ALIGNMENT STUDY

TAHOE / PYRAMID LINK

Regional Transportation Commission

sea

TAHOE & PYRAMID LINK STUDY - 12/2/82 REVIEW

- Does acknowledge the control of flood elevations (both Truckee River and Steamboat Creek) on the vertical alignment.
- 6 lane roadway (3 each way); access controlled expressway; 120 foot row.
- Steamboat Creek will probably require some realignment.
- Cost estimated @ $32.5 million; full improvement of entire alignment (1982 $)
- Master plans (i.e. Double Diamond & Damonte) affected horizontal alignment.
- Some alternatives were eliminated if they [illegible] Toyota, Double Diamond, and Bella Vista.
- Construction phasing is expected.
- Acknowledged: construction, erosion, if not controlled, could affect bottom conditions and hydrology of surrounding wetlands.

S E A incorporated
ENGINEERS/PLANNERS

October 21, 1983
Project No. 133-014-823

REGIONAL TRANSPORTATION COMMISSION
P.O. Box 11130
Reno, NV 89520

Dear Sirs:

We are transmitting herewith the Alignment Study for the Tahoe-Pyramid Link between the intersection of Mt. Rose Highway/U.S. Highway 395, and the intersection of Greg Street and the extension of Sparks Boulevard.

The report focuses on the establishment of a horizontal and a vertical alignment for the subject project. The purpose is to provide a planning tool for local agencies to use to acquire right-of-way and/or construct portions of the alignment as developments occur in the area.

We wish to thank you for the opportunity of preparing this alignment study. The close cooperation of the local agencies, as well as the U.S. Army Corps of Engineers, was extremely beneficial in the preparation of this report. We will be pleased to discuss and answer any questions that may arise.

Sincerely,

S E A ENGINEERS/PLANNERS

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TAHOE PYRAMID LINK
ALIGNMENT STUDY

PREPARED BY :

SEA ENGINEERS / PLANNERS

OCTOBER 1983

EXECUTIVE SUMMARY

The general corridor for the Tahoe-Pyramid Link between the intersection of Mt. Rose Highway/U.S. Highway 395 and Interstate 80 has been adopted by the Regional Planning Commission as shown on the Regional Master Plan of Streets and Highways. On October 14, 1982 the Regional Transportation Commission of Washoe County approved an engineering agreement with SEA Engineers/Planners to study this corridor for the purpose of defining and recommending a horizontal and vertical alignment for the subject project.

The Alignment Study focused upon the following primary items:

1. Horizontal and vertical alignment of the proposed project.

2. Conceptual design of drainage structure for crossing the Truckee River.

3. Identification of other major drainage structures that may be required and their conceptual design.

4. Conceptual geometrics for major at-grade intersections.

5. General right-of-way requirements.

6. Preliminary cost estimate for total project.

7. Development of logical project phasing and corresponding cost estimates for each phase.

8. Preliminary soils analysis.

Pertinent data with regard to topography, soils, hydrology, traffic, and property ownership were researched and gathered in order to formulate a set of general design guidelines in order to evaluate in general terms alternate routes and to refine the general corridor to a more defined route. As additional and more current data on soils conditions, topographic mapping, hydrology, and traffic became available a recommended set of design guidelines was developed for evaluating and establishing the proposed horizontal and vertical alignment. These recommended guidelines included:

1. Roadway design speed: 55 mph.

2. From Mt. Rose Highway and U.S. Highway 395 in the south northward to Greg Street the roadway would be designed to provide access during the 100-year flood.

3. Existing master plans were utilized in establishing the horizontal alignment.

4. Vertical grades: Minimum grade of .3 percent was used for the portion of the alignment between Mt. Rose Highway in the south to 6,000 feet north of the Huffaker Narrows. This minimum grade is based upon the proposed use of curb and gutter within these limits. From 6,000 feet north of the Huffaker Narrows to the Truckee River bridge the roadway is designed for a minimum grade of 0 percent. Curb and gutter is not proposed to be used within this reach. A maximum vertical grade on the proposed alignment would be limited to 5 percent.

5. Drainage structures for where the Tahoe-Pyramid Link crosses the Steamboat Creek, Boynton Slough, and Truckee River will be designed for the corresponding 100-year flows.

6. From Mt. Rose Highway to approximately 6,000 feet north of the Huffaker Narrows an R-value of 12 was used for the design of the paved structural sections. From 6,000 feet north of the Huffaker Narrows to the terminus of the project an R-value of 45 was used to design the paved structural section.

A soils investigation was conducted including field exploration, laboratory testing, and engineering analysis to determine the various soils properties pertinent to this project. Recommended construction practices are presented in detail in the body of the report.

The design of the Tahoe-Pyramid Link Alignment is affected by 5 water courses including the Truckee River, Steamboat Creek, Boynton Slough, Whites Creek, and Thomas Creek. Numerous existing studies regarding the hydrology of these waters were consulted in order to develop the following information:

A. Water surface elevations along the proposed roadway corridor during various flood events;

B. Design criteria for the conceptual design of structures at major drainage crossings; and

C. The general vertical alignment design guidelines.

Generally speaking, the vertical alignment of the Tahoe-Pyramid Link can be divided into two reaches. In the southern portion, from Gieger Grade (State Highway 341) to about one mile north of Huffaker Narrows, the flood elevation is controlled by the 100-year flood on the Steamboat Creek. From one mile north of the Huffaker Narrows to the Truckee River the water surfaces elevation is controlled by the 100-year flood on the Truckee River and its resulting backwater effects. Elevations and flows developed in the Hydrology section of this report were used to establish the minimum vertical grade of the roadway in order to allow access during the 100-year floods and to design the major drainage structures.

The proposed alignment will require realignment of the Steamboat Creek north of the Huffaker Narrows to the wetlands (Jones Ranch), and north of Pembroke Drive to Kimlick Lane. The realigned channel will be aligned along the western right-of-way of the Tahoe-Pyrmaid Link.

The major drainage structures consisted primarily of reinforced concrete boxes for the crossing of the Steamboat Creek, a 300-foot bridge for the crossing of the Steamboat Creek at Kimlick Lane, and

1,000-foot viaduct for the crossing of the Truckee River. The proposed alignment will consist ultimately of a 6-lane roadway, 3 through lanes in each direction, raised median with protected left-turn pockets at all intersections, curb and gutter on the southern portion of the alignment, and graded gravel shoulders on the northern portion of the alignment. The Tahoe-Pyramid Link will be an access controlled expressway with recommended intersections allowing cross traffic no closer than one-half mile apart. Eight major intersections have been identified at this time and include:

1. Mt. Rose Highway/U.S. Highway 395

2. Gieger Grade - State Highway 341

3. Extension of Zolezzi Lane from U.S. Highway 395

4. Extension of Mays Lane from U.S. Highway 395

5. Extension of Rio Poco Road and Mira Loma Road from McCarran Boulevard

6. Extension of Mira Loma Drive from McCarran Boulevard

7. Pembroke Drive

8. Intersection of Greg Street and Sparks Boulevard

Right-of-way should be acquired for the full cross section right-of-way improvements. These improvements, including graveled shoulders, will require a 120 foot right-of-way. Where special conditions exist, additional right-of-way may be required. An example of a special condition is at intersections where the right-of-way flares to accommodate right turn only lanes and other facilities.

Drainage easements will be required for the realigned portions of the Steamboat Creek. Easements widths will vary from 125 feet south of the confluence of the Boynton Slough and Steamboat Creek to 150 feet north of this confluence. Additional easements for relocated utilities will also be required.

Various cost estimates were prepared for the proposed alignment including stage construction, full improvements, and partial improvements. Construction of the entire alignment to full improvements is estimated to be $32,500,000. Partial improvements, including a four-lane roadway, graded median, and protected left-turn pockets at intersections is estimated to cost $28,000,000. Additional costs associated with the development of phase construction are included in the text of the report.

It is recommended that funding be sought to continue the planning and necessary engineering in anticipation of the demand for this road requiring either full or partial construction.

INTRODUCTION/ RESEARCH

INTRODUCTION / RESEARCH

INTRODUCTION

Purpose of Report

The general location for the Tahoe-Pyramid Link between the intersection of the Mt. Rose Highway/U.S. Highway 395 and Interstate 80 (I-80) has been adopted by the Regional Planning Commission as shown on the Regional Master Plan of Streets and Highways. The roadway lies in the southeastern portion of the Truckee Meadows and traverses large property holdings such as the Damonte, Double Diamond, Bella Vista, and Jones' Ranches, and portions of the Hidden Valley properties (see Plate No. 1). The potential development of these properties in conjunction with the increasing traffic demand on U.S. Highway 395/South Virginia Street necessitates an additional north-south expressway in the southeast portion of the Truckee Meadows. To assist in planning for future development in this area, the corridor of the Tahoe-Pyramid Link needed to be refined and a definite horizontal and vertical alignment established.

Authorization

On October 14, 1982 the Regional Transportation Commission (RTC) of Washoe County approved an engineering agreement with SEA Engineers/Planners for the alignment study of the Tahoe-Pyramid Link between Mt. Rose Highway and the proposed interchange for Sparks Boulevard at I-80. The project is funded and administered by the Regional Transportation Commission of Washoe County.

The purpose of this alignment study is to focus upon the following primary items:

Scope of Work

1. Horizontal and vertical alignment of the proposed project.


INTERSTATE
80
SPARKS BLVD. EXTENSION
GREG ST.
TRUCKEE
RIVER
KIMLICK RD.
U.N.R.
McCARRAN
BLVD.
PEMBROKE
LN.
VIRGINIA
RANGE
HIDDEN VALLEY
BOYNTON
SLOUGH
JONES
MIRA LOMA DR.
BELLA VISTA
RIO POCO RD. EXTENSION
HUFFAKER HILLS
MIRA LOMA RD.
STEAMBOAT
DOUBLE
DIAMOND
RANCH
THOMAS
CREEK
TAHOE/PYRAMID LINK
MAYS LN.
DAMONTE
RANCH
WHITES
CREEK
ZOLEZZI LN.
CREEK
U.S. 395
MT. ROSE
HWY.
GEIGER
GRADE
LOCATION MAP
PLATE 1
PAGE 2
N

2. Conceptual design of structure for crossing the Truckee River.

3. Identification of other major structures that may be required and their conceptual design.

4. Conceptual geometrics for major at-grade intersections.

5. General R/W requirements.

6. Preliminary cost estimate for total project.

7. Development of logical project phasing and corresponding cost estimates for each phase.

8. Preliminary soils analysis.

Methodology

The methodology used in the preparation of the alignment study was to first research and gather pertinent data with regard to topography, soils, hydrology, traffic, and property ownership in order to formulate basic design guidelines. Various alternates were developed based upon this criteria and presented to the governmental bodies involved and the property owners directly affected. The alternates were further reduced to one alignment which refined the general roadway corridor to a more specific one. This refined corridor was then studied focusing upon the previous listed primary items for the purpose of defining and recommending a horizontal and vertical alignment for the project.

The following report presents the data gathering process, development of the design guidelines, and the proposed alignment with corresponding recommendations and conclusions.

RESEARCH

Meetings

In order to fully understand the background of the decision to create the Tahoe-Pyramid Link, preliminary meetings with all the interested agencies were held. In addition, property owners directly affected by the alignment were consulted at the outset to incorporate their concerns where possible. Preliminary meetings were set with the staff of the Regional Transportation Commission (RTC), Cities of Reno and Sparks, and Washoe County to establish a more definitive scope of work, define design guidelines, and define an administrative process. Other governmental agencies were consulted for specific input and data as the need arose. Additional agencies contacted included the Washoe Council of Governments (WCOG), Nevada Department of Transportation (NDOT), U.S. Army Corps of Engineers, the Federal Emergency Management Agency (FEMA), and the Nevada Department of Wildlife. Finally, upon setting a reasonably close horizontal and vertical alignment, plan and profiles were sent to affected utility companies for their review and response where the alignment may affect their existing or future facilities. These included the Sierra Pacific Power Company, Nevada Bell, and the Washoe County Sanitary Department.

The ownership of all land affected by the alignment was researched and the owners contacted by mail to set a time and place to review and comment on the preliminary route. The meeting was held on December 16, 1982 in the Washoe County Commission Chambers and was attended by representative of the RTC, Washoe County, City of Reno and City of Sparks Public Works Department staffs as well as the property owners and the design team. Verbal and subsequent written comments from the property owners were considered and incorporated where possible to modify the alignment.

Data Gathering

Specific physical, legal, projected and calculated data needed to shape the alignment were researched and assembled. This information included the following:

1. Property lines
2. Soils
3. Topography
4. Traffic
5. Hydrology

During the course of this feasibility study the above data was incorporated into the design guidelines set forth in this report. Section II--Design Guidelines and Section III--Project Design include a more detailed explanation of the results of this data gathering.

DESIGN GUIDELINES

DESIGN GUIDELINES

Two levels of design guidelines were used to evaluate and establish the alignment for the Tahoe-Pyramid Link. A set of general design guidelines was developed early in the study to evaluate in general terms alternate routes and to refine the general corridor to a more defined route. As additional and more current data on soil conditions, topographic mapping, hydrology, and traffic became available, a recommended set of design guidelines was developed for evaluating and establishing the proposed horizontal and vertical alignment. In addition, these data were used to prepare conceptual designs of major drainage structures and at-grade intersections.

GENERAL DESIGN GUIDELINES

General design guidelines were developed based upon field reconnaissance to generally evaluate existing soils and topography; review existing hydrology studies, ownership property lines, and existing master plans. Evolving from this process, the following general guidelines were used to develop and evaluate various alternatives:

1. Roadway design speed: 55 mph

2. Vertical alignment limitations from Mt. Rose Highway and U.S. Highway 395 in the south, northward to Greg Street the roadway would be designed to provide access during the 100-year flood.

3. Existing master plans (i.e. Double Diamond and Damonte Ranches) were utilized in establishing the horizontal alignment of the roadway through these areas.

4. At points where the Tahoe-Pyramid Link crosses the Steamboat Creek, Boynton Slough, and Truckee River, drainage structures will be designed for the corresponding 100-year flows.

5. Preliminary field observations showed that areas in pasture and flat lands consist of very poor, fine grained soils whereas bedrock would be encountered in the hills adjacent to the proposed alignment. The observed soil conditions were considered in determining the vertical and horizontal alignment of the various alternatives.

