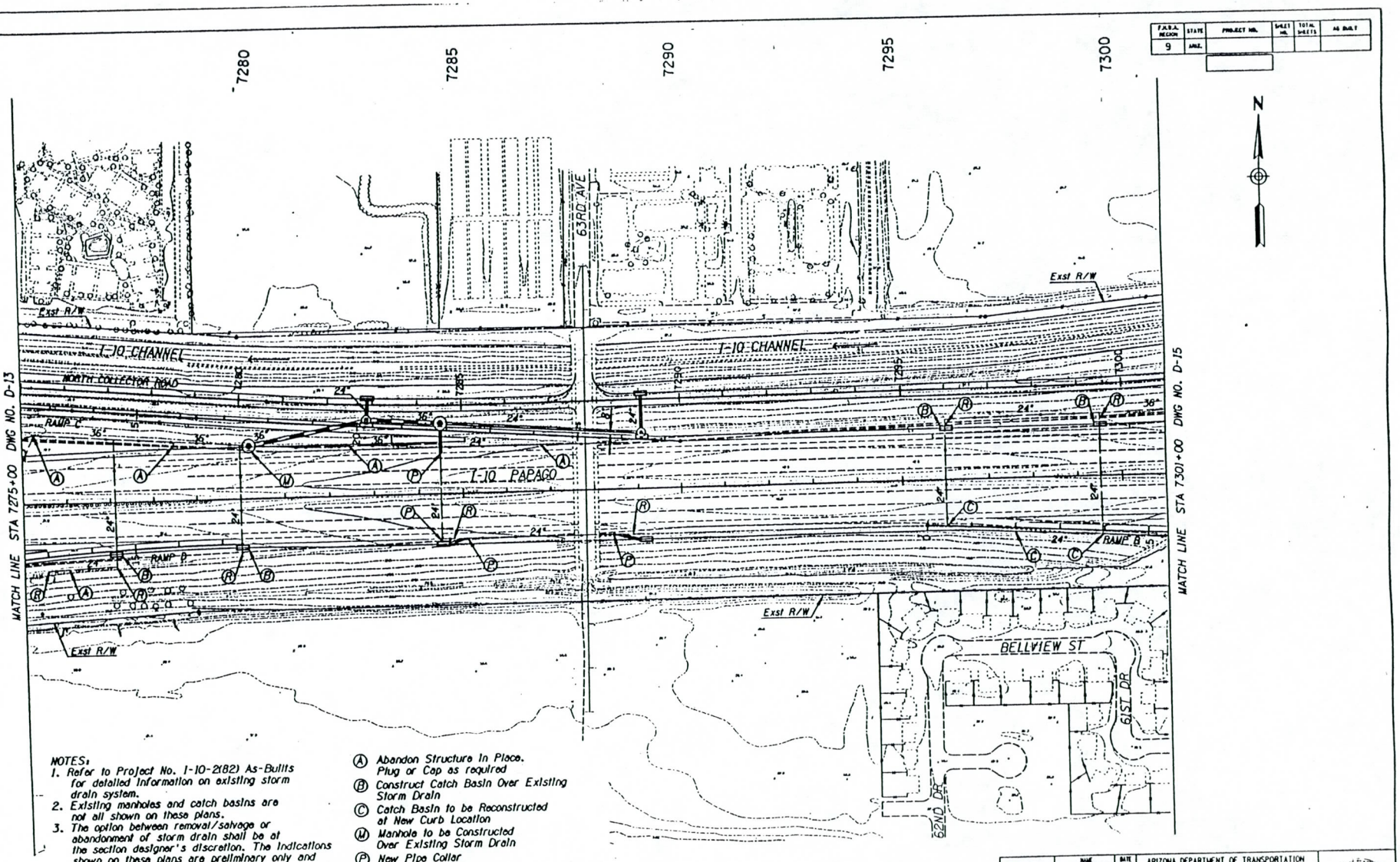
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 7260+00 TO STA 7275+00

I-10 WEST PAPAGO/55TH AVE TI

DWG NO. D-13 OF

TRACS NO. H-2222-01D | DRPAPA01 | OF



NOTES:

1. Refer to Project No. I-10-2(82) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown In Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	5-92
DRAWN	BAS	5-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 7275+00 TO STA 7301+00
LOCATION: I-10 WEST PAPAGO/55TH AVE TI

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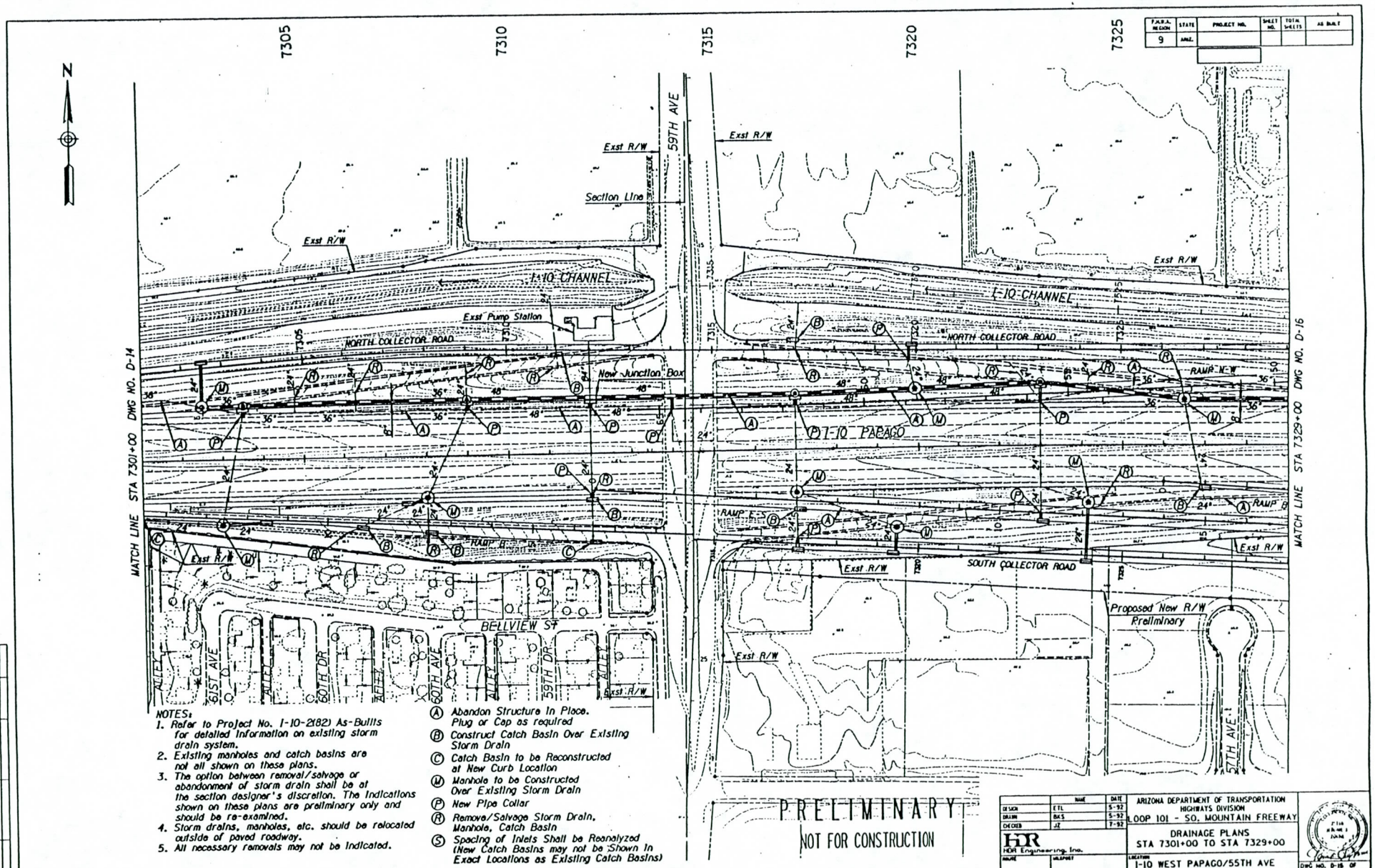
TRACS NO. H-2222-01D | DRPAPA02 | ___ OF ___



NOTES:

1. Refer to Project No. I-10-2(82) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown in Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

F.H.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

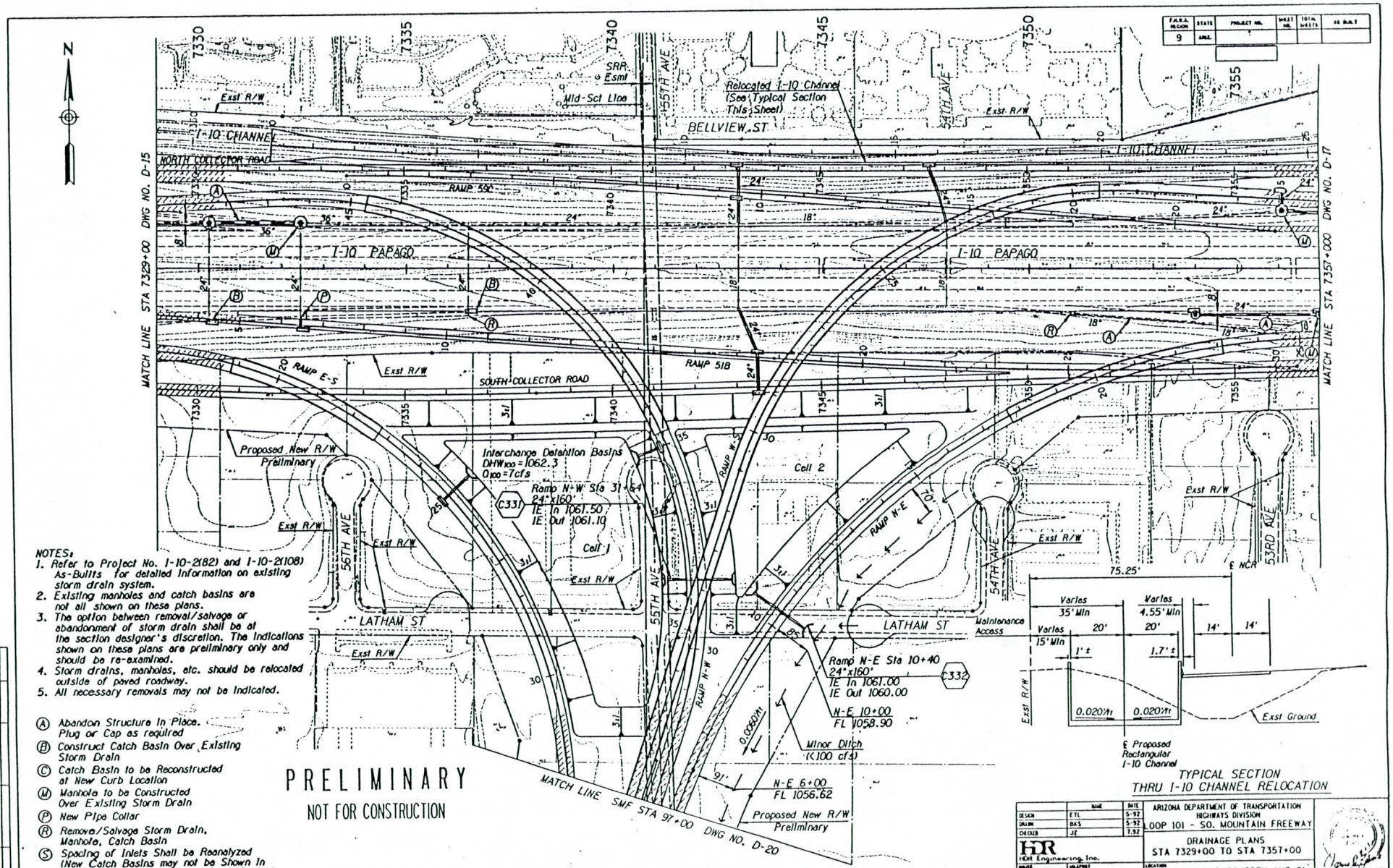
	NAME	DATE
DESIGN	ETL	5-92
DRAWN	BKS	5-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 7301+00 TO STA 7329+00
LOCATION: I-10 WEST PAPAGO/55TH AVE

DWG NO. D-15 OF

TRACS NO. H-2222-01D | DRPAPA03 | ___ OF ___



NOTES:

1. Refer to Project No. I-10-2(82) and I-10-21(08) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

- (A) Abandon Structure In Place. Plug or Cap as required
- (B) Construct Catch Basin Over Existing Storm Drain
- (C) Catch Basin to be Reconstructed at New Curb Location
- (M) Manhole to be Constructed Over Existing Storm Drain
- (P) New Pipe Collar
- (R) Remove/Salvage Storm Drain, Manhole, Catch Basin
- (S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown in Exact Locations as Existing Catch Basins)

PRELIMINARY

NOT FOR CONSTRUCTION

TYPICAL SECTION
THRU I-10 CHANNEL RELOCATION

FAP. NO.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	5-92
DRAWN	BAS	5-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

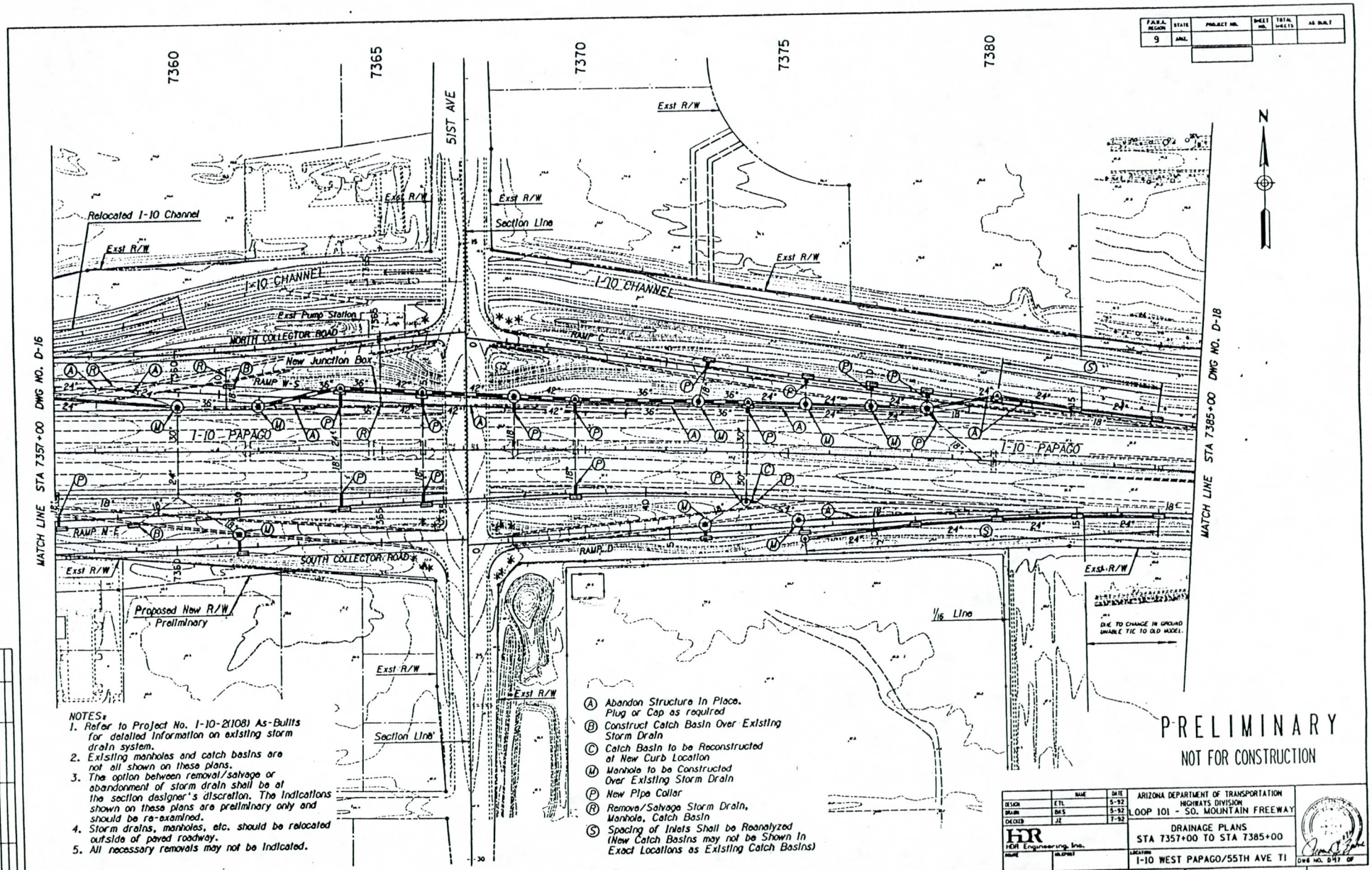
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 7329+00 TO STA 7357+00

LOCATION
I-10 WEST PAPAGO/55TH AVE TI

DWG NO. D-16 OF

TRACS NO. H-2222-01D | DRPAPA04 | ___ OF ___



NOTES:

1. Refer to Project No. I-10-2(108) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown In Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

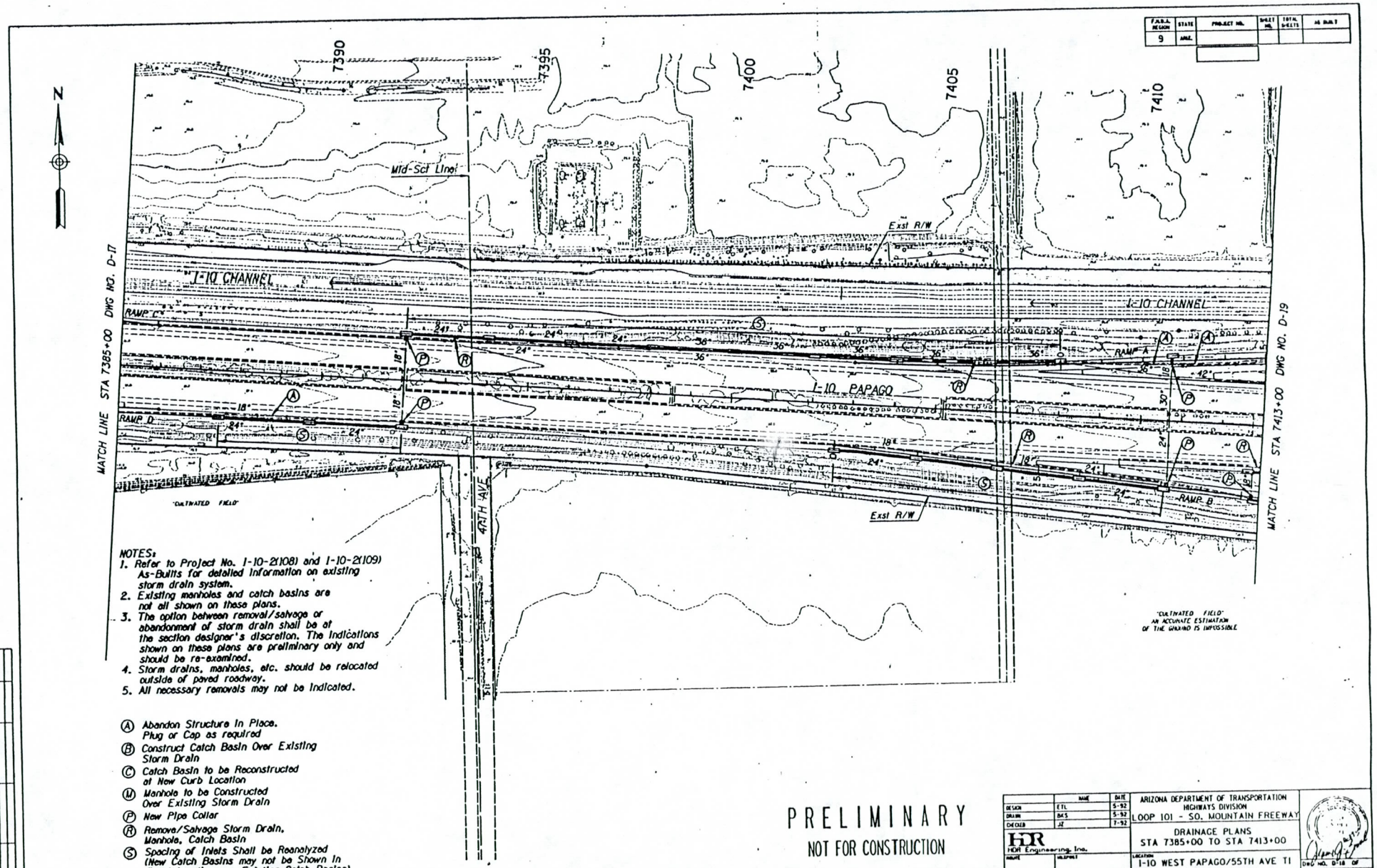
FAP.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	5-92
DRAWN	DAS	5-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 7357+00 TO STA 7385+00
LOCATION: I-10 WEST PAPAGO/55TH AVE TI
DWG NO. D-17 OF

TRACS NO. H-2222-01D | DRPAPA05 | OF



NOTES:
1. Refer to Project No. I-10-2(108) and I-10-2(109) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown In Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

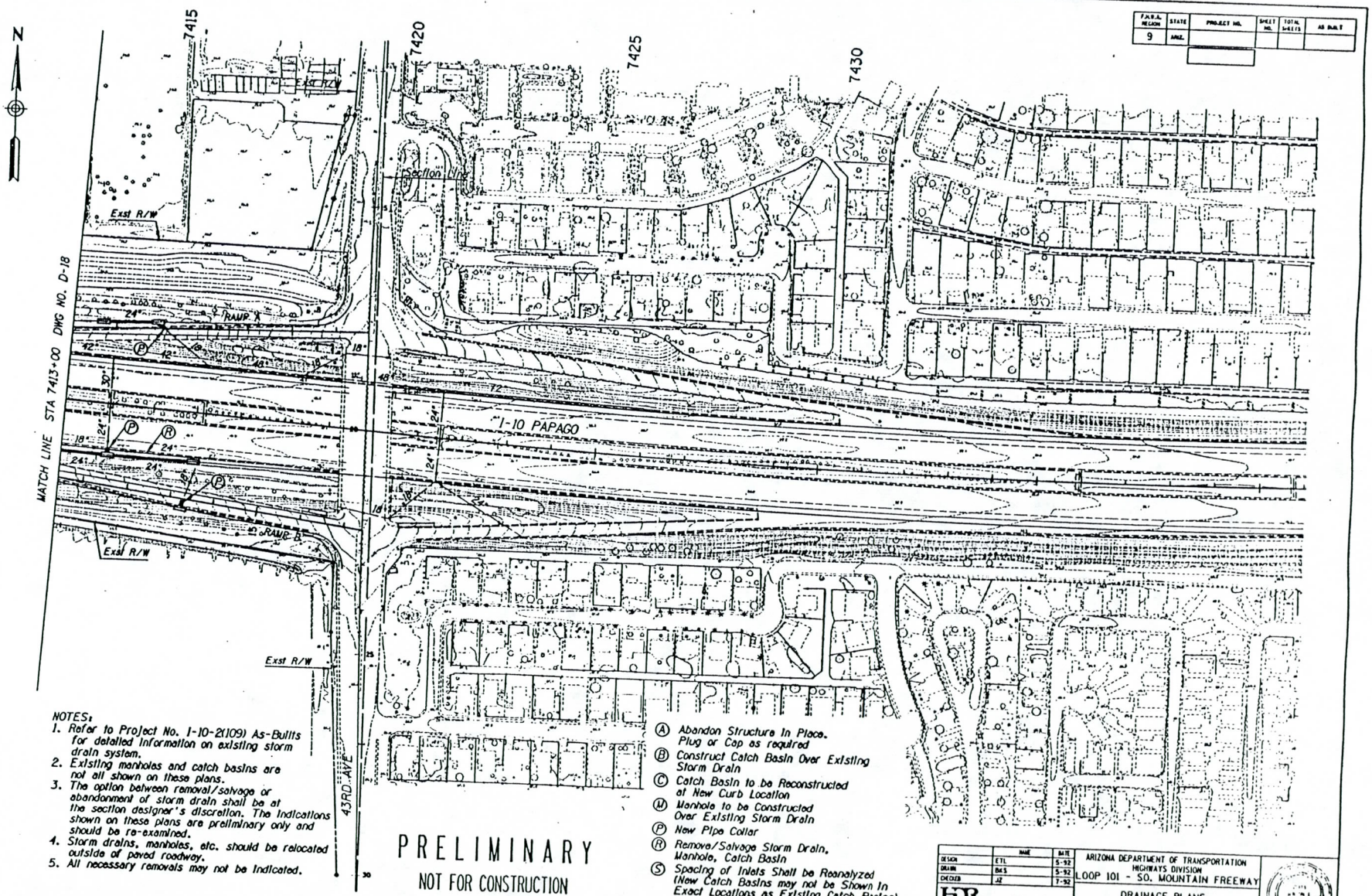
	NAME	DATE
DESIGN	ETL	5-92
DRAWN	DKS	5-92
CHECKED	JF	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 7385+00 TO STA 7413+00
LOCATION: I-10 WEST PAPAGO/55TH AVE TI

DWG NO. D-18 OF

TRACS NO. H-2222-01D | DRPAPA06 | OF



F.A.P. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

NOTES:
1. Refer to Project No. I-10-2(109) As-Builts for detailed information on existing storm drain system.
2. Existing manholes and catch basins are not all shown on these plans.
3. The option between removal/salvage or abandonment of storm drain shall be at the section designer's discretion. The indications shown on these plans are preliminary only and should be re-examined.
4. Storm drains, manholes, etc. should be relocated outside of paved roadway.
5. All necessary removals may not be indicated.

(A) Abandon Structure In Place. Plug or Cap as required
(B) Construct Catch Basin Over Existing Storm Drain
(C) Catch Basin to be Reconstructed at New Curb Location
(M) Manhole to be Constructed Over Existing Storm Drain
(P) New Pipe Collar
(R) Remove/Salvage Storm Drain, Manhole, Catch Basin
(S) Spacing of Inlets Shall be Reanalyzed (New Catch Basins may not be Shown In Exact Locations as Existing Catch Basins)

PRELIMINARY
NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	ETL	5-92
DRAWN	BKS	5-92
CHECKED	JZ	7-92

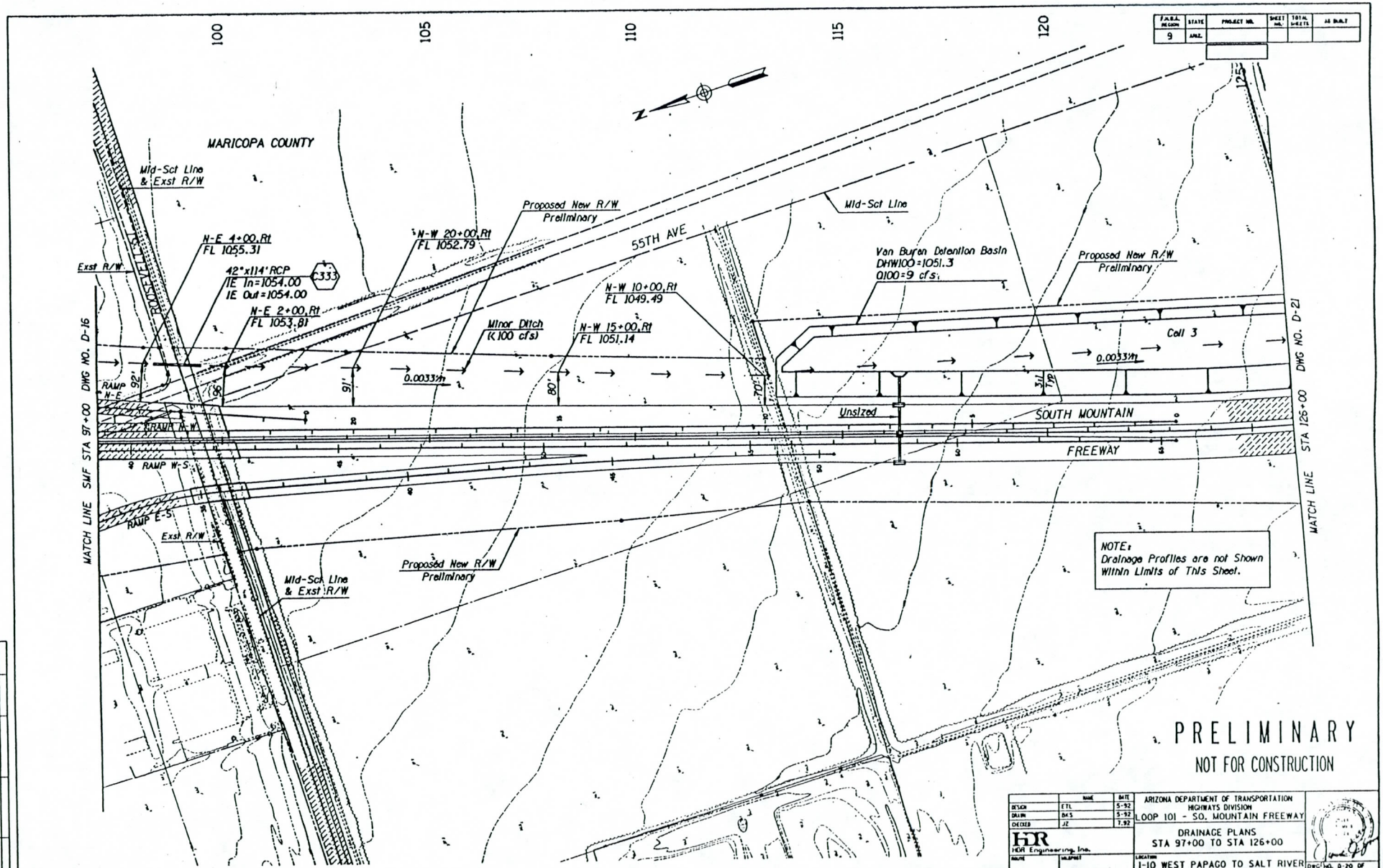
HDR Engineering, Inc.

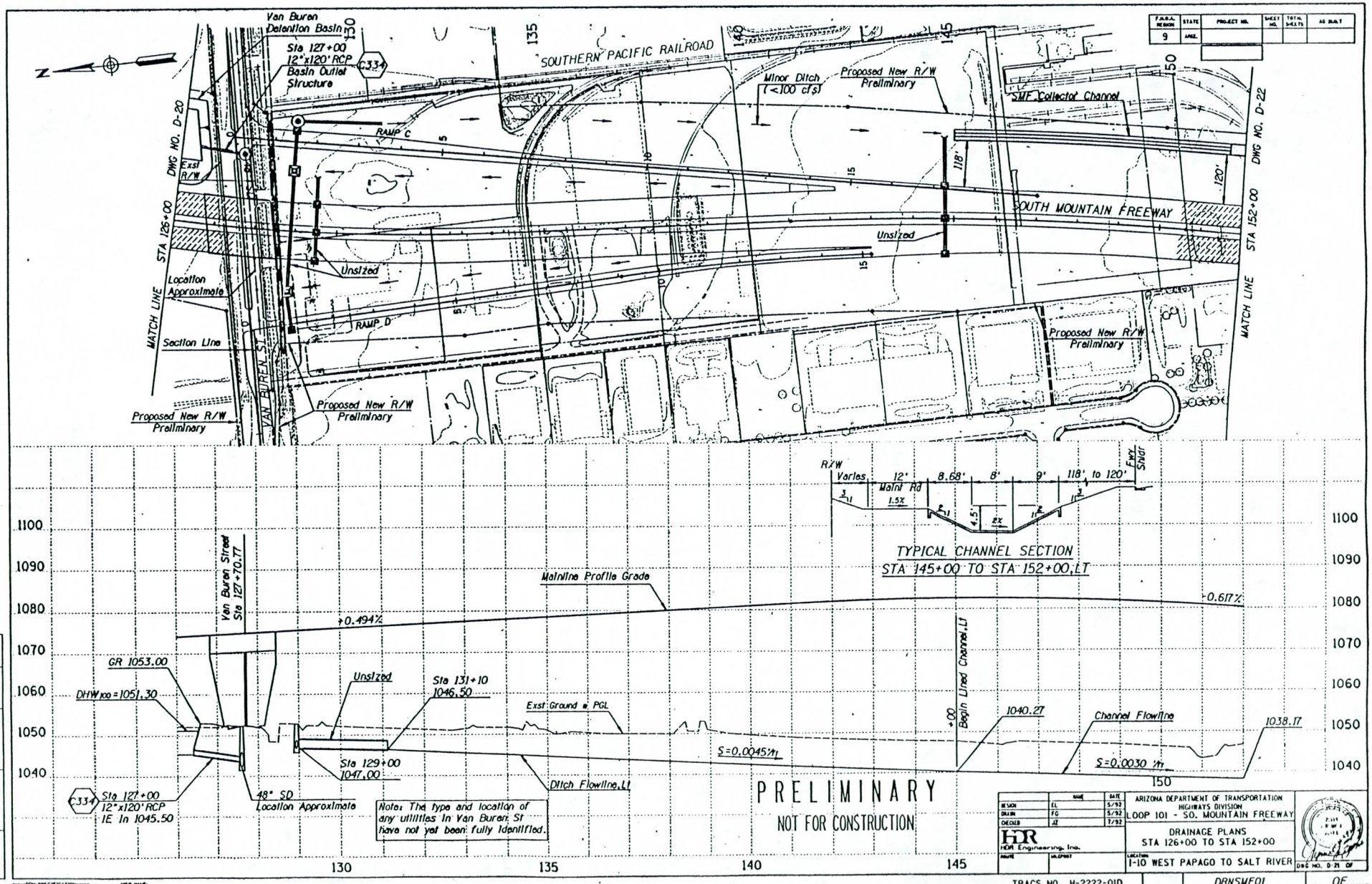
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 7413+00 TO STA 7430+00

LOCATION
I-10 WEST PAPAGO/55TH AVE TI

DRG NO. D-19 OF


MARICOPA COUNTY
Mid-Sct Line & Exst R/W
Proposed New R/W Preliminary
55TH AVE
Mid-Sct Line
N-E 4+00, Rt FL 1055.31
42"x114" RCP (333)
IE In=1054.00
IE Out=1054.00
N-E 2+00, Rt FL 1053.81
N-W 20+00, Rt FL 1052.79
N-W 10+00, Rt FL 1049.49
N-W 15+00, Rt FL 1051.14
Minor Ditch (K100 cfs)
Van Buren Detention Basin
DHW100=1051.3
Q100=9 cf.s.
Proposed New R/W Preliminary
Exst R/W
ROOSEVELT ST
RAMP N-E
RAMP W-N
RAMP W-S
RAMP E-S
Cell 3
0.0033ft/ft
Unsized
SOUTH MOUNTAIN FREEWAY
Exst R/W
Proposed New R/W Preliminary
Mid-Sct Line & Exst R/W
MATCH LINE SWF STA 97+00 DWG NO. D-16
MATCH LINE STA 126+00 DWG NO. D-21
NOTE: Drainage Profiles are not Shown Within Limits of This Sheet.
PRELIMINARY
NOT FOR CONSTRUCTION
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 97+00 TO STA 126+00
I-10 WEST PAPAGO TO SALT RIVER
HDR Engineering, Inc.
TRACS NO. H-2222-01D
DRPAPA08



Note: The type and location of any utilities in Van Buren St have not yet been fully identified.

PRELIMINARY

NOT FOR CONSTRUCTION

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	5/93
DRAWN	FG	5/92
CHECKED	JZ	7/92

HDR Engineering, Inc.