6. Existing drainage channels were taken into account with regard to the alignment.

7. Consideration was given to the environmentally sensitive areas such as the wetlands on the Jones' Ranch and visible cutfaces where skirting the foothills.

These guidelines were used to develop and evaluate alternative alignments. The alternative alignments (see Section III - Project Design for discussion) were presented to the governmental agencies involved for the purpose of selecting the most feasible alignment for evaluation, and to incorporate comments from these sources in the study.

As more current and detailed information became available, recommended design guidelines were developed to evaluate and refine the proposed horizontal and vertical alignment. The following sections detail and describe these recommended design elements.

RECOMMENDED DESIGN GUIDELINES

ROADWAY GEOMETRICS

The roadway geometric design standards for the horizontal and vertical alignment of the Tahoe-Pyramid Link were developed based upon existing ordinances and design practices for the Reno, Sparks, and Washoe County area.

The recommended design criteria used for this analysis include:

Design Speed

The design speed (55 mph) utilized in the General Guidelines is recommended for the roadway to the Truckee River bridge.

From the Truckee River bridge crossing to the terminus of the project, at the proposed intersection of Greg Street and the extension of Sparks Boulevard over Interstate 80 (I-80), would be designed for 45 mph. This reduction in design speed is due to the previous establishment of the Greg Street/Sparks Boulevard intersection, and a short portion of the alignment between this intersection and the Truckee River. This portion of the alignment included a horizontal curve with a radius of approximately 1000 feet which with a 2 percent super would correspond to a 45 mph design speed.

Super-elevations

The Tahoe-Pyramid Link Road has been functionally classified by the Regional Transportation Commission as an "expressway." Therefore, a maximum super elevation of 3 percent was used to establish the minimum horizontal curve. Within these limits the road cross slope could vary from a normal crown section of -2 percent to the maximum super elevated section of +3 percent. Tables 1 and 2 show the minimum centerline radii and corresponding super elevation for design speeds of 55 mph and 45 mph respectively.

TABLE 1

DESIGN SPEED 55 MPH

Centerline Radius	Super Elevation, Percent (%)
1800 feet	-2% (normal crown)
1350 feet	+2%
1270 feet (minimum)	+3% (maximum)

TABLE 2

DESIGN SPEED 45 MPH

Centerline Radius	Super Elevation, Percent (%)
1125 feet	-2% (normal crown)
865 feet	+2%
815 feet (minimum)	+3% (maximum)

Vertical Alignment

The vertical alignment of the roadway was controlled by a number factors.

The bottom of the structural section (top of sub-grade) will be set at the 100-year flood flow depth of the Steamboat Creek for that area of the alignment between Mt. Rose Highway and U.S. 395 northward to approximately 6000 feet north of the Huffaker Narrows. From the Huffaker Narrows northward to the Truckee River bridge the bottom of the paving structural section will be set at the 100-year Truckee River pool elevation.

By establishing the subgrade elevation of the profile to be equal to the 100-year flow or pool elevation, the paving structural section will be above the water and will provide approximately a 12 inch to 18 inch freeboard.

The proposed bridge structures for the crossing of the Steamboat Creek and the Truckee River were designed so the bottom of the structures will be a minimum of 2 feet above the 100-year flood pool elevation. This corresponds to a minimum freeboard as established by the Corps of Engineers.

The 100-year flow depth and flood pool elevations are developed in more detail in the section under Hydrology.

Maximum vertical grades on the proposed alignment will be limited to 5 percent. A minimum grade of .3 percent was used for the portion of the alignment between Mt. Rose Highway in the south to 6000 feet north of the Huffaker Narrows. This minimum grade is based upon the proposed use of curb and gutter within these limits.

From 6000 feet north of Huffaker Narrows to the Truckee River bridge, the roadway is designed so that the subgrade matches the flood pool elevation. The minimum grade within this reach is 0 percent. Curb and gutter is not proposed to be used within this area. Specific data on the bridge structure sites are presented under the Drainage Structures section of the report (see Section III - Project Design.)

Plan and profile drawings (Sheets 4 through 12) have been prepared to show the proposed horizontal and vertical alignment of the Tahoe-Pyramid Link and are attached at the end of the study.

SOILS

The soils investigation consisted of field exploration, laboratory testing, and engineering analysis to determine the various soils properties pertinent to this project. Field and laboratory testing form the basis for all recommendations and are included in this report. Portions of the alignment have been investigated during other studies, and the pertinent field and laboratory data from these earlier studies are incorporated into this report.

The alignment will cross a very diverse group of soil and bedrock conditions and can be divided into three physiographic divisions.

Physiographic Divisions

The alignment will cross a very diverse group of soil and bedrock conditions and can be divided into three physiographic divisions.

The first physiographic division consists of that portion of the alignment which traverses irrigated fields. This division is encountered throughout the alignment, but primarily south of the Huffaker Narrows. Additional areas are traversed south of Pembroke Drive (Station 362± to Station 403±) and north of Kimlick lane to the Truckee River (Station 472± to 504±). Principally soft, saturated, fine grained soils exist in these fields. The southern portion of the alignment, south of Station 78±, is at higher elevations and soils will not be as saturated or as fine grained as the northern fields. All traversed fields are seasonally flooded for irrigation or lie adjacent to irrigation fields where they, too, become flooded or highly saturated.

A smaller portion of undeveloped flat ground that is traversed from Pembroke Drive (Station 403±) to Kimlick Lane (Station 472±) constitutes the second physiographic division. This segment of the alignment will be located at the eastern edge of the Truckee Meadows at the base of the Virginia Range. Numerous dirt roads traverse this segment and debris piles are widely scattered. Vegetation is restricted to shrub brush and varying thicknesses of grass.

The third physiographic division is from Station 250± to Station 362± located along the eastern edge of the Bella Vista Ranch at the western toe of the bordering foothills. This portion of road will cross both bedrock in-cut and portions of irrigated field and swamps. Where soils are soft and saturated much of the year; sod thicknesses can be as much as 0.7 feet.

Geologic and General Soil Conditions

The site lies on the broad flood plains of the Truckee River on the north, and Thomas, White, and Steamboat Creeks on the south. Sedimentation in the Truckee Meadows has been in progress at varying rates since the formation of the block faulted basin. Most of the recent sediments, including the coarse grain sands that underlie the majority of the Truckee Meadows were deposited quite abruptly in the post-glacial period during torrential flooding. With the advent of a warm, drier climate, the volume and size distribution of sediment transported was greatly reduced and the sedimentation process became largely limited to the reworking of early deposits. Geothermal waters have and still flow through many of the aquifers at the southern portions of the site. These laden waters have in the past cemented near surface soil horizons and so occasional hardpan will be encountered.

The soils south of approximately Station 79± are coarse grained with the groundwater deeper than 9 feet. The predominantly granular soils are moist, slightly compact, brown, silty sands with 20-40 percent nonplastic to slightly plastic fines, and 60-80 percent fine to coarse sand. The silty sands are often interbedded with 1/2 foot to 2 feet thick horizons of clayey sand or poorly graded sand. Occasional hardpan horizons may also be encountered in the southern portion of the alignment, especially near the junction of U.S. Highway 395. The hardpan can be extremely firm.

From Station 79± (approximately 1500 feet south of the section corner of Sections 15, 16, 21, and 22) to 2000 feet south of the Huffaker Narrows (Station 250±), the soils present are extremely variable and complexly interbedded. These soils consist of wet, slightly compact to compact, clayey sands, silty sands, and poorly graded sands interbedded with wet, slightly stiff to stiff, sandy silts and clays. The individual units vary in thickness from a few inches to 3 feet. Water table depths generally are 4 to 5 feet below original ground.

The soils present from 2000 feet south of the Huffaker Narrows to the Truckee River (Station 250± to Station 500±), not including the bedrock areas, are almost exclusively fine grain clays and silts. These soils are saturated, soft to slightly stiff, brown to black and contain 60-99 percent slightly to highly plastic fines and 0-40 percent fine to medium sand. These soils are occasionally interbedded or thinly overlain by silty sands. The fine grain soils extend to at least 4 to 5 feet from the surface, and often exist in excess of 11 feet.

From aproximately 2000 feet south of the Huffaker Narrows to the Huffaker Narrows (Station 250± to 270±), the water table is approximately 4 feet below the ground surface. North of the Huffaker Narrows to 4000 feet south of Pembroke Drive (Station 270± to 363±) the water table is less than 2 feet below the ground surface and generally 2 to 4 feet deep from Station 363± to Pembroke Drive (Station 403±). The water table north of Pembroke to the Truckee River (Station 403± to 500±) is generally deeper than 5 feet and often deeper than 10 feet.

A thick surface sod layer covers most of the flat fields along the alignment. This organic unit will extend from 0.2 to 0.7 foot thick and is comprised of sod, sand, and usually clay.

Portions of the alignment will intersect bedrock outcrops between 2000 feet south of the Huffaker Narrows to 4200 feet south of Pembroke Drive (Stations 250± to 361±). The bedrock consists of volcanic breccias and mud flows of the Tertiary Period Kate Peak Formation. The volcanics exist as both massive rim rocks and rounded, weathered bedrock hills.

Exploration

Exploration consisted of excavation of a series of 46 backhoe test pits along approximate 1000 foot centers. Test pits 1 through 21 and 36 through 46 were excavated during this phase of the road development. Test pits 22 through 33 were excavated during soils exploration of the Double Diamond Ranch in 1980. Test pits 34 and 35 were dug during the CDB exporation in 1979. Test pits were excavated to depths of approximately 10 feet with occasional pits from 4 to 5 feet. Ten (10) deep borings were drilled to observe soils that exist in locations of proposed bridges and large box culvert structures. Test borings 1, and 8 through 10 were drilled during this phase of the roadway investigation. Borings 2 through 7 were drilled during the Reno-Sparks Joint Sewer Treatment Plant exploration in 1963.

An engineering geologist examined and classified the test pit and boring soils in the field. Drill hole soils were sampled in-place by use of a Standard 2 inch O.D. split spoon sampler driven by a standard 140 pound drive hammer with a 30 inch stroke. The number of blows to drive the sample 12 inch into undisturbed soil is an indication of the density and consistency of the soils.

Representative samples were collected and returned to the laboratory for testing.

The locations of the test pits and borings are shown on Sheets 4 through 12 of the attached drawings. Descriptions of each test pit and boring are shown in Book II, Tahoe-Pyarmid Link - Supportive Data.

Laboratory Tests

Samples of each distinct soil type were analyzed in the laboratory to determine grain size distribution and plasticity. The results of these tests were used to classify the soils according to the Unified Soils Classification System.

Nine (9) subgrade samples were collected for R-value determination to be used in the design of the roadway structural sections.

All tests were performed in accordance with ASTM Standards. The results of all testing are presented in Book II, Tahoe Pyramid Link - Supportive Data.

Recommended Construction Practices

The Tahoe-Pyramid Link alignment will encounter a diverse mixture of soil and rock conditions ranging from saturated soft clay soils to hard bedrock in-cut. The recommendations presented in this report are based upon preliminary subgrade elevations developed from engineering design. Because the vast majority of the alignment will lie on soft, fine grain soils, stabilizing fills will be necessary for construction. Excavated bedrock materials should provide a good quality rock fill. As presently designed, import will be required for the majority of fill needed.

1. Site Preparation - All surface water should be re-routed away from the road alignment prior to construction, and debris, fences, and objectionable rubble removed from the site.

Any of the test pits excavated in the proposed alignment should be thoroughly wheel-rolled with loaded construction equipment. The upper 12 inches should be densified to a minimum of 90 percent relative compaction (ASTM D1557-78).

On the southern 6900 feet of the roadway, from U.S. Highway 395 northward (Station 10± to Station 79±) the soils are predominantly granular and unsaturated. These areas should be stripped of all vegetation and root growth to a depth of at least 0.3 of one foot. Any areas to receive structural fill or aggregate base should be scarified to at least 8 inches, brought to a moisture content near optimum and densified to at least 90 percent relative compaction in accordance with ASTM D1557-78. Any isolated areas of soft subgrade soils or clay rich soils should be overexcavated 2 feet and backfilled with a 12 inch minus rock fill. The backfill should be densified as much as possible without causing deterioration of the underlying soils.

The next segment northward to the Huffaker Narrows (Station 79± to Station 270±) is presently saturated and traversed with flood and irrigation channels. Several box culvert structures are planned to route the Steamboat Creek under the roadway. Surface water should be rerouted or cutoff from the alignment several months prior to construction. In any areas where the alignment crosses soft, irrigated fields or undeveloped flatland and where a thick fill is anticipated (greater than 2 feet), the existing sod or grass should be left in place with only the large brush removed prior to fill placement.

Two (2) to 4 feet of fill is planned above existing ground for this portion of the alignment so the existing ground need only have large brush removed prior to placement of the fill. All abandoned irrigation channels should be throughly overexcavated and backfilled. A 12 inch minus material placed in no thicker than 18 inch lifts should suffice for the rock fill.

The first lift of rock fill should be densifed as much as possible without further deteriorating the underlying native soils. Any localized areas that deteriorate or become soft after fill placement should be overexcavated as necessary and backfilled again. A 24 inch minus material may be needed for the initial lift in highly saturated areas.

Prior to construction of the roadway north of the Huffaker Narrows (Station 270±), the Steamboat Creek will be rerouted to the west of the roadway to minimize costly bridge and box structures. Large trackhoes or track mounted draglines will probably be needed to cross the soft fields. Once the creek has been rerouted, the old channel, where present in the road section should be thoroughly overexcavated to remove soft, wet, organic and fine grained soils. The overexcavated channel will need to be backfilled with a granular, rock fill. The initial lift should consist of 24 inch minus material to bridge remaining soft, wet soils. This lift should be densified to as much as possible without further deteriorating the underlying native soils. The following rock backfill should consist of a 12 inch minus rock fill placed in an approximate 18 inch lift followed by unclassified fill to subgrade. This procedure should be used for all large abandoned ditches which are crossed.

If willows are present, they can regenerate and grow through a road section. Because of this, it is recommended that either a herbicide be applied to the willows prior to construction to kill both surface vegetation and root structure or remove the roots at least 5 feet below original ground elevations. The options of herbicide use or root excavations should be considered prior to construction. If a herbicide is chosen to control vegetation, it should satisfy ecological concerns.