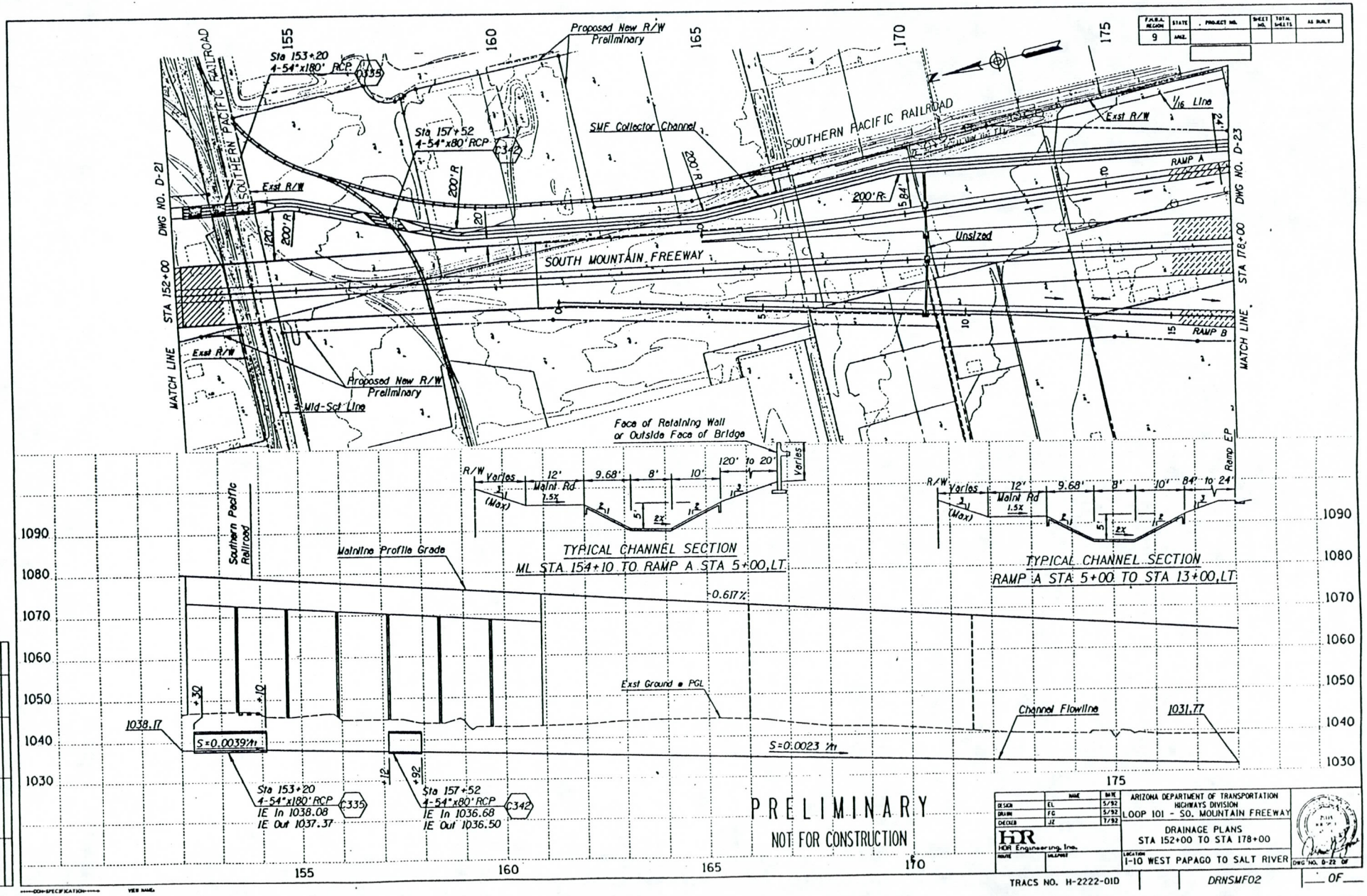
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 126+00 TO STA 152+00

LOCATION: I-10 WEST PAPAGO TO SALT RIVER

DWG NO. D-21 OF

TRACS NO. H-2222-01D | DRNSWF01 | OF



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.M. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

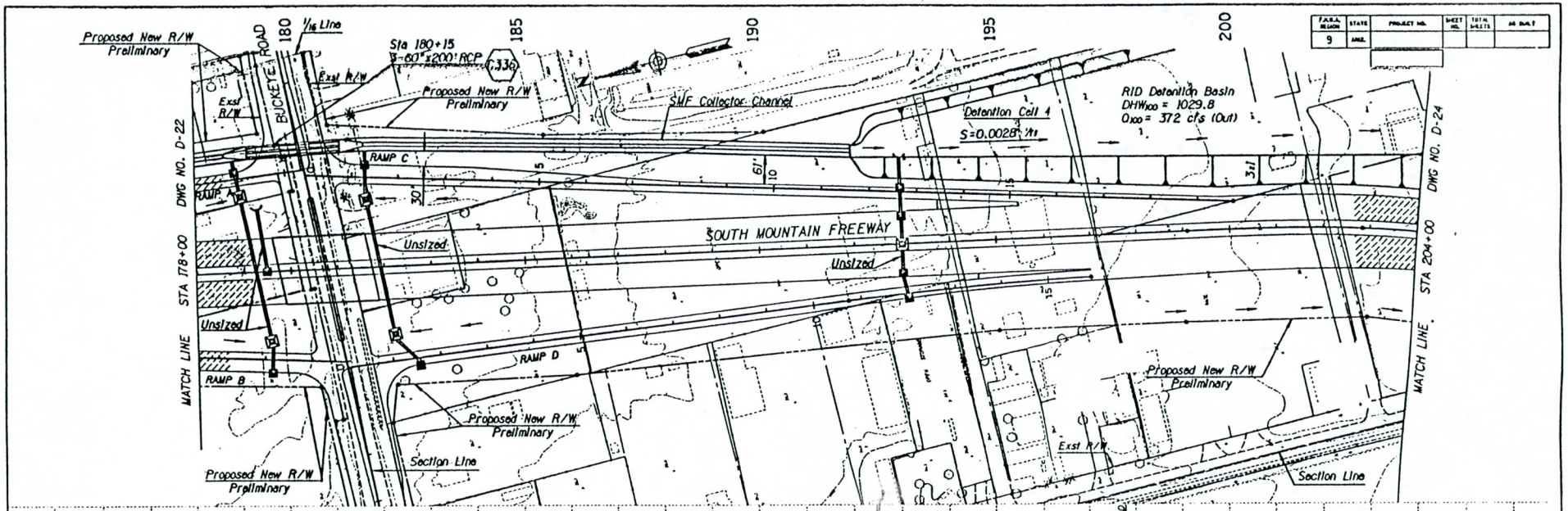
	NAME	DATE
DESIGN	EL	5/92
DRAWN	FG	5/92
CHECKED	JZ	7/92

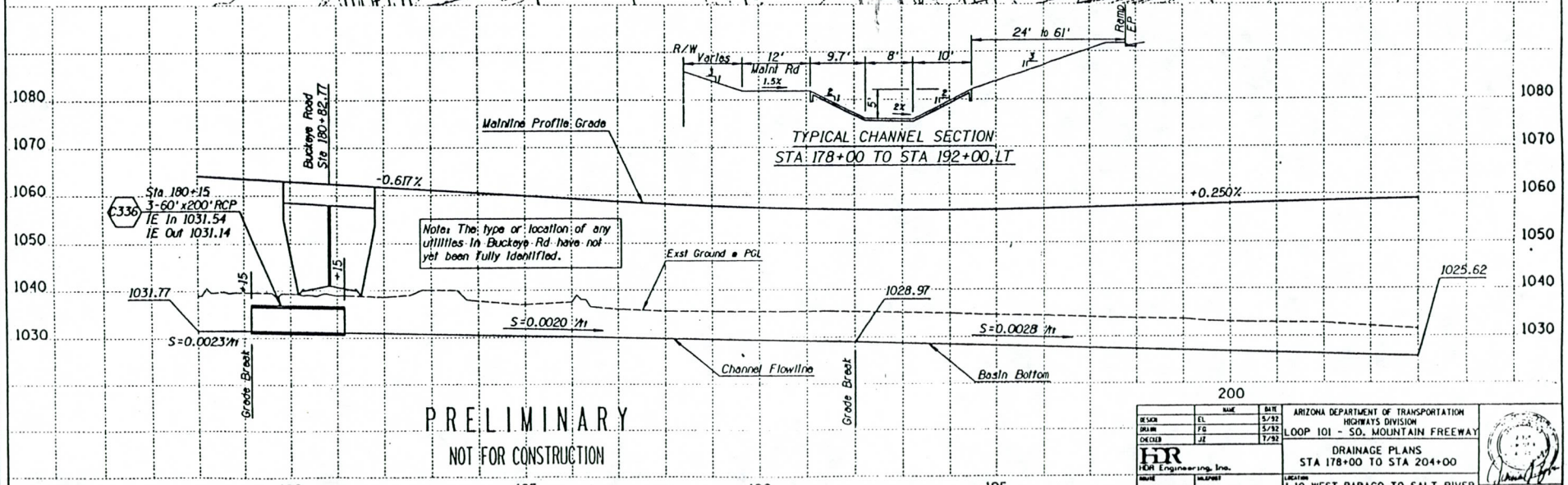
HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 152+00 TO STA 178+00
I-10 WEST PAPAGO TO SALT RIVER

DWG NO. D-22 OF

TRACS NO. H-2222-01D | DRNSMF02 | OF





PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	5/92
DRAWN	FG	5/92
CHECKED	JE	7/92

HDR Engineering, Inc.

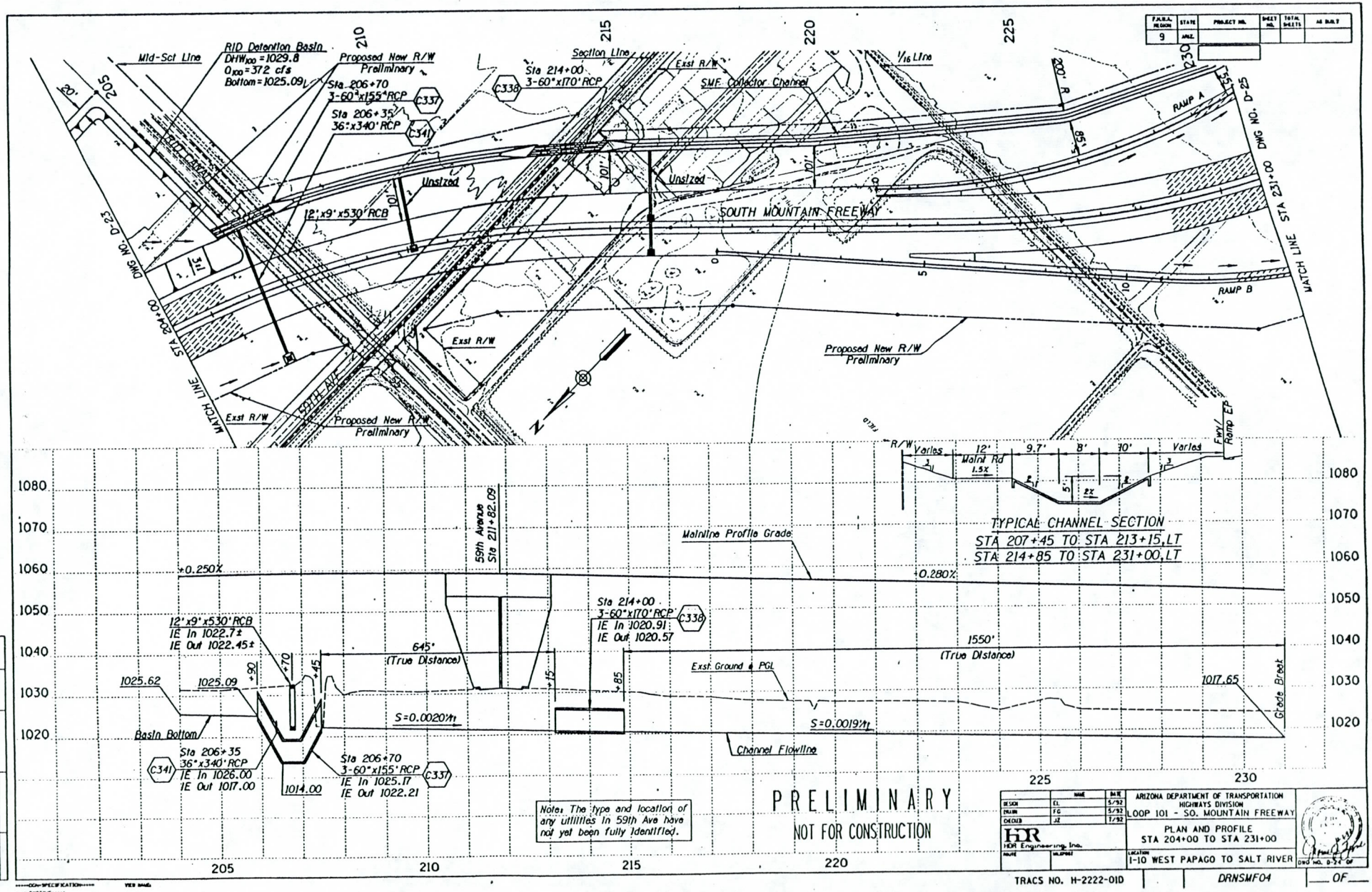
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 178+00 TO STA 204+00

LOCATION
I-10 WEST PAPAGO TO SALT RIVER

Dwg No. D-23 OF

TRACS NO. H-2222-01D | DRNSWF03 | ___ OF ___



Note: The type and location of any utilities in 59th Ave have not yet been fully identified.

PRELIMINARY
NOT FOR CONSTRUCTION

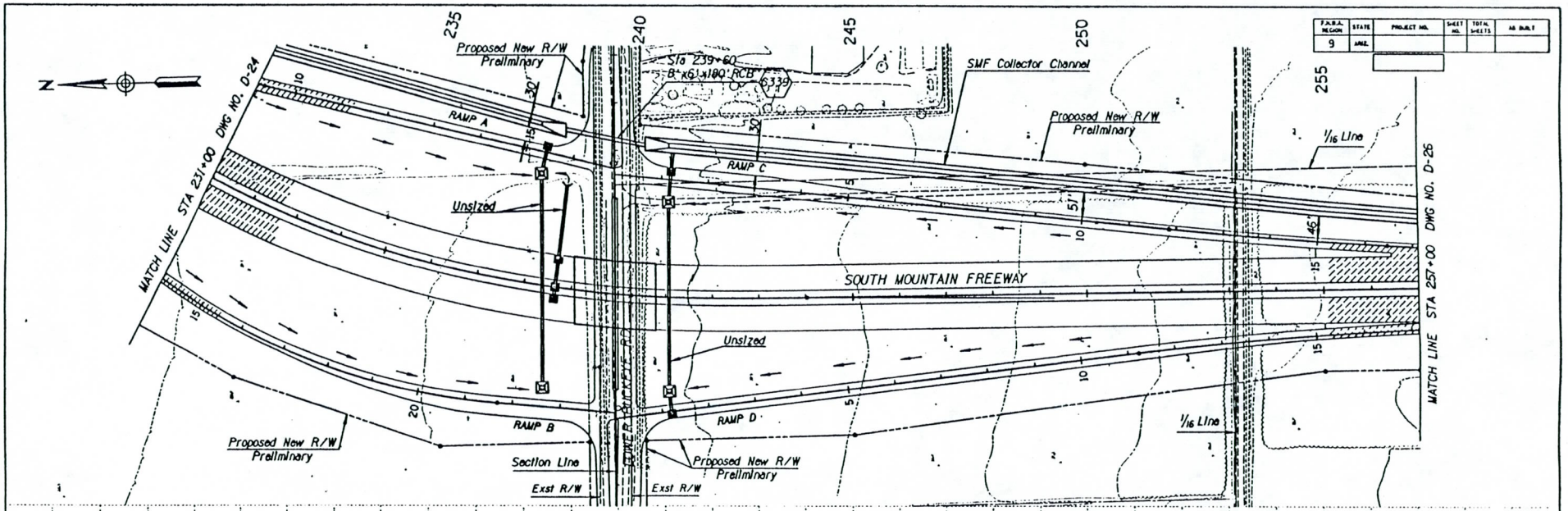
F.A.P. No.	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	5/92
DRAWN	FG	5/92
CHECKED	JZ	7/92

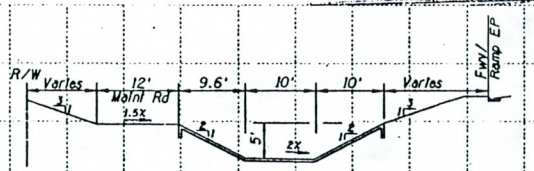
HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
PLAN AND PROFILE
STA 204+00 TO STA 231+00
LOCATION: I-10 WEST PAPAGO TO SALT RIVER
DWG NO. D-24 OF

TRACS NO. H-2222-01D | DRNSMF04 | ___ OF ___



Note: The type and location of any utilities in lower Buckeye Rd have not yet been fully identified.



TYPICAL CHANNEL SECTION
STA 231+00 TO STA 239+94,LT
STA 240+69 TO STA 257+00,LT

PRELIMINARY
NOT FOR CONSTRUCTION

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

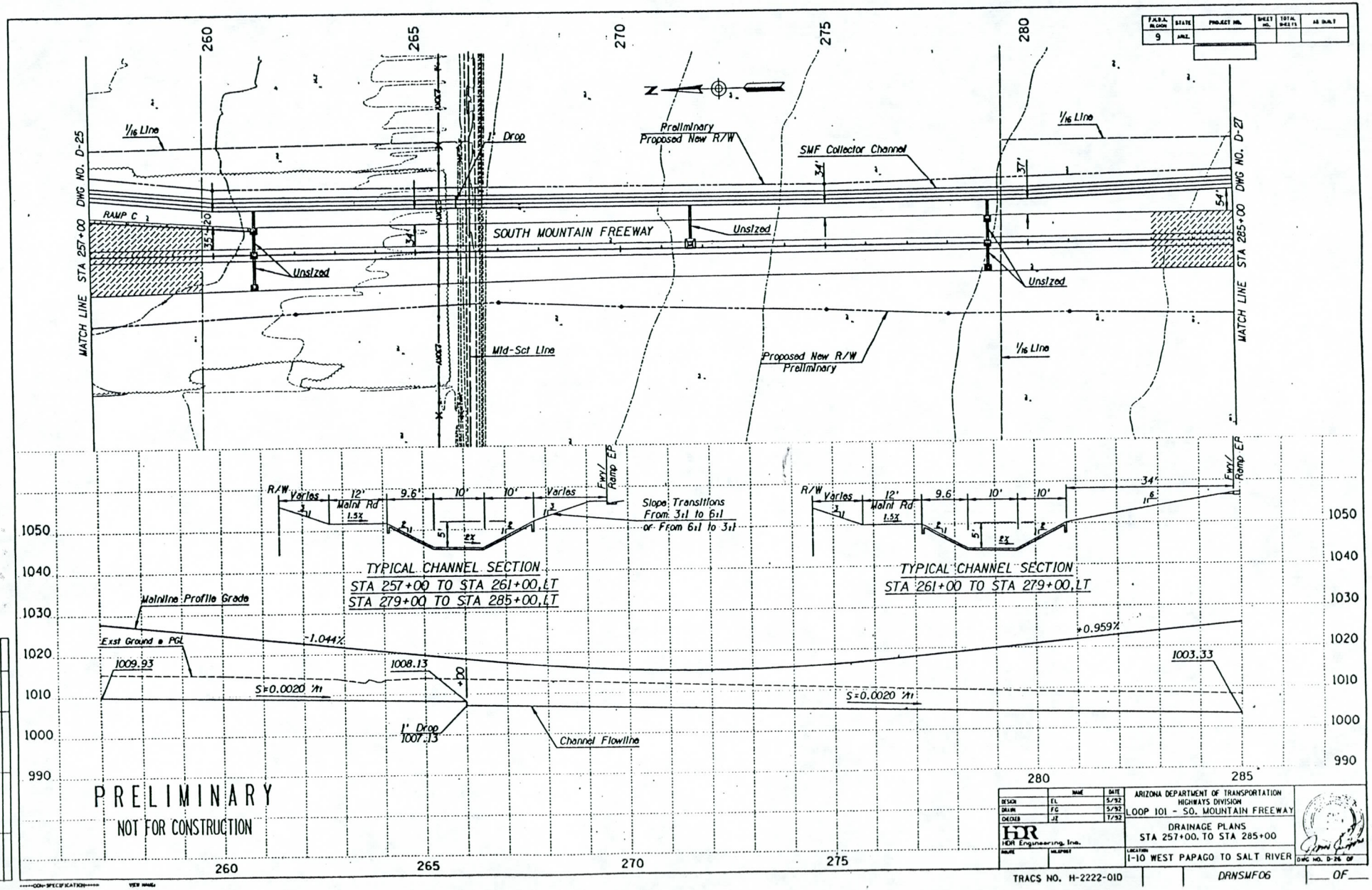
	NAME	DATE
DESIGN	EL	3/92
DRAWN	FC	3/92
CHECKED	JZ	7/92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 231+00 TO STA 257+00
I-10 WEST PAPAGO TO SALT RIVER

Dwg No. D-25 OF

TRACS NO. H-2222-01D | DRNSMF05 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	5/93
DRAWN	FC	5/93
CHECKED	JZ	7/93

HDR Engineering, Inc.

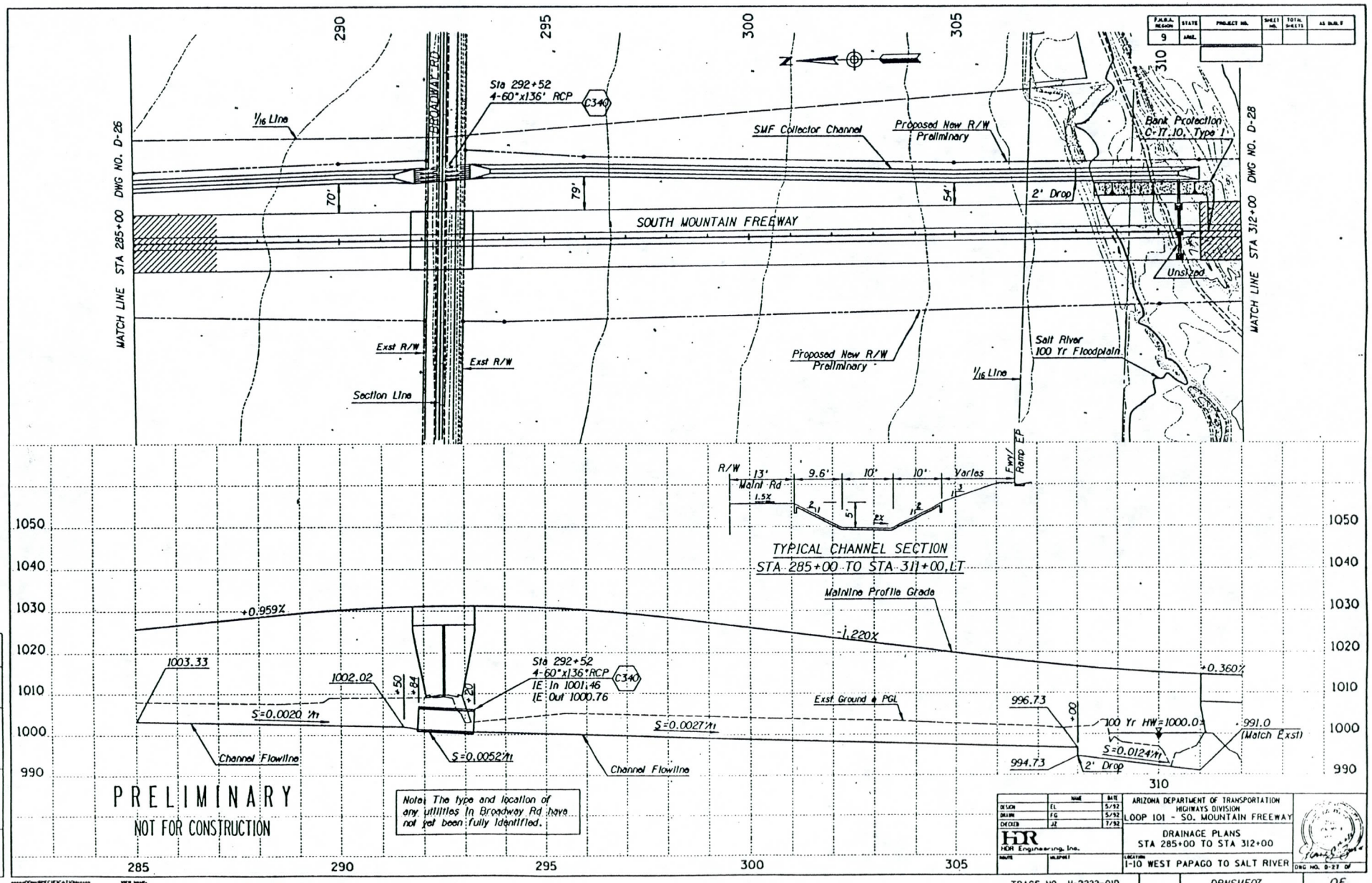
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 257+00. TO STA 285+00

LOCATION: I-10 WEST PAPAGO TO SALT RIVER

DWG NO. D-26 OF

TRACS NO. H-2222-010 | DRNSWF06 | OF



PRELIMINARY

NOT FOR CONSTRUCTION

Note: The type and location of any utilities in Broadway Rd have not yet been fully identified.

	NAME	DATE
DESIGN	EL	5/92
DRAWN	FG	5/92
CHECKED	JZ	7/92

HDR Engineering, Inc.

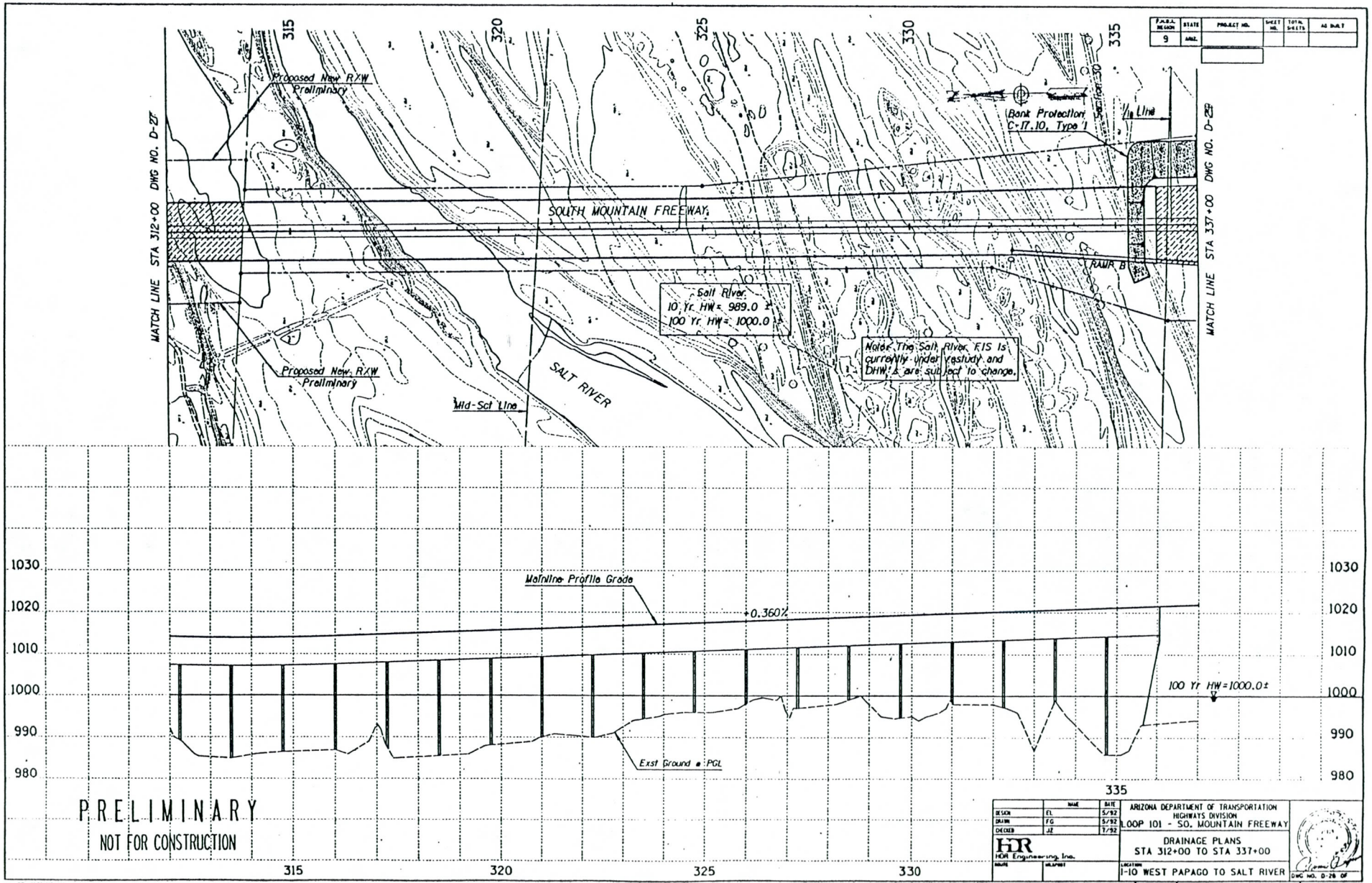
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

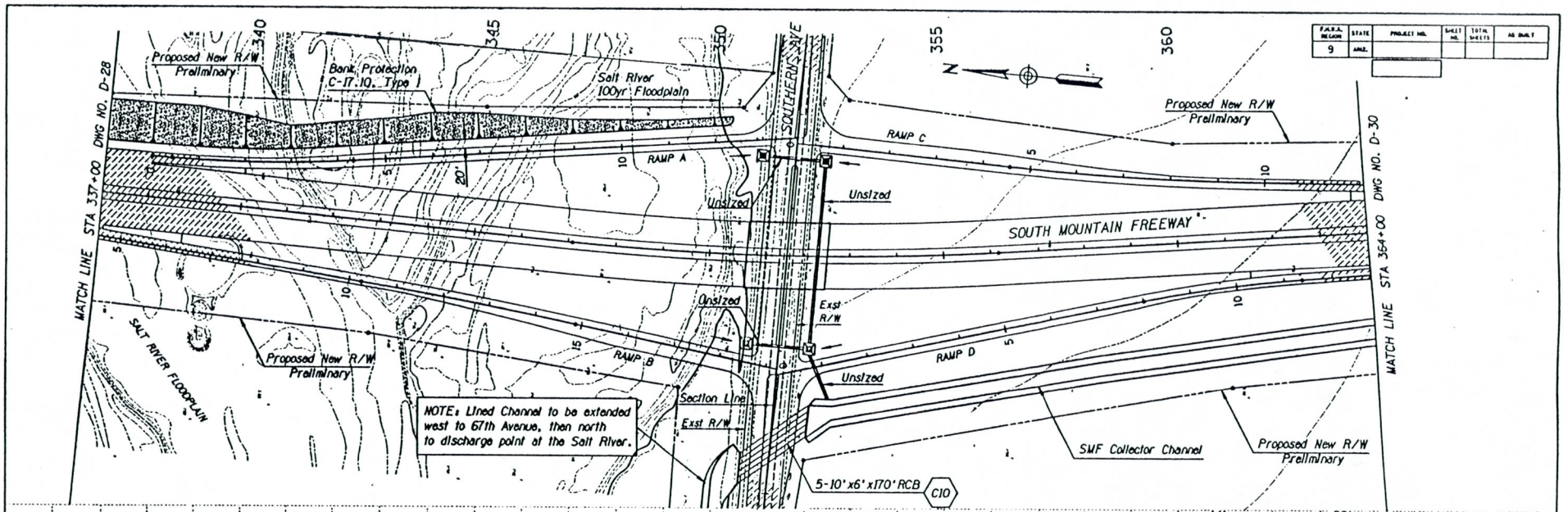
DRAINAGE PLANS
STA 285+00 TO STA 312+00

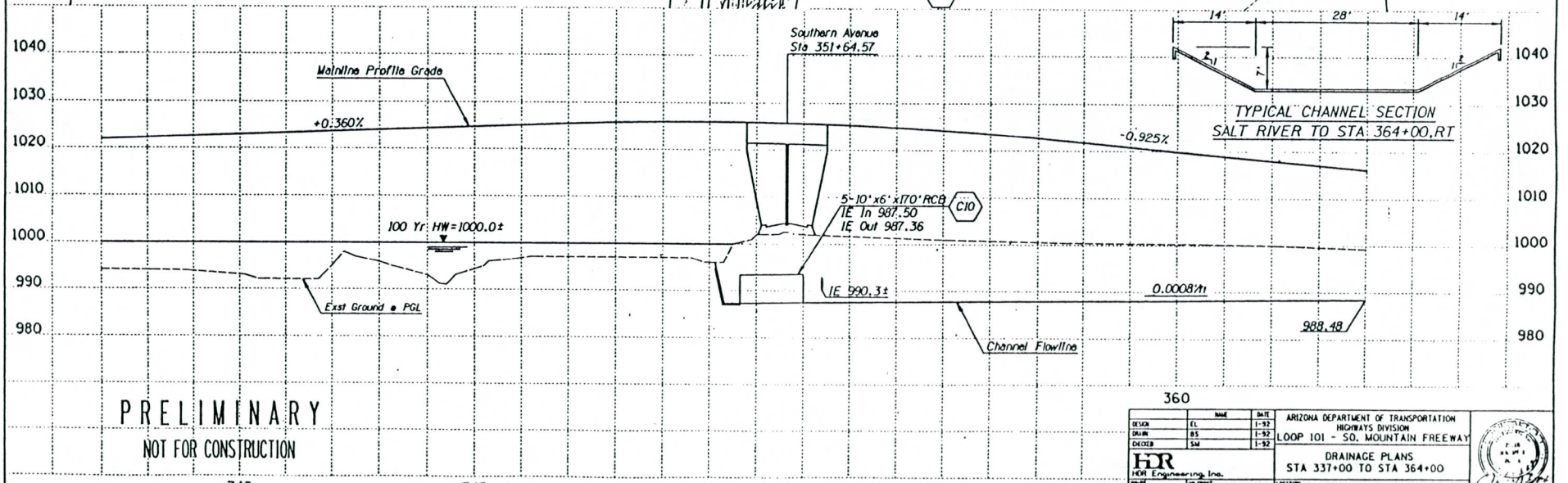
I-10 WEST PAPAGO TO SALT RIVER

DRG NO. D-27 OF

TRACS NO. H-2222-01D | DRNSMF07 | OF


315
320
325
330
335
MATCH LINE STA 312+00 DWG NO. D-27
MATCH LINE STA 337+00 DWG NO. D-29
Proposed New R/W Preliminary
SOUTH MOUNTAIN FREEWAY
Bank Protection C-17.10, Type 1
℄ Line
Section 30
RAMP B
Salt River
10 Yr. HW = 989.0 ±
100 Yr. HW = 1000.0 ±
Note: The Salt River EIS is currently under restudy and DHW's are subject to change.
Proposed New R/W Preliminary
Mid-Sct Line
SALT RIVER
1030
1020
1010
1000
990
980
Mainline Profile Grade
+0.360%
100 Yr HW=1000.0±
Exst Ground ● PGL
PRELIMINARY
NOT FOR CONSTRUCTION
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 312+00 TO STA 337+00
I-10 WEST PAPAGO TO SALT RIVER
HDR Engineering, Inc.
DESIGN FL 5/92
DRAWN FG 5/92
CHECKED JZ 7/92
TRACS NO. H-2222-01D
DRNSWF08





PRELIMINARY

NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

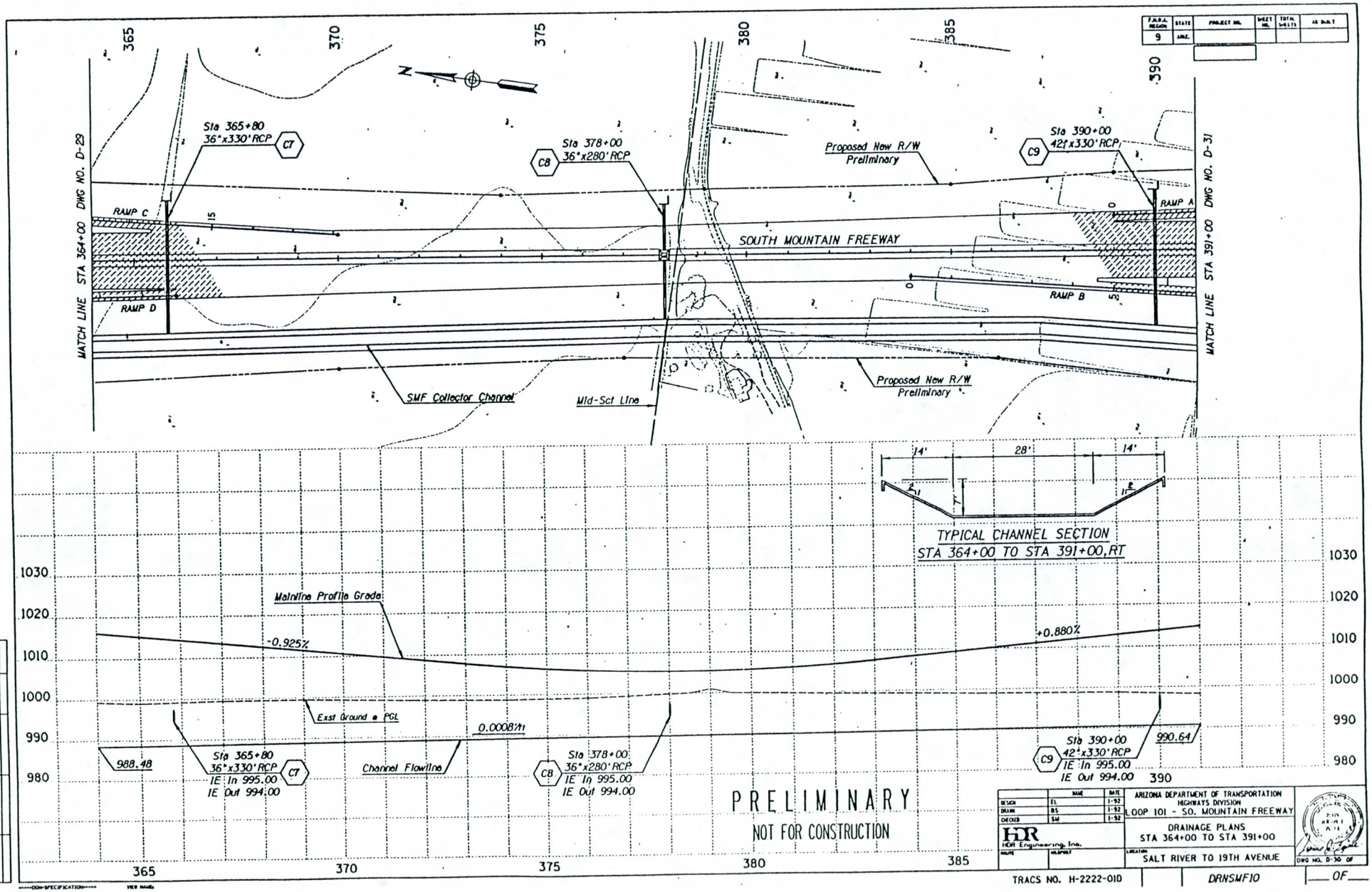
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 337+00 TO STA 364+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-29 OF ___