2. Grading and Filling - Rock fill will be utilized for both ground stabilization and rock fill operations. The rock fill will be used for the initial lift for all fill areas. Occasional initial lifts of 24 inch minus rock fill may be necessary in isolated

soft areas. The majority of initial rock fill should consist of a 3 to 12 inch rock fragments. This material may be placed in thicknesses to 18 inches. Once the native materials have been stabilized, additional fill to subgrade, if required, may consist of unclassified fill.

All fill slopes should repose at no steeper than 2:1. Cut slopes should also be constructed at 2:1 except through bedrock where steeper slopes are stable.

Bedrock slopes in cut should be designed in the range of 1/2:1 to 1-1/2:1 depending upon rock hardness, fracturing, and joint systems as determined by the final geotechnical investigation. Bedrock cut slopes may have a tendency to ravel so that adequate protection should be provided by placement of either rock fences or horizontal separation between the toe of slope and the roadway.

The native, clay rich soils will not be acceptable as structural fill. Questionable materials should be examined by a soils engineer prior to being incorporated in structural fill. Material produced from excavation of the bedrock areas between Stations 251± and 362± will need to be processed to meet the size requirements. Blasting may be required to excavate this material.

Unclassified fill should consist of a 6 inch minus material having an R-value greater than 45 with a plasticity index less than 6, a liquid limit less than 35, and containing less than 20 percent passing the No. 200 sieve. This material should be placed in no greater than 8 inch compacted lifts.

Minimum 12-ton vibratory or self-propelled sheeps-foot units are recommended for fill compaction. Acceptance of unclassified fill is done by visual observation of compactive effort in conjunction with a proof-rolling program. Standard density tests which are normally taken in unclassified fill are not practical in rock fills. Fill certification of rock fills requires full-time inspection. All other structural fill should be densified to at least 90 percent relative compaction in accordance with ASTM D 1557.

3. Trenching - Dry to moist trench excavations should stand with near vertical construction side slopes to depths of 5 feet. Additional depths or saturated soils will require shoring or laying back of side slopes to insure adequate stability and working safety.

4. Proposed Structures - Several engineered structures will be utilized in crossing the major waterways along the alignment. Exploration performed at these sites is prelimnary in nature and will need more in-depth study when actual design is undertaken.

   The reinforced concrete box structures planned for the crossings of the Steamboat Creek and Boynton Slough lie in saturated poor foundation soils. These should be set on 6 feet of engineered fill. The intial 5 feet should consist of clean, rock fill covered with 1 foot of drain rock. This will provide adequate foundation support for these structures.

   Two bridge crossings are proposed; one over the Truckee River, and one over the Steamboat Creek at Kimlick Lane. At the Truckee River crossing, either driven pipe or precast concrete piles can be utilized. These will be driven to firm gravels at depths between 45 and 50 feet. The bridge traversing the Steamboat Creek at Kimlick Lane will be situated on extremely variable soils. For this reason, driven pipe piles are the most reasonable method of support. The piles should be driven until firm, granular soils are encountered. Driven depths of 50 or more feet are expected.

Structural Section Criteria

Table 3 shows a general summary of fill depths at centerline above existing ground for the proposed alignment.

TABLE 3

FILL DEPTHS TO SUBGRADE

Stations		Depth of Fill to Subgrade
10± - 110±		1-2 feet
110± - 224±		2-4 feet
224± - 270±	(Narrows)	4-8 feet
270± - 330±		3-5 feet
330± - 498±		5-9 feet

The depth of fill above existing ground can substantially alter the R-value used for structural section design. From Station 10+00 to 330±, the fill depths are thin enough that the existing ground soils will need to be considered. The recommended R-value for this section of roadway design is 12. North of Station 330±, the fill is thick enough that the underlying soils are bridged and the minimum unclassified fill R-value specification of 45 is recommended to be used in structural section calculations.

HYDROLOGY

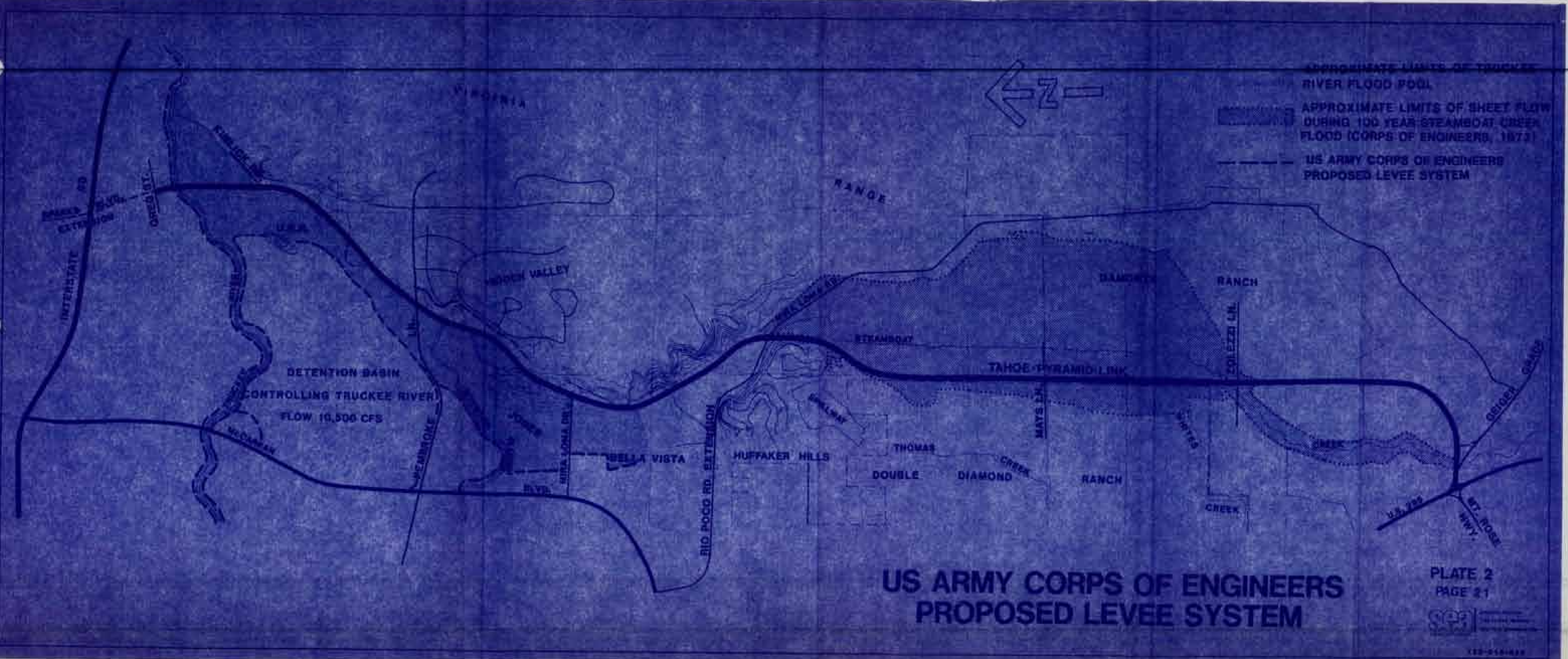
The design of the Tahoe-Pyramid Link is affected by five water courses: the Truckee River, Steamboat Creek, Boynton Slough, Whites Creek, and Thomas Creek. The U.S. Army Corps of Engineers has conducted numerous studies with regard to the hydrology of these water courses. In addition to the Corps of Engineers' studies, Tudor Engineers is conducting flood insurance studies for the U.S. Department of Housing and Urban Development on the City of Sparks-City of Reno area, SEA Engineers has done hydrologic analysis for Hidden Valley and the Damonte Ranch, and Collins and Ryder Engineers evaluated the hydrology for the Double Diamond Ranch.

U.S. Corps of Engineers Level Project

The Corps of Engineers is currently conducting a feasibility study of a flood control project on the Truckee River. This project includes berming along portions of the banks of the river and utilizing the University of Nevada's farm as a detention basin during floods exceeding 10,500 cubic feet per second (cfs) (see Plate 2). This study also considers the effects of improved channels on the Truckee River and Steamboat Creek, which will reduce storage in the flood plain and result in lower peak flows. Preliminary data from the Corps show that this project results in a higher water surface elevation in the vicinity of the proposed road crossing of the Truckee River due to confining the flood to an area between the berms. The Corps of Engineers also assumed that the conveyance of the Truckee River flood was limited to an area approximately 1000 feet wide through this reach.

The Corps anticipates completion of the rough draft of their flood control project including the Feasibility Report and EIS in draft form by September 1983. This will then be sent out for public review. Upon receiving all comments and incorporating them, a final public hearing and meeting will be held in the Reno/Sparks area in January 1984 to receive final comments. A final report is anticipated to be available April 1984 at which time it will be sent through its final review process. This final review process, which includes various governmental agencies as well as local agencies, is anticipated optimistically to take approximately two years. It is anticipated that the report and EIS in final form will be before congress in 1986 at which time it will be in position to be authorized. Prior to sending the final report to congress, the Corps of Engineers will need a Letter of Intent from all non-federal sponsors (local Reno/Sparks governmental agencies) supporting the project. If there is no Letter of Intent from these agencies, there will be no project.

These studies were reviewed and evaluated for the purpose of developing the following information:



US ARMY CORPS OF ENGINEERS PROPOSED LEVEE SYSTEM

PLATE 2

a. Water surface elevations along the proposed roadway corridor during various flood events;

b. Design criteria for the conceptual design of structures at major drainage crossings; and

c. The general vertical alignment design guidelines.

Whites Creek and Thomas Creek

Whites Creek and Thomas Creek are tributaries of Steamboat Creek, which enter the Steamboat Creek in the southern portion of the Truckee Meadows (Plate 2). Under current conditions, these streams are largely conveyed as sheet flow from U.S. Highway 395 across the Damonte and Double Diamond Ranches. However, when these ranches are developed, the flow will be conveyed down artificial channels to a channel along the west side of the Tahoe-Pyramid Link. For the purpose of this study it was assumed that future developments will not be allowed to raise the water surface elevation of the 100-year flood from its current level. To estimate the flood elevation of the sheet flow areas, discharges were taken from the Corps of Engineers 1980 report, "Truckee River, California and Nevada Hydrology" and flood plain widths were adopted from their 1972 report, "Flood Plain Information Steamboat and Pleasant Valley."

Whites Creek's estimated 100-year flow is 3900 cfs. From studies done for Whites Creek Estates, it was estimated that 2900 cfs of the 100-year flow would be conveyed down the northern channel of Whites Creek ultimately to the Double Diamond Ranch and thence eastward along Mays Lane to the proposed Tahoe-Pyramid Link. The remaining 1000 cfs is anticipated to be routed through the Damonte Ranch.

Thomas Creek estimated 100-year flow is 2500 cfs. Thomas Creek's confluence with the Steamboat Creek is located just south of the Huffaker Narrows.

Table 4 shows both the Whites Creek and Thomas Creek 100-year flows and estimated corresponding depths.

TABLE 4

WHITES CREEK AND THOMAS CREEK
100-YEAR FLOWS

Drainage	100-Year Flow	Flood Plain Width	Estimated Depth of Flow
Whites Creek	2900 cfs	800 ft.	0.7 ft.
Whites Creek	1000 cfs	500 ft.	0.4 ft.
Thomas Creek	2500 cfs	1000 ft.	0.5 ft.

Steamboat Creek and Boynton Slough

For puposes of this study, Steamboat Creek can be divided into 2 reaches. The southern portion, from Geiger Grade (State Highway 341) to about 1 mile north of the Huffaker Narrows, and a northern reach from this point to its confluence with the Truckee River.

In the southern portion, the flood elevation is controlled by the 100-year flood on Steamboat Creek. As the capacity of the channel is inadequate for the 100-year event, much of the flow is conveyed as sheet flow, principally east of the channel (Plate 2). To estimate the elevation of the sheet flow, the discharge was obtained from the Corps of Engineers' current flood control study and typical cross-sections were taken from various reports. Table 5 shows the various reaches of the southern portion of the Steamboat Creek and the corresponding flows and estimated depths. These depths were used to establish the vertical alignment for this portion of the proposed roadway.

TABLE 5

STEAMBOAT CREEK FLOOD PLAIN DEPTH

Reach	Flow, cfs (*)	Estimated Depth of Flood Plain Ft.
2500 Feet North of Geiger Grade	5450 (5700)	2
8000 Feet North of Geiger Grade	5450 (5700)	1
4500 Feet South of Huffaker Narrows	5450 (5700)	1
Huffaker Narrows	5450 (5700)	3

* Flow with Corps of Engineers' flood control project. Increase in flow will not significantly increase depth of flow in flood plain.

For the northern portions of Steamboat Creek, the water surface elevation is controlled by the 100-year flood on the Truckee River and its resulting backwater effects. Flow rates and corresponding water surface elevations for various events were developed by the Corps of Engineers for their proposed flood control project. Tables 6 and 7 show the flow rates and corresponding water surface elevation for various Steamboat Creek flood events with and without the Corps of Engineers' proposed flood control project.

TABLE 6

STEAMBOAT CREEK FLOWS/ELEVATIONS WITH CORPS OF ENGINEERS' PROJECT

Location/ Event	Flow Rates (cfs)/Water Surface Elevations* Steamboat Concurrent with Truckee River General Rain Storm	Cloudburst Steamboat Low Flow Truckee River	General Rain Steamboat/ Low Flow Truckee
Steamboat at Confluence with Truckee River			
25 Yr.	1850/4389	1570/4379.5	2250/4380.9
50 Yr.	3240/4390.8	2800/4381.9	4300/4383.7
100 Yr.	5500/4393.4	4550/4384	7500/4387.7
Steamboat Downstream of Confluence with Boynton Slough			
25 Yr.	1850/4389.6	1570/4387.9	2250/4388.9
50 Yr.	3240/4391.6	2800/4389.6	4300/4391.6
100 Yr.	5500/4393.9	4550/4391.9	7500/4394.4
Steamboat U/S of Confluence with Boynton Slough			
25 Yr.	1310/4389.6	1480/4387.9	1700/4388.9
50 Yr.	2440/4391.6	2550/4389.6	3250/4391.6
100 Yr.	4120/4393.9	4340/4392	5700/4394.4
Steamboat at Huffaker Narrows			
25 Yr.	1310/4412.5	1480/4412.9	1700/4413.7
50 yr.	2440/4414.2	2550/4414.3	3250/4414.5
100 Yr.	4120/4414.8	4340/4414.9	5700/4415.4

* Corps of Engineers' information is preliminary and subject to change.