TRACS NO. H-2222-01D | DRNSWF09 | ___ OF ___



F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

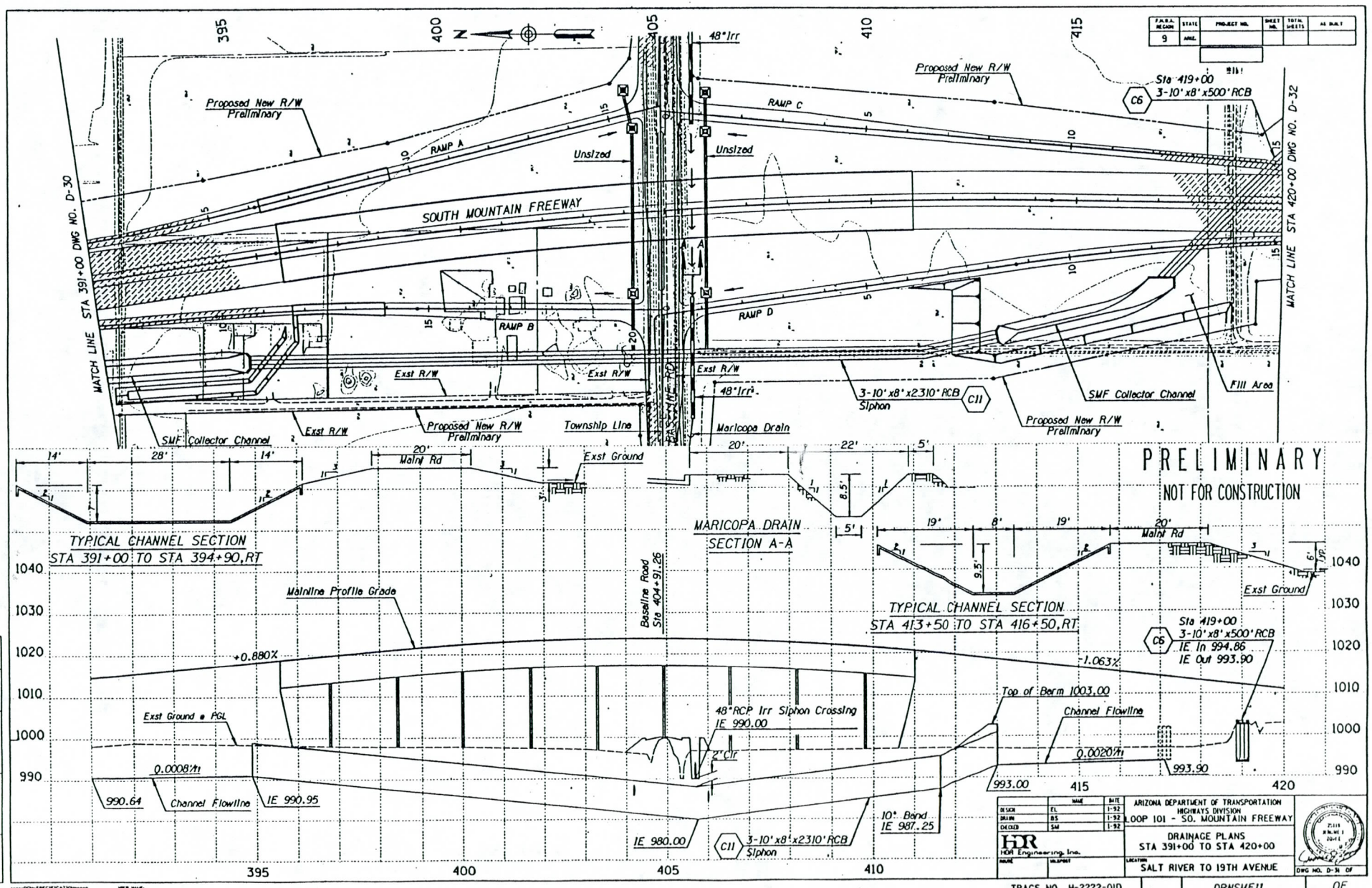
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 364+00 TO STA 391+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-30 OF

TRACS NO. H-2222-01D | DRNSWF10 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	FL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

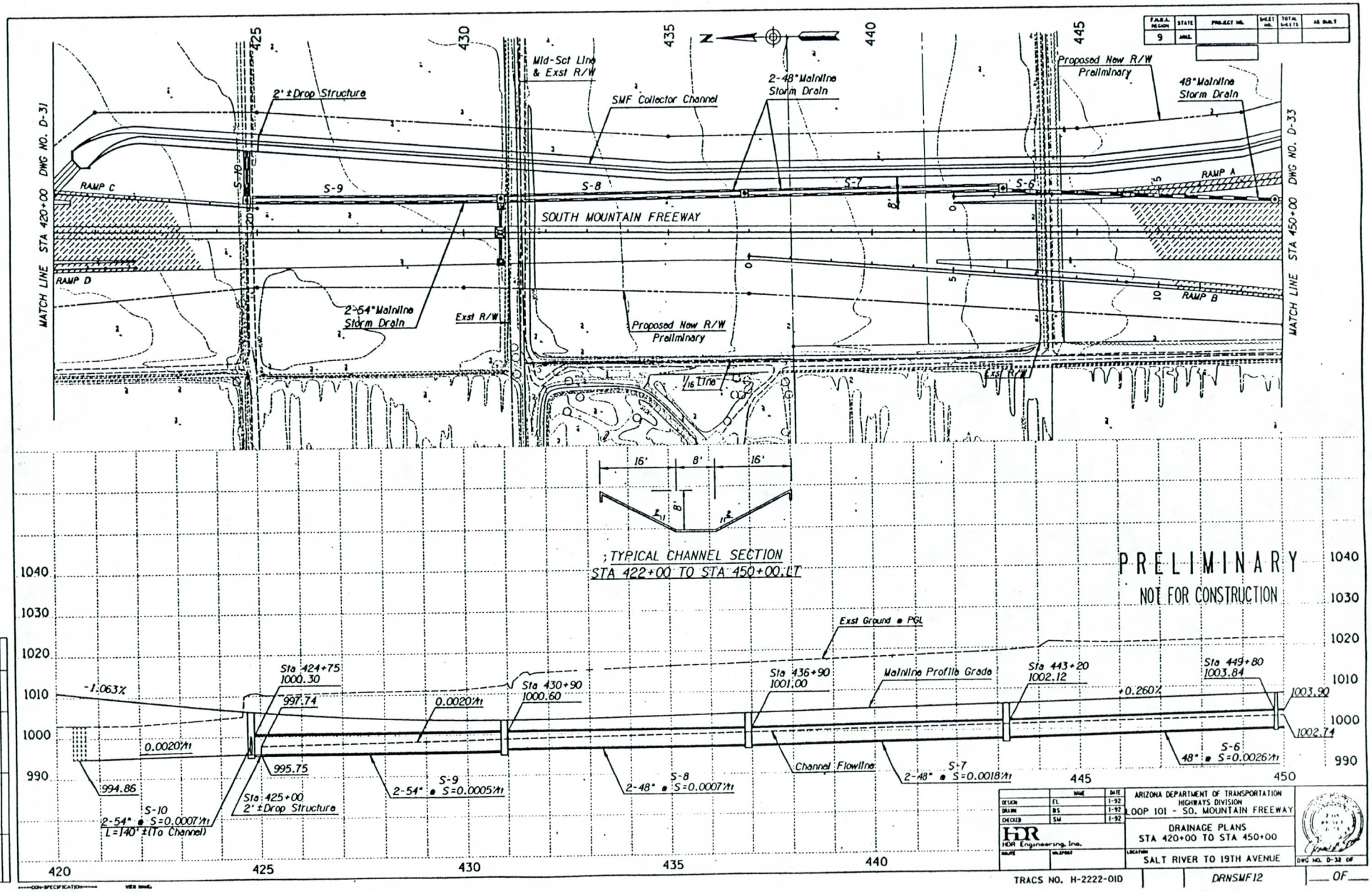
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 391+00 TO STA 420+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-31 OF ___

TRACS NO. H-2222-01D | DRNSMF11 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

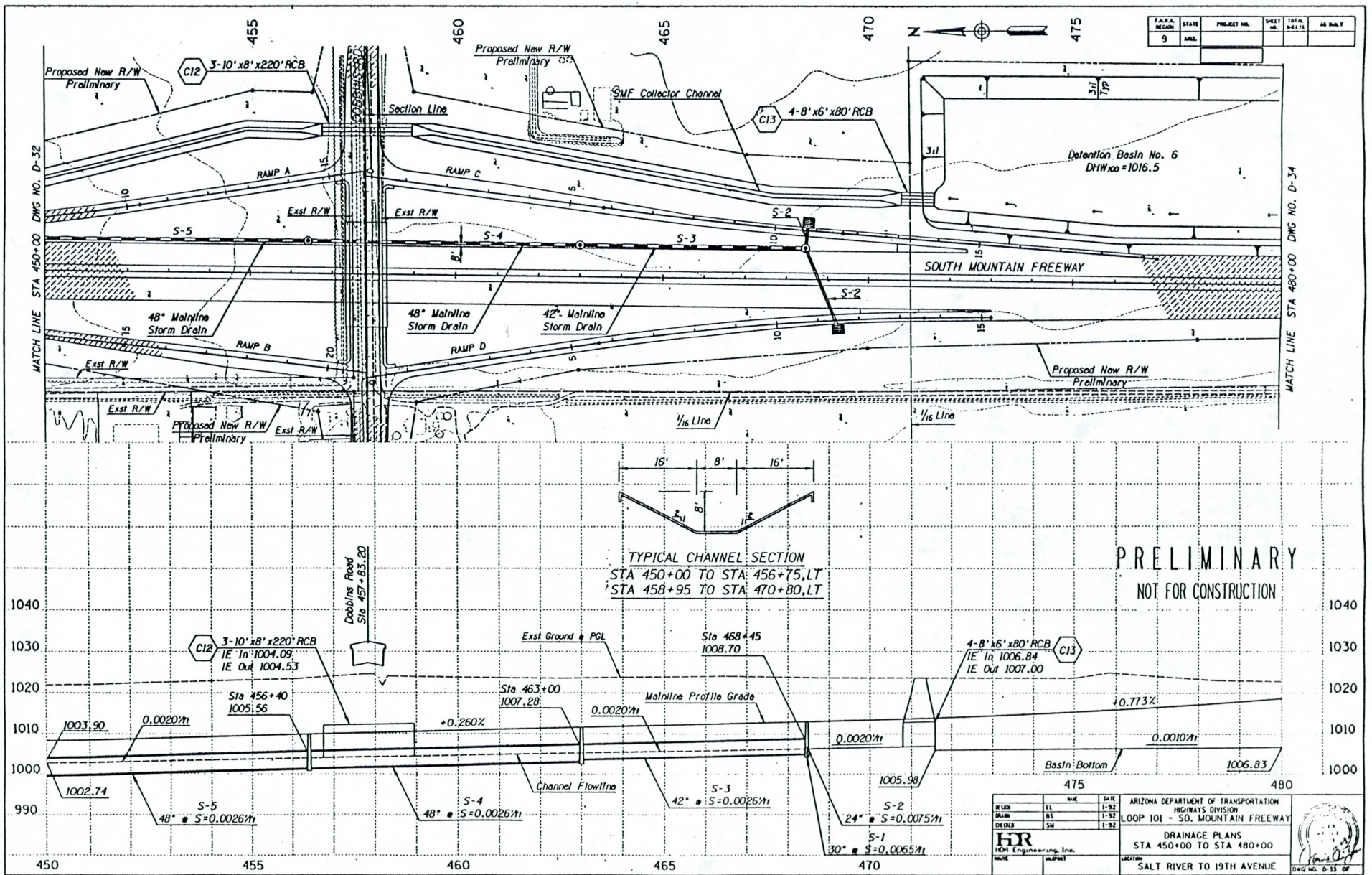
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 420+00 TO STA 450+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-32 OF

TRACS NO. H-2222-01D | DRNSMF12 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS Built ?
9	ARIZ.				

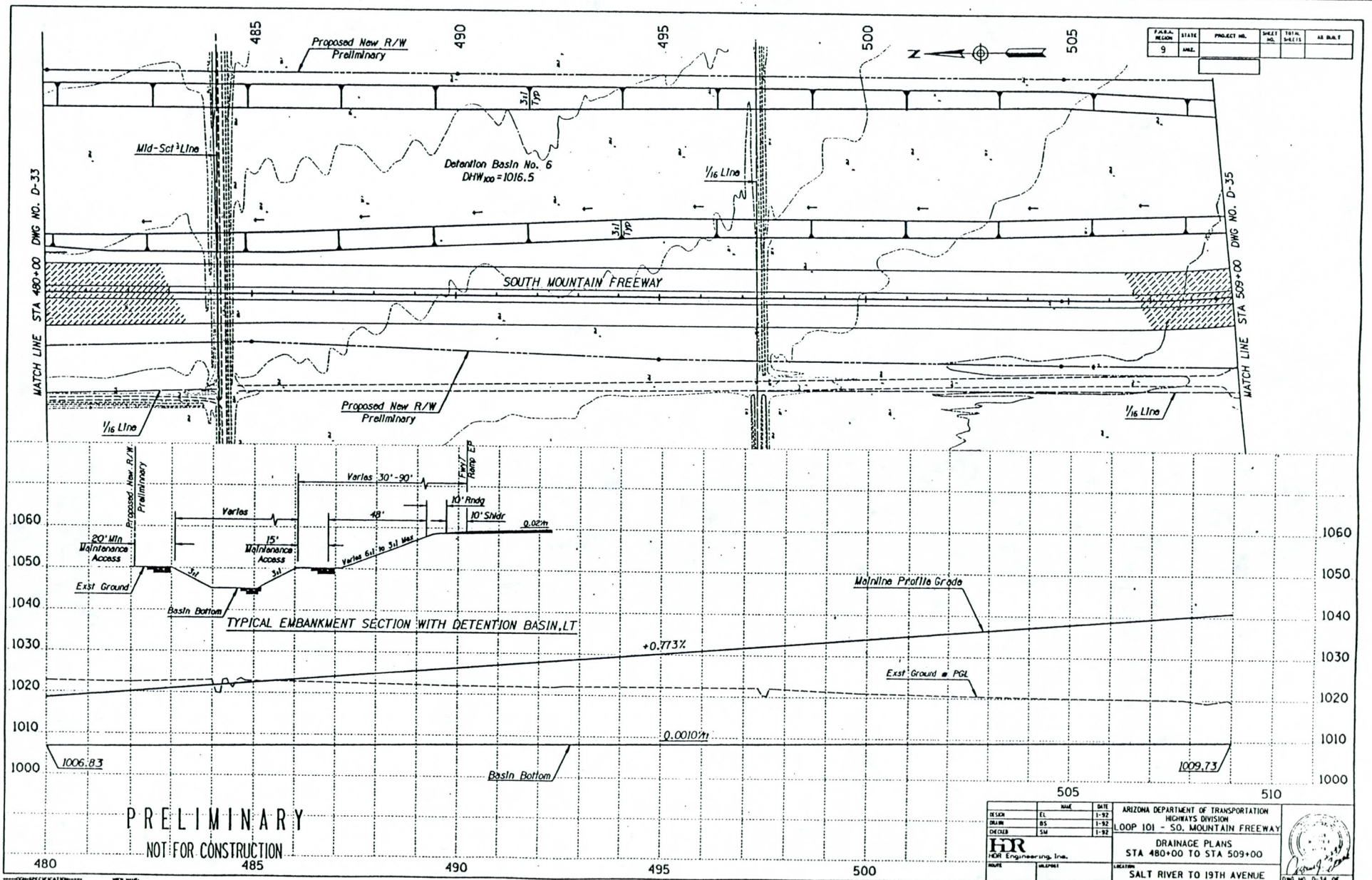
	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SW	1-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 450+00 TO STA 480+00
LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-33 OF

TRACS NO. H-2222-01D | DRNSMF13 | ___ OF ___



F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 480+00 TO STA 509+00

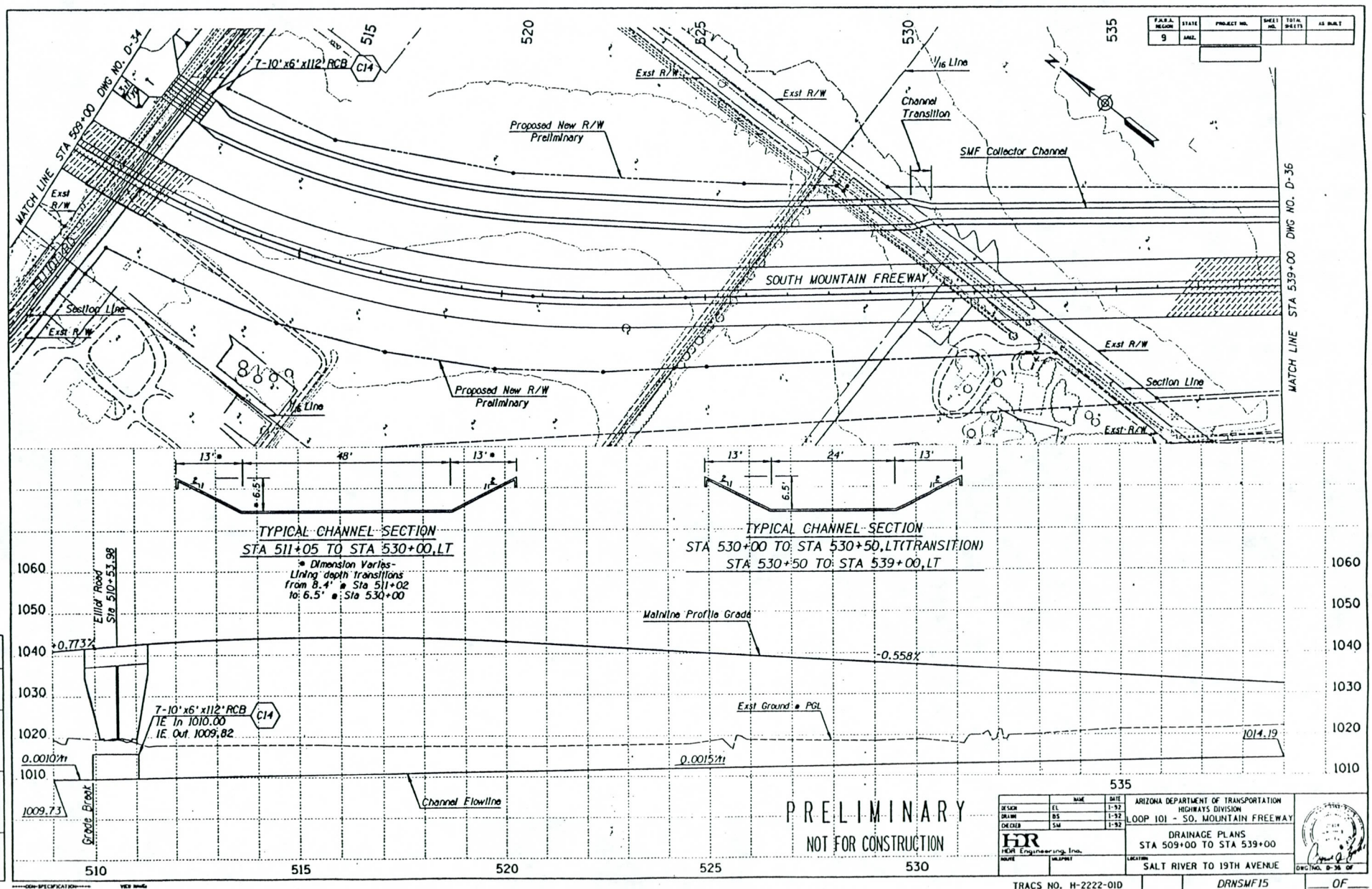
LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-34 OF

TRACS NO. H-2222-010

DRNSMF14

OF



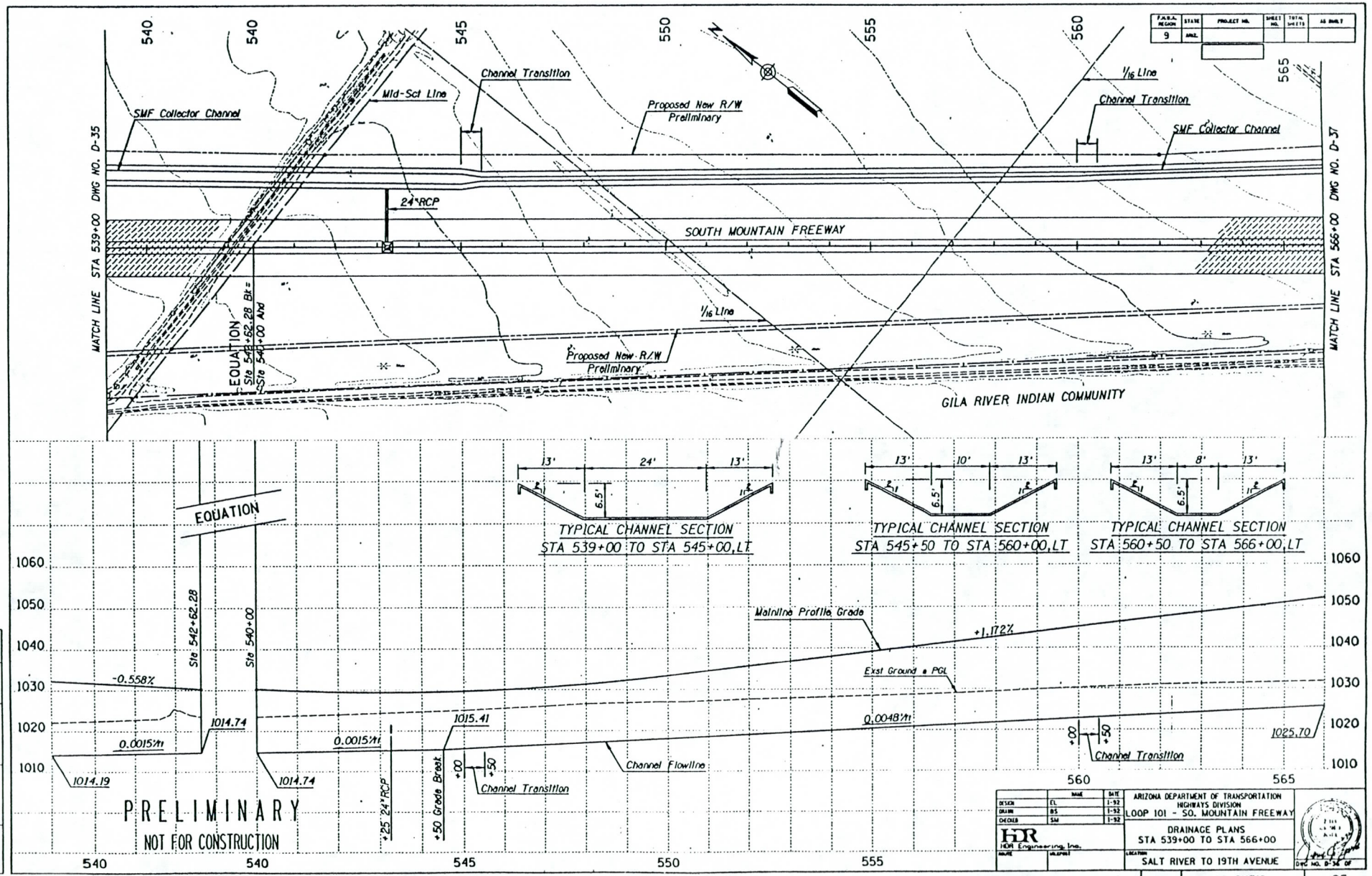
PRELIMINARY
NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 509+00 TO STA 539+00
LOCATION: SALT RIVER TO 19TH AVENUE

TRACS NO. H-2222-01D | DRNSMF15 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

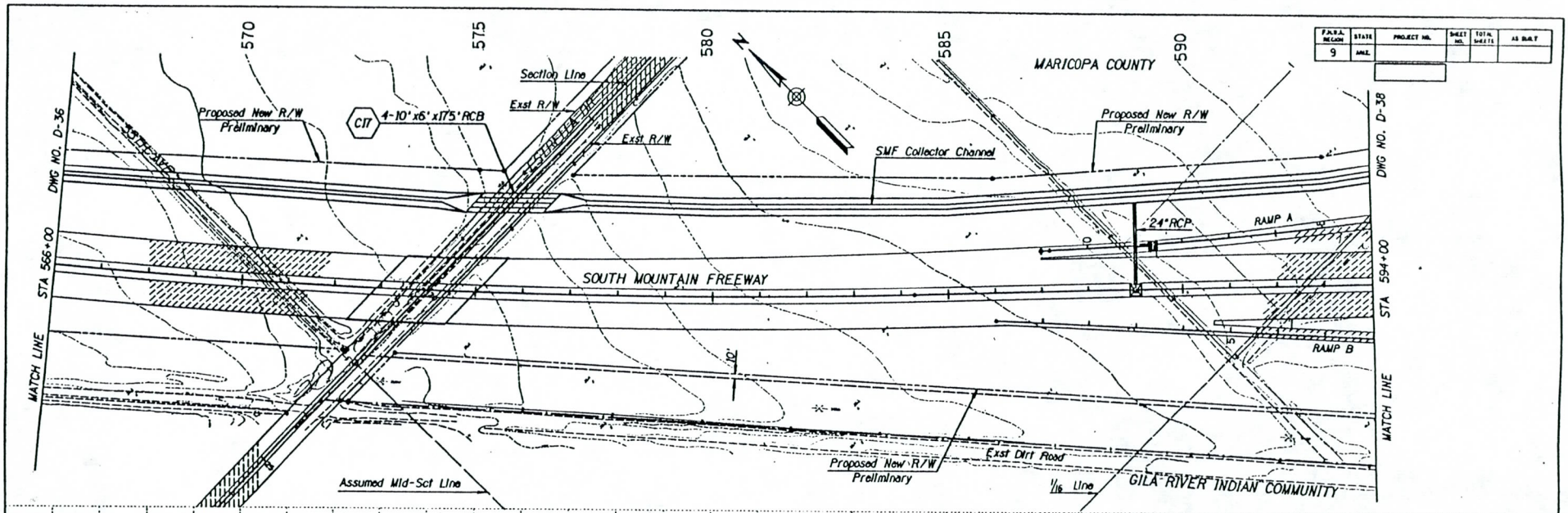
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 539+00 TO STA 566+00

LOCATION: SALT RIVER TO 19TH AVENUE

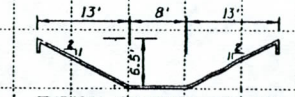
DWG NO. D-36 OF

TRACS NO. H-2222-01D | DRNSMF16 | ___ OF ___

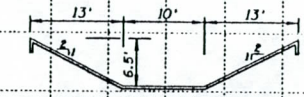


PRELIMINARY

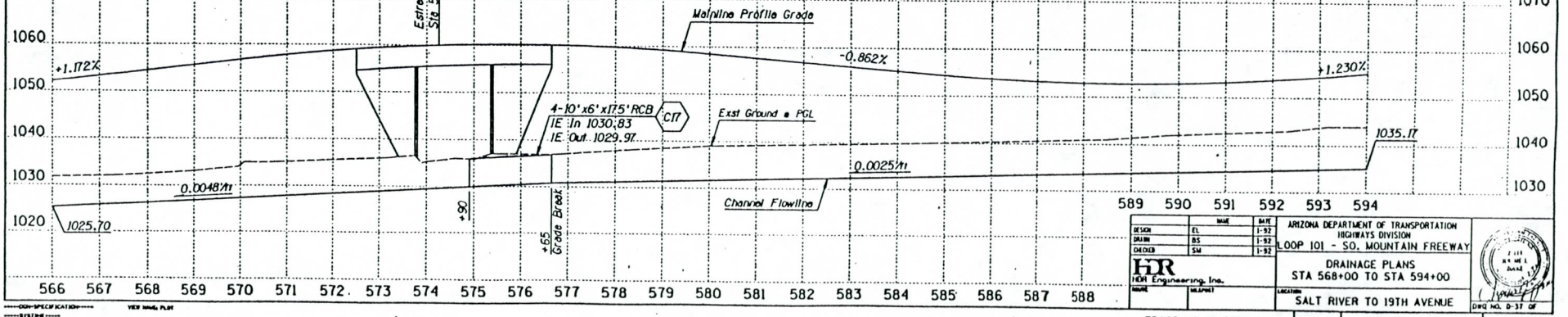
NOT FOR CONSTRUCTION



TYPICAL CHANNEL SECTION
STA 566+00 TO STA 574+90, LT



TYPICAL CHANNEL SECTION
STA 576+65 TO STA 594+00, LT



	NAME	DATE
DESIGN	EL	1-92
DRAWN	BS	1-92
CHECKED	SM	1-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

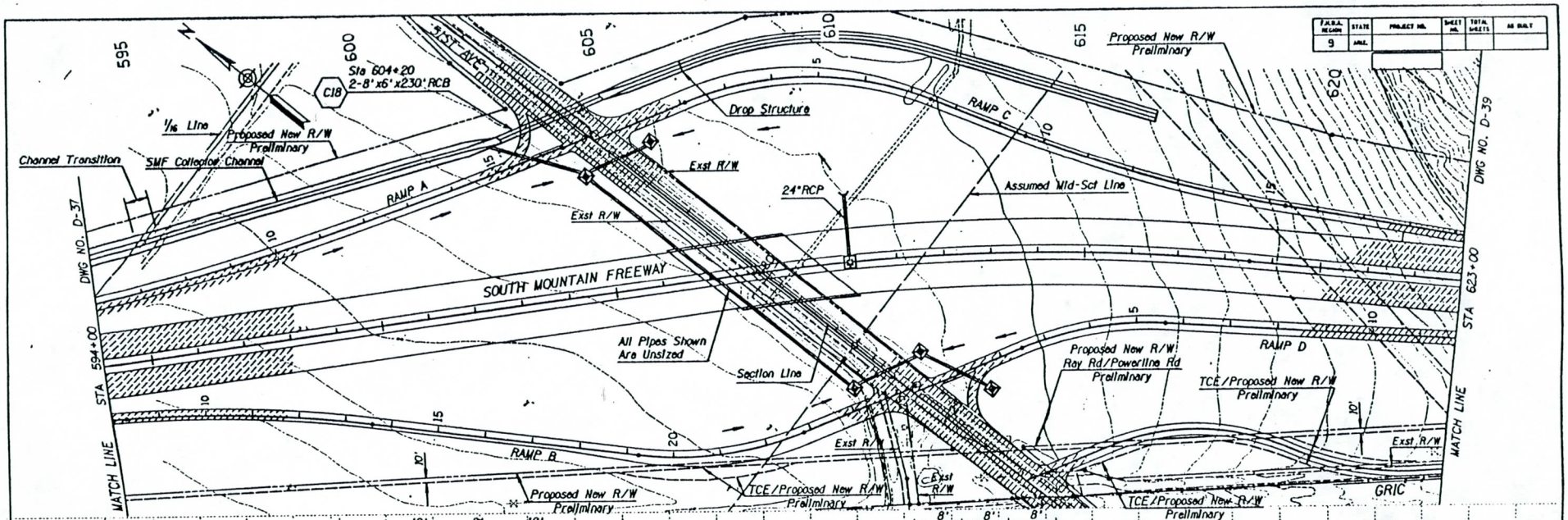
DRAINAGE PLANS
STA 568+00 TO STA 594+00

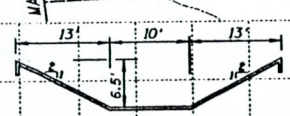
LOCATION: SALT RIVER TO 19TH AVENUE

TRACS NO. H-2222-01D

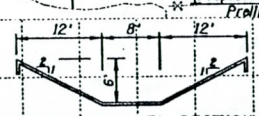
DRSWL212

DWG NO. D-37 OF ___

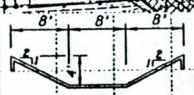




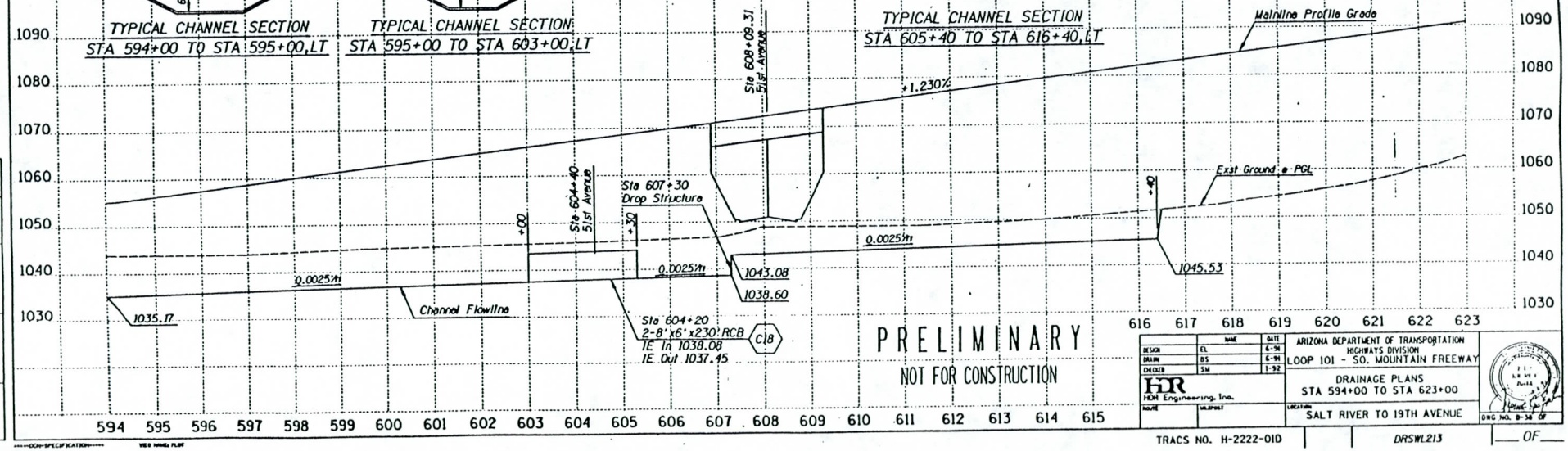
TYPICAL CHANNEL SECTION
STA 594+00 TO STA 595+00,LT



TYPICAL CHANNEL SECTION
STA 595+00 TO STA 603+00,LT



TYPICAL CHANNEL SECTION
STA 605+40 TO STA 616+40,LT



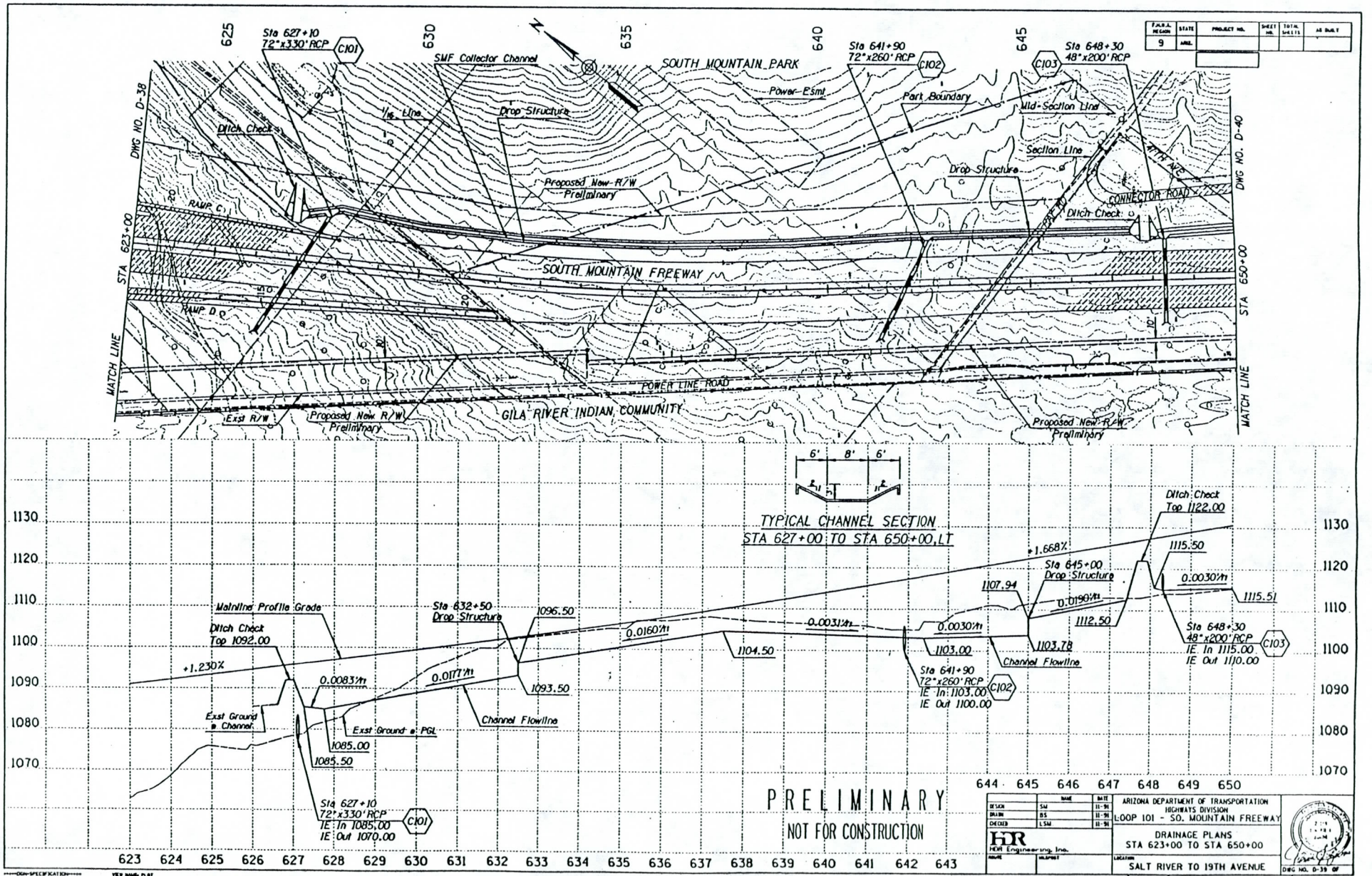
PRELIMINARY
NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	EL	6-91
DRAWN	BS	6-91
CHECKED	SM	1-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 594+00 TO STA 623+00
SALT RIVER TO 19TH AVENUE

TRACS NO. H-2222-01D
DRSWL213
DWG NO. D-38 OF ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SM	11-96
DRAWN	BS	11-96
CHECKED	LSM	11-96

HDR Engineering, Inc.

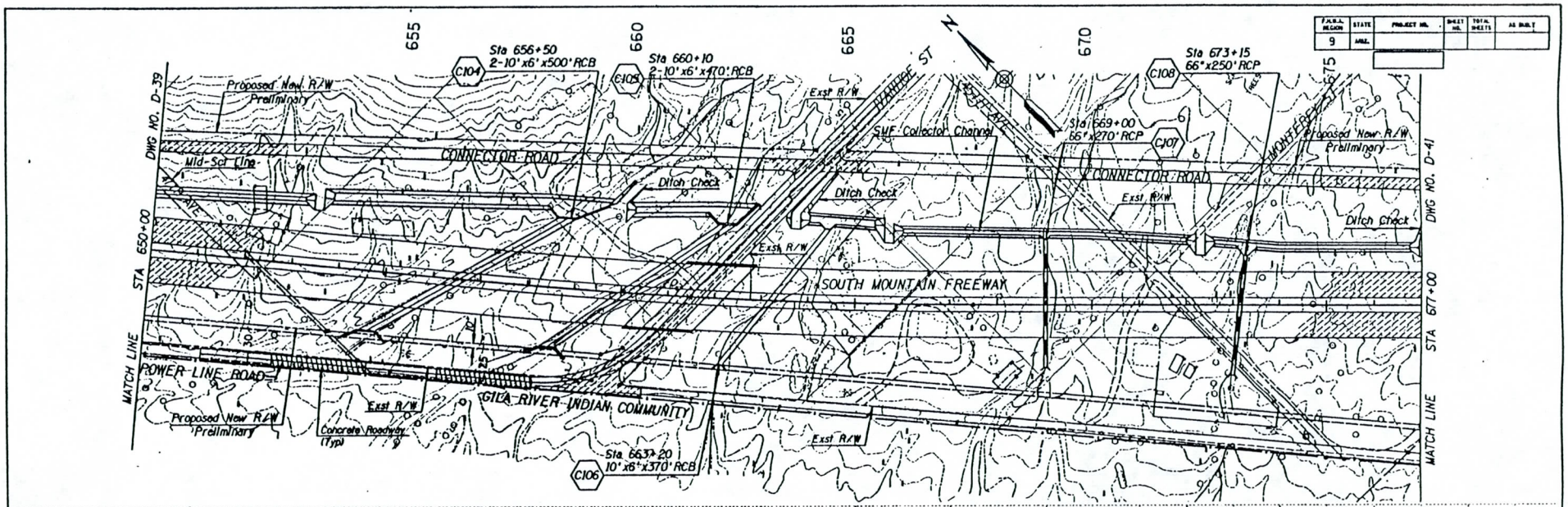
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

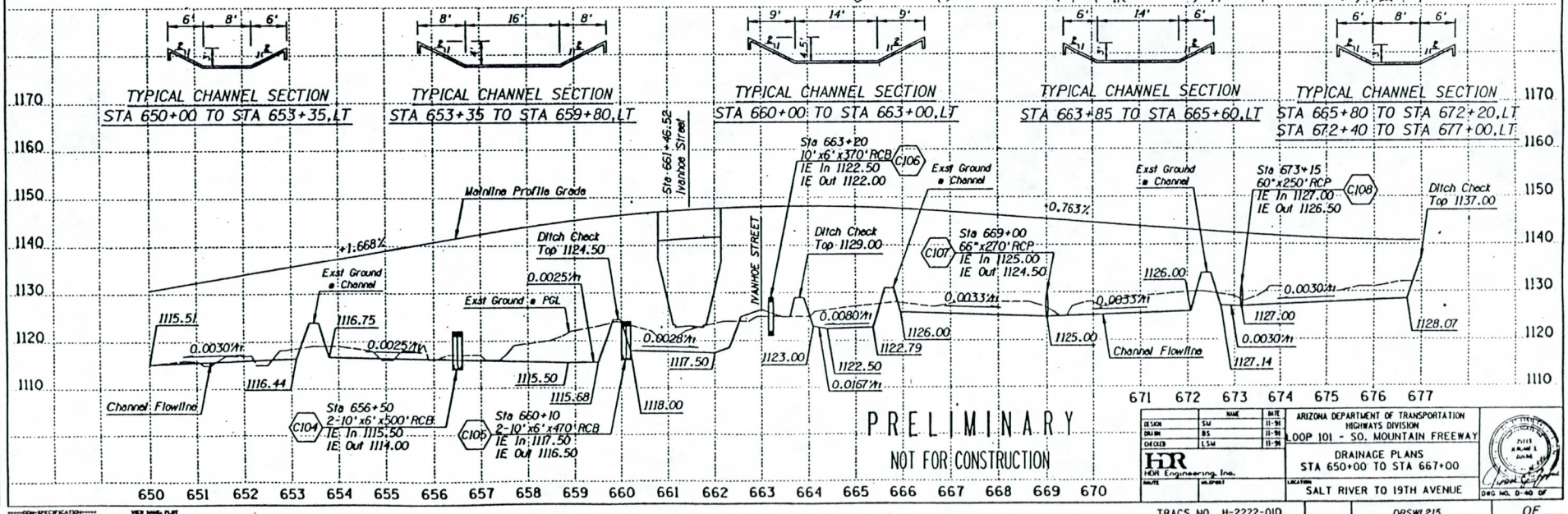
DRAINAGE PLANS
STA 623+00 TO STA 650+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-39 OF

TRACS NO. H-2222-01D | DRSW1214 | ___ OF ___





PRELIMINARY
NOT FOR CONSTRUCTION

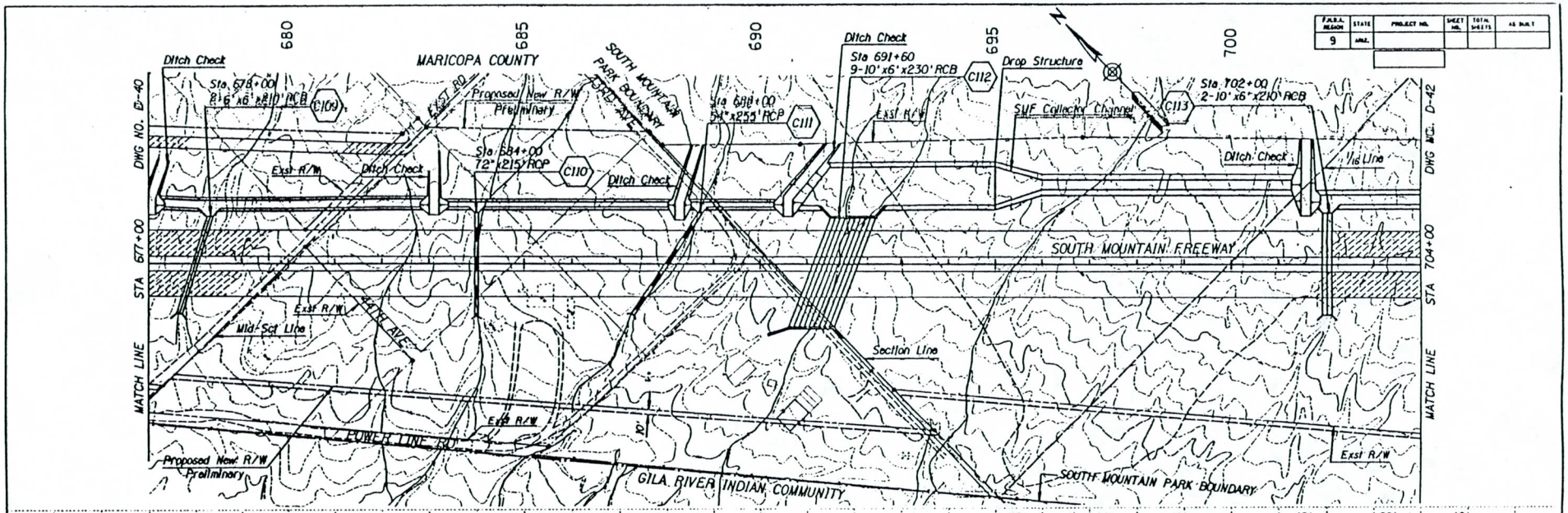
	NAME	DATE
DESIGN	SM	11-98
DRAWN	BS	11-98
CHECKED	LSM	11-98

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 650+00 TO STA 667+00
SALT RIVER TO 19TH AVENUE

DWG NO. D-40 OF

TRACS NO. H-2222-01D | DRSWL215 | OF



TYPICAL CHANNEL SECTION
STA 677+20 TO STA 683+00,LT

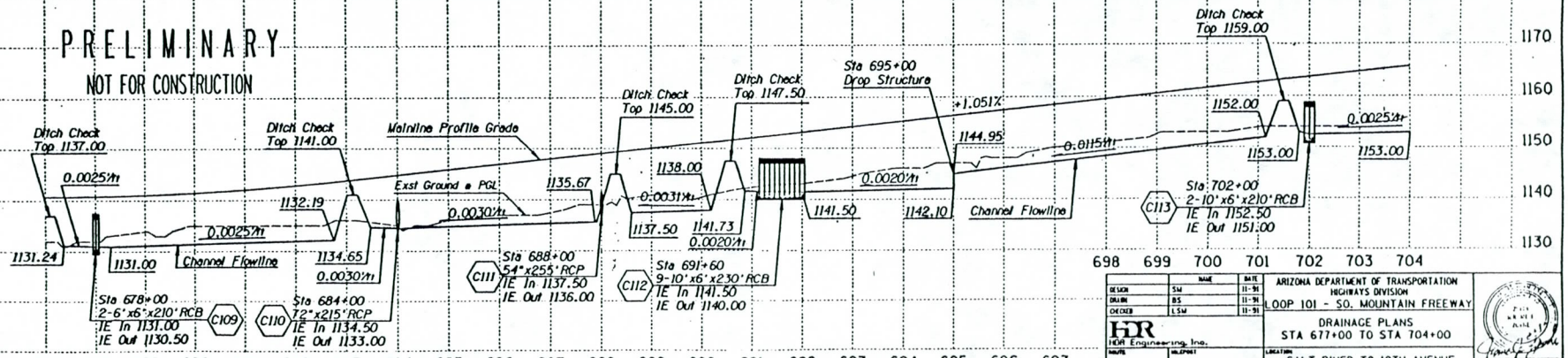
TYPICAL CHANNEL SECTION
STA 683+20 TO STA 688+15,LT
STA 688+35 TO STA 690+50,LT

TYPICAL CHANNEL SECTION
STA 690+70 TO STA 695+00,LT

TYPICAL CHANNEL SECTION
STA 695+00 TO STA 701+45,LT

TYPICAL CHANNEL SECTION
STA 701+65 TO STA 704+00,LT

PRELIMINARY
NOT FOR CONSTRUCTION

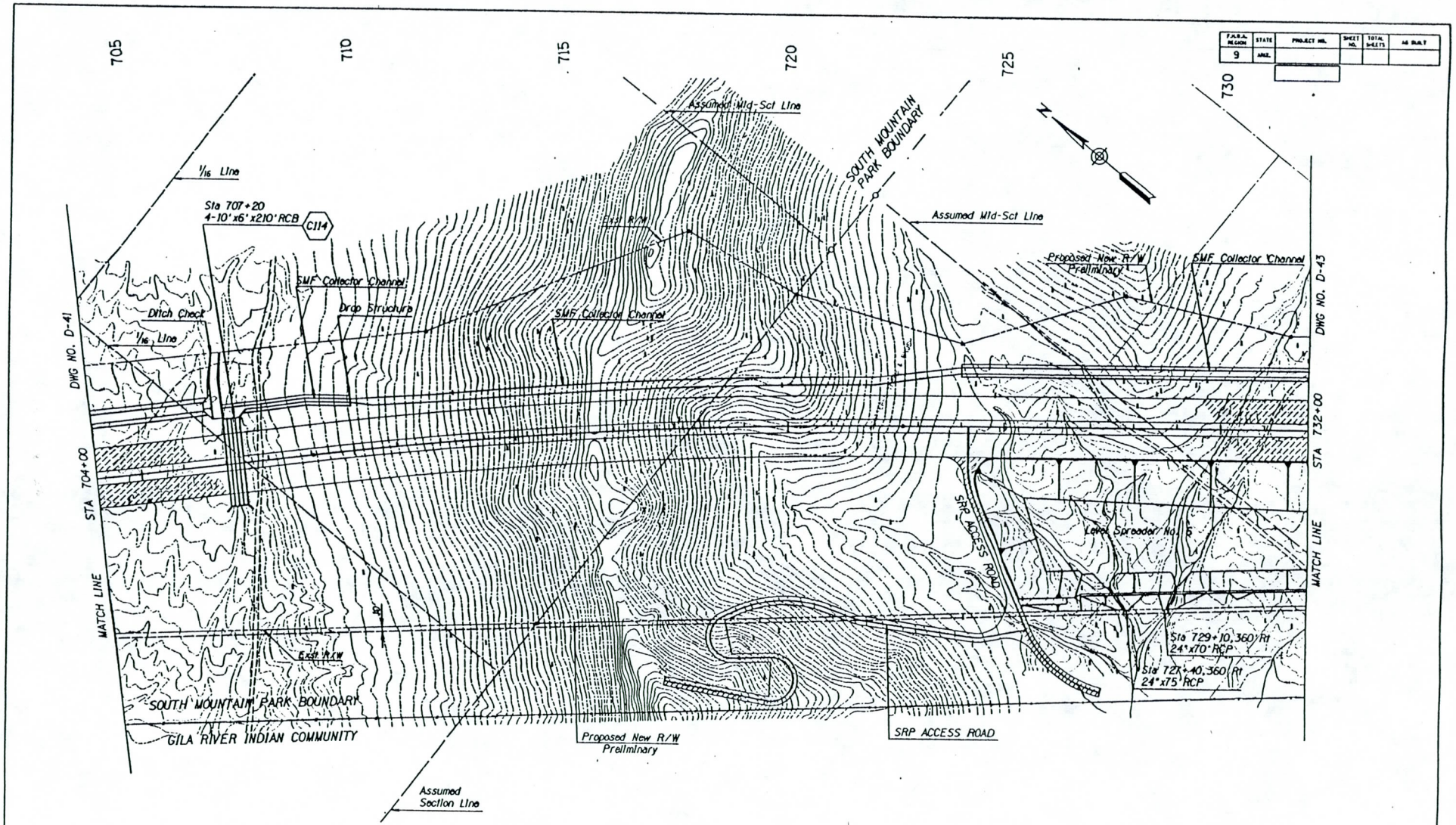


	NAME	DATE
DESIGN	SM	11-91
DRAWN	BS	11-91
CHECKED	LSW	11-91

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 677+00 TO STA 704+00
LOCATION: SALT RIVER TO 19TH AVENUE

TRACS NO. H-2222-01D | DRSWL216 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	NO. BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SM	11-91
DRAWN	BS	11-91
CHECKED	LSM	11-91

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 704+00 TO STA 732+00

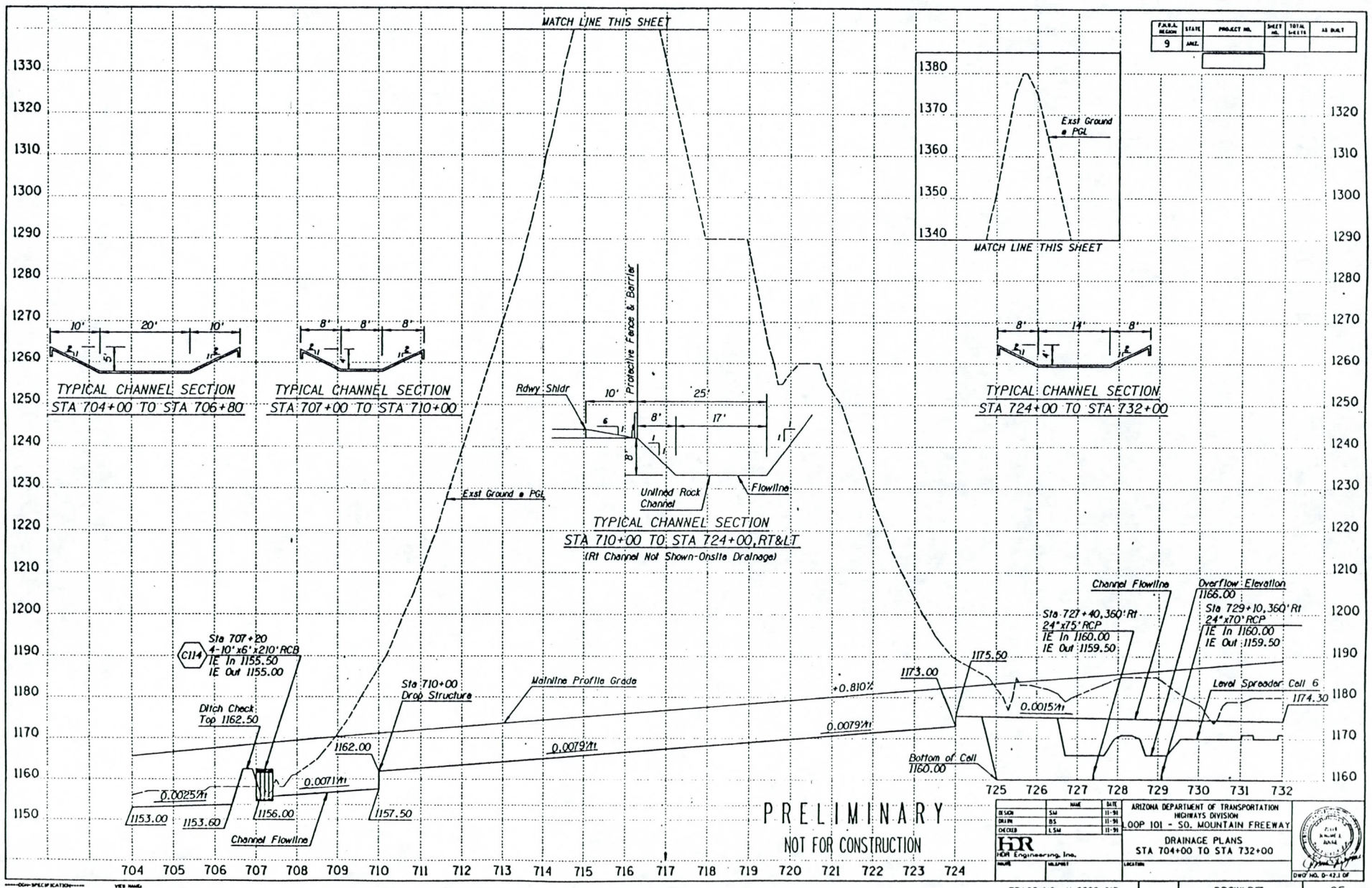
LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-42 OF

TRACS NO. H-2222-01D

DRSW1217

___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SM	11-91
DRAWN	BS	11-91
CHECKED	LSM	11-91

HDR Engineering, Inc.

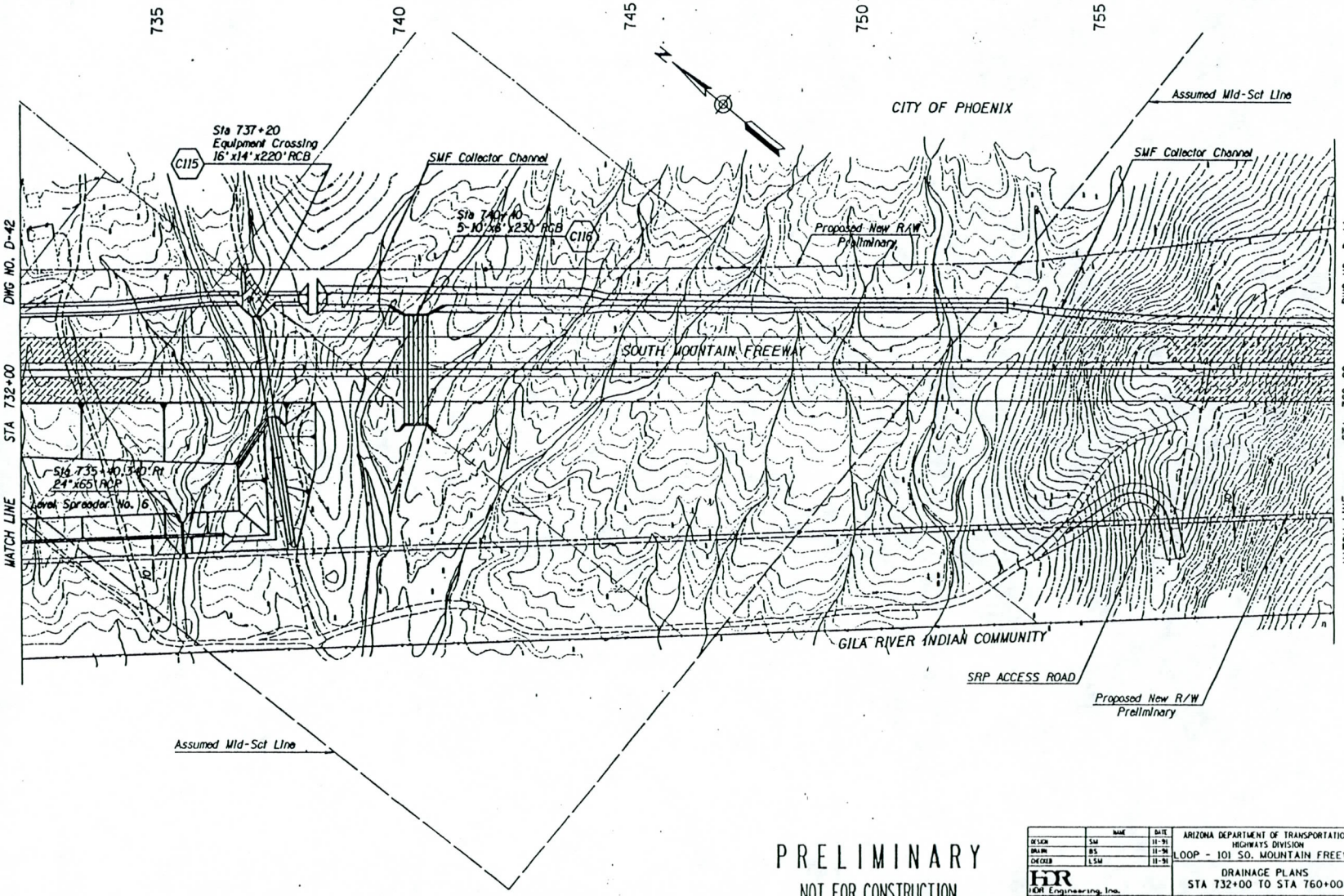
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 704+00 TO STA 732+00

DWG NO. D-42.1 DF

TRACS NO. H-2222-01D | DRSWLP17 | OF

F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



PRELIMINARY
NOT FOR CONSTRUCTION

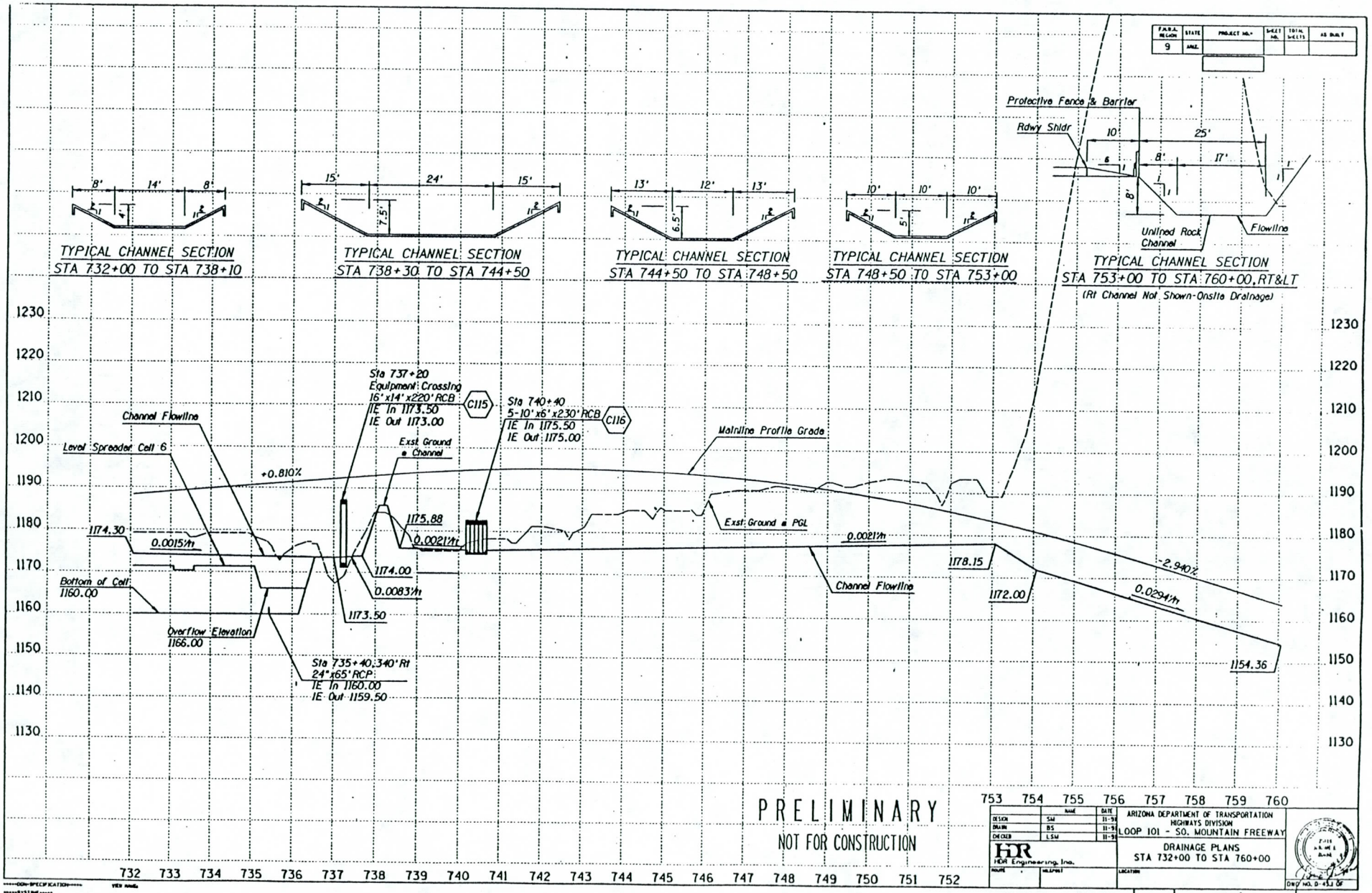
	NAME	DATE
DESIGN	SM	11-91
DRAWN	BS	11-91
CHECKED	LSW	11-91

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP - 101 SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 732+00 TO STA 760+00
SALT RIVER TO 19TH AVENUE

DWG NO. D-43 OF

TRACS NO. H-2222-010 | DRSWL218 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

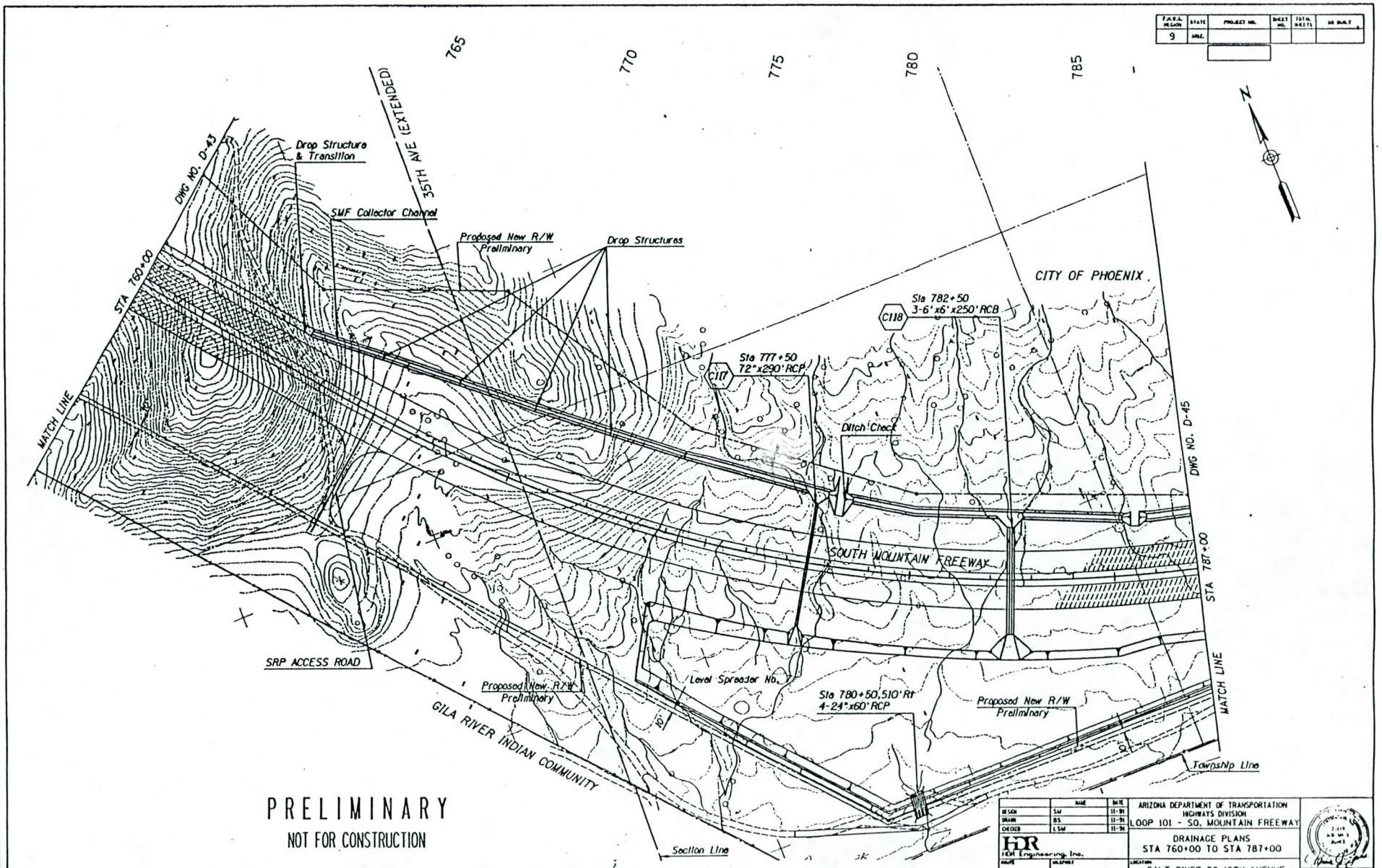
	NAME	DATE
DESIGN	SM	11-94
DRAWN	BS	11-94
CHECKED	LSM	11-94

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 732+00 TO STA 760+00

DWG NO. D-453 OF

TRACS NO. H-2222-01D | DRSWLP18 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.M. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SM	11-94
DRAWN	BS	11-94
CHECKED	LSM	11-94

HDR Engineering, Inc.

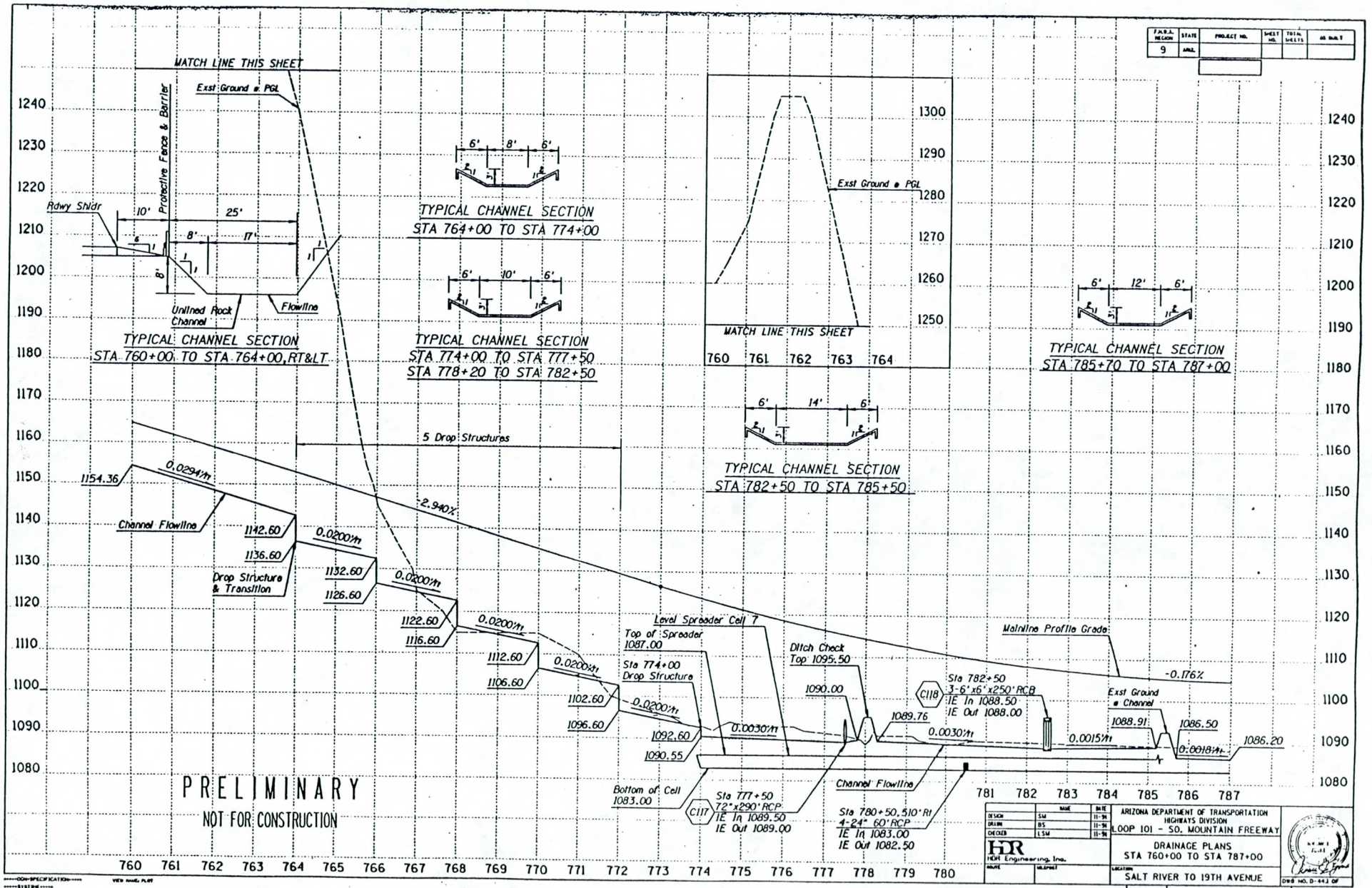
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 760+00 TO STA 787+00

LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-44 OF

TRACS NO. H-2222-01D | DRSWL219 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

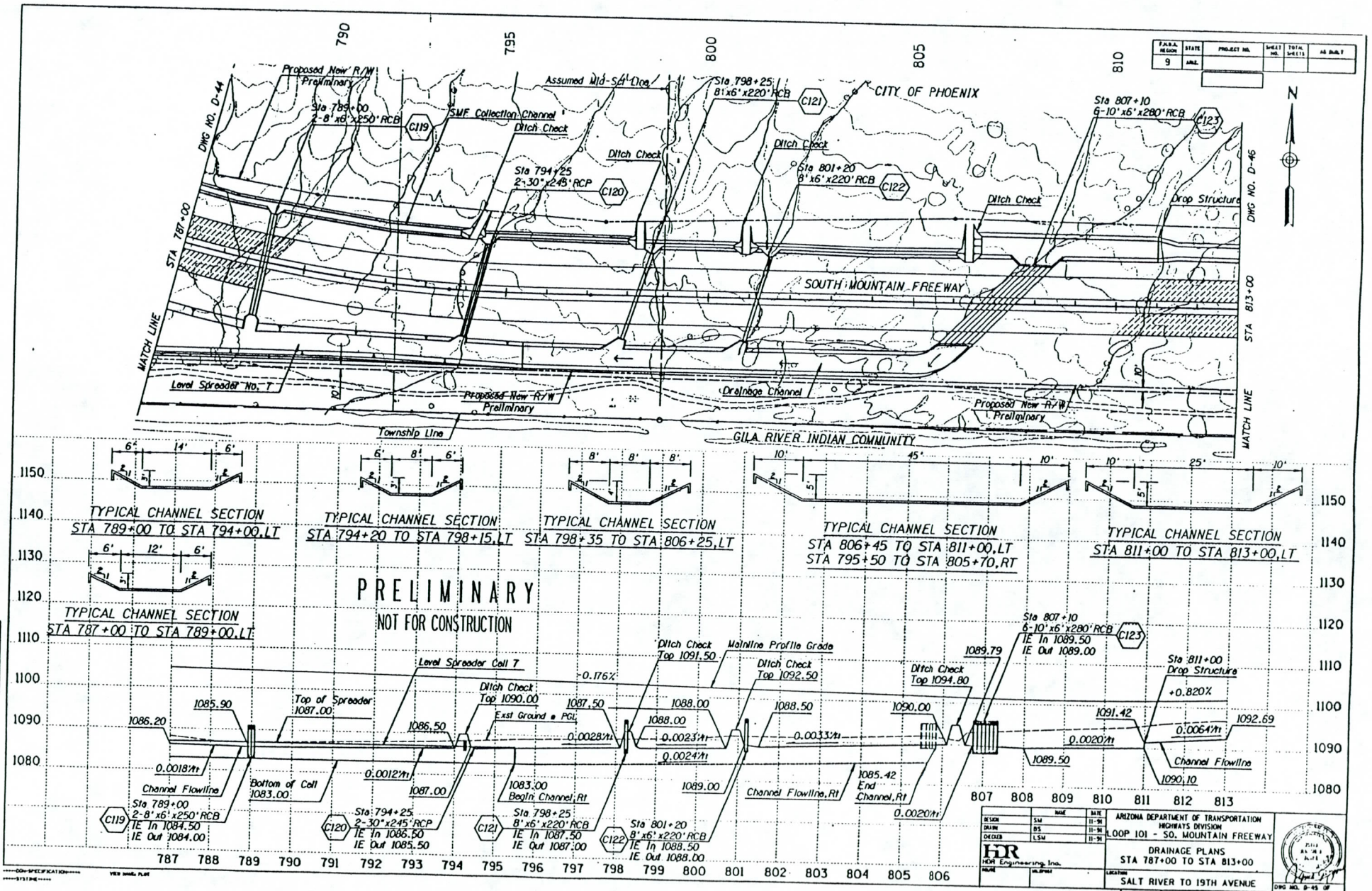
	NAME	DATE
DESIGN	SM	11-96
DRAWN	BS	11-96
CHECKED	LSM	11-96
QUANT.		
SUPVSR		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 760+00 TO STA 787+00
LOCATION: SALT RIVER TO 19TH AVENUE