TABLE 7

STEAMBOAT CREEK FLOWS/ELEVATIONS
WITHOUT CORPS OF ENGINEERS' PROJECT

Location/ Event	Flow Rates (cfs)/Water Surface Elevations*: Steamboat Concurrent with Truckee River General Rain Storm	Cloudburst Steamboat Low Flow Truckee River	General Rain Steamboat/ Low Flow Truckee
Steamboat at Confluence with Truckee River			
25 Yr.	1850/4389	680/4376.9	1200/4378.5
50 Yr.	3240/4390	1040/4377.9	3450/4382.8
100 Yr.	5500/4392	1800/4380.1	6500/4387.3
Steamboat Downstream of Confluence with Boynton Slough			
25 Yr.	1850/4389.6	680/4385.7	1200/4387.2
50 Yr.	3240/4391.1	1040/4386.8	3450/4390.3
100 Yr.	5500/4393.6	1800/4388.2	6500/4393.8
Steamboat Upstream of Confluence with Boynton Slough			
25 Yr.	1310/4389.6	475/4385.5	700/4387.3
50 Yr.	2440/4391.1	690/4386.9	3150/4390.3
100 Yr.	4120/4393.6	1140/4388.2	5450/4393.8
Steamboat at Huffaker Narrows			
25 Yr.	1310/4412.5	475/4411.6	700/4412
50 yr.	2440/4414.2	690/4412.0	3150/4414.5
100 Yr.	4120/4414.9	1140/4412.4	5450/4415.4

* Corps of Engineers' information is preliminary and subject to change.

The vertical alignment of the northern portion of the roadway alignment, 1 mile north of the Huffaker Narrows to the Truckee River, is governed by the Truckee River flood pool.

Truckee River The Truckee River was studied under existing conditions as well as under conditions that would prevail after construction of the Corps' flood control project. Preliminary data obtained from the Corps of Engineers indicates a Truckee River 100-year flood pool elevation of 4392.4 near the confluence with Steamboat Creek prior to construction of the Corps of Engineers' flood control project and an elevation of 4393.5 after its construction. Tudor Engineers estimated a 100-year flood elevation of 4390.8 in this area under existing conditions.

The Corps of Engineers provided various return period flows and corresponding flood elevations as shown in Table 8 and 9.

TABLE 8

TRUCKEE RIVER
FLOWS AT VISTA

Event Year	Flow Without Corps of Engineers' Project*	Flow With Corps of Engineers' Project*
25	10,500 cfs	--
50	11,700 cfs	--
100	19,900 cfs	19,350 cfs

* Corps of Engineers' 1983 data is preliminary and subject to revision.

Elevations as shown in Table 9 with the U.S. Army Corps of Engineers' project were used to develop the vertical alignment for the northern portion of the Tahoe-Pyramid Link.

TABLE 9

TRUCKEE RIVER FLOOD POOL ELEVATIONS

Location	Ret. Pd., Year	Flood Elevation: With Corps of Engineers' Project	Flood Elevation: Without Corps of Engineers' Project
Downstream end of Steamboat Creek near Truckee River	25	4389.0	4389.0
	50	4390.9	4390.0
	100	4393.4	4392.0
Steamboat Creek at Kimlick	25	4389.2	4389.0
	50	4391.0	4390.2
	100	4393.5	4392.2
Steamboat Creek, just downstream of Pembroke	25	4389.3	4389.3
	50	4391.0	4390.4
	100	4393.6	4392.4
In the middle of the marsh about 1800 ft. north of Mira Loma Ext.	25	4389.6	4389.6
	50	4391.6	4391.1
	100	4393.7	4393.6
Steamboat Creek at Mira Loma Extension	25	4389.6	4389.6
	50	4391.6	4391.1
	100	4393.7	4393.6
Steamboat Creek about 1700 ft. south of Mira Loma Extension	25	4389.6	4389.6
	50	4391.6	4391.1
	100	4393.7	4393.6
Steamboat Creek 0.5 mile south of Mira Loma Extension	25	4392.8	4392.8
	50	4393.0	4393.0
	100	4393.7	4393.5
Steamboat Creek about 4000 feet north of Huffaker Narrows	25	4396.0	4396.0
	50	4396.2	4396.3
	100	4396.4	4396.5
Steamboat Creek about 3000 feet north of Huffaker Narrows	25	4399.2	4399.2
	50	4399.5	4399.5
	100	4399.8	4399.7
Steamboat Creek through Huffaker Narrows	25	4411.9	4411.9
	50	4412.7	4412.7
	100	4413.5	4413.6
Steamboat Creek about 1500 feet south of Huffaker Narrows on Bella Vista Ranch	25	4416.2	4416.2
	50	4416.7	4416.7
	100	4417.5	4417.4
Steamboat Creek about 4500 feet south of Huffaker Narrows	25	4423.5	4423.5
	50	4425.2	4425.2
	100	4427.1	4427.1

Hidden Valley Drainage

The drainage from the Hidden Valley area, although minor compared to the 100-year flow rates of the Steamboat Creek and Truckee River, should be considered during the preliminary design phase(s) of the subject project. The use of control gates and/or berms will be necessary to prevent flooding west of the Tahoe-Pyramid Link from the Truckee River 100-year flood pool. Field investigations and review of existing studies indicate 4 main points of concentration for the Hidden Valley drainage area (see Plate #2). The 4 points of concentration are:

1. North end of Hidden Valley Highlands - an open ditch flows toward the Steamboat Creek. This ditch intercepts some mountain watersheds. It was designed for a 10-year storm of 152 cfs. The 100-year flow is 263 cfs.

2. A 36 inch CMP with a wheeled gate is located on the northwest side of Hidden Valley. The estimated 100-year discharge rate is 155 cfs at this point.

3. Just south of point two is the main draiange for Hidden Valley. A 36" X 72" concrete arch pipe drains to the Steamboat Creek. The 100-year design flow is estimated to be 500 cfs.

4. An area including the golf course plus some runoff from the mountains drains via overland flow to Steamboat Creek. The 100-year flow is extimated to be 250 cfs.

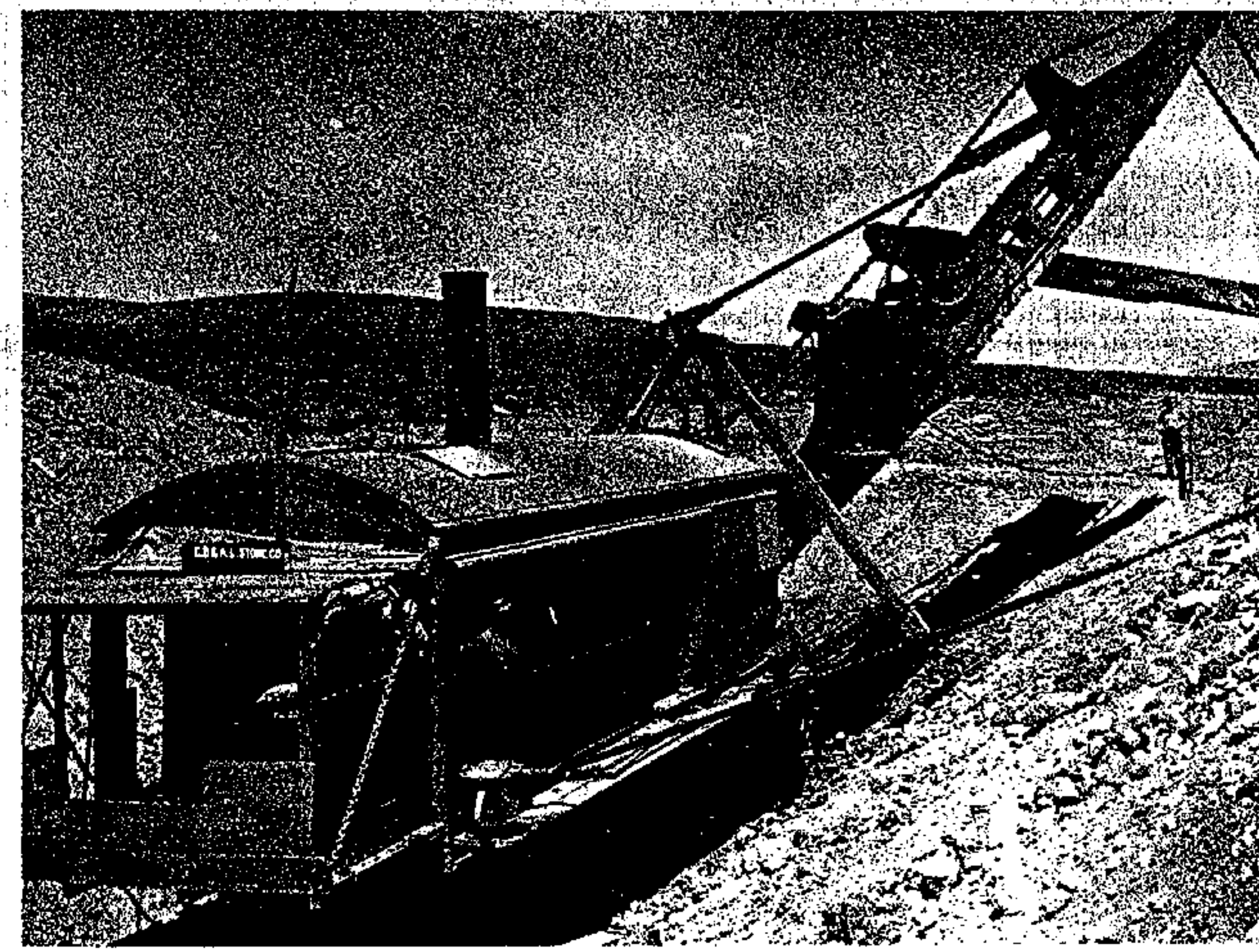
PROPERTY LINES

The alignment starts at the intersection of Mt. Rose Highway, U.S. Highway 395, andGieger Grade (State Highway 341) in Section 28, Township 18N, Range 20E, M.D.M. and proceeds in a northerly direction approximately 9.4 miles to its ending at the intersection of Greg Street and Sparks Boulevard in Section 11, Township 19N, Range 20E, M.D.M. Ground surveys were performed to physically tie existing section corners to the roadway alignment centerline. This entire system was calculated and put on the Nevada State Coordinate System, West Zone Reno Modified, the standard geographical location system used for the Truckee Meadows area. Where corners were not found as a result of this survey, SEA and other agency records were researched, the Nevada State Plane Coordinates were retrieved, and calculated positions were set. A list of coordinates for both section corners and along the center line of the roadway, by station, are set forth in tables on the attached drawings, Sheet No. 2.

The Scope of Work for this study authorized the determination of the precise alignment of the roadway with regard to its position relative to government-established section corners through the sections of land affected. This was accomplished and is set forth on the previously described drawings, Sheets 2 and 3.

The establishment of exact property lines was not within the scope of work. Property lines were scaled onto the alignment drawings using existing property ownership information. This existing information is in the form of Assessor's Parcel Maps, published Record of Surveys, Parcel Maps, or subdivisions. Since most of the parcels involved are large land holdings, and in numerous instances their property lines follow section lines, this approach resulted in a reasonably accurate location of property lines. Consequently, the alignment and the associated right-of-way can be located for planning purposes within any particular property.

For specific right-of-way acquisition from a particular parcel affected, a property line survey must be conducted and coordinated with the Nevada State Coordinate System for an accurate location of the right-of-way.



PROJECT DESIGN

PROJECT DESIGN

ALIGNMENT ALTERNATES

Various roadway alignments were developed and reviewed on a conceptual basis for refining the general corridor of the Tahoe-Pyramid Link. These alternatives (Plate 3) were developed based upon the general design guidelines discussed in Section II - Design Guidelines of the report.

Alternate No. 1

Alternate No. 1 employs the same alignment as that of the primary one from Mt. Rose Highway in the south, northward to the Huffaker Narrows. At the Huffaker Narrows the alignment traverses the western boundary of the Bella Vista Ranch and hence is directed northward along the eastern boundary of Donner Springs. From here it is oriented northeast adjacent to the Boynton Slough to where it joins the primary alignment in the vicinity of the confluence of the Boynton Slough and Steamboat Creek. Although this alignment would eliminate the need for two structures, it is approximately one mile longer than the primary alignment within the same reach. Construction costs are essentially the same for Alternate No. 1 and the primary alignment, within the same reach due to less fill required in Alternate No. 1. The primary alignment within this reach is preferred to Alternate No. 1 for two main reasons. These are:

1. The close proximity of Alternate No. 1's alignment to the southeast quadrant of McCarran Boulevard, does not allow it to function as efficiently as the primary alignment in providing adequate circulation in the area. In addition, it does not pro-

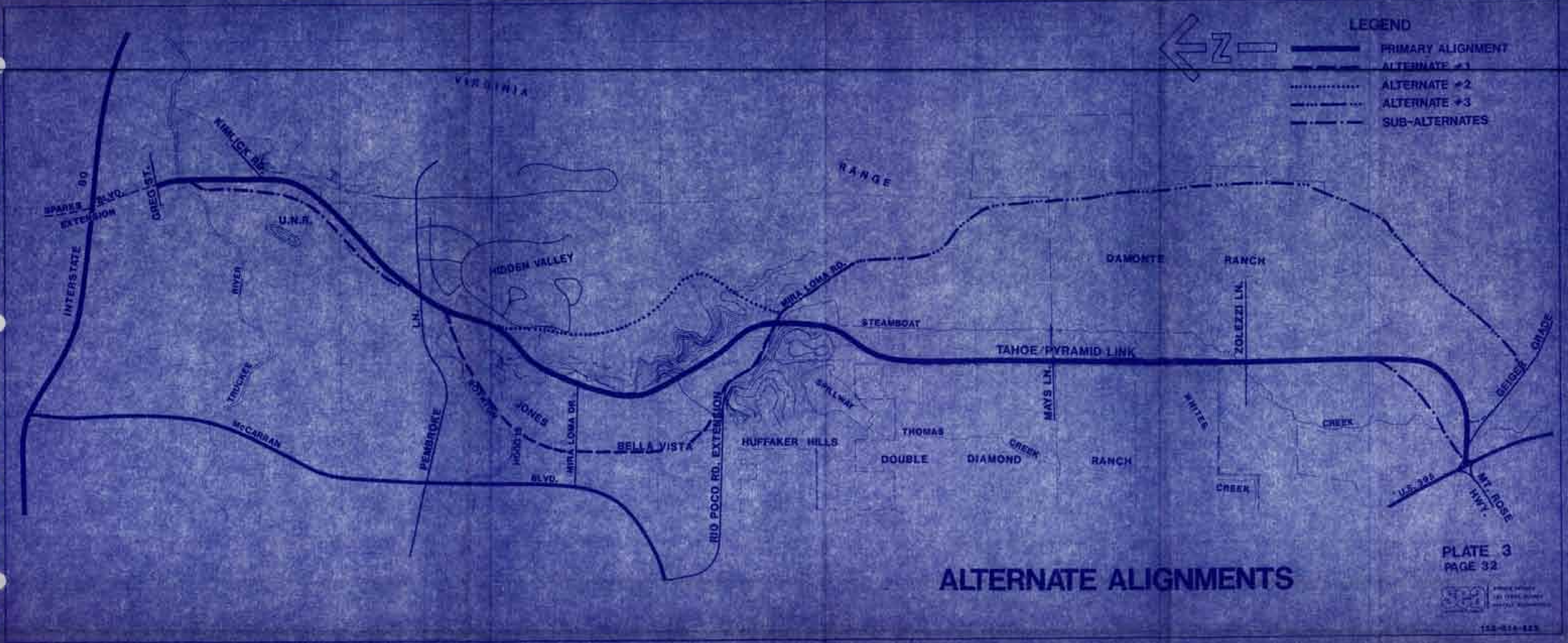


PLATE 3
PAGE 32

ALTERNATE ALIGNMENTS

vide adequate access to future development of the Bella Vista and Jones Ranches.