DRB NO. D-44J OF

TRACS NO. H-2222-01D | DRSWLP19 | ___ OF ___



F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

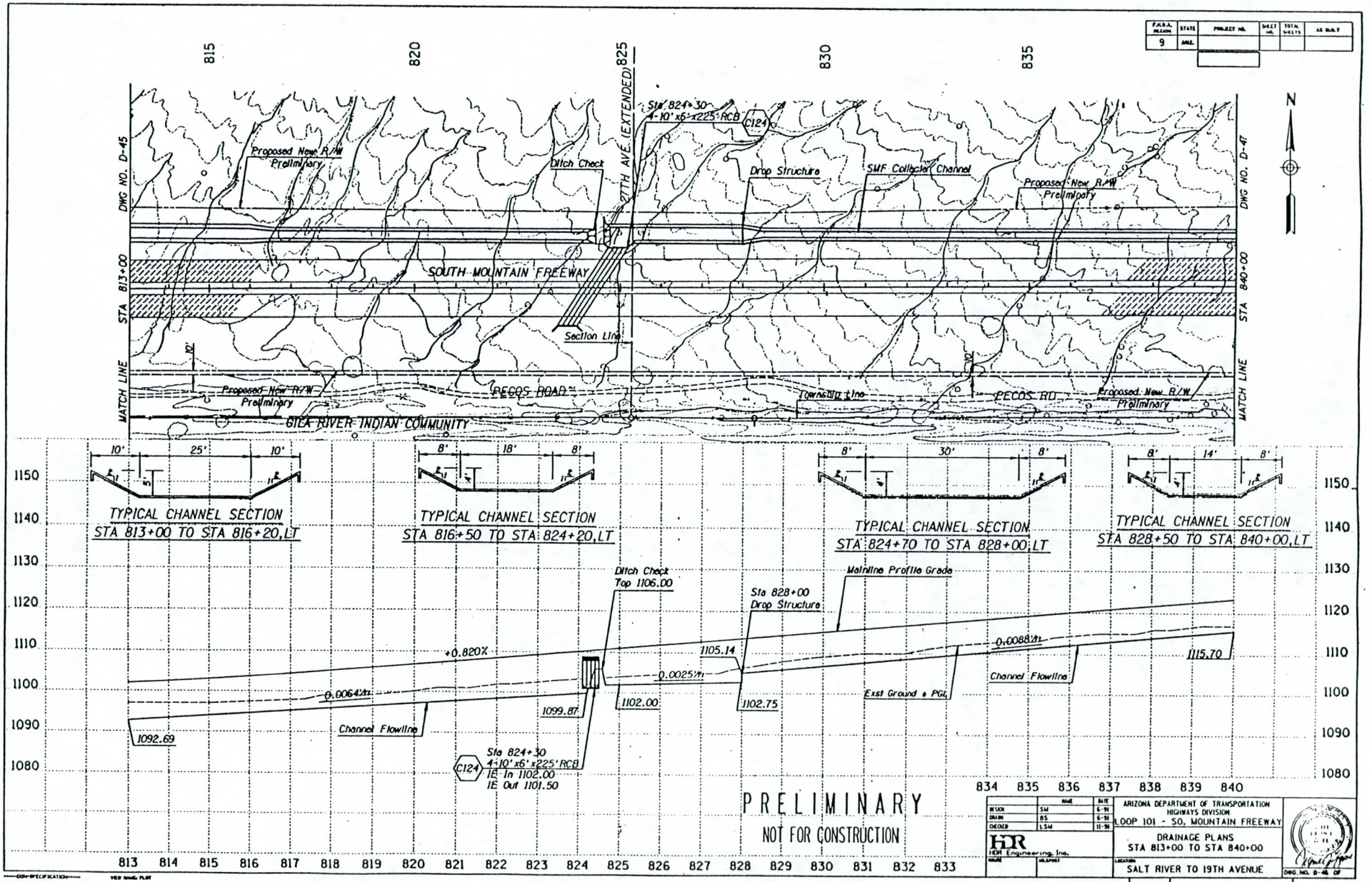
	NAME	DATE
DESIGN	SM	11-91
DRAWN	BS	11-91
CHECKED	LSM	11-91

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 787+00 TO STA 813+00
LOCATION: SALT RIVER TO 19TH AVENUE

TRACS NO. H-2222-01D | DRSWL220 | DWG NO. D-45 OF ___

___ OF ___



F.A.P.N. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SW	6-91
DRAWN	BS	6-91
CHECKED	LSW	11-91

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 813+00 TO STA 840+00

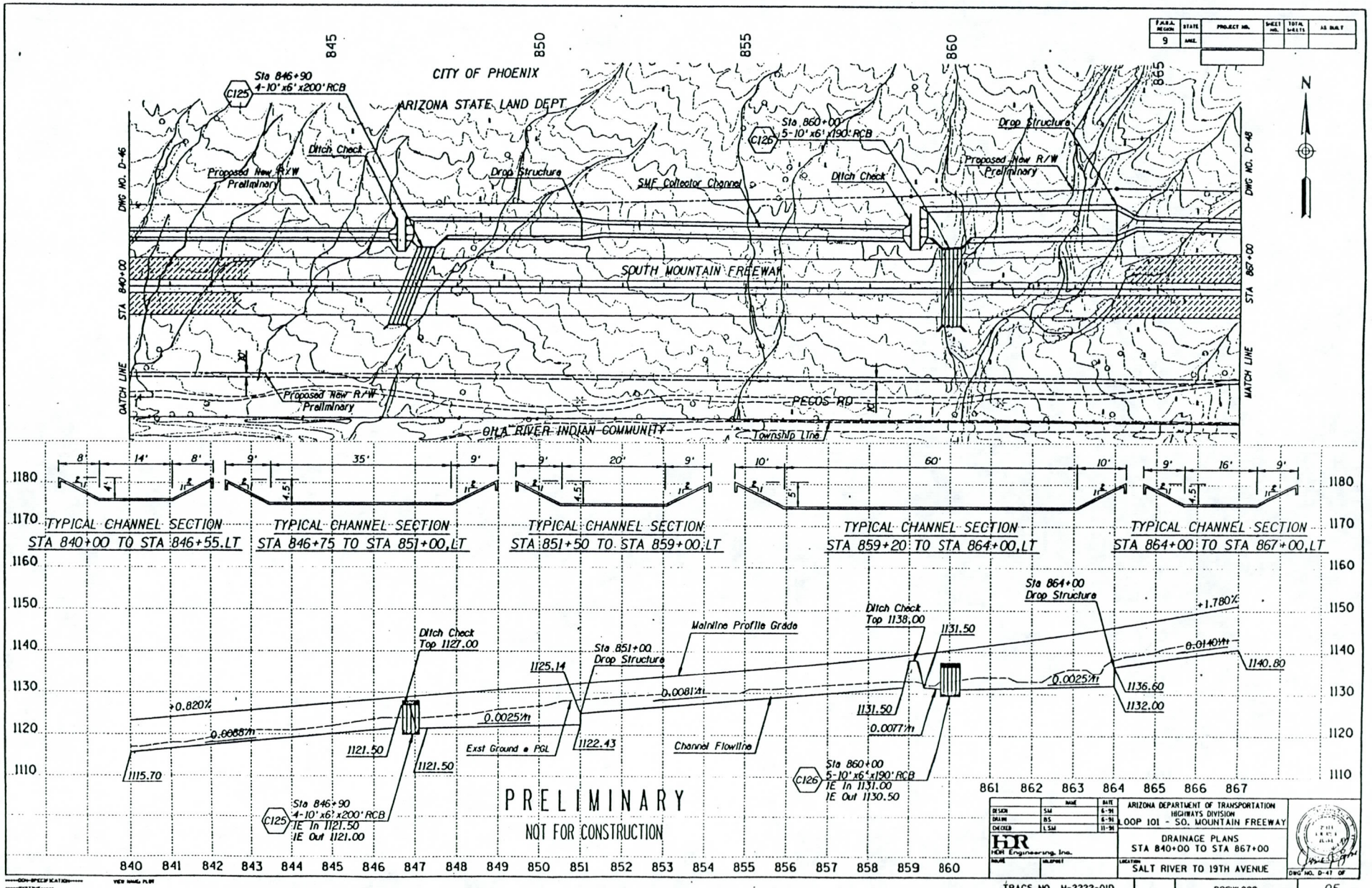
LOCATION
SALT RIVER TO 19TH AVENUE

DWG. NO. D-46 OF

TRACS NO. H-2222-01D

DRSWL221

OF



F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

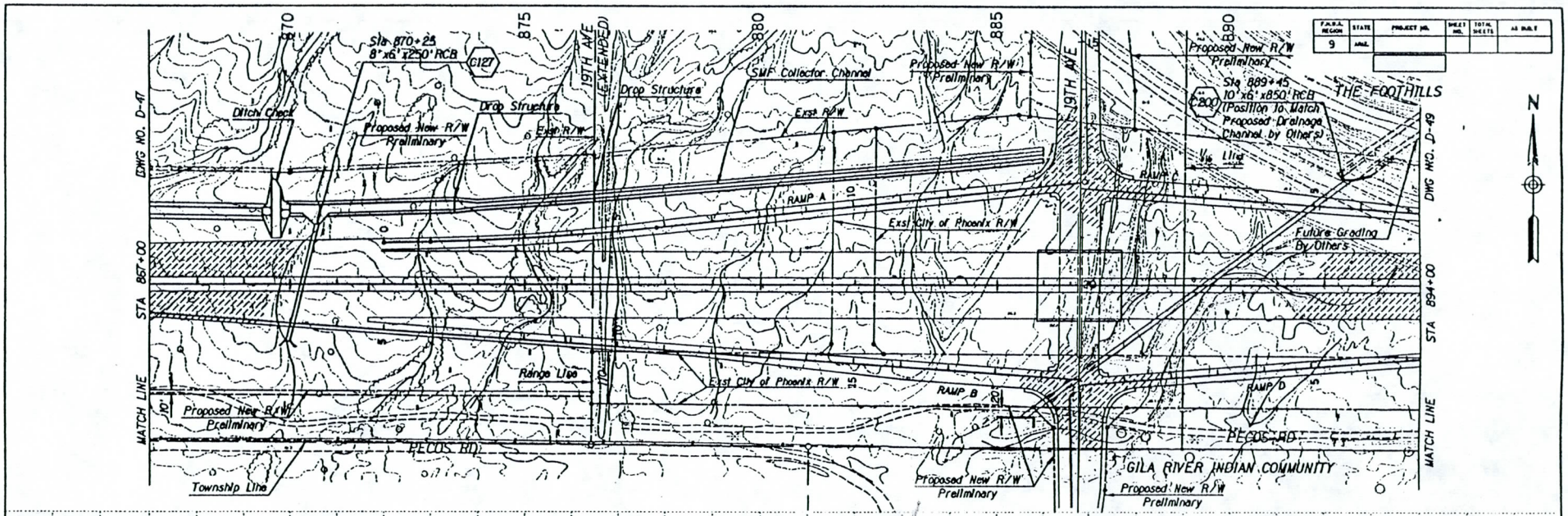
	NAME	DATE
DESIGN	SM	6-96
DRAWN	BS	6-96
CHECKED	LSM	11-96

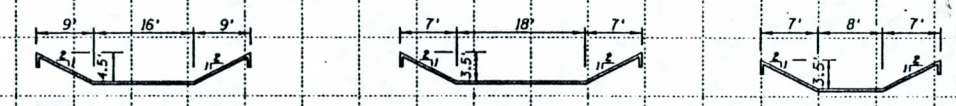
HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 840+00 TO STA 867+00
LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-47 OF

TRACS NO. H-2222-01D | DRSWL222 | OF





TYPICAL CHANNEL SECTION
STA 867+00 TO STA 869+60, LT

TYPICAL CHANNEL SECTION
STA 869+80 TO STA 873+50, LT

TYPICAL CHANNEL SECTION
STA 874+00 TO STA 886+00, LT

PRELIMINARY
NOT FOR CONSTRUCTION

F.A.P.D.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92
QUANTITY		
SUBMITTED		

HDR Engineering, Inc.

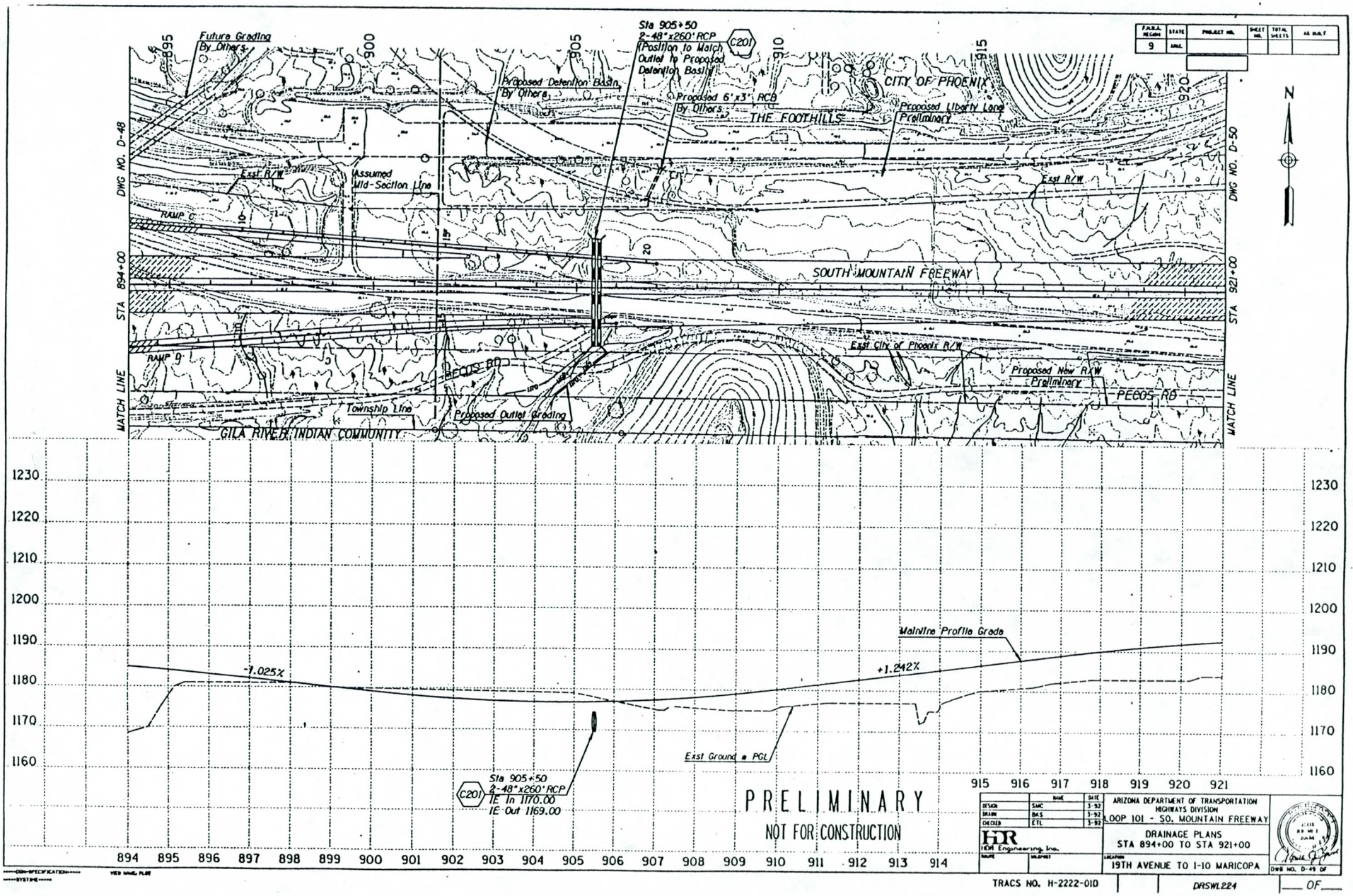
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

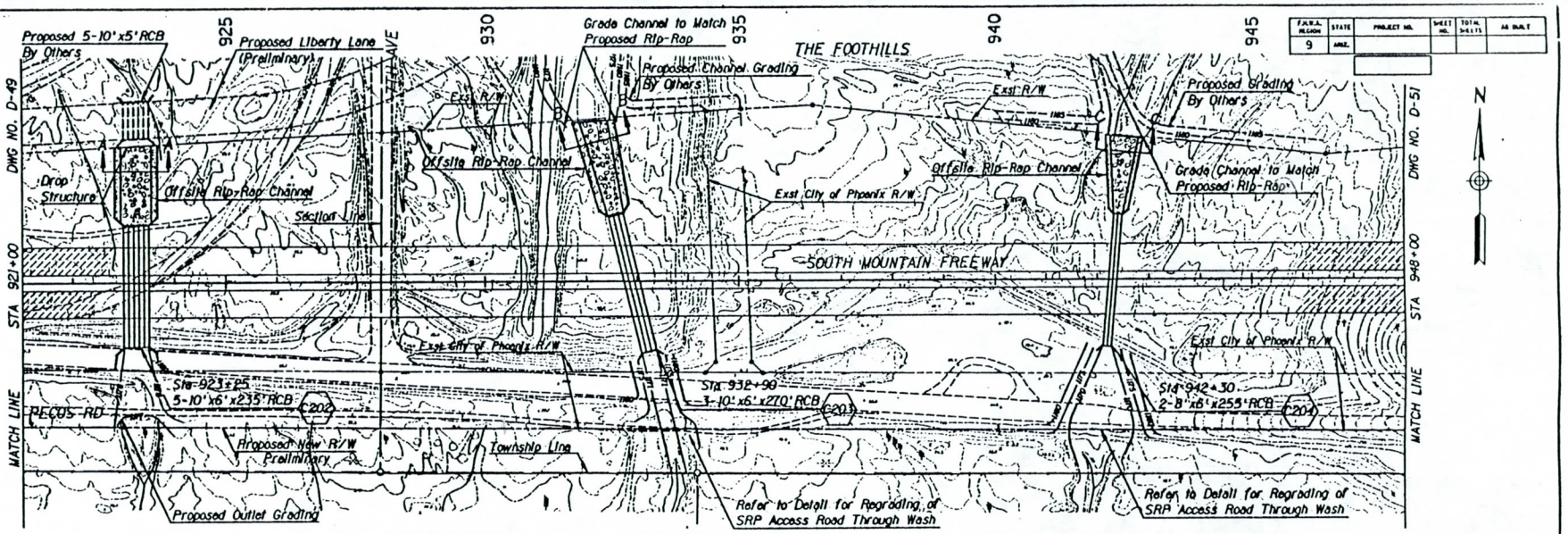
DRAINAGE PLANS
STA 867+00 TO STA 894+00

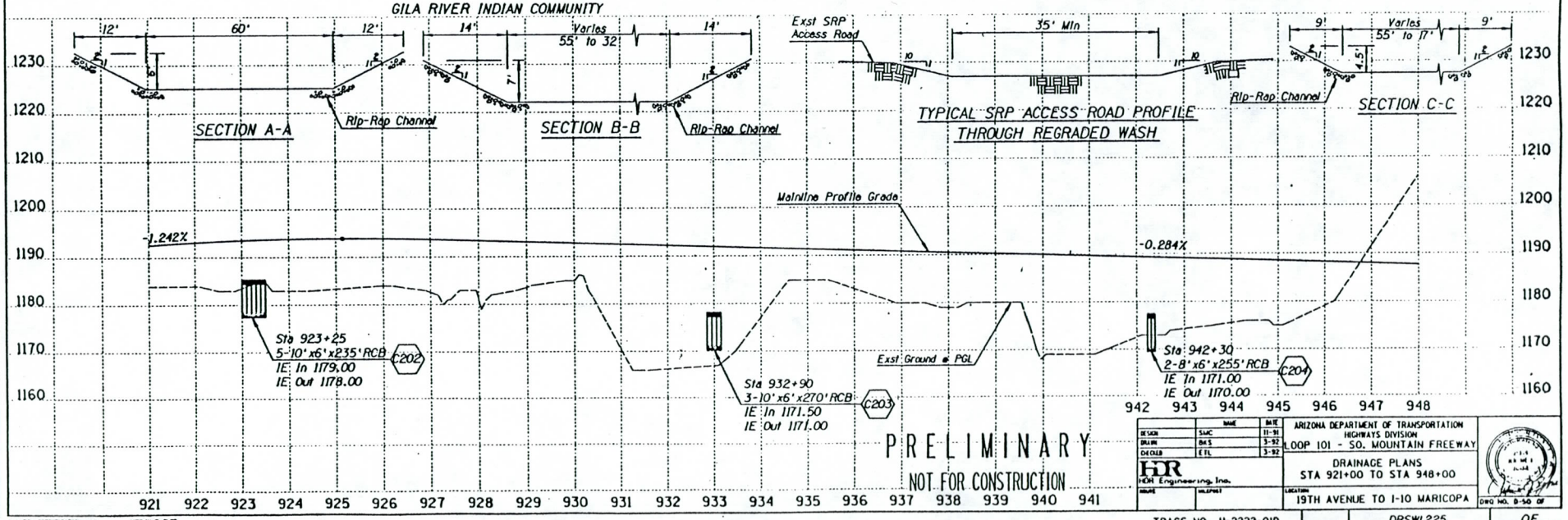
LOCATION: SALT RIVER TO 19TH AVENUE

DWG NO. D-48 OF

TRACS NO. H-2222-01D | DRSWL223 | ___ OF ___


Future Grading By Others
Sta 905+50
2-48"x260' RCP
(Position to Match Outlet to Proposed Detention Basin)
C201
Proposed Detention Basin By Others
Proposed 6'x3' RCB By Others
CITY OF PHOENIX
THE FOOTHILLS
Proposed Liberty Lane Preliminary
East R/W
Assumed Mid-Section Line
DWG NO. D-48
DWG NO. D-50
STA 894+00
STA 921+00
RAMP C
RAMP D
SOUTH MOUNTAIN FREEWAY
East City of Phoenix R/W
Proposed New R/W Preliminary
PECOS RD
Township Line
Proposed Outlet Grading
GILA RIVER INDIAN COMMUNITY
MATCH LINE
Mainline Profile Grade
-1.025%
+1.242%
East Ground & PGL
Sta 905+50
2-48"x260' RCP
IE In 1170.00
IE Out 1169.00
PRELIMINARY
NOT FOR CONSTRUCTION
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 894+00 TO STA 921+00
19TH AVENUE TO I-10 MARICOPA
HDR Engineering, Inc.
TRACS NO. H-2222-01D
DRSW1.224





F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

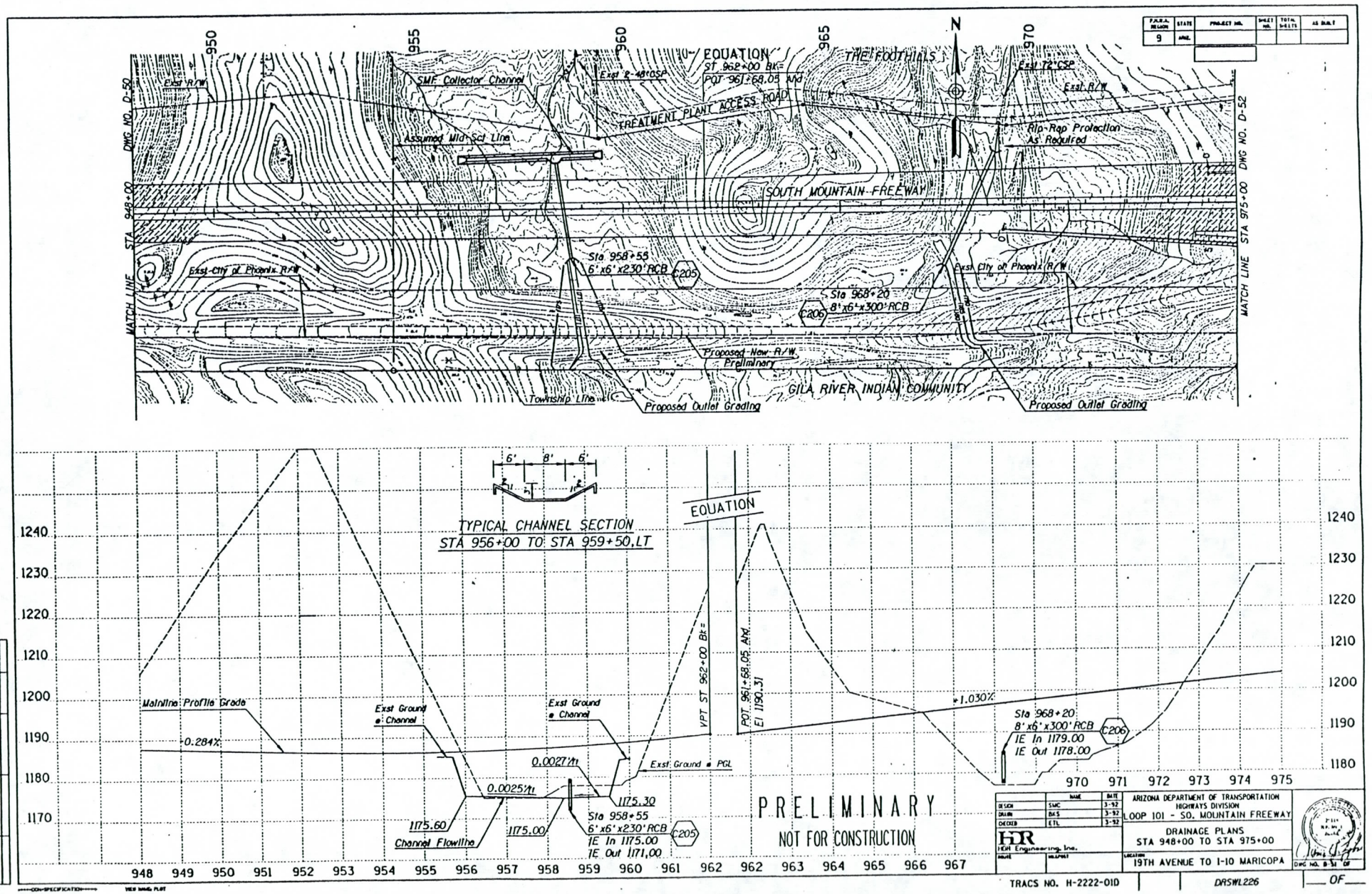
	NAME	DATE
DESIGN	SMC	11-91
DRAWN	BAS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 921+00 TO STA 948+00
LOCATION 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-50 OF

TRACS NO. H-2222-01D | DRSWL225 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

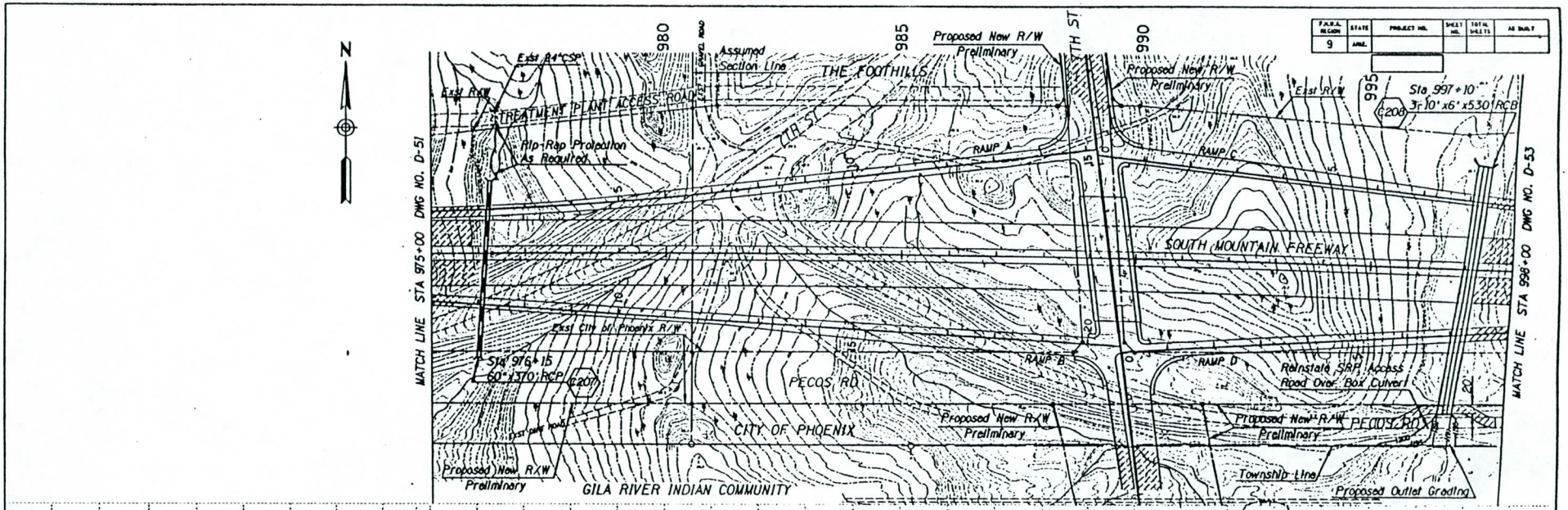
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

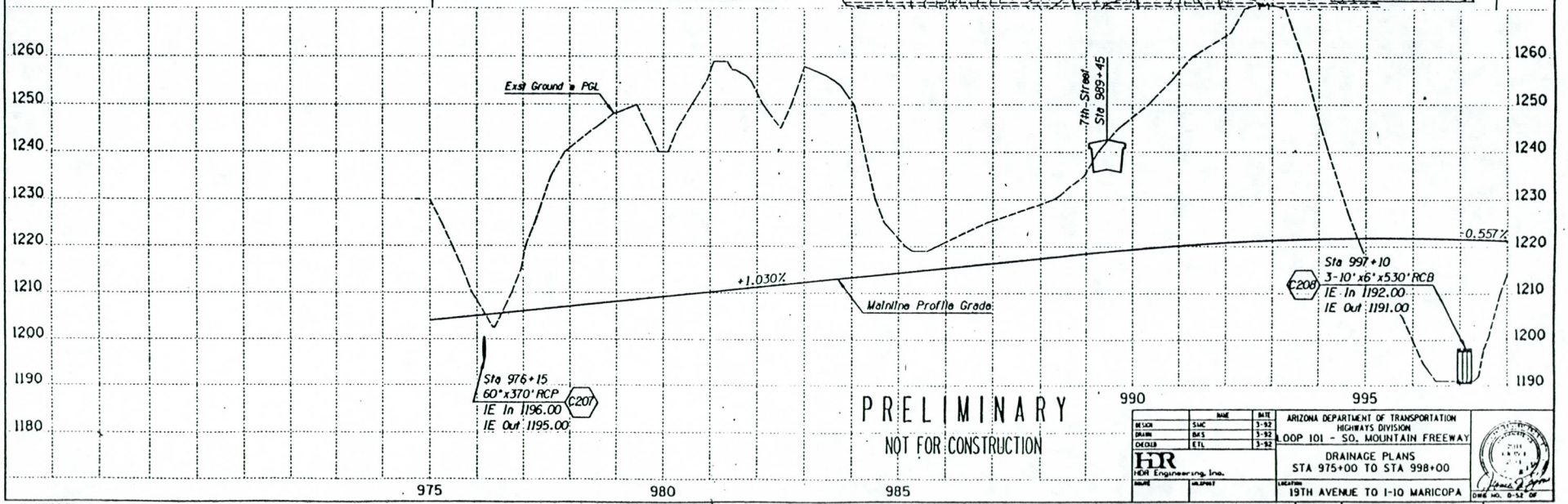
DRAINAGE PLANS
STA 948+00 TO STA 975+00

LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. 8 OF

TRACS NO. H-2222-01D | DRSWL226 | ___ OF ___





PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BMS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

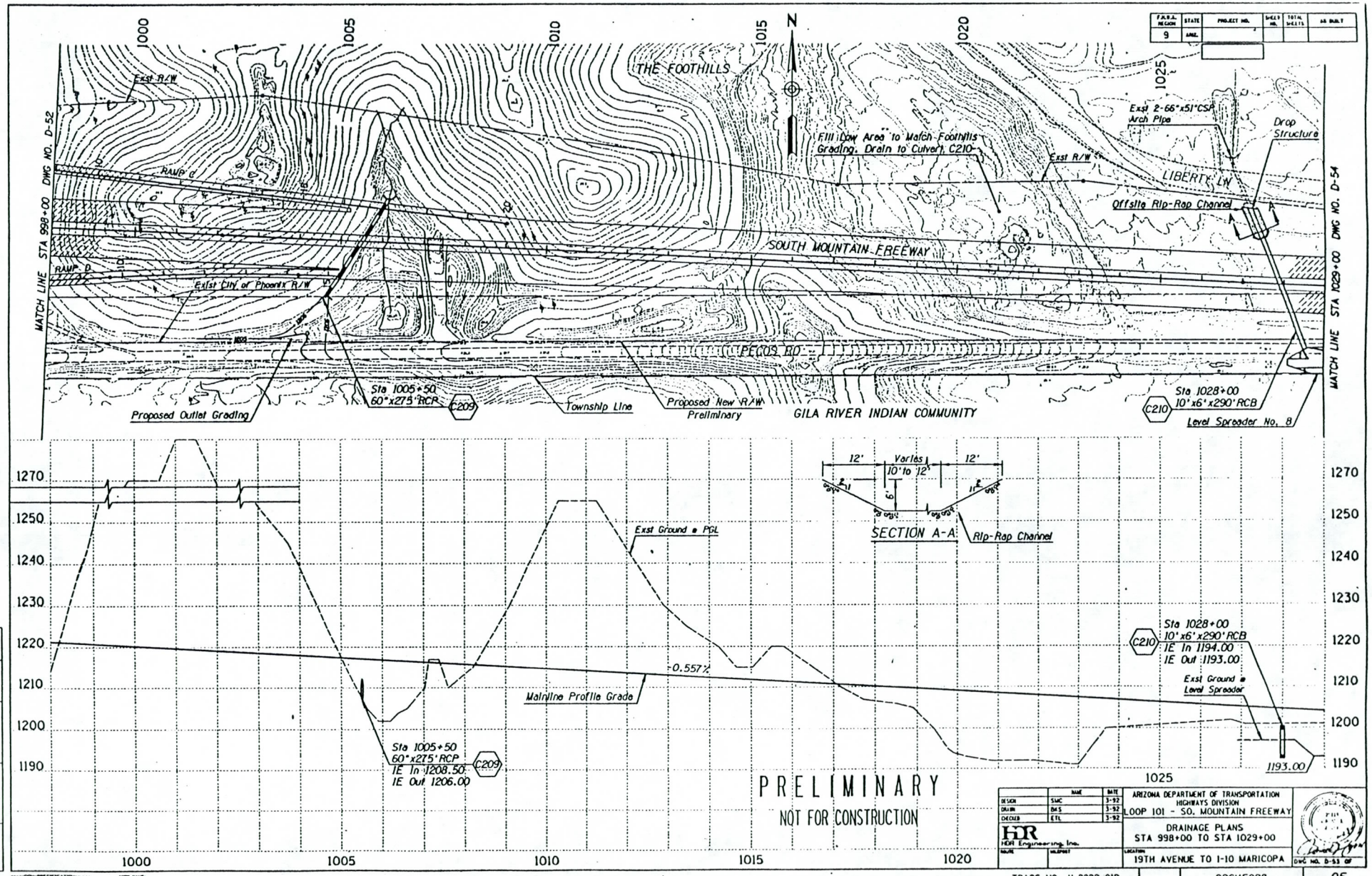
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 975+00 TO STA 998+00

LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-52

TRACS NO. H-2222-01D | DRSMF227 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

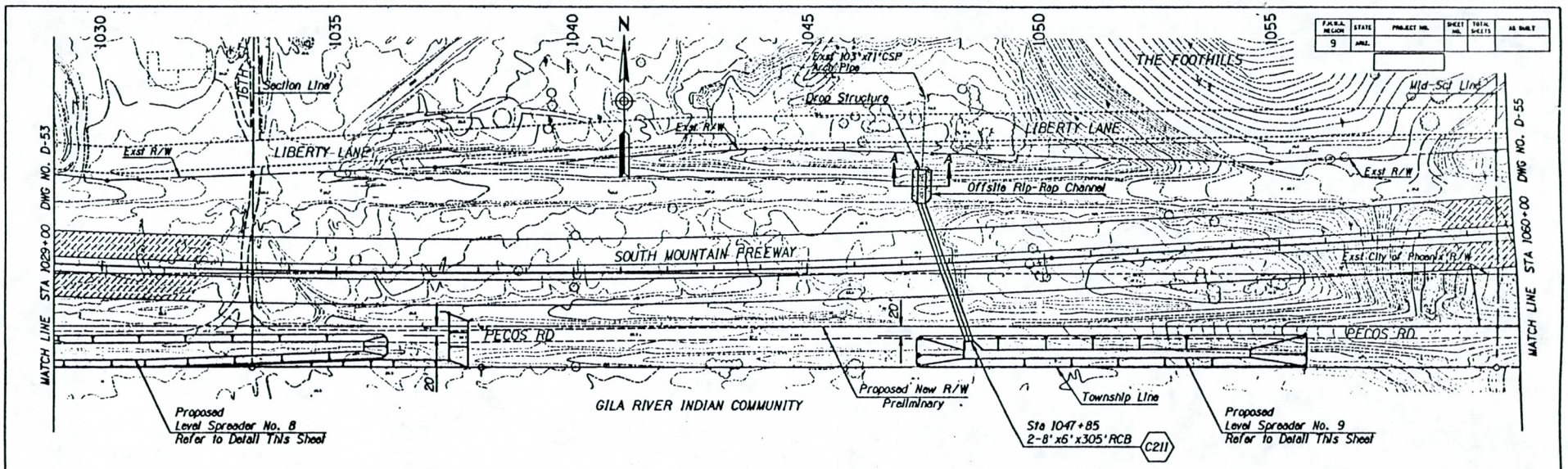
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