2. The additional mile in travel will cost the users of the roadway a substantial amount of money as well as additional travel time. Additional user costs for this additional mile of travel is estimated to exceed $40 million over the life of the roadway.

Alternate No. 2

Alternate No. 2 employs basically those same portions of the primary alignment as Alternate No. 1. However, Alternate No. 2 deviates from the primary alignment at the Huffaker Narrows and hence traverses eastward, then northwest along the eastern side of the Hidden Valley hills and adjacent to the western boundary of the Hidden Valley Golf Course. It rejoins the primary alignment in the general vicinity of the confluence of the Boynton Slough and the Steamboat Creek. There is very little difference in the cost of Alternate No. 2 with regard to the same reach of the primary alignment. The primary alignment is preferred over Alternate 2 for the following reasons:

1. Alternate No. 2 would require that the extension of Mira Loma Drive from approximately 1,400 feet east of McCarran Boulevard be extended an additional 3600 feet along the western slope of the hills adjacent to Hidden Valley. The Mira Loma Drive extension would terminate at an intersection with the Tahoe-Pyramid Link just upstream of the confluence of the Boynton Slough and Steamboat Creek. This additional length of roadway would cost users approximately $1.8 million in user costs over the life of the roadway.

2. Alternate 2 increases the travel time on this stretch of the roadway.

3. Alternate No. 2 does not serve the need of future development of the Bella Vista and Jones Ranches.

Alternate No. 3

Alternate No. 3 presents a variation in the southern portion of the primary alignment from Mt. Rose Highway in the south, northward to the Huffaker Narrows. This portion of the alignment would be routed further eastward to the existing Mira Loma Road and follow the existing Mira Loma Road alignment northward to the Huffaker Narrows where it would join with the primary alignment. This alignment again is approximately one mile longer in length than the primary alignment within the same reach. Alternate 3 was eliminated from further consideration for the following reasons:

1. Although this alignment would not impact as many properties as the primary alignment, it would increase travel time considerably.

2. Additional user costs for the additional one mile of travel is estimated to exceed $40 million over the life of the roadway.

3. It does not serve the proposed developments of the Damonte, Double Diamond, and Bella Vista Ranches south of the Huffaker Narrows. If and when these ranches are developed, an additional major arterial would be required in the same general location as the primary alignment in order to adequately handle traffic generated from these developments.

4. Construction costs are approximately $200,000 higher than the same reach of the primary alignment.

Miscellaneous Alternates

Two smaller variations to the primary alignment were reviewed conceptually. These two sub-alternates, one in the southern portion of the alignment and one in the northern portion of the alignment, are shown in Plate 3. Although Sub-alternate No. 2 would provide a more direct route from Mt. Rose Highway, it is not recommended since the proposed primary alignment better serves the area with regard to future development. The northern sub-alternate was also not adopted since it would place the proposed alignment of the Tahoe-Pyramid Link in the middle of the Steamboat Creek floodway. This would require additional drainage structures as well as splitting the floodway which would then flow down both sides of the roadway. As a result, it would have greater impacts associated with raising flood levels than would the primary alignment.

PRIMARY ALIGNMENT

Horizontal

The primary alignment which evolved out of the alternative alignments is shown in Plate 3, and in detail on Sheets 2 and 3 of the attached drawings.

The adoption of the primary alignment will require the Steamboat Creek to be realigned in two specific areas. From the Huffaker Narrows northward to the wetlands, approximately 5,000 feet south of Pembroke Drive, the Steamboat will be realigned adjacent to the western right-of-way of the Tahoe-Pyramid Link. Additional channel construction will be required in various reaches north of the existing confluence of the Boynton Slough and Steamboat Creek to Kimlick Lane. These realigned sections will also be adjacent to the western right-of-way of the subject project.

One other possible realignment of the Steamboat Creek would be from Kimlick Lane northward to the Truckee River. Within this reach, the Steamboat Creek would be realigned along the western right-of-way of the subject project. A thorough hydraulic analysis should be conducted during the preliminary design phase to see if this realignment is feasible.

Vertical

The vertical alignment of the proposed roadway can be divided up into two reaches. The southern reach from Mt. Rose Highway to the Huffaker Narrows is governed by the flood plain of the Steamboat Creek. The roadway in this area is generally elevated at centerline approximately two to three feet above existing ground. From the Huffaker Narrows northward to the terminus of the project, the vertical alignment of the roadway is governed by the flood pool of the Truckee River. Fills in this area vary from 5 to 10 feet in height at centerline in order to allow the bottom of the structural section to be above the flood pool.

Intersections Eight major intersections are anticipated along the proposed alignment of the Tahoe-Pyramid Link. These intersections are generally spaced approximately 1 mile apart. It is recommended that any further intersections which allow cross traffic movement be spaced no closer than 1/2 mile apart. Additional intersections allowing right-in/right-out movements only could be spaced as close as 1/4 mile.

Major intersections anticipated along the proposed alignment are shown in Plate 1 and include:

1. Mt. Rose Highway--This intersection is at the beginning of the project on the southern end of the alignment. Tahoe-Pyramid Link is proposed to intersect U.S. Highway 395 at approximately a 75° skew.

2. Geiger Grade--Geiger Grade will be realigned to provide a "T" intersection with the Tahoe-Pyramid Link. The proposed intersection is located at approximately Station 27± and will have a 90° skew.

3. Zolezzi Lane--Zolezzi Lane will be extended from its present location east of U.S. Highway 395 to a proposed intersection with the Tahoe-Pyramid Lind at Station 107±.

4. Mays Lane--Mays Lane is proposed to be extended from its present location east of U.S. Highway 395 to an intersection with the Tahoe-Pyramid Link at Station 119±.

5. Rio Poco Road-Mira Loma Road--Rio Poco Road would be extended from its present location east of McCarran Boulevard to the Huffaker Narrows. In addition to the extension of Rio Poco Road, Mira Loma Road would tie in to the Tahoe-Pyramid Link at the same location. This in turn would provide a four-way intersection at Station approximately 270±. The existing Mira Loma haul road would "T" into Rio Poco Road west of this intersection.

6. Mira Loma Drive Extension--Mira Loma Drive would be extended from its present location east of McCarran Boulevard to provide a "T" intersection with the Tahoe-Pyramid Link. This intersection is proposed to have a 90° skew and would be located at Station 352±.

7. Pembroke Drive--A major intersection would be provided where the Tahoe-Pyramid Link intersects existing Pembroke Drive. This intersection would have a skew of approximately 50°.

8. Greg Street--The Tahoe-Pyramid Link will terminate at the intersection of Greg Street and the extension of Sparks Boulevard southward.

An additional intersection between the Mt. Rose Highway and the proposed realigned Geiger Grade intersection would develop if the Steamboat Station project, south of Geiger Grade, is constructed. This project has a proposed major access point approximately 650 feet east of U.S. Highway 395.

Access to Kimlick Lane will be via a "T" intersection with the Tahoe-Pyramid Link. The present alignment of Kimlick Lane will terminate west of the Boynton Slough.

Full Construction

"Full construction" would be the construction of the entire alignment to full cross section improvements from Mt. Rose Highway and U.S. 395 to the Greg Street and Sparks Boulevard intersection.

Due to demand or economic considerations it may be necessary to construct the alignment in portions or phases. The demand may be generated by the general need to improve traffic circulation in a more localized area of the alignment. The development of one of the large parcels may also require phasing construction. A review of these alternatives suggest possible sequences of construction which follow.

Construction Sequence "A"

Recent development requests on the Damonte and Double Diamond Ranches in the south portion of the alignment may dictate construction of the Tahoe-Pyramid Link in this area. This construction sequence could start with Phase I--the construction of the Tahoe-Pyramid Link from the extension of Zolezzi Lane (Station 107±) to the intersection with Rio Poco Road (Station 270±). This would include the construction of Rio Poco from the intersection of Tahoe-Pyramid Link to the existing Rio Poco east of McCarran Boulevard as well as the construction of Zolezzi Lane to U.S. 395.

Phase II would consist of the construction of the Tahoe-Pyramid Link from the Rio Poco intersection (Station 270±) to the intersection of Greg Street and Sparks Boulevard (Station 505±).

Phase III would construct the alignment from the intersection of Zolezzi Lane to the intersection of Mt. Rose Highway and U.S. 395.

Construction Sequence "A" is shown in Plate 4.

Construction Sequence "B"

On the north end of the alignment the City of Sparks is completing the final design of the interstate I-80/Sparks Boulevard interchange. They are presently seeking the federal funding necessary to begin construction. Traffic congestion at the Interstate 80/McCarran Boulevard intersection creates an immediate need for this particular interchange. The construction of Sparks Boulevard south to service the Hidden Valley area would be appropriate for partial construction. This alternative would consist of the construction of the alignment from the intersection of Greg Street and Sparks Boulevard to the intersection with the extension of Mira Loma Drive (Station 352±). The construction of Mira Loma Drive from Tahoe-Pyramid Link to the existing Mira Loma Drive east of McCarran.

The second phase of this construction would be from Mira Loma Drive (Station 352±) to Zolezzi Lane (Station 107±).

The final portion of this construction sequence would be construction from Zolezzi Lane (Station 107±) to the intersection of Mt. Rose Highway and U.S. 395.

Construction Sequence "B" is shown in Plate 5.

Each of the above construction sequences would provide traffic relief to existing routes (e.g., McCarran Boulevard or U.S. 395 south of the intersection of McCarran Boulevard and Zolezzi Lane intersection on U.S. 395).

It may be desirable to construct partial cross section improvements for any portion of the sequences outlined above. For purposes of definition, full cross section improvements and partial cross section improvements are defined as follows:

a. <u>Full cross section improvements:</u> Construction of the Tahoe-Pyramid Link would include 6-lane roadway with emergency lanes, raised medians, and curb and gutter from the Mt. Rose Highway to approximately 1 mile north of the Huffaker Narrows. North of this point full improvements would not include curb and gutter. Mira Loma Drive, Rio Poco Road, and Zolezzi Lane would be constructed to City of Reno standards for an eighty foot right-of-way.

b. <u>Partial cross section improvements:</u> Construction of the Tahoe-Pyramid Link would include a 4-lane roadway with a graded median and gravel shoulders. Mira Loma Drive, Rio Poco, and Zolezzi Lane would be constructed to 4 paved lanes with gravel shoulders.

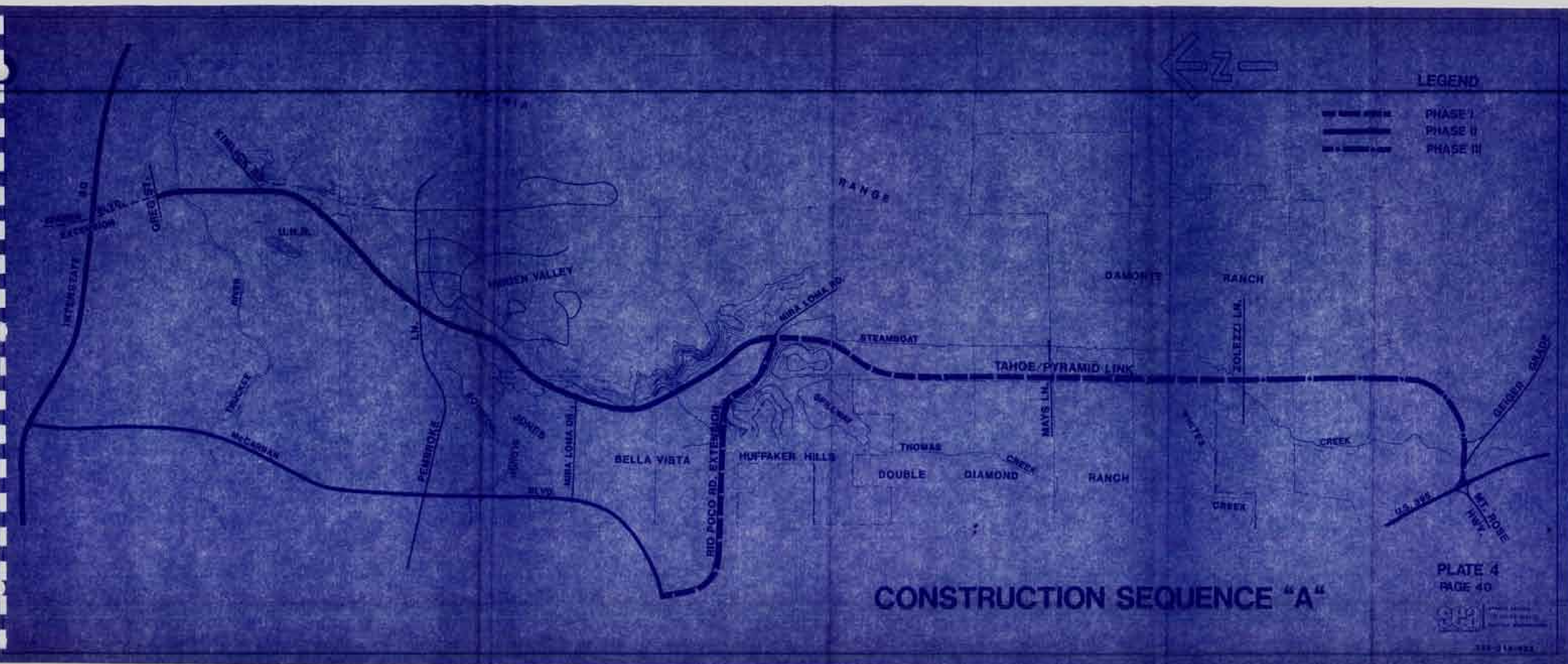


PLATE 4
PAGE 40

CONSTRUCTION SEQUENCE "A"

PLATE 5
PAGE 41

CONSTRUCTION SEQUENCE "B"

TRAFFIC

Traffic projections used to determine roadway pavement structural sections and intersection geometrics were developed based upon data obtained from the following sources:

a. Regional Transportation Commission of Washoe County, Traffic Computer Model;

b. Nevada Department of Transportation, Annual Traffic Report, 1981; and

c. "Circulation Study Southeast Truckee Meadows," December 1980, Alan Voorhees and Associates.

The Regional Transportation Commission Traffic Computer Model provided the primary source of information with regard to projected average daily traffic (ADT) and projected intersection turning movements. The highway network utilized in the computer model included the existing roadway system plus the buildout of the adopted Regional Street and Highway Plan. This included the completion of U.S. 395 south of Mt. Rose Highway. ADT's and projected intersection turning movements represent the year 2002 traffic volumes. Growth is addressed in the computer model by the inputing of the adopted master plans of the City of Sparks and the City of Reno Planning Commission. Growth in the county areas was estimated by the Regional Administrative Planning Agency (RAPA) taking into account approved projects and existing zoning. The computer model was further adjusted to match the year 2002 projected population of 352,000.

ADT volumes varied from 26,000 in the vicinity of the Mt. Rose Highway--South Virginia Street intersection to 38,000 in the northern end of the alignment. Table 10 shows the ADT's for the various lengths of the proposed roadway.

TABLE 10

LINK VOLUMES

Link	ADT (Total Both Directions)
South Virginia Street to Geiger Grade	28,803
From Geiger Grade to Zolezzi Lane	Varies from 26,141 to 33,275
Zolezzi Lane to Mays Lane	Varies from 29,745 to 33,275
Mays Lane to Mira Loma Rd.--Rio Poco Rd.	Varies from 29,745 to 36,347
Mira Loma Rd.--Rio Poco Rd. to Mira Loma Drive Extension	Varies from 36,347 to 38,396
Mira Loma Dr. Extension to Pembroke	Varies from 36,776 to 38,396
Pembroke Dr. to Intersection Greg St.	Varies from 36,776 to 37,182

Because urban traffic problems are primarily a function of traffic flows and roadway conditions at intersections, the following major intersections were selected for analysis:

a. South Virginia Street and Mt. Rose Highway

b. Geiger Grade

c. Zolezzi Lane

d. Mays Lane

e. Mira Loma Road--Rio Poco Road

f. Mira Loma Drive Extension

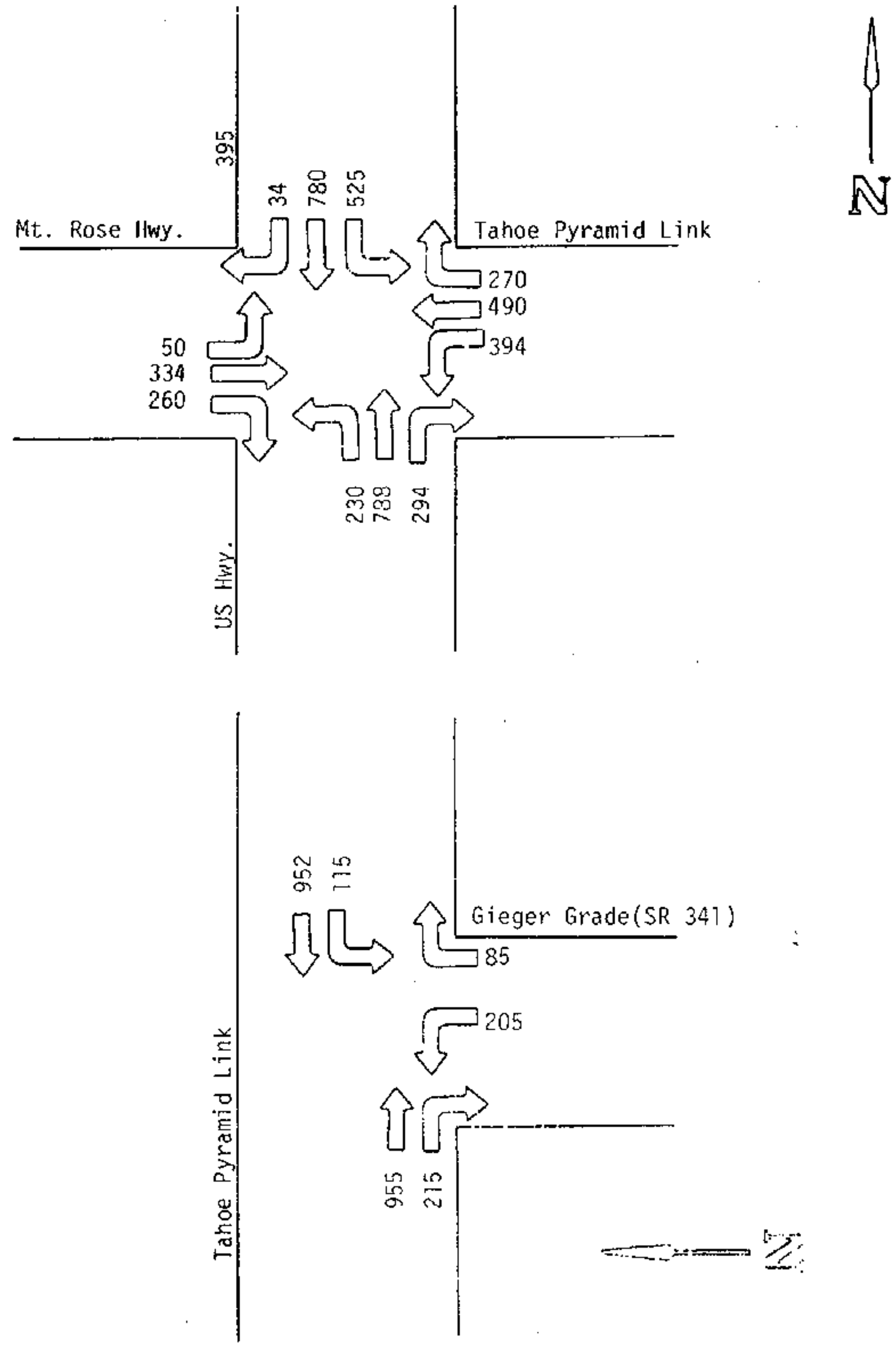
g. Pembroke Drive

Projected intersection turning movements for the subject intersections were developed based upon data from the Regional Transportation Commission's traffic computer model. The traffic computer model bases its traffic assignments on the Washoe County Area Transportation Study

(WCATS) traffic analysis zones. These projected turning movements were adjusted to account for zones which straddle both sides of the Tahoe-Pyramid Link but which the computer only loads on one side. Adjustments were based upon data developed in the Voorhees study for the Truckee Meadows as well as roadway networks laid out in approved master plans for the area. Plates 6 through 9 shows the projected year 2002 intersection turning movements for the subject intersection.

These intersections in turn were analyzed with regard to level of service for the year 2002 traffic. The analysis is based upon the Critical Movement Analysis for Planning from the Transportation Research Boards' "Transportation Research Circular 212." "Level of Service" (L.O.S.) is a measure used to quantitatively evaluate the quality of traffic flow through an intersection. The descriptions of level of service operation conditions for a signalized intersection are shown in Table 11.

2002 Projected Peak Hour Turning Movements



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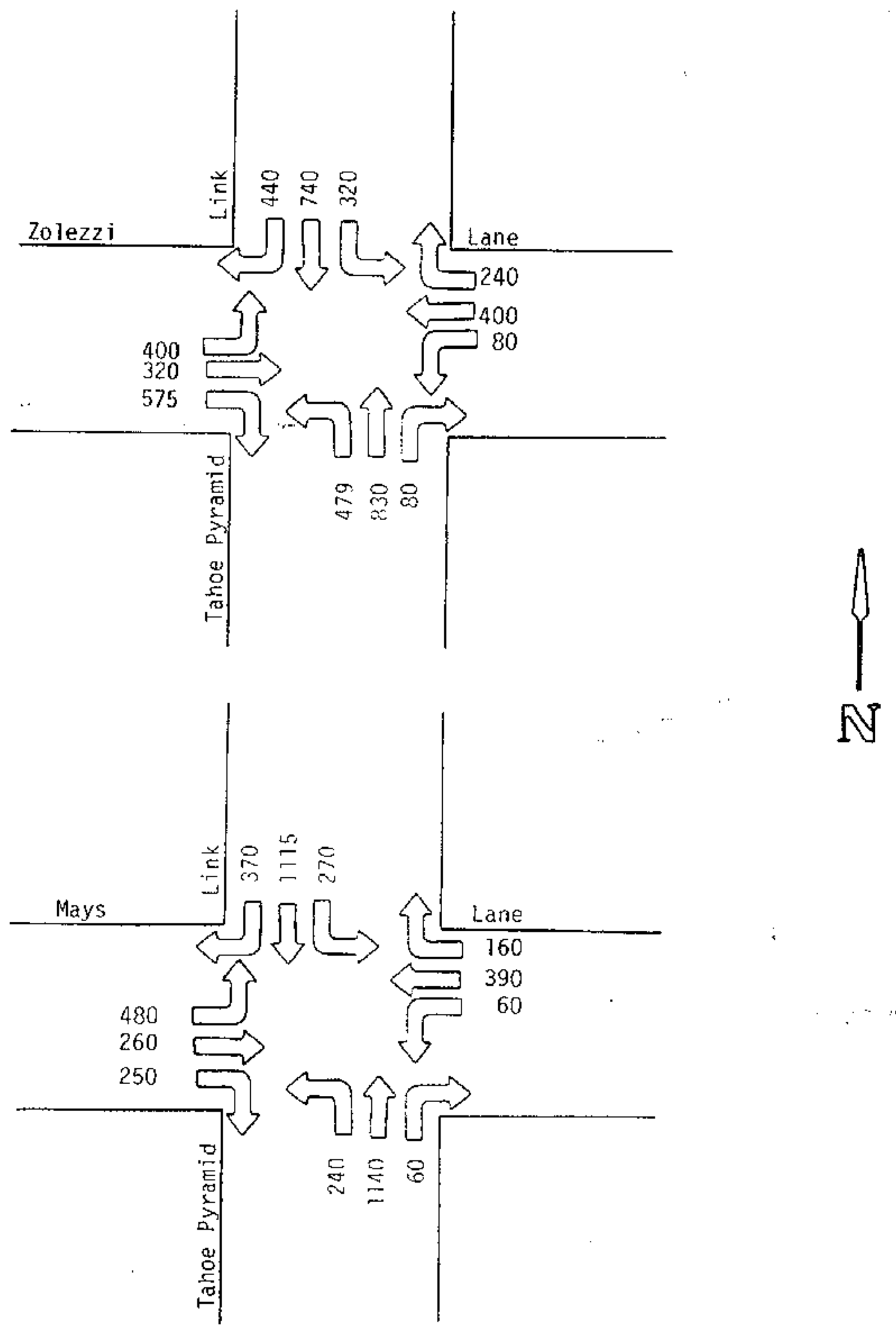
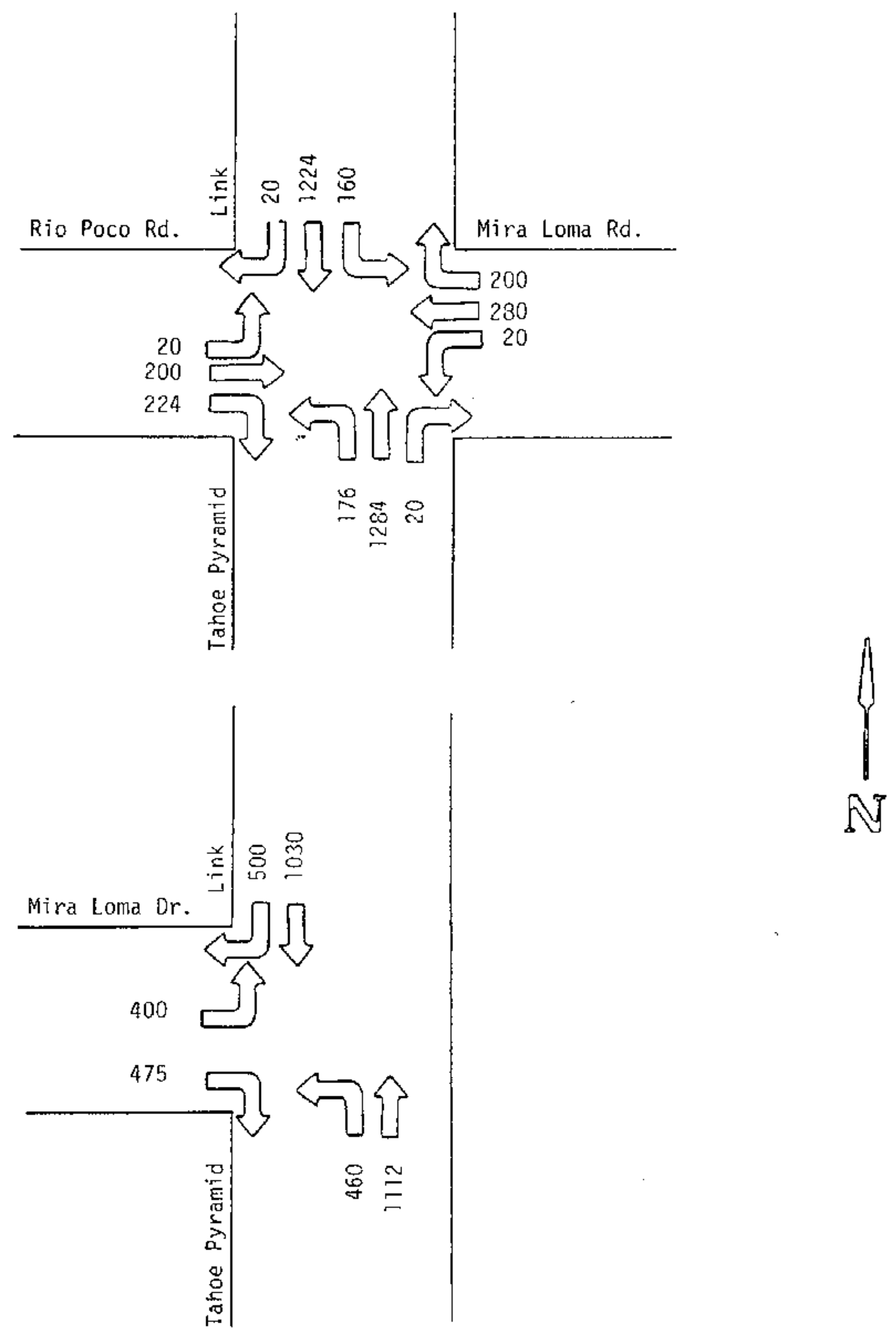
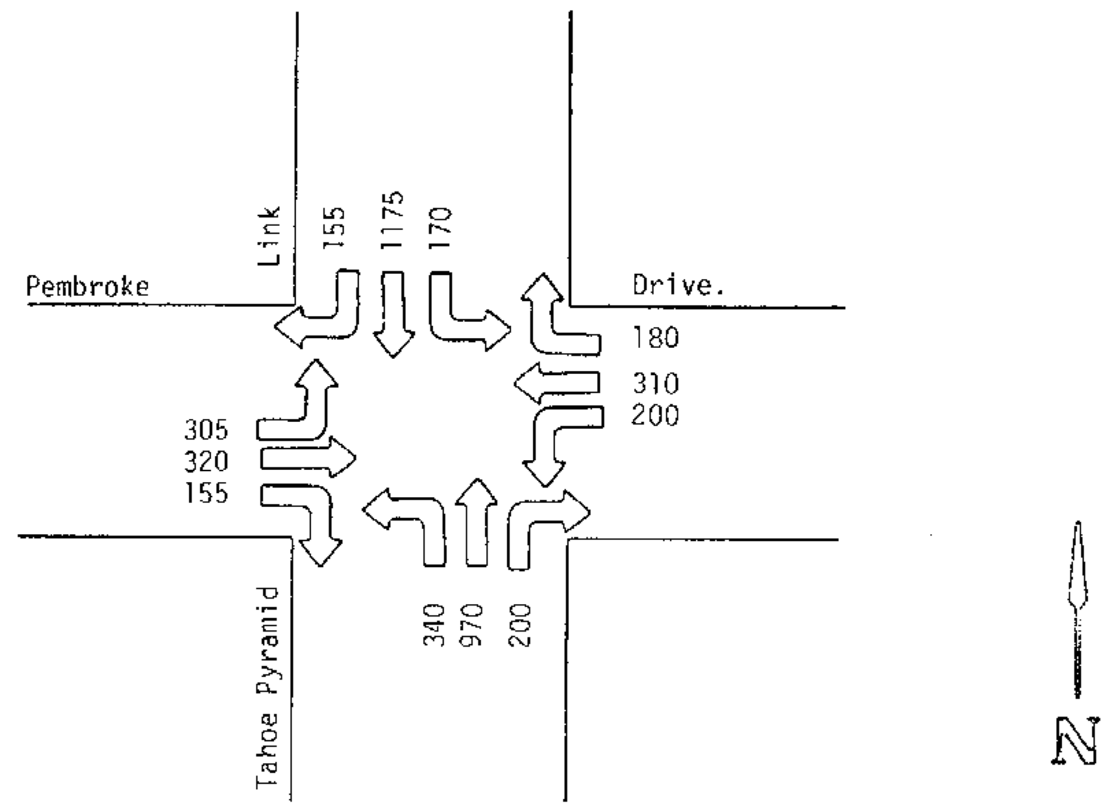