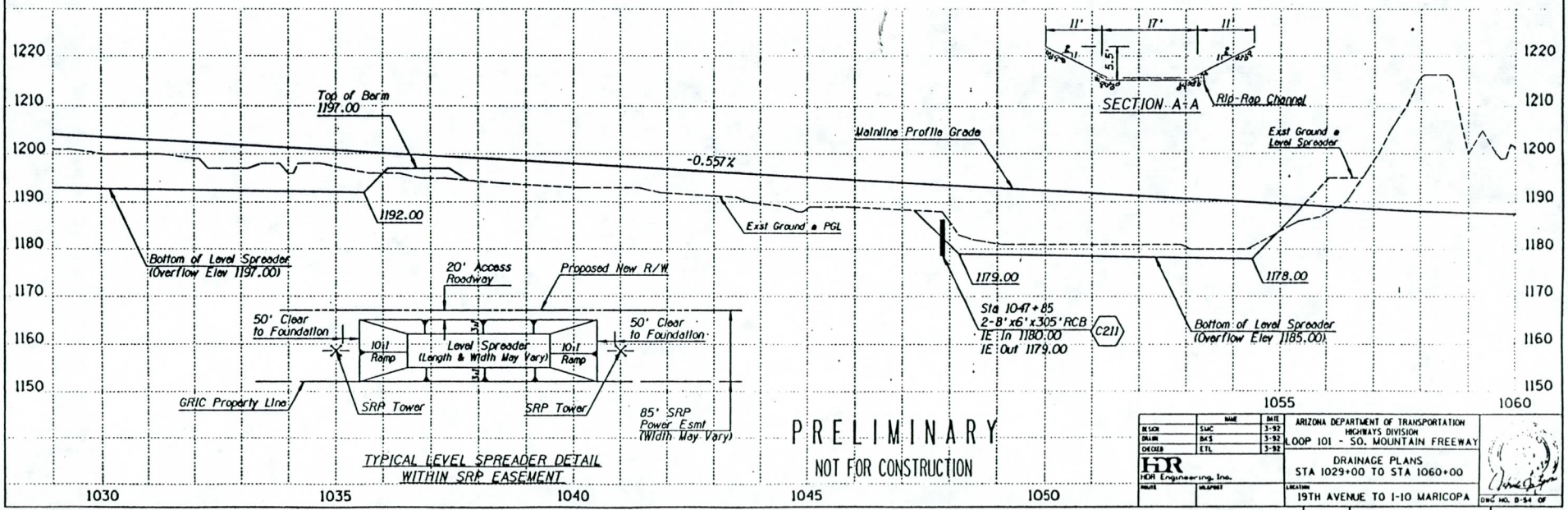
DRAINAGE PLANS
STA 998+00 TO STA 1029+00

LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-53 OF

TRACS NO. H-2222-01D | DRSMF228 | OF





F.A.H.U. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

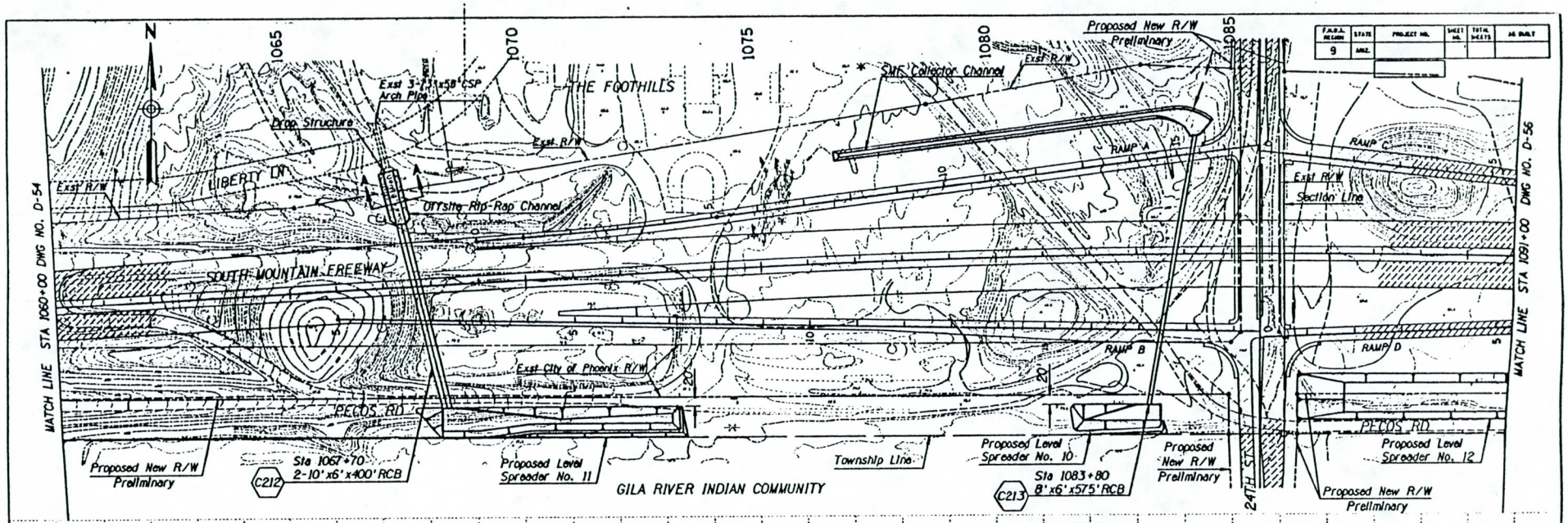
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

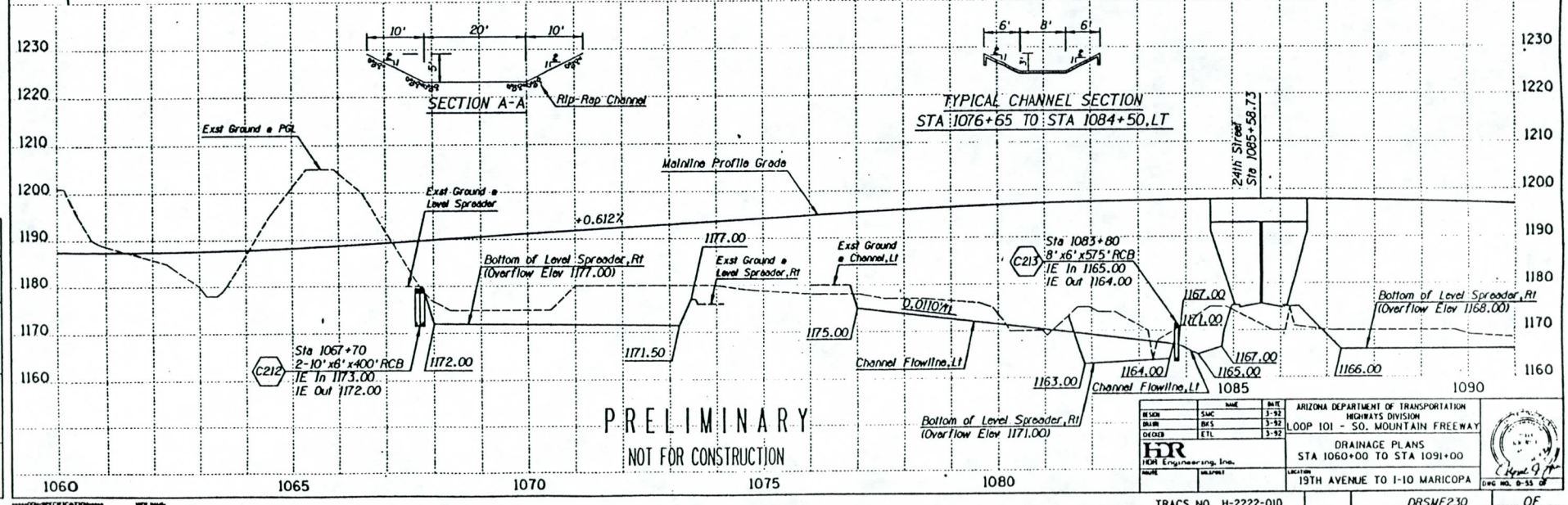
DRAINAGE PLANS
STA 1029+00 TO STA 1060+00

LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-54 OF

TRACS NO. H-2222-01D | DRSMF229 | OF





PRELIMINARY
NOT FOR CONSTRUCTION

F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

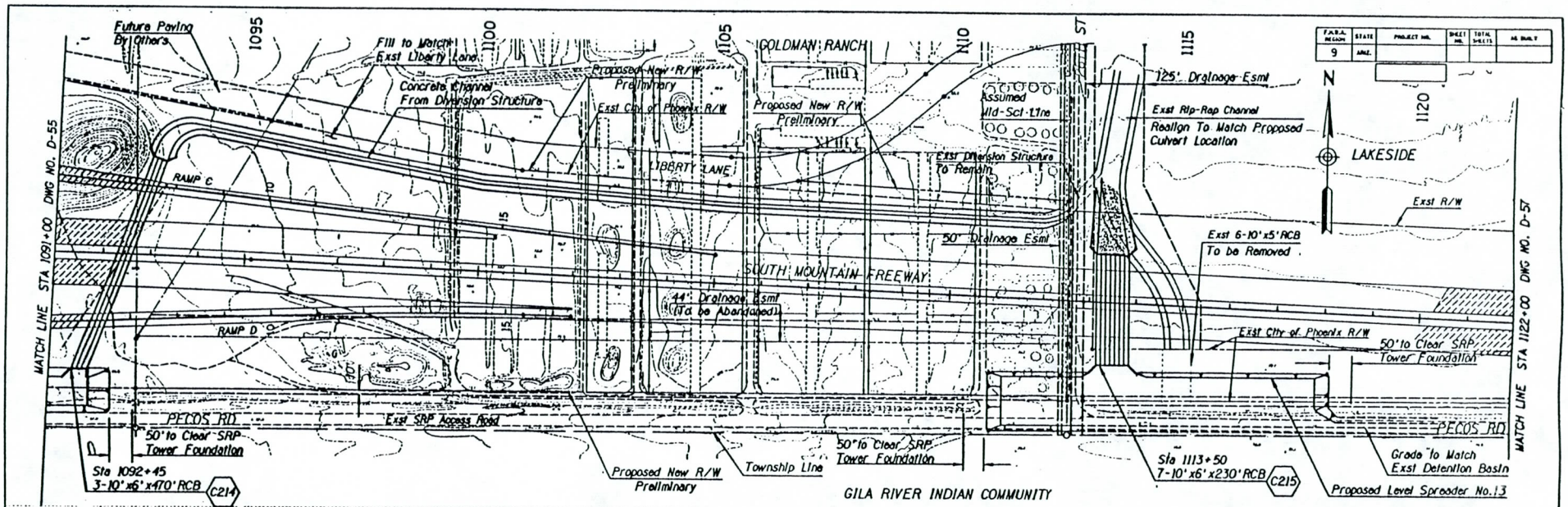
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

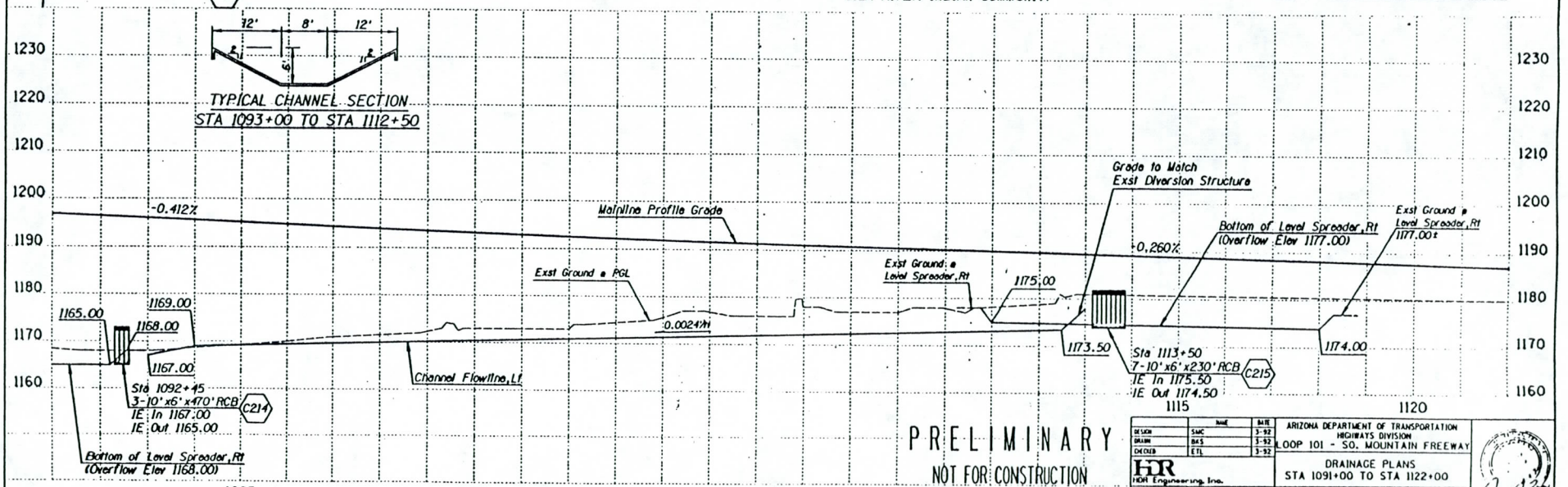
DRAINAGE PLANS
STA 1060+00 TO STA 1091+00

LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-55 OF

TRACS NO. H-2222-010 | DRSMF230 | ___ OF ___





PRELIMINARY

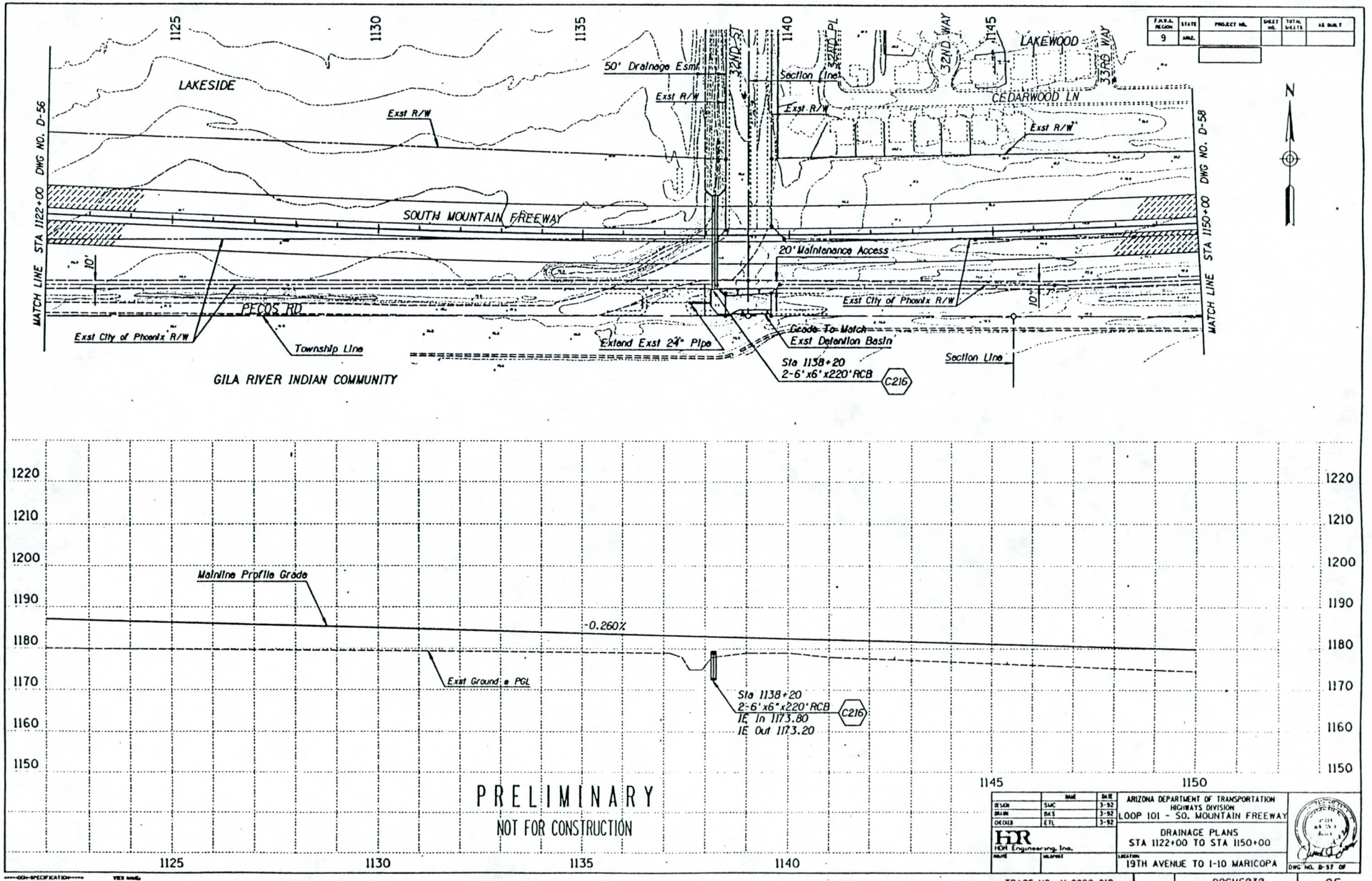
NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BAS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1091+00 TO STA 1122+00
19TH AVENUE TO I-10 MARICOPA

TRACS NO. H-2222-01D | DRSWF231 | ___ OF ___



F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

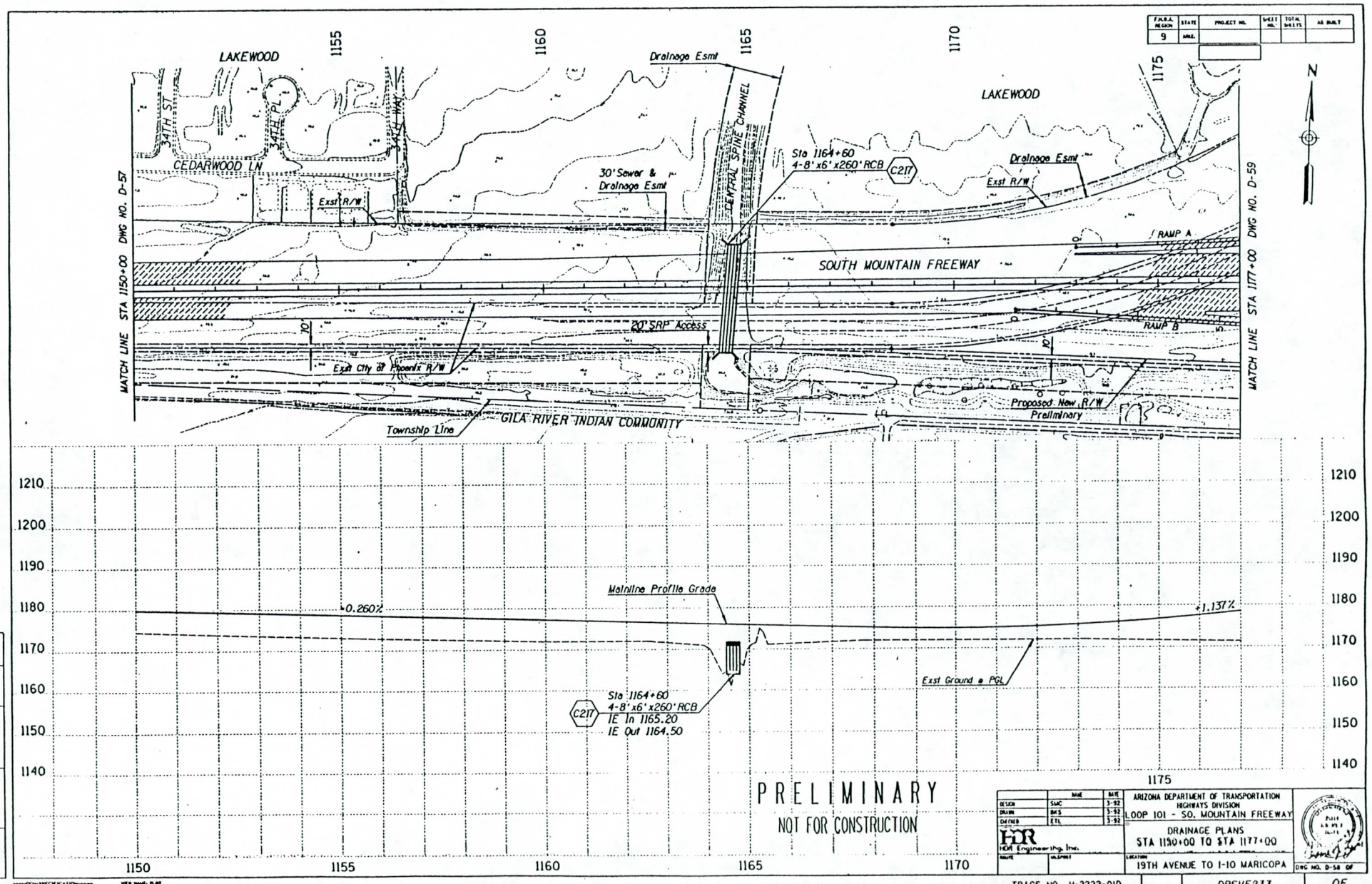
	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BKS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1122+00 TO STA 1150+00
LOCATION: 19TH AVENUE TO I-10 MARICOPA

DWG NO. D-57 OF ___

TRACS NO. H-2222-01D | DRSMF232 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

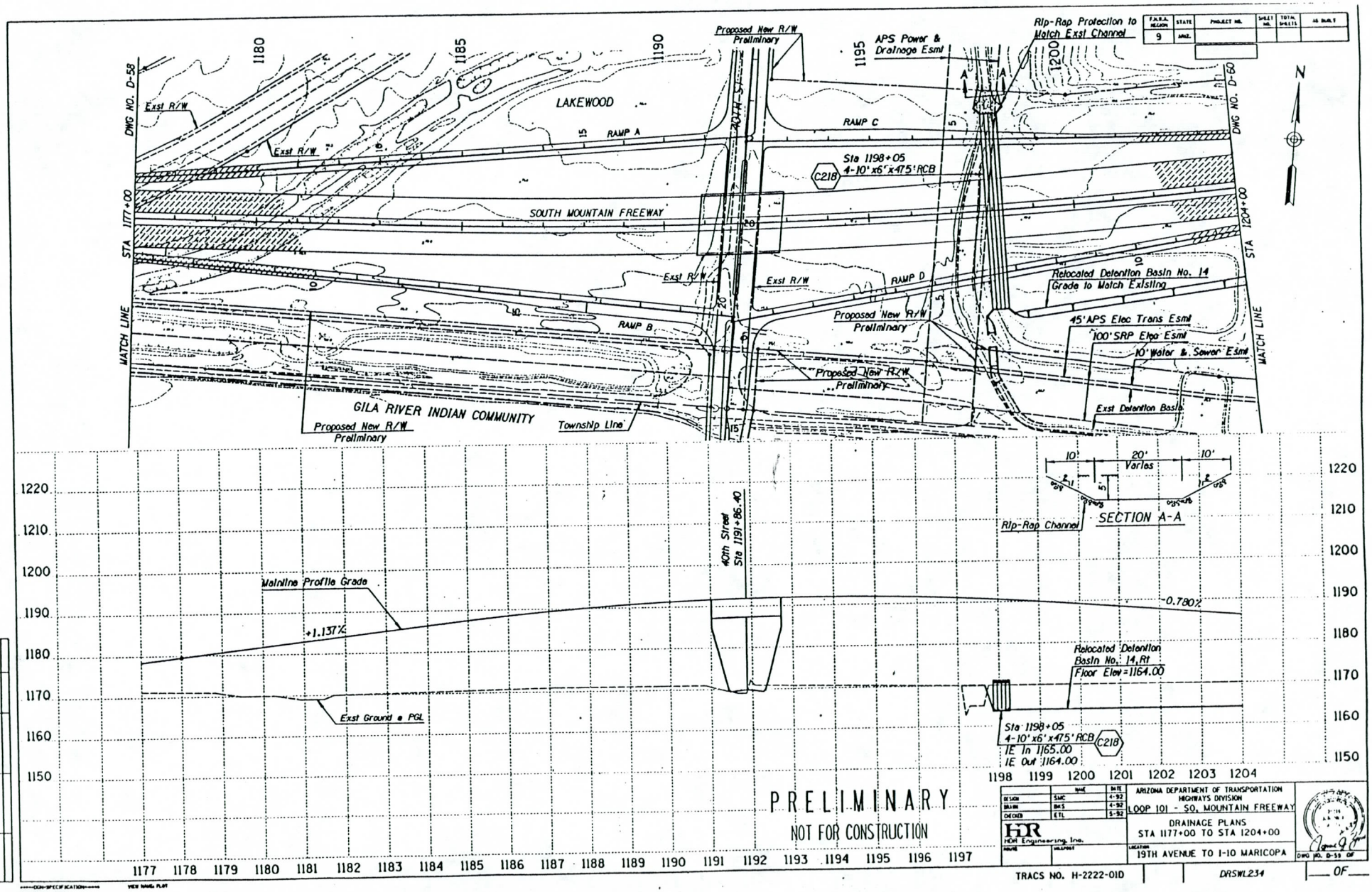
	NAME	DATE
DESIGN	SMC	3-92
DRAWN	BMS	3-92
CHECKED	ETL	3-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1150+00 TO STA 1177+00
19TH AVENUE TO I-10 MARICOPA

DWG NO. D-58 OF

TRACS NO. H-2222-01D | DRSWF233 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

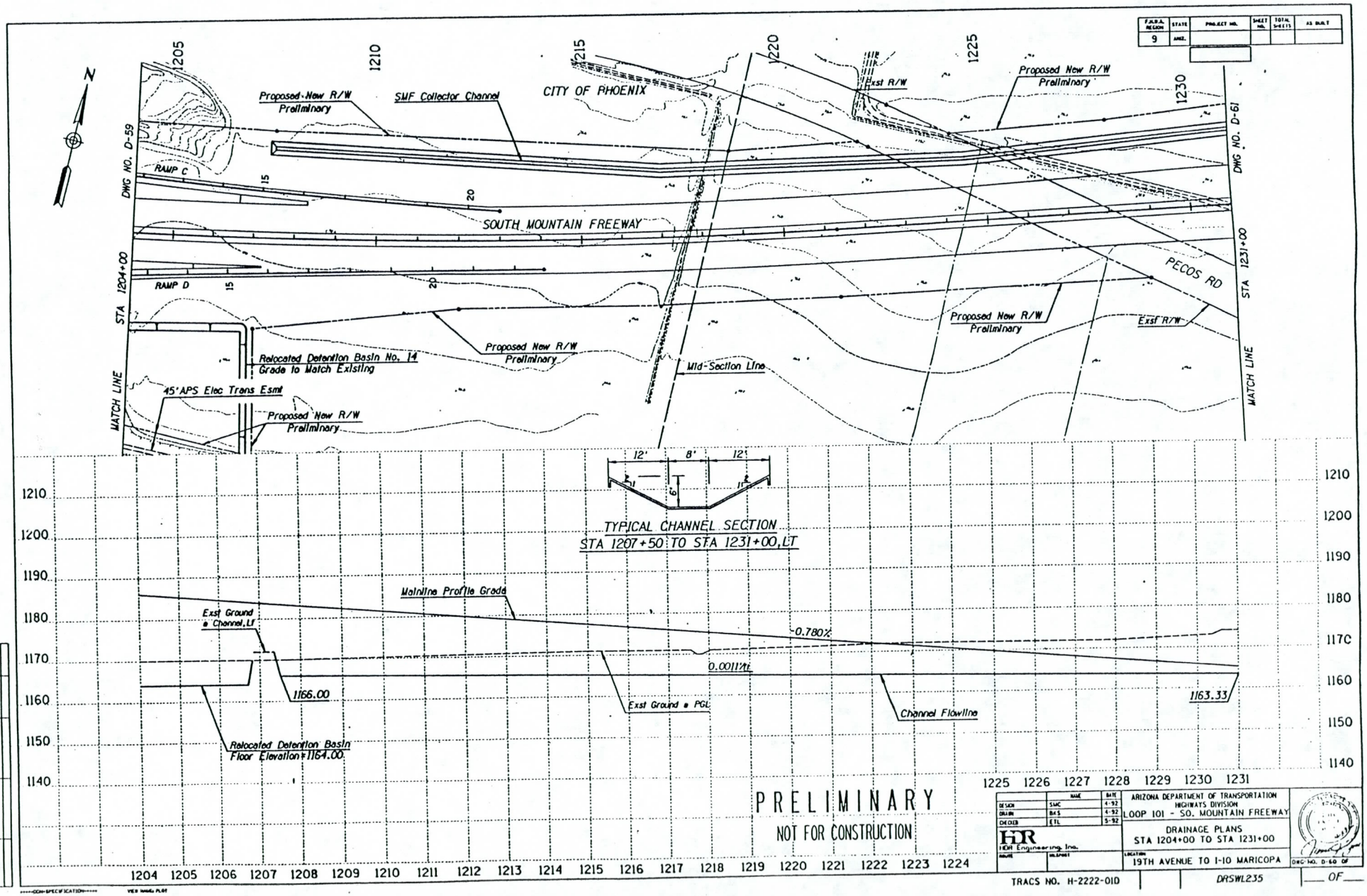
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	4-92
DRAWN	BMS	4-92
CHECKED	ETL	5-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1177+00 TO STA 1204+00
LOCATION: 19TH AVENUE TO I-10 MARICOPA

TRACS NO. H-2222-01D | DRSWL234 | DWG NO. D-59 OF ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	4-92
DRAWN	BAS	4-92
CHECKED	ETL	5-92

HDR Engineering, Inc.

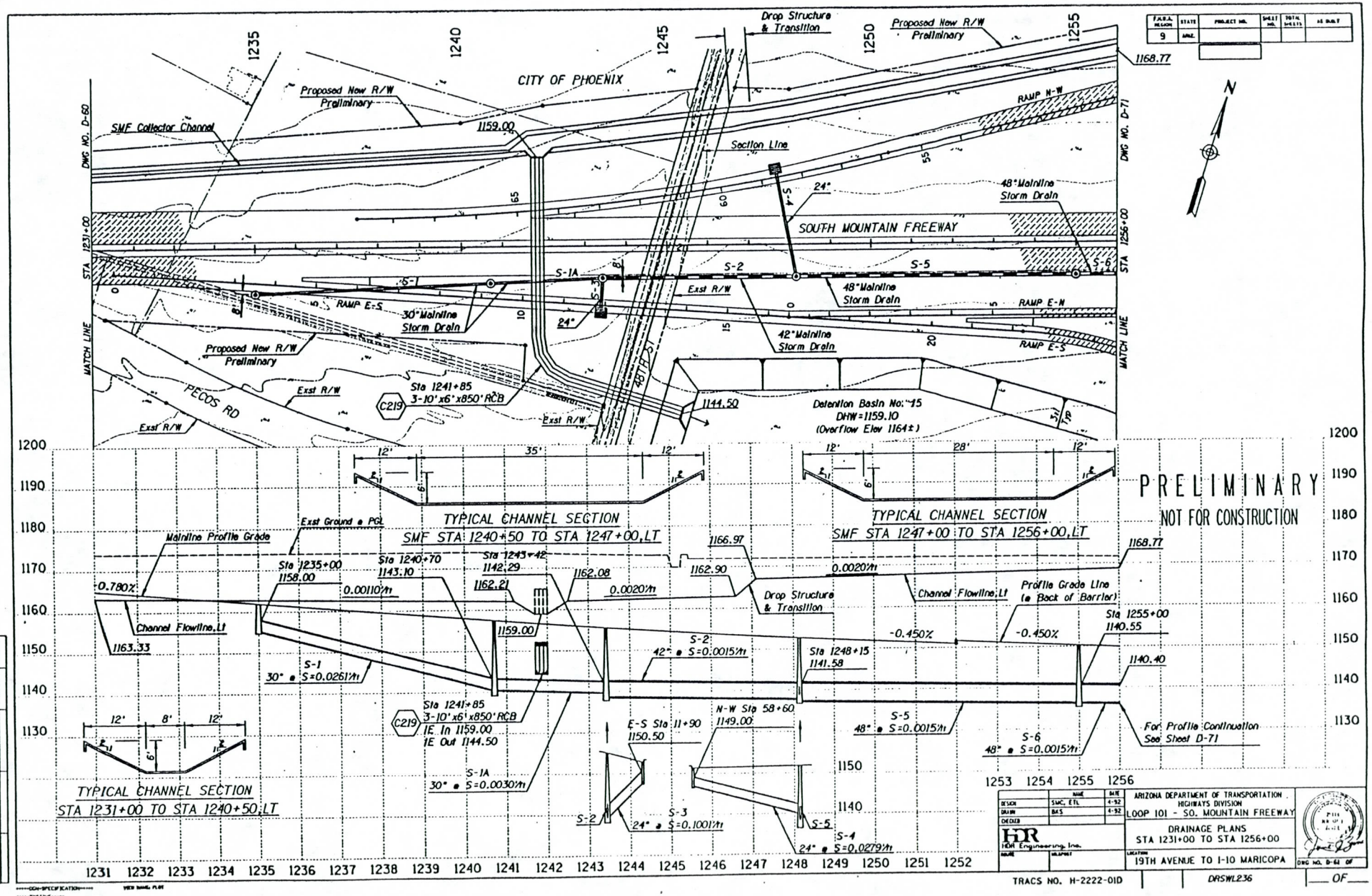
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 1204+00 TO STA 1231+00

LOCATION
19TH AVENUE TO I-10 MARICOPA

DWG NO. D-60 OF

TRACS NO. H-2222-010 | DRSWL235 | ___ OF ___



FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	NO. BARS
9	ARIZ.				