2002 Projected Peak Hour Turning Movements



2002 Projected Peak Hour Turning Movements



Tahoe Pyramid Link

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PROJECT NO. 133-014-823

PLATE 9

TABLE 11

LEVEL OF SERVICE DEFINITIONS: SIGNALIZED INTERSECTIONS

Level of Service	Definitions
A,B	Uncongested Operations, all queues clear in a single cycle
C	Light congestions, occassional backups on critical approaches
D	Significant, congestion on critical approaches but intersection functional. Cars required to wait through more than one cycle during short peaks. No long standing queues formed.
E	Severe congestion with some long standing queues on critical approaches. Blockage of intersection may occur if traffic signal does not provide for protected turning movements. Traffic queues may block nearby intersection upstream of critical approaches.
F	Total breakdown stop and go operation.

Table 12 shows level of service anticipated at each of the intersections analyzed.

TABLE 12

INTERSECTION LEVEL OF SERVICE

Intersection	Level of Service
South Virginia Street- Mt. Rose Highway	C
Geiger Grade (SR341)	A
Zolezzi Lane	C
Mays Lane	B/C
Mira Loma Road- Rio Poco Road	A
Mira Loma Drive Extension	A/B
Pembroke Drive	C

Projected 2002 year traffic volumes dicated the need for a 6-lane roadway, 3 lanes in each direction, for the Tahoe-Pyramid Link. Additional lanes such as left turn and free right turn lanes are required at the subject at grade intersections. Table 13 shows the number and type of lanes required on each approach to these intersections.

TABLE 13

INTERSECTION LANE CONFIGURATION

Intersection	Direction of Travel/#Lanes East Bound	West Bound	South Bound	North Bound
S. Virginia/ Mt. Rose Hwy.	2 Lt.* turn 2-Thru* 1-Free Rt.*	1-Lt. Turn 2-Thru 1-Free Rt.	2-Lt. Turns 2-Thru 1-Free Rt.	1-Lt. Turn 2-Thru 1-Free Rt.
Geiger Grade	-- -- --	1-Lt. Turn -- 1-Free Rt.	1-Lt. Turn 3-Thru --	-- 3-Thru 1-Free Rt.
Zolezzi	2-Lt. Turn 2-Thru 1-Free Rt.	1-Lt. Turn 2-Thru 1-Free Rt.	2-Lt. Turn 3-Thru 1-Free Rt.	2-Lt. Turn 3-Thru 1-Free Rt.
Mays	2-Lt. Turn 2-Thru 1-Free Rt.	1-Lt. Turn 2-Thru 1-Free Rt.	2-Lt. Turn 3-Thru 1-Free Rt.	2-Lt. Turn 3-Thru 1-Free Rt.
Mira Loma Rd.-Rio Poco Rd.	1-Lt. Turn 2-Thru 1-Free Rt.	1-Lt. Turn 2-Thru 1-Free Rt.	1-Lt. Turn 3-Thru 1-Free Rt.	1-Lt. Turn 3-Thru 1-Free Rt.
Mira Loma Dr. Extension	2-Lt. Turns -- 1-Free Rt.	-- -- --	-- 3-Thru 1-Free Rt.	2-Lt. Turn 3-Thru --
Pembroke	1-Lt. Turn 1-Thru 1-Free Rt.	1-Lt. Turn 1-Thru 1-Free Rt.	1-Lt. Turn 3-Thru 1-Free Rt.	2-Lt. Turn 3-Thru 1-Free Rt.

* Lt. -- Left
Thru -- Through
Rt. -- Right

Conceptual intersection layouts showing lane configurations for each of the subject intersections are shown on Sheets 13 and 14 of the attached drawings. These intersections represent a conceptual design based upon available traffic data. Each intersection should be thoroughly evaluated in the preliminary design phase with regard to any new master plans and road networks which may have a significant effect on the turning movements at the intersection. It is recommended that full intersection improvement be constructed with any partial roadway improvements.

PAVING STRUCTURAL SECTIONS

Subgrade strengths of the native soils and unclassified fill as determined by R value testing, average daily traffic (ADT) volumes, and truck weights and classifications were utilized in the development of pavement structural sections for the Tahoe-Pyramid Link.

Design R Values

Design R values were developed in the soils section of this report. The proposed roadway alignment is divided into two distinct sections with regard to design R values. From Mt. Rose (Station 10+00) northward to approximately 1 mile north of the Huffaker Narrows (Station 330±) a design R value of 12 was used. From 1 mile north of the Huffaker Narrows to the terminus of the project at the intersection of the Tahoe-Pyramid Link and Greg Street (Station 504+88±) a design R value of 45 was utilized.

Design ADT's

Average daily traffic (ADT) volumes developed in the traffic section of this report varied from 26,141 to 38,396 vehicles per day for the horizon year 2002. The ADT volumes were smallest at the southern end of the alignment, Mt. Rose Highway, and increased to the maximum ADT's at the Greg Street intersection. The proposed alignment was broken up into three reaches with regard to developing design ADT's. These limits are as follows:

1. From Mt. Rose Highway (Station 10+00) to the extension of Mays Lane (Station 119±) the ADT varied from 26,141 to 33,319 vehicles per day. For design purposes an ADT of 33,500 for the year 2002 was utilized for this reach.

2. From Mays Lane (Station 119±) to the intersection of the Mira Loma haul road at the Huffaker Narrows (Station 270±) the ADT varied from 33,319 to 36,347 vehicles per day. An ADT of 36,500 vehicles per day in the year 2002 was utilized for design purposes.

3. From the intersection of the Mira Loma Haul Road at the Huffaker Narrows (Station 270±) to the terminus of the project at Greg Street (Station 504+88±) the ADT varied from 35,105 to 38,396 vehicles per day. An ADT of 38,500 for the year 2002 was used for design purposes.

A design period of 20 years was selected for developing the pavement structural sections for the subject roadway. A design period from 1985 to the year 2005 was assumed for the purpose of this analysis. A growth rate of 6 percent was assumed to adjust the 2002 ADT volumes to reflect 1985 first year ADT volumes as well as 1995 mean ADT volumes. Table 14 shows the 2002 year ADT's as well as 1985 first year traffic volumes, and 1995 mean year traffic volumes. This data was utilized in the design of the structural sections.

TABLE 14

DESIGN ADT'S

ADT, Year 2002	ADT, Year 1985	ADT, Year 1995
33,500	11,735	21,020
36,500	12,786	22,900
38,500	13,487	24,155

Truck weight, classifications, and volumes were obtained from the Nevada Department of Transportation Planning Section. Trucks are projected to comprise approximately 10 percent of the average daily traffic volumes. Single and tandem axle load data, as well as equivalence factors, and average daily truck traffic (ADTT) percentages for flexible pavement design, are shown in Table 15.

TABLE 15

TRUCK WEIGHT AND CLASSIFICATIONS

Axle Load	Equivalence Factor	% ADTT
0-8K	.006	38.00
8-16K	.20	40.39
16-20K	1.0	10.71
20-24K	2.2	0.47

Tandem Axles

Axle Load	Equivalence Factor	% ADTT
0-8K	0	0
8-16K	.02	2.73
16-20K	.09	1.05
20-24K	.21	1.20
24-30K	.50	1.51
30-34K	.87	2.35
34-38K	1.38	1.41
38-44K	2.30	.18
Passenger Car	.0002	--

NOTE: Average number of axles per vehicle equals 3.154.

Alternate Paving Structural Sections

Alternate street paving structural sections were then prepared utilizing this traffic and soils data. Two methodologies were used to develop the alternate structural sections. They are:

1. The Asphalt Institute Manual Series Number 1 (MS-1), September 1981, "Thickness Design--Asphalt Pavements for Highways and Streets,"

2. State of Nevada Department of Transportation, Road Design Division, "Design Manual."

In developing structural sections the Asphalt Institute methodology utilizes total 18 kip equivalent axle loads (EAL) over the design life of the pavement in conjuction with a resilient modulous which can be approximated from R value test results. The total EAL is further reduced to a design EAL based upon the number of trucks in the design lane. For a 6-lane road the number of trucks in the design lane can vary from 25 to 48 percent, and in a 4-lane roadway the number of trucks vary from 35 to 48 percent. For the purpose of this analysis 40 percent of the trucks are assumed to travel in the design lane. Table 16 shows the 2002 year ADT, total EAL, and the design EAL.

TABLE 16

DESIGN EAL

Year 2002 ADT	Total 18 Kip EAL	Design 18 Kip EAL
33,500	12,727,279	5.1×10^6
36,500	13,867,034	5.5×10^6
38,500	14,626,877	5.9×10^6

An R value of 12 corresponds to a resiliant modulous of approximately 7.8×10^3 whereas an R value of 45 is approximately equal to a resiliant modulous of 2.6×10^4. Utilizing the charts developed in the Asphalt Insitute's Design Manual, alternate structural sections and corresponding unit costs were developed and are shown Table 17.

TABLE 17

PAVING STRUCTURAL SECTIONS
ASPHALT INSTITUTE METHOD

Structural Section/ Unit Cost	Limits/R Value		
	Sta. 10+00 to 270+00 R Value = 12	Sta. 270+00 to 330+00 R Value = 12	Sta. 330+00 to 504+88± R Value = 45
Full Depth Asphaltic Concrete			
Open Grade	3/4"	3/4"	3/4"
AC Plantmix	12.5"	13"	10"
Unit Cost	$18.15/sy	$18.75/sy	$14.75/sy
Asphaltic Concrete on Untreated Agg. Base			
Open Grade	3/4"	3/4"	3/4"
AC Plantmix	11"	11.5"	8.5"
Untreated Agg. Base	10"	10"	6"
Unit Cost	$19.35/sy	$20.00/sy	$14.75/sy
Asphaltic Concrete on Cement Treated Base (CTB)			
Open Grade	3/4"	3/4"	3/4"
AC Plantmix	6"	6"	5"
CTB	10"	11"	8"
Unit Cost	$15.10/sy	$15.75/sy	$12.70/sy

NDOT design procedure develops structural sections based upon 18 kip equivalent daily single axle loads (EWL) of the mean year truck traffic. The total 18 kip equivalent single axle load is reduced to a design EWL based upon percentage of the EWL in one direction of travel. For this analysis 50 percent was assumed to occur in one direction. Table 18 shows 2002 year ADT, mean year average daily truck traffic, total 18 kip equivalent daily single axle loads and the design 18 kip equivalent daily single axle load.