	NAME	DATE
DESIGN	SMC, ETL	4-92
DRAWN	BAS	4-92
CHECKED		

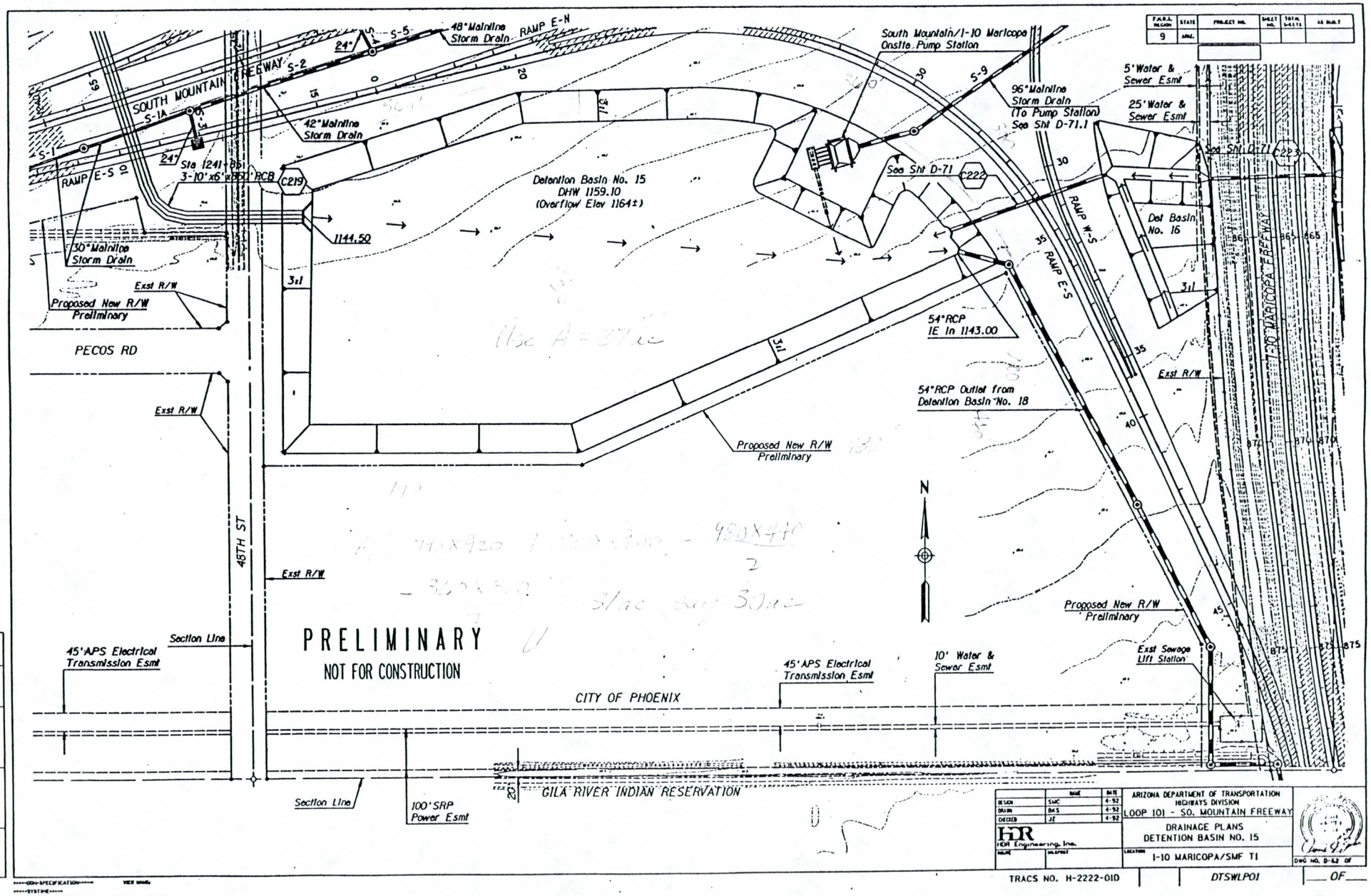
HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PLANS
STA 1231+00 TO STA 1256+00

LOCATION
19TH AVENUE TO I-10 MARICOPA

TRACS NO. H-2222-01D | DRSWL236 | DWG NO. D-64 OF ___ | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

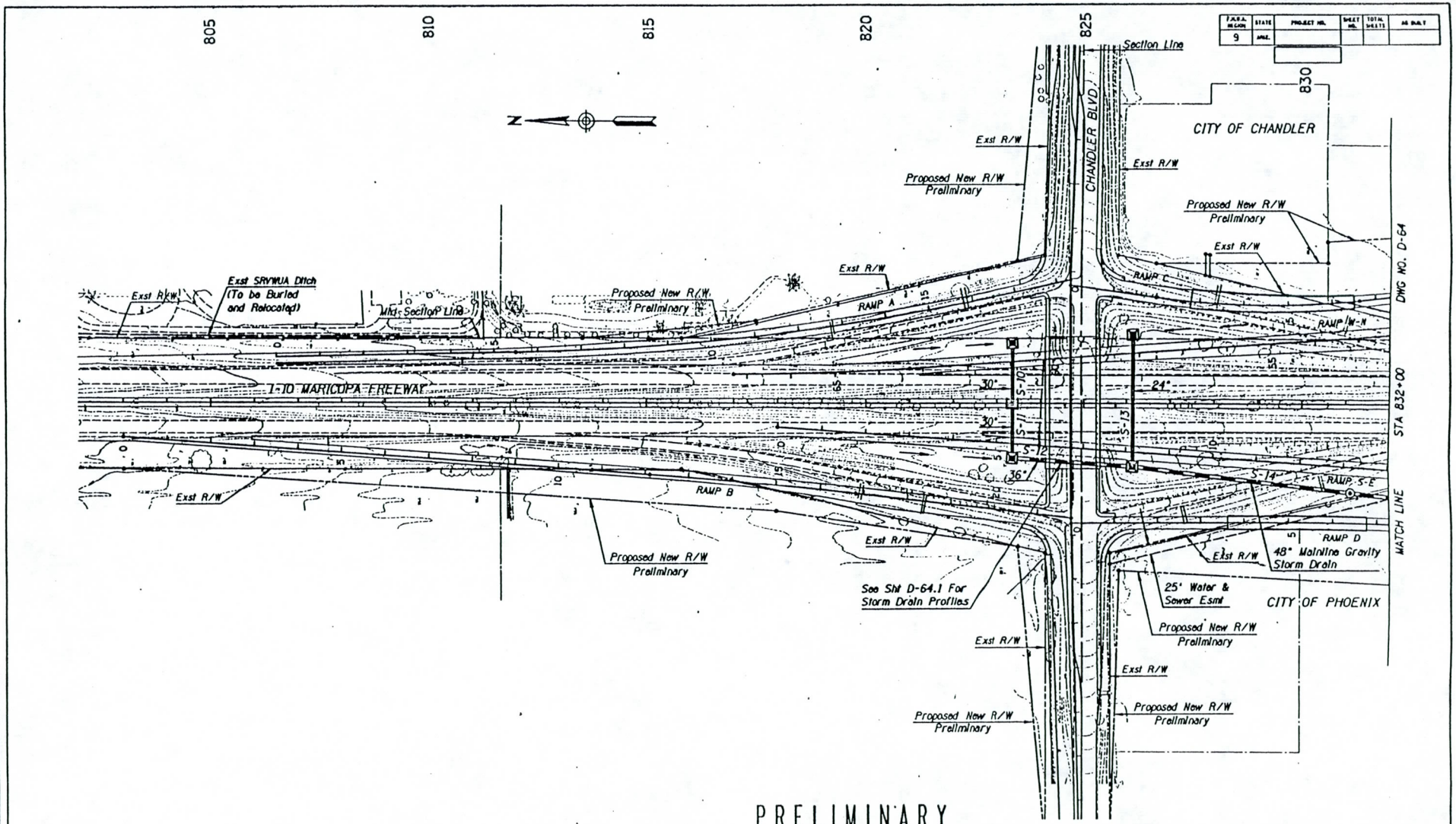
	NAME	DATE
DESIGN	S.M.C.	4-92
DRAWN	B.K.S.	4-92
CHECKED	J.F.	4-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
DETENTION BASIN NO. 15
I-10 MARICOPA/SMF TI

DWG NO. D-62 OF

TRACS NO. H-2222-01D | DTSWLP01 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	4-92
DRAWN	BAS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

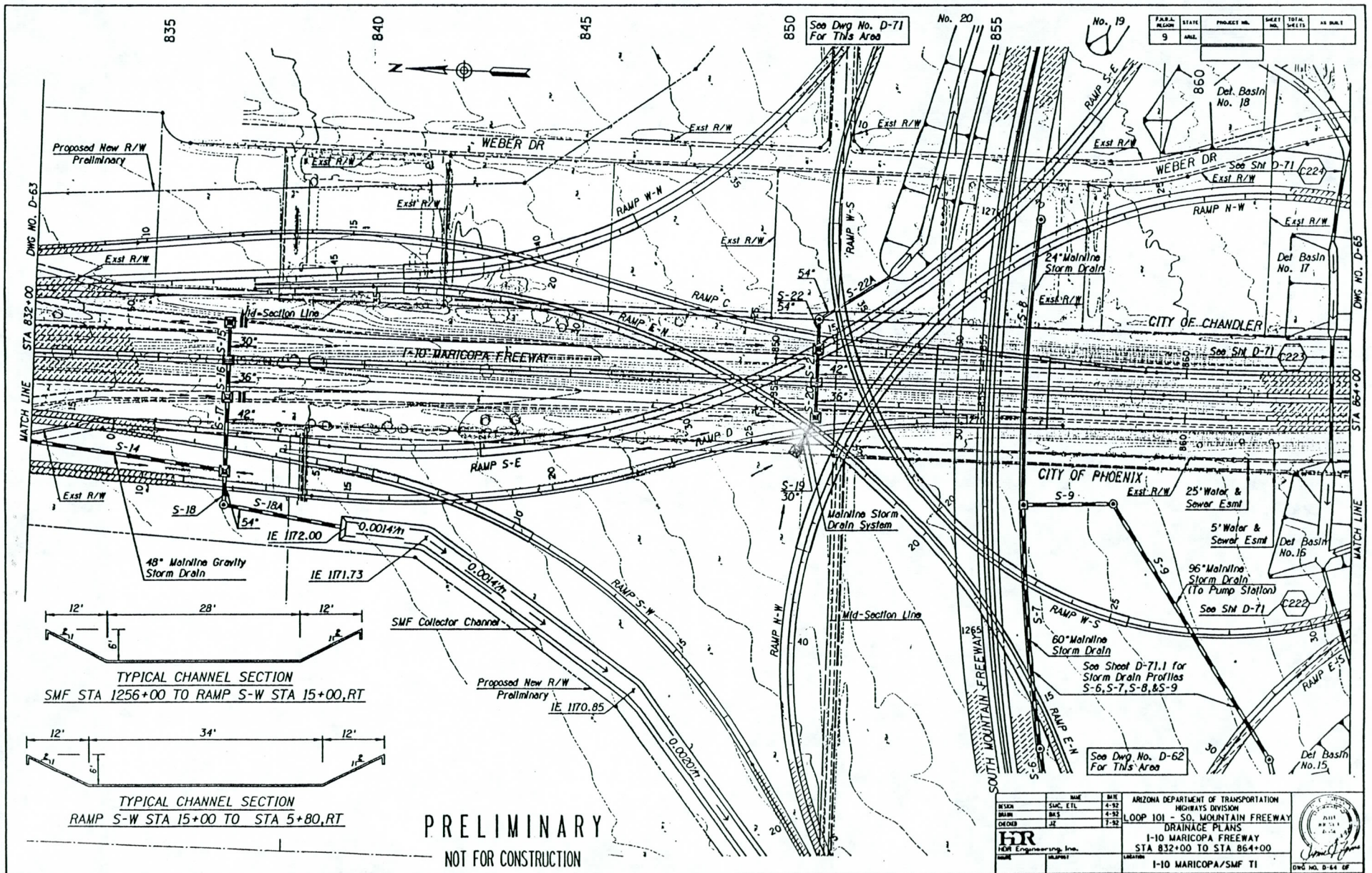
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
I-10 MARICOPA/SMF TI
STA 802+00 TO STA 832+00
CHANDLER BLVD AREA

DWG NO. D-63 OF

TRACS NO. H-2222-010 | DRSWL237 | ___ OF ___

-----CON-SPECIFICATION-----
-----SYSTIME-----
VIEW NAME: PLOT



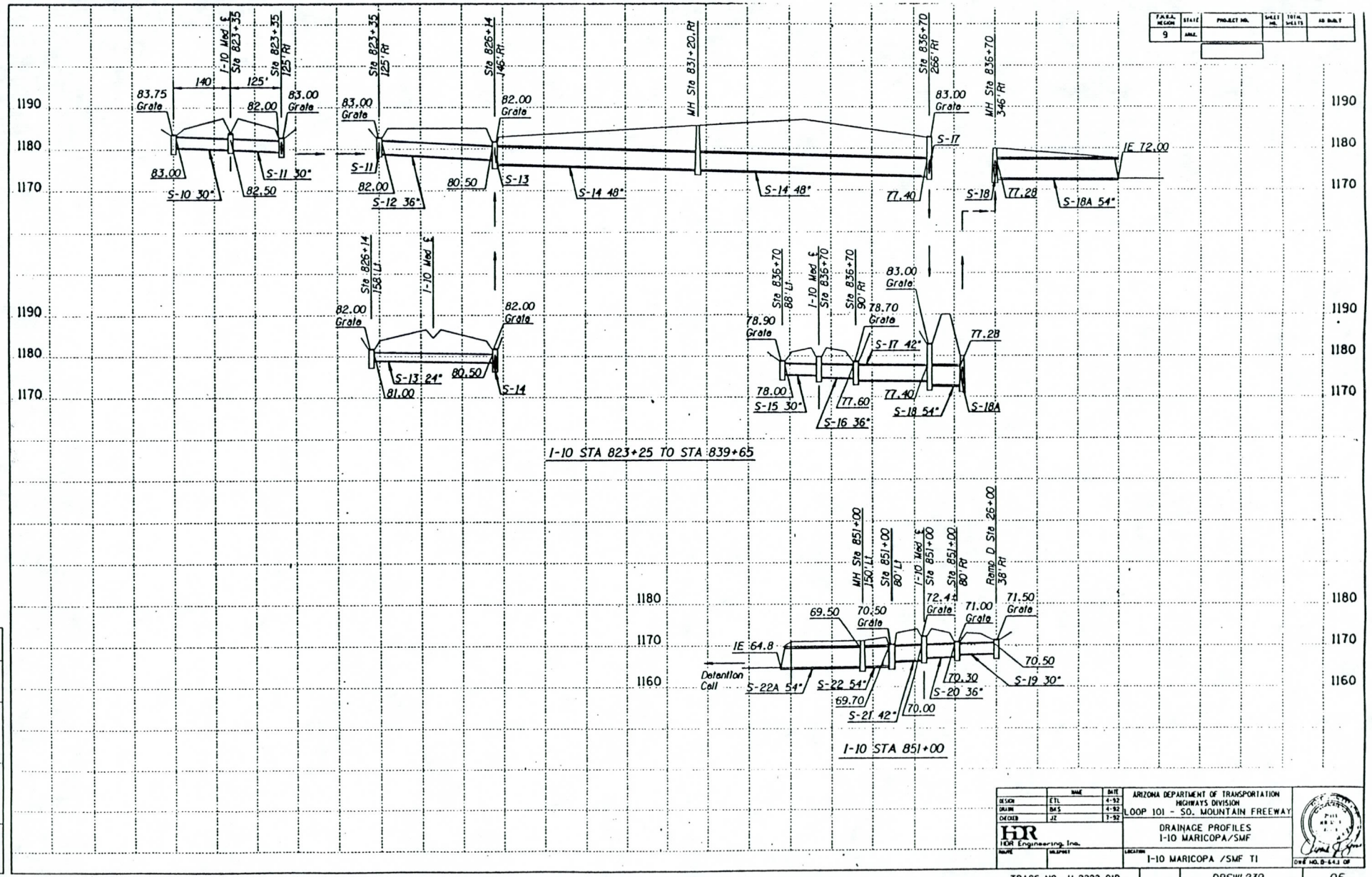
	NAME	DATE
DESIGN	SWC, ETL	4-92
DRAWN	BKS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
I-10 MARICOPA FREEWAY
STA 832+00 TO STA 864+00
LOCATION: I-10 MARICOPA/SMF TI

DWG NO. D-64 OF

TRACS NO. H-2222-01D | DRSWL238 | ___ OF ___



F.A.H.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	CTL	4-92
DRAWN	BMS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

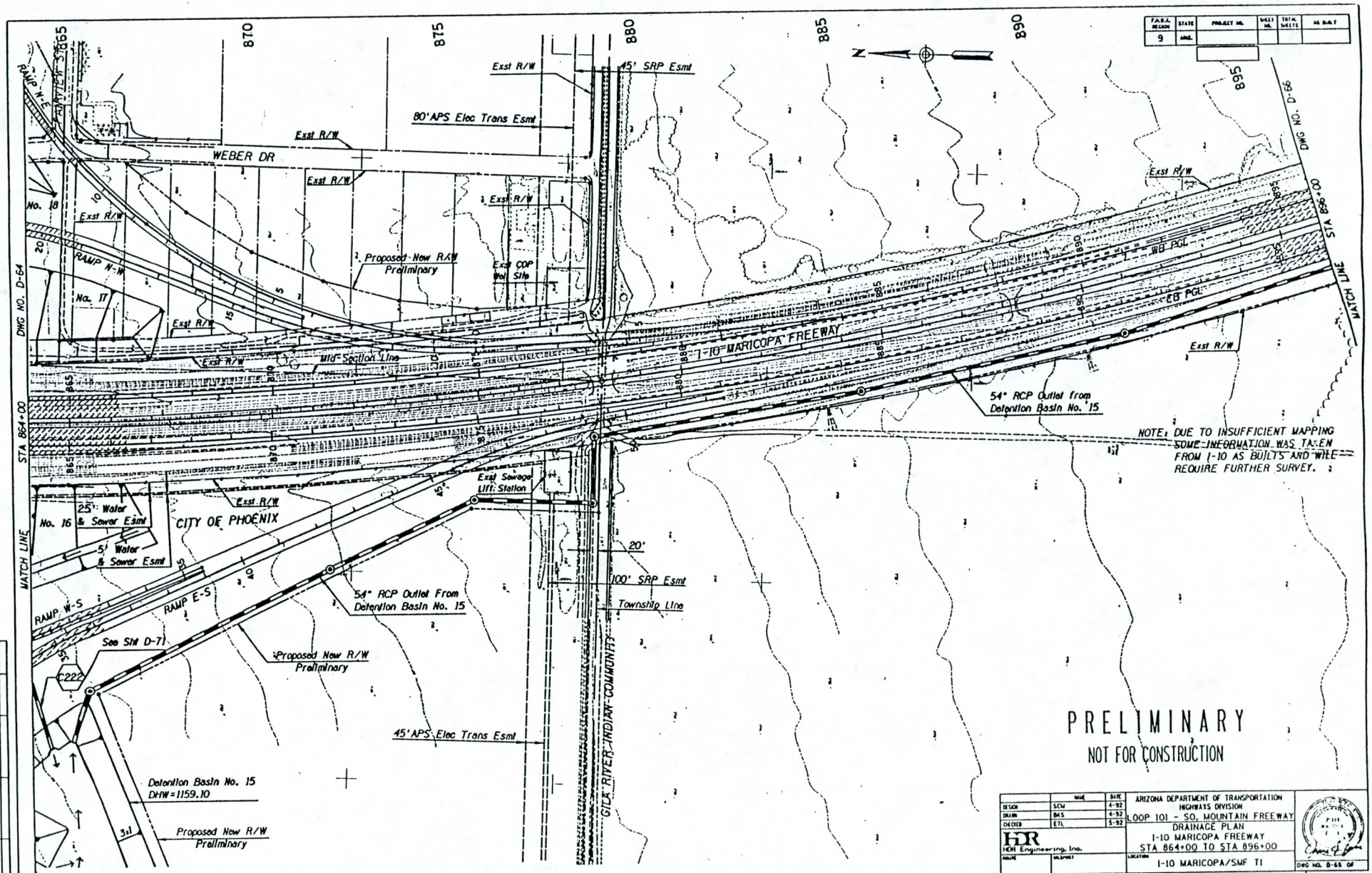
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

DRAINAGE PROFILES
I-10 MARICOPA/SMF

I-10 MARICOPA /SMF TI

DWG NO. D-643 OF

TRACS NO. H-2222-01D | DRSWL239 | ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.P.U. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	NO. DATE
9	ARIZ.				

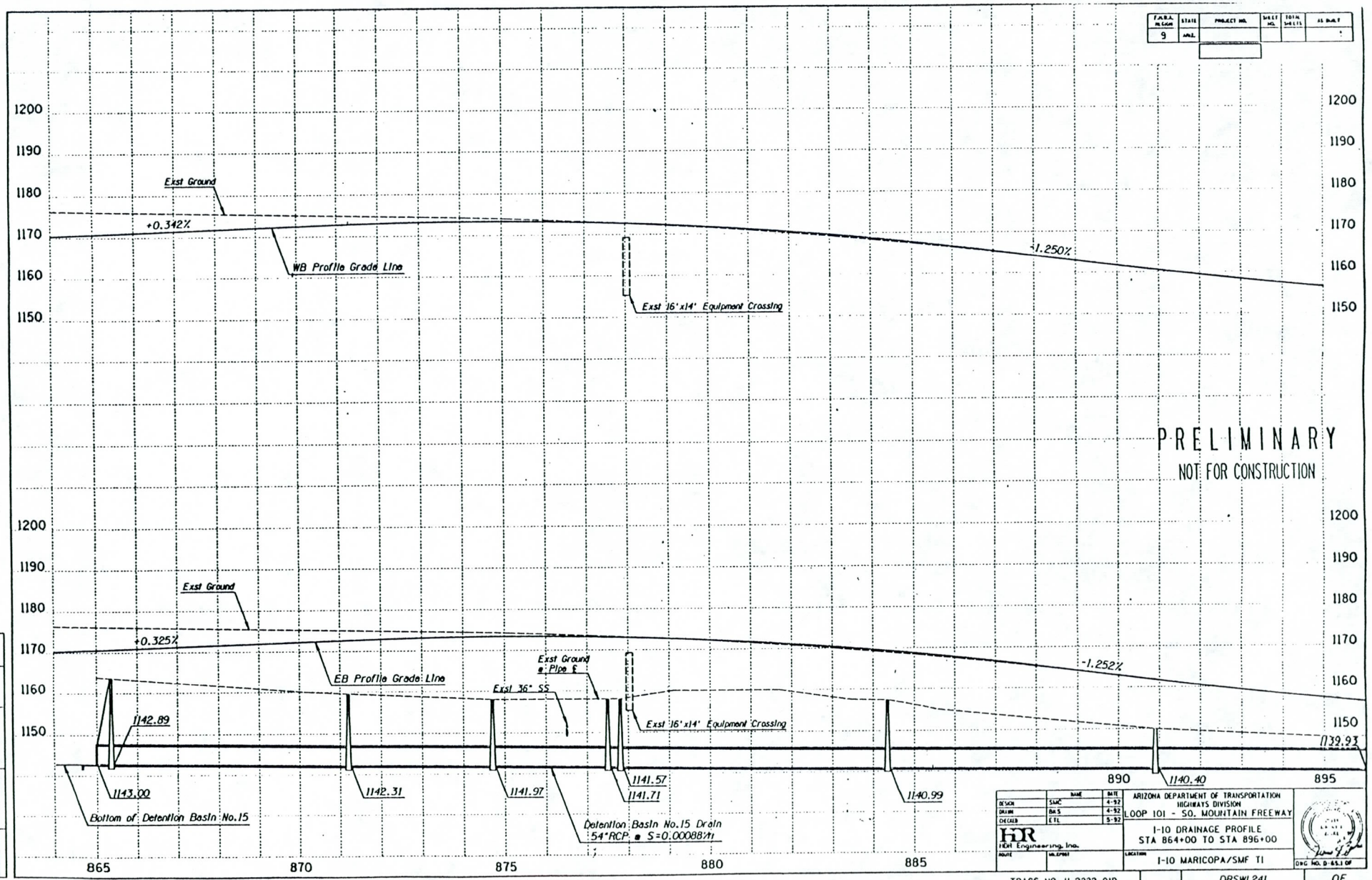
	NAME	DATE
DESIGN	SCW	4-92
DRAWN	BAS	4-92
CHECKED	ETL	5-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLAN
I-10 MARICOPA FREEWAY
STA 864+00 TO STA 896+00
LOCATION: I-10 MARICOPA/SMF TI

DWG NO. D-65 OF ___

TRACS NO. H-2222-01D | DRSWL240 | ___ OF ___



F.A.R.S. or F.A.U.S. Route No.	State	Project No.	Sheet No.	Total Sheets	As Built
9	ARIZ.				

	Name	Date
Design	SMC	4-92
Drawn	BAS	4-92
Checked	ETL	5-92

HDR Engineering, Inc.

Route — Milepost

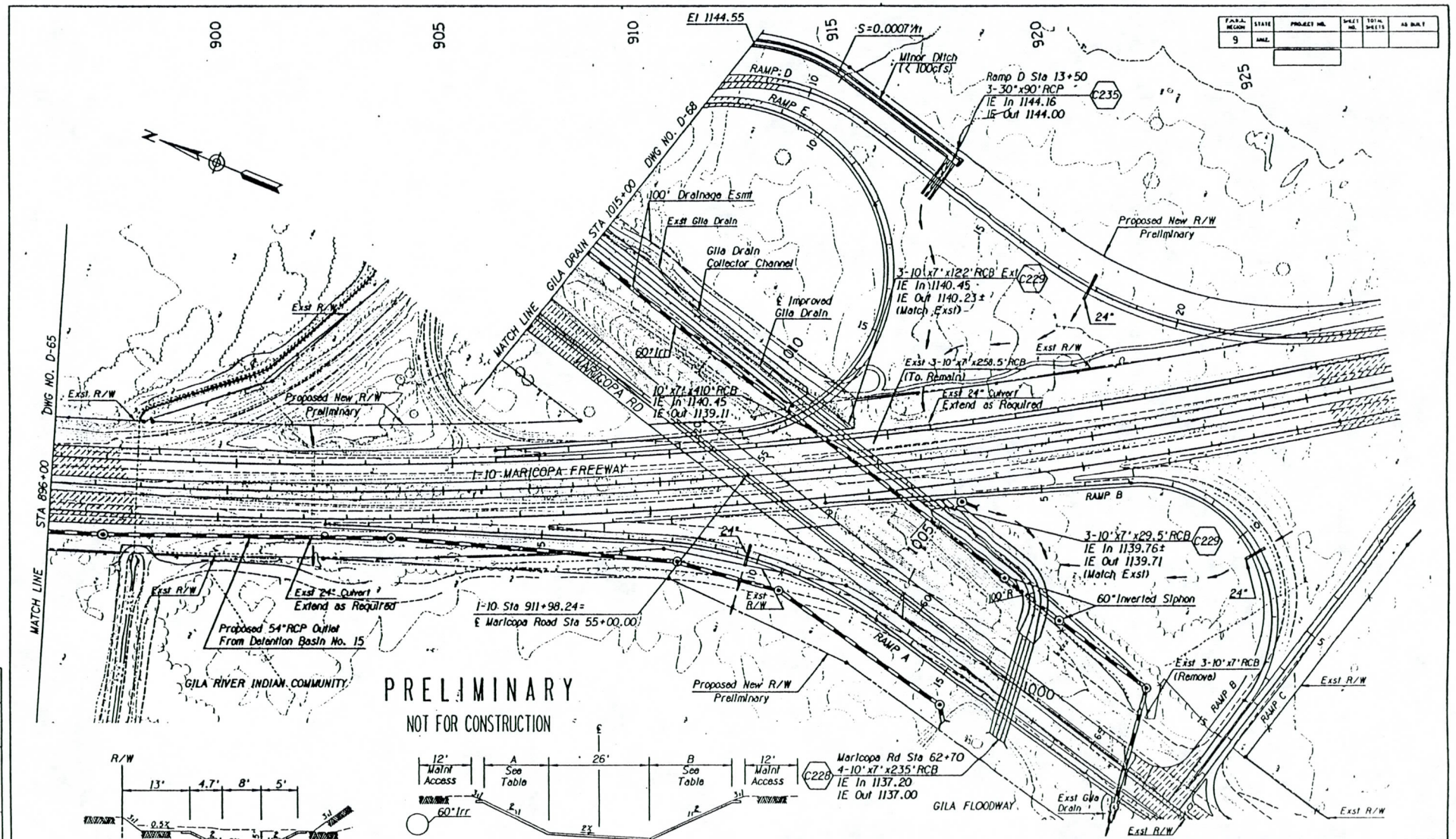
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

I-10 DRAINAGE PROFILE
STA 864+00 TO STA 896+00

Location: I-10 MARICOPA/SMF TI

DRG. NO. D-65.1 OF

TRACS NO. H-2222-01D | DRSWL241 | ___ OF ___



STATION RANGE	A	B
1001+05 TO 1005+01	15'	16'
1009+11 TO 1015+00	13'	15'

F.A.P.R. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

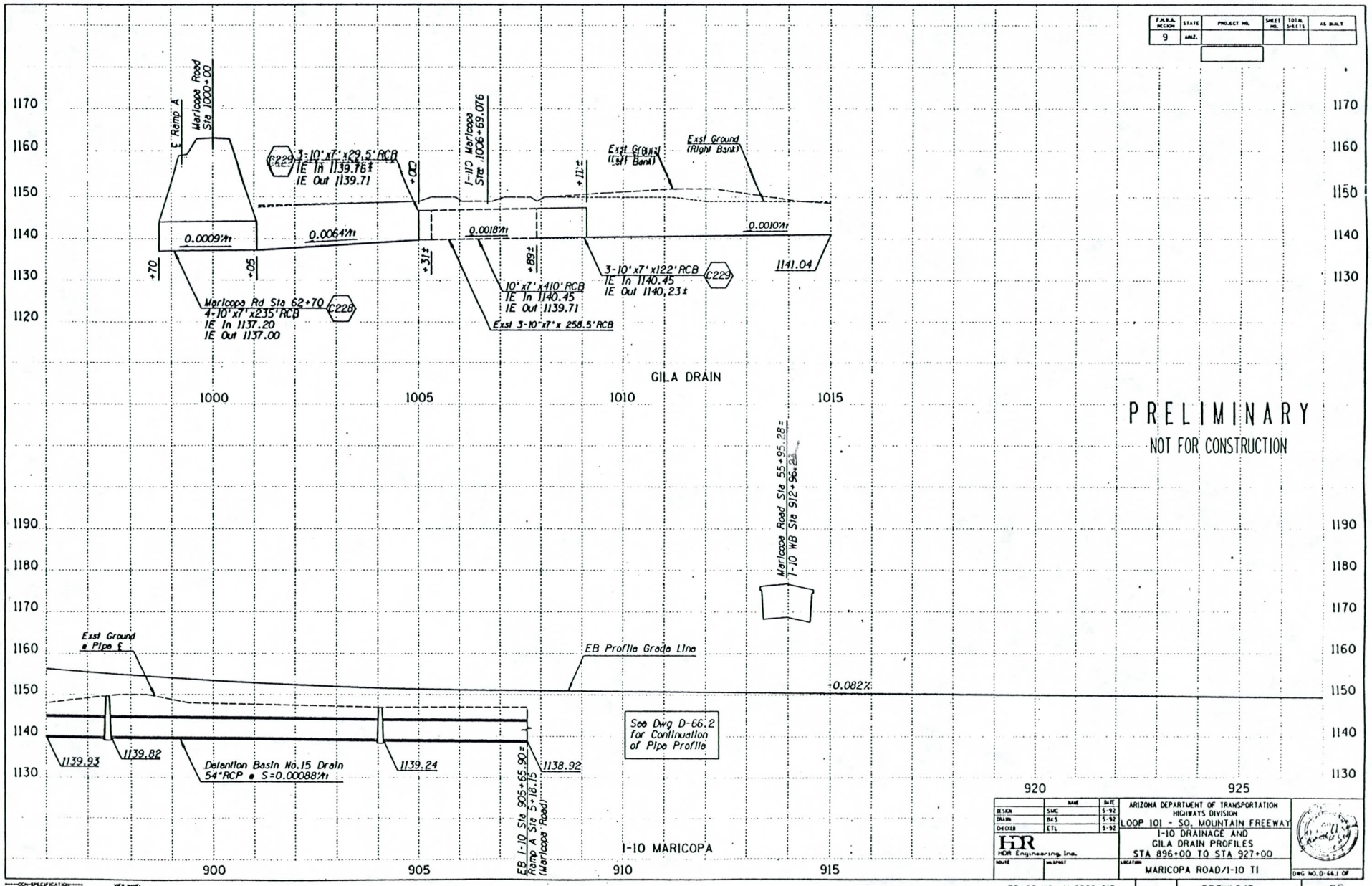
	NAME	DATE
DESIGN	SMC/ETL	8-92
DRAWN	BKS	8-92
CHECKED	JE	8-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
I-10 MARICOPA FREEWAY
GILA STA 1001+05 TO STA 1015+00
I-10 MARICOPA/SMF TI

DWG NO. D-66 OF

TRACS NO. H-2222-01D | DRSWL242 | ___ OF ___



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

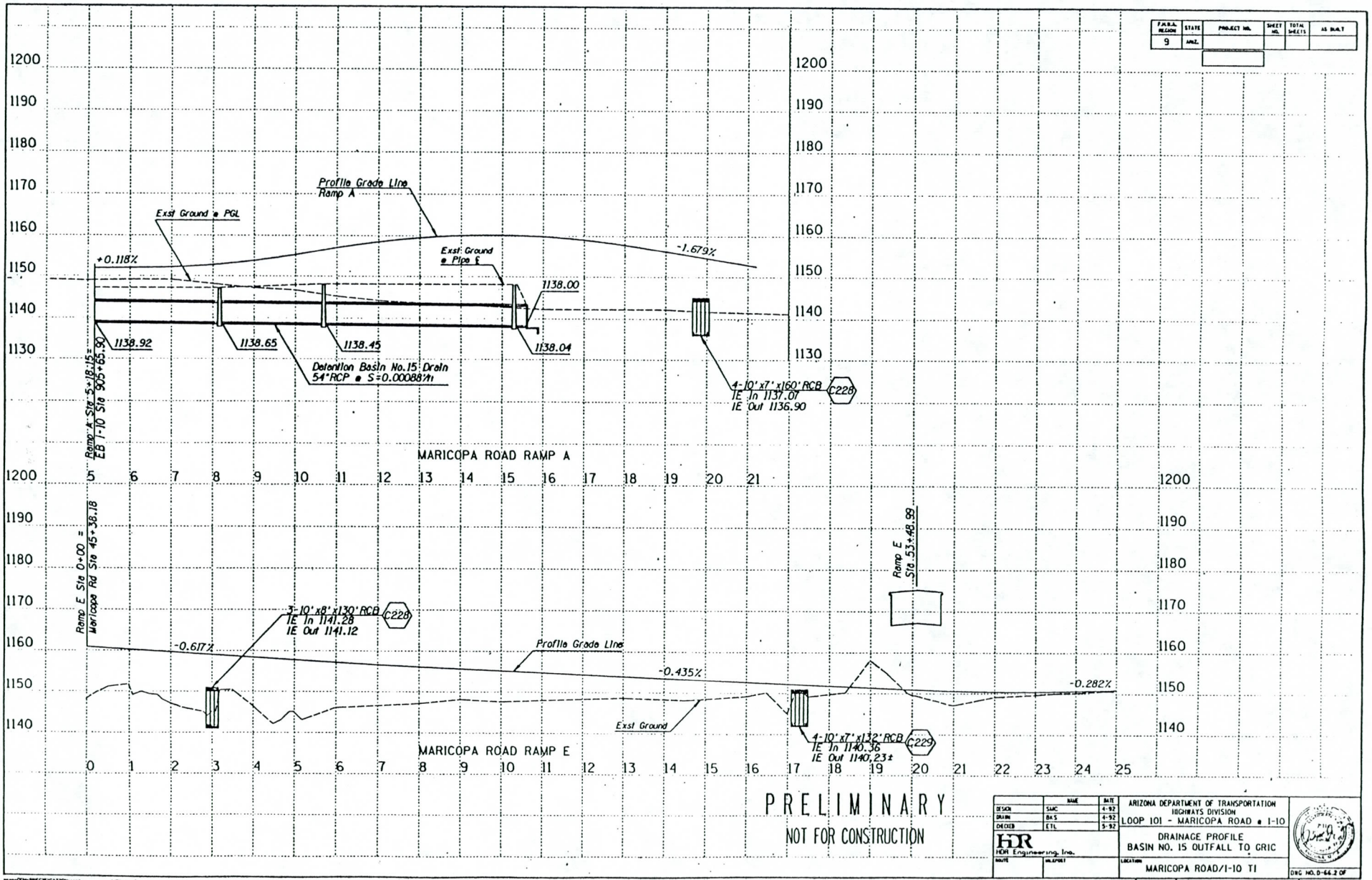
	NAME	DATE
DESIGN	SMC	5-92
DRAWN	BKS	5-92
CHECKED	ETL	5-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
I-10 DRAINAGE AND
GILA DRAIN PROFILES
STA 896+00 TO STA 927+00
MARICOPA ROAD/I-10 TI

DWG NO. D-66.1 OF ___

TRACS NO. H-2222-010 | DRSWL243 | ___ OF ___



F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC	4-92
DRAWN	BKS	4-92
CHECKED	ETL	5-92

HDR Engineering, Inc.