TABLE 18

DESIGN EWL

Year 2002 ADT	Mean Year ADTT	Total 18 Kip EWL	Design EWL
33,500	2,102	1,703	852
36,500	2,290	1,855	928
38,500	2,416	1,957	979

Utilizing the design EWL in conjunction with the design R values alternate strucural sections were developed utilizing the charts in the NDOT design manual. Table 19 shows the alternate structural sections with corresponding unit costs.

TABLE 19

PAVING STRUCTURAL SECTIONS
NDOT METHOD

Structural Section/ Unit Cost	Limits/R Value	
	Sta. 10+00 to 330+00 R Value = 12	Sta. 330+00 to 504+88± R Value = 45
Full Depth Asphaltic Concrete		
Open Grade	3/4"	3/4"
AC Plantmix	17"	12"
Unit Cost	$24.25/sy	$17.45/sy
Asphaltic Concrete on Untreated Agg. Base		
Open Grade	3/4"	3/4"
AC Plantmix	10"	8"
Untreated Agg. Base	24"	13"
Unit Cost	$22.75/sy	$16.35/sy
Asphaltic Concrete on Cement Treated Base (CTB)		
Open Grade	3/4"	3/4"
AC Plantmix	8"	6"
CTB	15"	10"
Unit Cost	$20.75/sy	$15.10/sy

Structural sections developed under the NDOT procedure will be required wherever the proposed roadway alignment ties into a state highway. Structural sections developed underneath the Asphalt Institute methodology for asphaltic concrete paving on a CTB course is recommended for the remainder of the alignment for two reasons:

1. These sections are the most cost effective; and

2. CTB generally requires approximately five days to cure prior to paving operations or allowing traffic access. The construction of the Tahoe-Pyramid Link is in a rural area with little or no cross traffic to maintain. Therefore, this condition is ideal for the construction of the CTB alternates.

DRAINAGE STRUCTURES

The proposed roadway will require a number of major drainage structures where the alignment crosses the major drainage channels of the Steamboat Creek, Whites and Thomas Creek, the Boynton Slough, and the Truckee River. The proposed bridge crossings of the Steamboat Creek and Truckee River in the northern portion of the alignment, as well as the other major structures, were conceptually designed for the flows developed in Section II of the study. The proposed structure locations and corresponding flows are shown in Plate 10.

All structures for drainage courses crossing the Tahoe-Pyramid Link were conceptually designed to accommodate the 100-year flows assuming the Corps of Engineers Flood Control Project will be constructed.

The proposed major drainage structures between Mt. Rose Highway and U.S. Highway 395 in the south, northward to the Huffaker Narrows (Station 270±) were conceptually designed to minimize backwater effects from the reinforced concrete box (RCB) culverts. Head loses through the structures which affect the backwater profile can be mitigated by proper channel transitions and through the use of berms at the entrance and outlet of the structures.

At the Huffaker Narrows, the entire flow has to be conveyed through the culverts. This resulted in an increased water surface elevation upstream. It was found that widening the transitions upstream and downstream of the crossing had little effect on this elevation. The best way to mitigate this problem is to lower the flowline elevation through the Huffaker Narrows by approximately 1.3 feet.

Table 20 summarizes the conceptual structure sizes on the Tahoe-Pyramid Link alignment as well as anticipated channel transitions.

WATERWAYS

PLATE 10
PAGE 60

TABLE 20

STRUCTURE SIZES AND CHANNEL TRANSITIONS

Location Station	Drainage Course	100-year Flow cfs	Structure Size	Channel Transitions Upstream of Structure Ft.	Downstream of Structure Ft.
17±	Steamboat	5700	6-barrel 10' X 12' RCB	350'	350'
113±	Steamboat	5700	6-barrel 10' X 12' RCB	500'	350'
248±	Whites Creek Thomas Creek	5400	6-barrel 10' X 12' RCB	500'	350'
270±	Steamboat Creek	5700	6-barrel 10' X 12' RCB	500'	500'

Drainage structures on the remainder of the alignment, excluding the bridge crossings, were evaluated for backwater effects using the computer program "HEC-2." In addition, the effects of the proposed Tahoe-Pyramid Link Road on Steamboat Creek and Truckee River flood pool elevations were also evaluated using the same computer program. The alignment will force relocation of the channel along much of the route north of the Huffaker Narrows which will also somewhat reduce the effective flood conveyance area.

The realigned Steamboat Creek channel is not designed to convey the 100-year flow. The channel is designed to mitigate the impact of the roadway on the natural floodway and thereby maintain existing flood elevations.

The controlling water surface from the downstream confluence of the Steamboat Creek and Truckee River to Station 291± is the pool created by the 100-year Truckee River flood and the simultaneous flood on Steamboat Creek. Upstream of this point, the controlling elevation is created by the 100-year Steamboat Creek flood. The discharges are shown in Tables 21 and 22.

TABLE 21

DESIGN FLOOD DISCHARGES: 100-YEAR TRUCKEE RIVER FLOOD

Event/Reach	Discharge, cfs
100-year Truckee River flood	19,350
Steamboat Creek flood simultaneous with Truckee River 100-year flood	
a. Downstream of Boynton Slough	5,500
b. Upstream of Boynton Slough	4,120

TABLE 22

DESIGN FLOOD DISCHARGES: 100-YEAR STEAMBOAT CREEK FLOOD

Event/Reach	Discharge, cfs
100-year Steamboat Creek flood	
a. Downstream of Boynton Slough	7,500
b. Upstream of Boynton Slough	5,700

In addition to relocating the channel, road crossings had to be considered at the points where Steamboat Creek intersects Pembroke Drive, and the future Mira Loma Drive extension.

The Pembroke crossing consists of an 5-barrel 10' X 12' RCB. The RCB is designed to convey approximately the 50-year Steamboat Creek flood. During the 100-year event flood water will flow around and over Pembroke Drive to the west of Tahoe Pyramid Link. This overbank flow will occur in the natural floodway. Table 23 lists the structures used for the Pembroke Drive and Mira Loma Drive crossings.

TABLE 23

ROAD CROSSINGS ON STEAMBOAT CREEK

Road	Type of Structure
Pembroke	5-10 X 12 RCB
Mira Loma Extension	6-10 X 12 RCB

In summary, the assumptions and results of this evaluation are:

1. The existing flowline elevations were maintained.

2. Channels and crossings were designed to maintain the controlling water surface elevation.

3. A 65-foot flat bottom channel was used for the realigned portion of the Steamboat Creek downstream of its confluence with the Boynton Slough. A 40-foot flat bottom channel was used for the realigned Steamboat Creek upstream of the Boynton Slough confluence.

4. The flowline elevation of Steamboat Creek through the Huffaker Narrows will have to be lowered to avoid raising the upstream water surface elevation.

5. Culverts were sized to be able to convey the 100-year Steamboat Creek flow with the exception of the crossing at Pembroke Drive.

Truckee River-Steamboat Creek Bridge The two proposed bridge crossings are located on the northern portion of the proposed alignment between Kimlick Lane and the terminus of the project at Greg Street and Sparks Boulevard as shown in Plate 10.

The affects of the Steamboat Creek and Truckee River structures is influenced by the presence or absence of the proposed Corps of Engineers' flood control measures. With the Corps of Engineers' project, the 100-year water surface elevation is 4393.5. The Corps of Engineers assumes that the effective flow area with regard to the Truckee River extends approximately 1,000 feet south of the Truckee River and that the area beyond this point is merely a ponding area. To evaluate the effects of the Truckee River bridge, "HEC-2" computer program cross section data was obtained from the Corps of Engineers and various bridge length alternatives were evaluated hydraulically for the proposed crossing.

Several bridge span alternates were developed and analyzed. They include:

A. A 1000-foot viaduct crossing of the Truckee River and a 300-foot crossing of the Steamboat Creek;

B. A 500-foot viaduct crossing of the Truckee River and 300-foot crossing of the Steamboat Creek; and

C. A 300-foot bridge crossing of both the Truckee River and Steamboat Creek.

As would be expected, a 1000-foot viaduct for the Truckee River crossing had little effect on water surface elevations, while a 500-foot viaduct raised the water surface elevation about 0.5 foot over existing conditions for the 100-year flow. Both Alternates A and B are designed to convey the entire 100-year flow of 19,350 cfs through the Truckee River bridge crossing. The 300-foot crossing of both the Truckee River and Steamboat Creek (Alternate C.) would also raise the water surface elevations approximately 0.5 foot over existing conditions. Alternate "C" would require a portion of the

Truckee River flow to divert to the Steamboat Creek structure once the Truckee River had crested its banks. This condition would require considerable open space between the Steamboat Creek and Truckee River to accommodate the Truckee River 100-year flood flows; this would eliminate potential development between the two water courses. The Steamboat Creek bridge crossing is sized to convey the 100-year Steamboat Creek flow of 7500 cfs. An RCB structure was examined in the economic evaluation of this crossing.

Substructure Evaluation Preliminary subsurface investigation of the channels and flood plain crossing sites indicated poor support conditions at both crossings. All pier and abutment locations will, therefore, require friction pile supports to depths probably in excess of 50 feet below ground line. This would require superstructure spans in the 90 foot to 100 foot range to economically balance the expensive support system for each of the three alternatives considered.

Superstructure Types Alternatives A, B, C were conceptually designed and economically evaluated for three structural systems:

1. Prestressed concrete box girders;

2. Structural steel box sections; and

3. Reinforced concrete box girders.

All three were considered continuous over three or more supports by use of a deck continuous over these supports.

Proposed spans for the three structural systems varied from 92 feet to 97 feet, and structural depths ranged from 4 feet-3 inches to 5 feet-2 inches. These depths included the girder depths plus a reinforced concrete slab and an asphalt wearing surface. Sheet 16 of the attached drawings show cross sections of the structure types and their corresponding depths.

Table 24 shows the types, spans depths, and estimated costs for the proposed alternates.

An additional alternate was considered and evaluated. This alternate would combine the cast-in-place concrete spans in the flood plain areas with either precast or steel spans over the live channels.

TABLE 24

TRUCKEE RIVER BRIDGE AND STEAMBOAT CREEK

Alternative/Type	Span	Structure Depth	Total Cost
"A" 1000' Viaduct	11-97' spans		
1. Prestress		4'-4"	$4,704,000
2. Structural Steel		4'-3"	4,855,000
3. Cast-in-Place		5'-2"	3,540,000
"B" 500' Viaduct	6-94' spans		
1. Prestress		4'-4"	$2,859,000
2. Structural Steel		4'-3"	3,049,000
3. Cast-in-Place		5'-2"	2,152,000
"A" 1000' Viaduct			
1. Cast-in-Place &	8-97' spans &	5'-2"	
Prestress	3-94' spans	4'-4"	$4,500,000
2. Cast-in-Place &	8-97' spans	5'-2"	
Structural Steel	3-94' spans	4'-3"	4,616,000
"C" 300' Bridge	97' spans		
1. Prestress		4'-4"	$1,947,000
2. Structural Steel		4'-3"	2,093,000
3. Cast-in-Place		5'-2"	1,465,000
Steamboat Creek			
Crossing: RCB	10-Barrel 14' X 14' RCB		$ 750,000

In order to evaluate the advantages and/or disadvantages of selecting Alternate A, 1000-foot viaduct, versus Alternate B, a 500-foot viaduct, other factors had to be considered. Preliminary damage estimates for the various flood events of the Truckee River were obtained from the U.S. Army Corps of Engineers. The two areas most affected by raising the back water at the location of the Truckee River bridge crossing were:

1. The area which is located primarily within the City of Sparks and extends from McCarran Boulevard to the entrance of the canyon near Vista. This reach lies north of the Truckee River and south of I-80; and

2. That area which is located south of and adjacent to the Truckee River, bordered on the west by McCarran Boulevard, on the east by the Virginia Foothills and on the south by Pembroke Drive and Hidden Valley Estates.

Damages associated with the 25-year, 50-year, 100-year, and Standard Project Flood (SPF) were reviewed. The Standard Project Flood is the flood event that is expected to occur very infrequently (once every 300 to 500 years).

Tables 25 and 26 show the flood event, flow, average flood depth, and the estimated total damage for each event.

TABLE 25

DAMAGE ESTIMATES FOR VARIOUS FLOOD EVENTS IN AREA ONE

Flood Event, Year	Q (Flow)	Average Flood Depth	Estimated Total Damage*
25 year	9,800 cfs	1.8 feet	$ 7,605,000
50 year	13,970 cfs	2.4 feet	$ 11,864,000
100 year	19,350 cfs	4.0 feet	$ 56,681,000
Standard Project Flood (SPF)	36,700 cfs	9.0 feet	$318,117,000

* U.S. Corps of Engineers' data is preliminary and subject to change.

TABLE 26

DAMAGE ESTIMATES FOR VARIOUS FLOOD EVENTS IN AREA TWO

Flood Event, Year	Q (Flow)	Average Flood Depth	Estimated Total Damage*
25 year	9,800 cfs	1.0 foot	$ 62,000
50 year	13,970 cfs	2.5 feet	$ 120,000
100 year	19,350 cfs	3.1 feet	$ 762,000
SPF	36,700 cfs	6.5 feet	$1,687,000

* U.S. Corps of Engineers' data is preliminary and subject to change.

The effects of both bridge Alternates A and B with regard to raising of the flood pool depths was evaluated utilizing the preliminary damage estimates supplied by the U.S. Army Corps of Engineers. For the purpose of this analysis 50 percent of both areas previously mentioned was assumed to be affected by the raise in the flood depths. Table 27 shows the effect of both bridge Alternates A and B on the flood depths of the various flood events.

TABLE 27

EFFECTS OF TRUCKEE RIVER BRIDGE CROSSING ON FLOOD DEPTHS

Return Period	Alternate A, 1000' Viaduct	Alternate B, 500' Viaduct
25 year	No effect	No effect
50 year	No effect	No effect
100 year	No effect	50% of area raised 1/2 foot
SPF (300 year)	50% of area raised 1/2