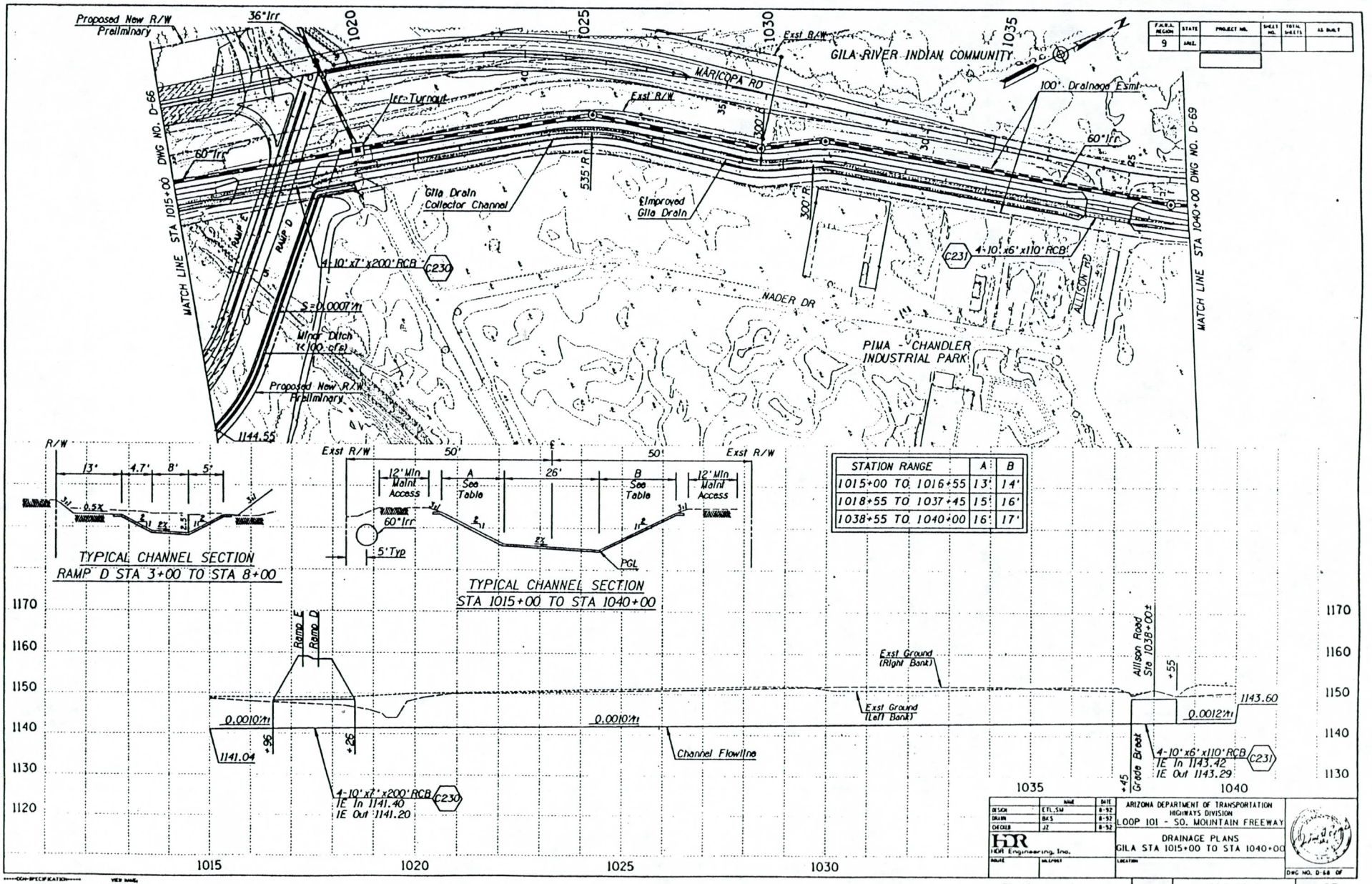
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - MARICOPA ROAD ● I-10

DRAINAGE PROFILE
BASIN NO. 15 OUTFALL TO GRIC

LOCATION: MARICOPA ROAD/I-10 TI

DWG NO. D-66.2 OF

TRACS NO. H-2222-01D | DRSWL244 | ___ OF ___



F.A.R.L. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

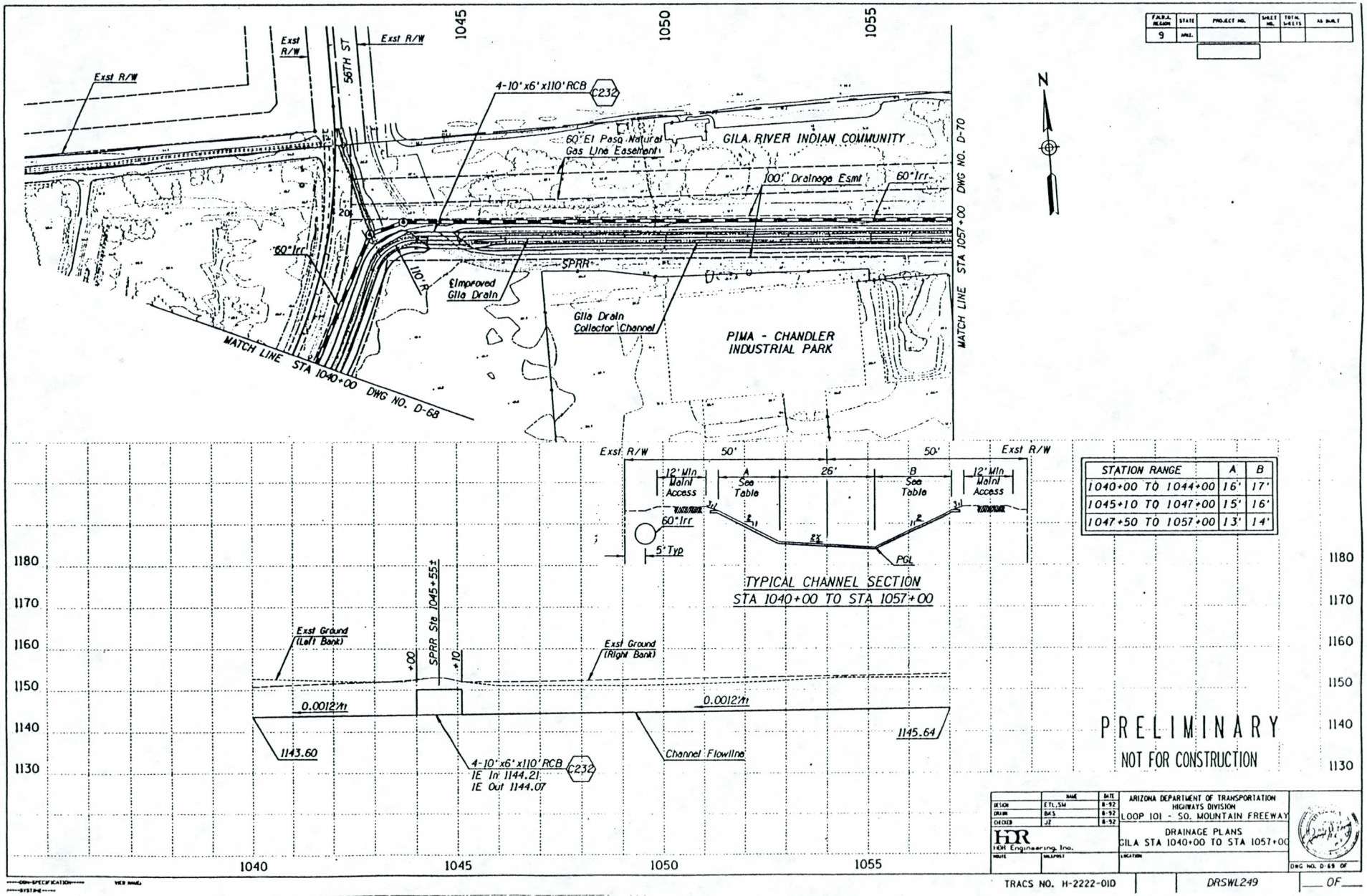
	NAME	DATE
DESIGN	ETL,SM	8-92
DRAWN	BKS	8-92
CHECKED	JZ	8-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
GILA STA 1015+00 TO STA 1040+00

DWG NO. D-68 OF

TRACS NO. H-2222-01D | DRSWL248 | ___ OF ___



FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

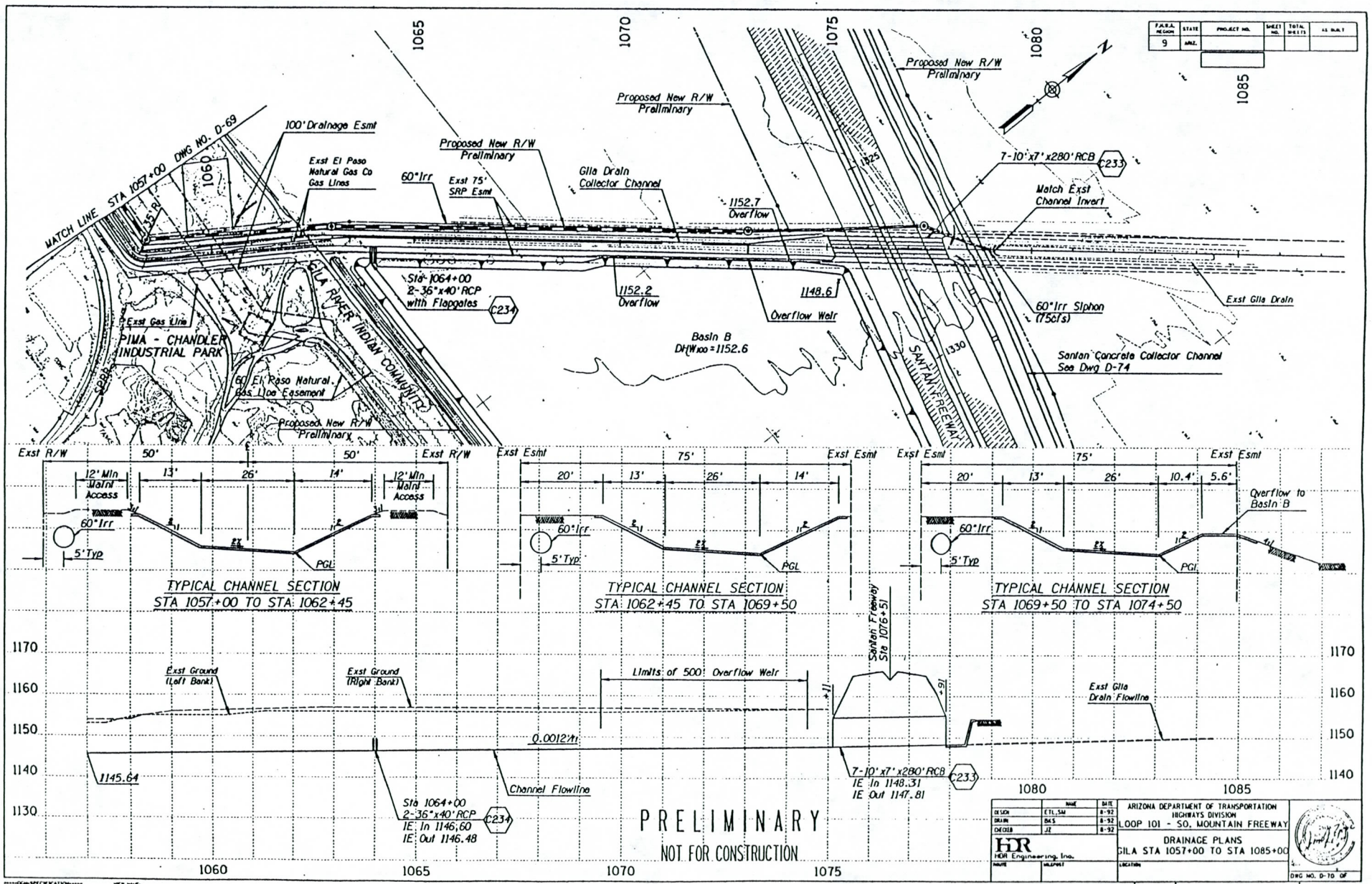
	NAME	DATE
DESIGN	ETL,SM	8-92
DRAWN	BKS	8-92
CHECKED	JZ	8-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
GILA STA 1040+00 TO STA 1057+00

DWG NO. D-69 OF

TRACS NO. H-2222-01D | DRSWL249 | ___ OF ___



F.A.R.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

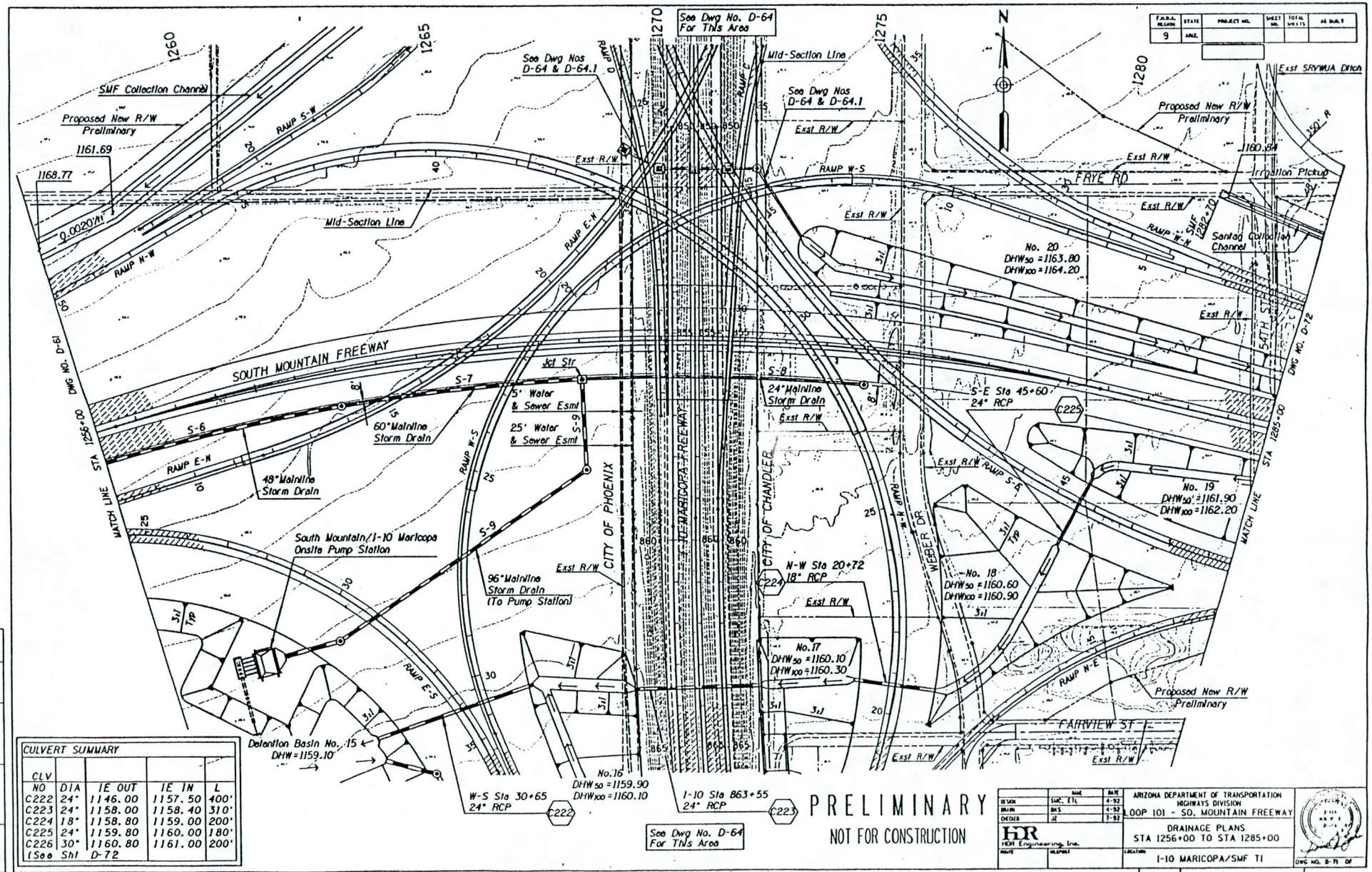
	NAME	DATE
DESIGN	ETL,SM	8-92
DRAWN	BKS	8-92
CHECKED	JZ	8-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
GILA STA 1057+00 TO STA 1085+00

DWG NO. D-70 OF

TRACS NO. H-2222-010 | DRSWL250 | ___ OF ___



CULVERT SUMMARY				
CLV NO	DIA	IE OUT	IE IN	L
C222	24"	1146.00	1157.50	400'
C223	24"	1158.00	1158.40	310'
C224	18"	1158.80	1159.00	200'
C225	24"	1159.80	1160.00	180'
C226	30"	1160.80	1161.00	200'
(See Sht D-72				

PRELIMINARY
NOT FOR CONSTRUCTION

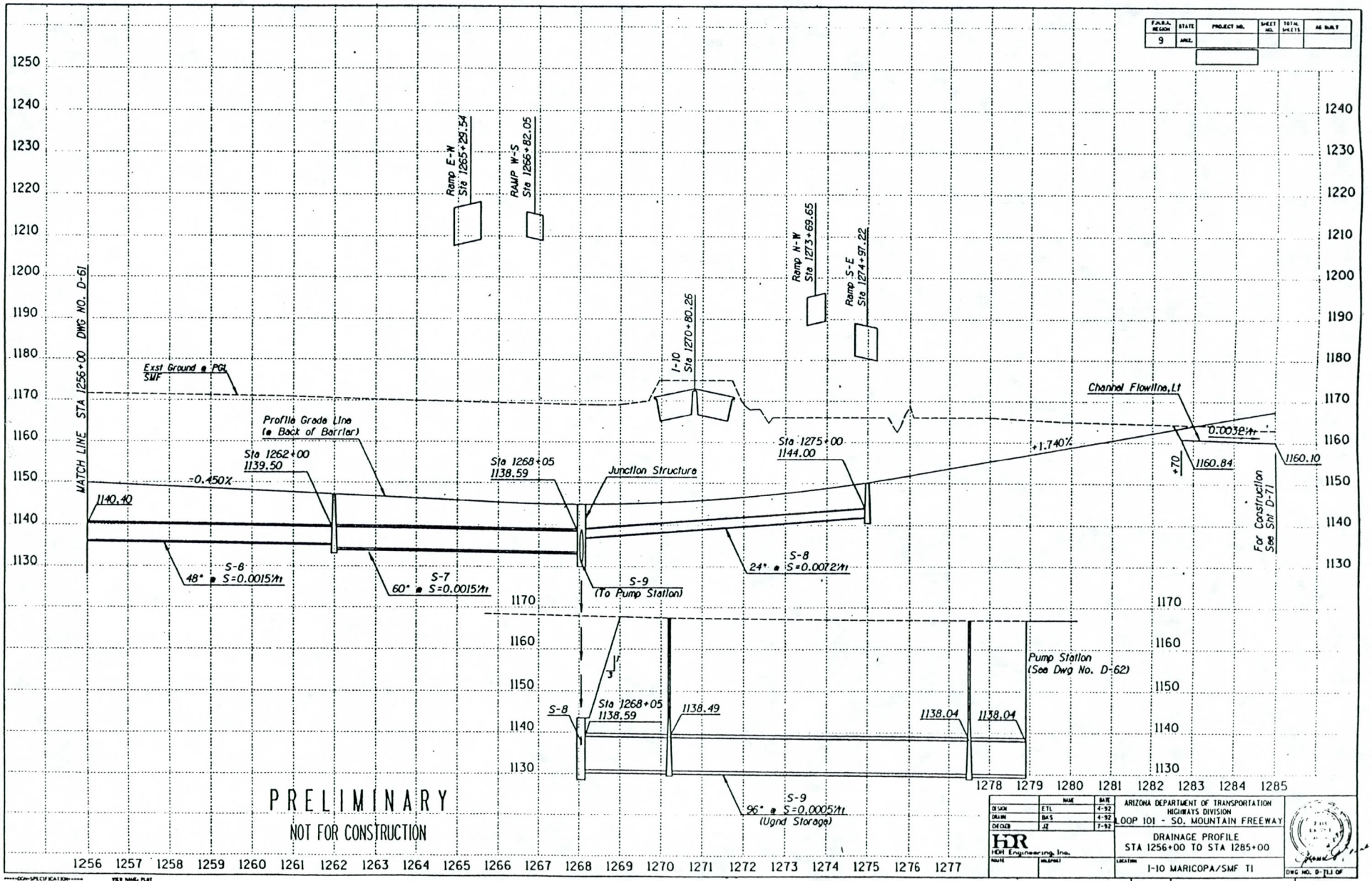
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	SMC, ETL	4-92
DRAWN	BAS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1256+00 TO STA 1285+00
I-10 MARICOPA/SMF TI

TRACS NO. H-2222-01D | DRSWL245 | DWG NO. D-71 OF ___ OF ___



PRELIMINARY

NOT FOR CONSTRUCTION

F.A.R.S. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

	NAME	DATE
DESIGN	ETL	4-92
DRAWN	BAS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

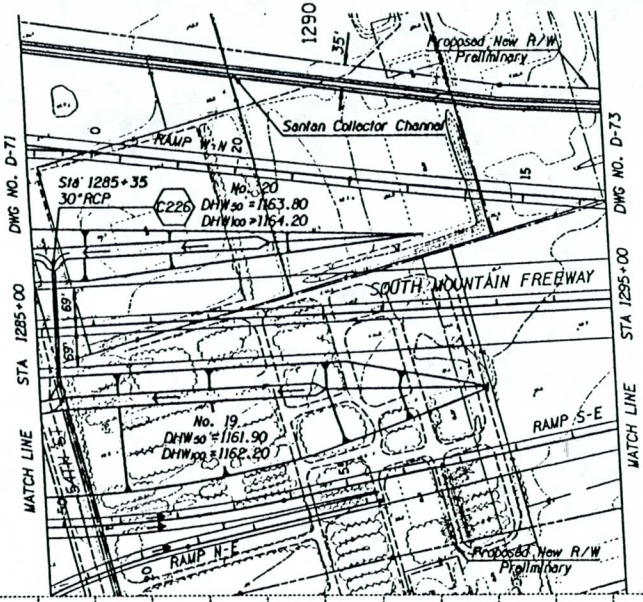
DRAINAGE PROFILE
STA 1256+00 TO STA 1285+00

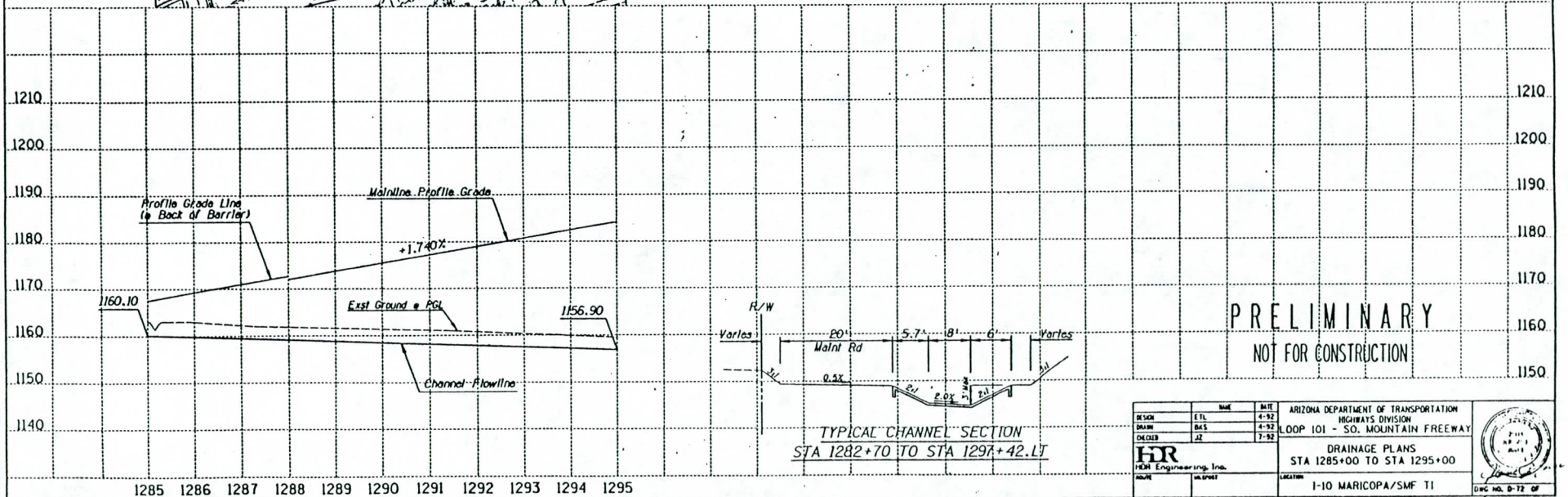
I-10 MARICOPA/SMF TI

DWG NO. D-71 OF

TRACS NO. H-2222-01D | DRSWL246 | OF

FHWA REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				





TYPICAL CHANNEL SECTION
STA 1282+70 TO STA 1297+42.LT

PRELIMINARY
NOT FOR CONSTRUCTION

	NAME	DATE
DESIGN	ETL	4-92
DRAWN	BAS	4-92
CHECKED	JZ	7-92

HDR Engineering, Inc.

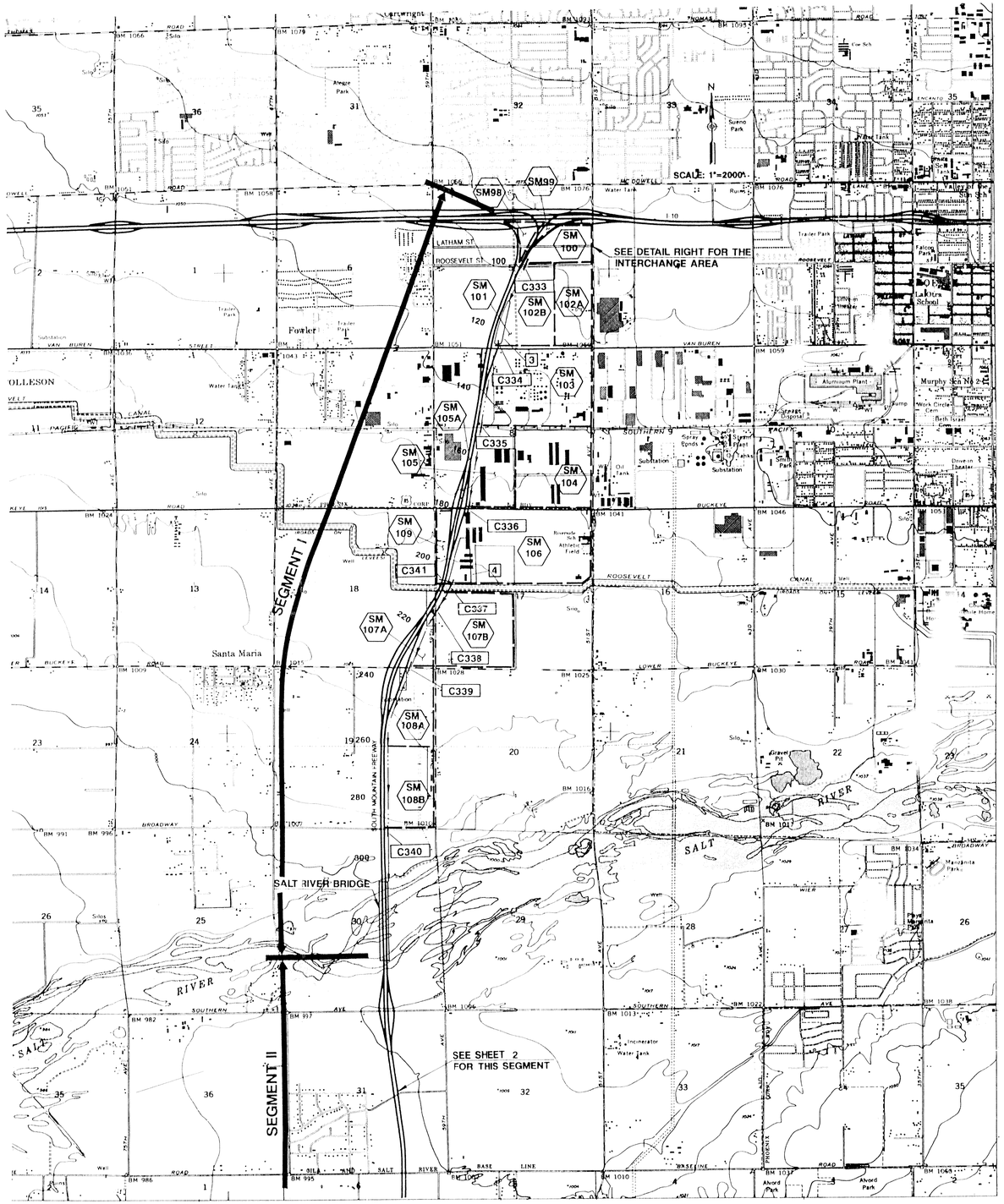
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY
DRAINAGE PLANS
STA 1285+00 TO STA 1295+00
LOCATION: I-10 MARICOPA/SMF TI

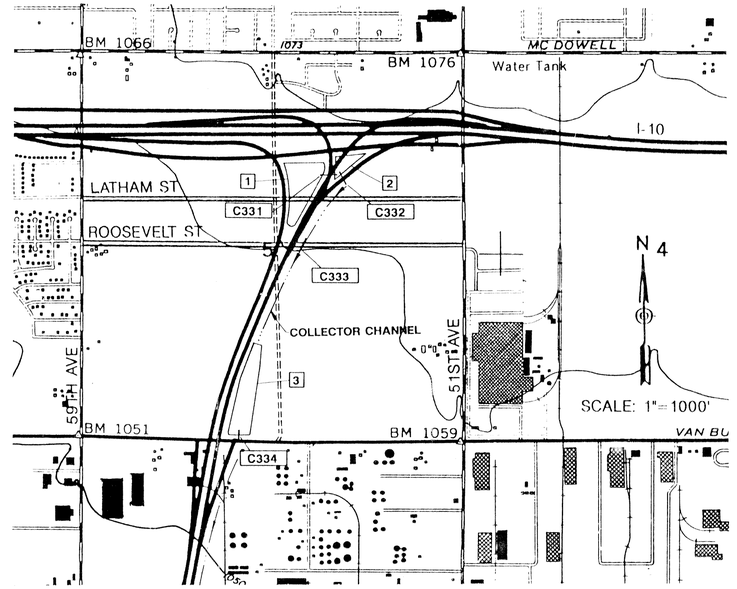
DWG NO. D-72 OF

TRACS NO. H-2222-01D | DRSW1247 | OF

-----CCH-SPECIFICATION-----
-----SYSTEM-----

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				





LEGEND

- C100 — STRUCTURE CULVERT NUMBER
- SM98 — DRAINAGE AREA NUMBER
- 1 — DETENTION CELL NUMBER
- DRAINAGE AREA BOUNDARY
- DRAINAGE DITCH/CHANNEL

	NAME	DATE
DESIGN	ETL	5/92
DRAWN	JOM	5/92
CHECKED		

HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 202-SO. MOUNTAIN FREEWAY

SEGMENT I
DRAINAGE AREA MAP

LOCATION
I-10 TO THE SALT RIVER

DWG NO. | OF

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

*****DGN=SPECIFICATION*****
*****SYSTIME*****
VIEW NAME:

TRACS NO. H-2222-01D

1 OF 5

TRACS NO. H 2333 01D

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.		2		

LEGEND

- C123 — STRUCTURE/CULVERT NUMBER
- SW123 — DRAINAGE BASIN NUMBER
- 12 — DETENTION/LEVEL SPREADER CELL NUMBER
- DRAINAGE BASIN BOUNDARY
- DRAINAGE DITCH /CHANNEL
- NONCONTRIBUTING AREA

SEGMENT II

SEGMENT III

SEGMENT IV SEE SHEET 4

	NAME	DATE
DESIGN		
DRAWN		
CHECKED		

HDR Engineering, Inc.

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 101 - SO. MOUNTAIN FREEWAY

SEGMENTS II & III
DRAINAGE AREA MAP

ROUTE	MILEPOST	LOCATION	DWG NO.	OF
		SALT RIVER TO 19TH AVENUE		

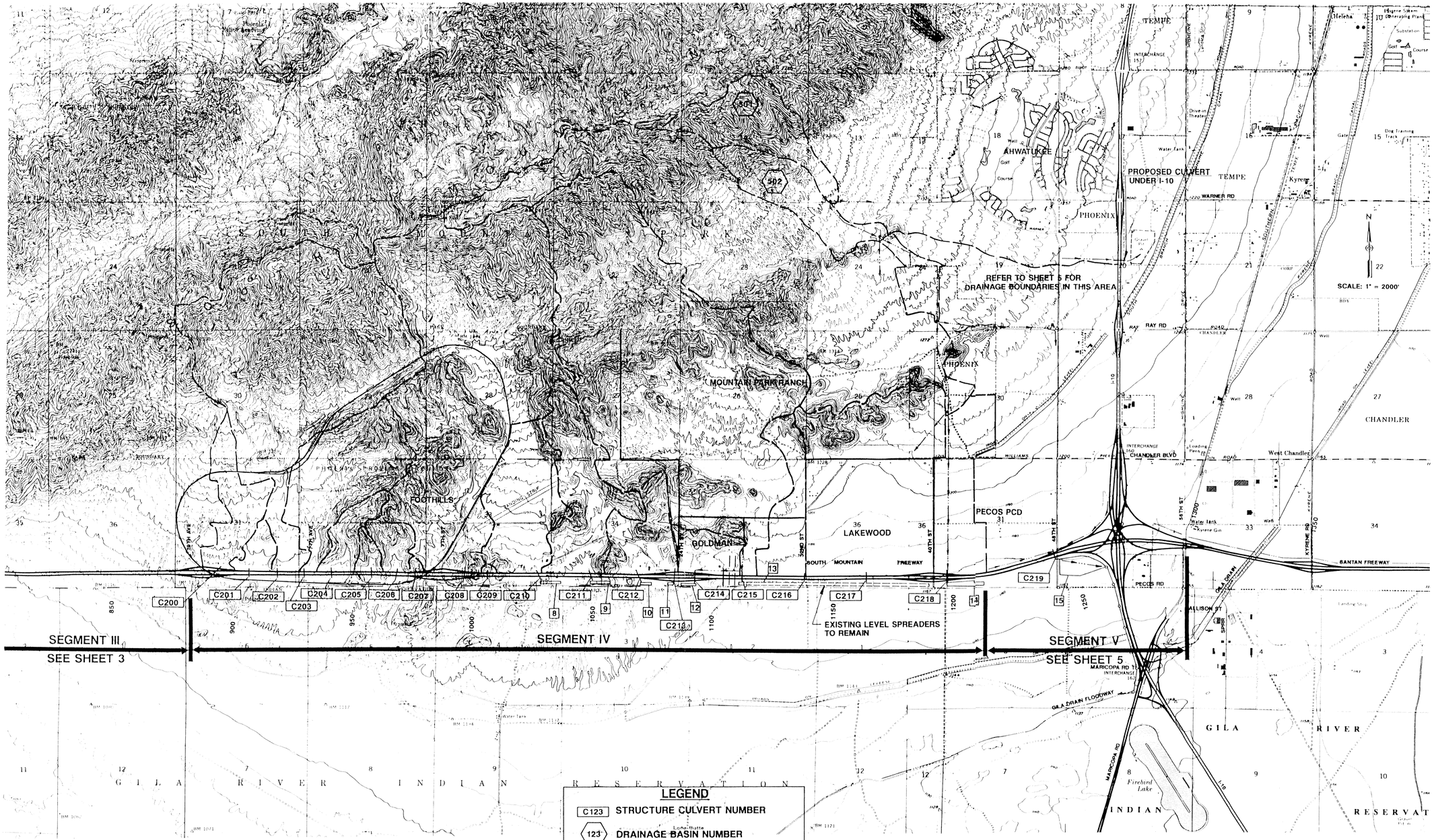
TRACS NO. H-2222-01D

3 OF 5

SURVEY NO.	FINISHED PLANS	REVISIONS	LOCATION	DATE

-----DGN=SPECIFICATION-----
-----SYSTIME-----
VIEW NAME=

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



LEGEND

- C123 — STRUCTURE CULVERT NUMBER
- 123 — DRAINAGE BASIN NUMBER
- 2 — DETENTION/LEVEL SPREADER CELL
- DRAINAGE BASIN BOUNDARY
- DITCH/CHANNEL

	NAME	DATE
DESIGN	SMC & ETL	4.92
DRAWN	JDM	5.92
CHECKED		

HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 202-SO. MOUNTAIN FREEWAY

SEGMENT IV
DRAINAGE AREA MAP

LOCATION
19TH AVENUE TO 56TH STREET

DWG NO. | OF

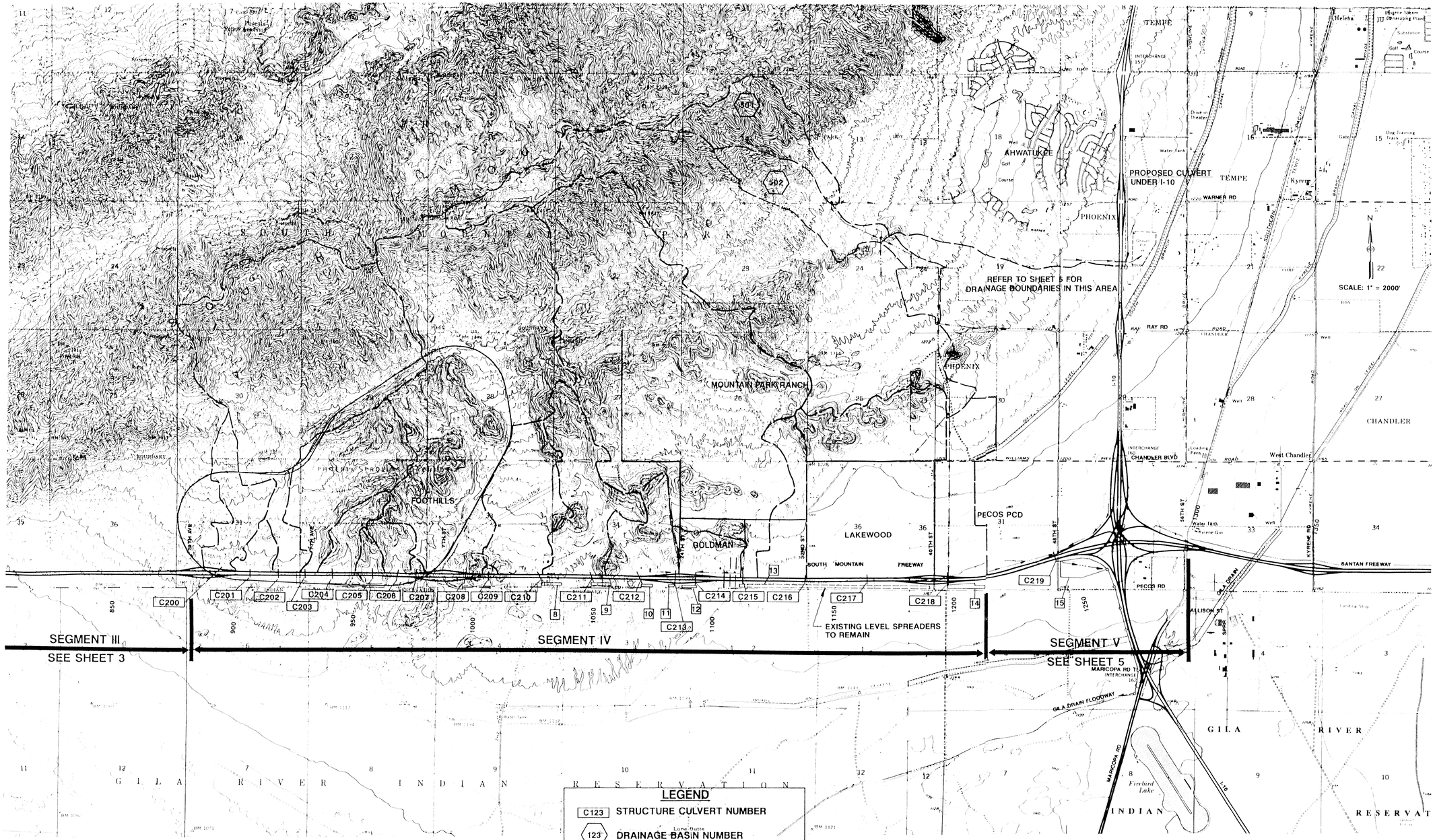
TRACS NO. H-2222-01D

4 OF 5

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

•••••DGN=SPECIFICATION••••• VIEW NAME:
•••••SYSTIME•••••

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				



	NAME	DATE
DESIGN	SMC & LTL	4-92
DRAWN	JDM	5-92
CHECKED		

HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 202-SO. MOUNTAIN FREEWAY

SEGMENT IV
DRAINAGE AREA MAP

LOCATION
19TH AVENUE TO 56TH STREET

DWG NO. | OF

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

*****DGN=SPECIFICATION*****
*****SYSTIME*****
VIEW NAME:

TRACS NO. H-2222-01D

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	ARIZ.				

LEGEND

- C100 — STRUCTURE CULVERT NUMBER
- 510 — DRAINAGE BASIN NUMBER
- 10 — DETENTION/LEVEL SPREADER CELL
- DRAINAGE BASIN BOUNDARY
- DITCH CHANNEL
- DRAINAGE FLOW PATH

NOTE:
SEE GENERAL PLAN SHEETS FOR CONFIGURATION OF INTERCHANGE DETENTION CELLS.

ON-SITE PUMP STATION

SEE PRICE EXPRESSWAY/SANTAN FREEWAY DRAINAGE CONCEPTS

SCALE: 1"=1000'

	NAME	DATE
DESIGN	SMC & EH	4-92
DRAWN	JOM	4-92
CHECKED		

HDR Engineering, Inc.

ROUTE | MILEPOST

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
LOOP 202-SO. MOUNTAIN FREEWAY

SEGMENT V
DRAINAGE AREA MAP

LOCATION
19TH AVENUE TO 56TH STREET

DWG NO. | OF

TRACS NO. H-2222-01D

5 OF 5

SURVEY NO. | FINISHED PLANS | REVISIONS | LOCATION | DATE

*****DGN=SPECIFICATION*****
-----SYSTEM-----
VIEW NAME: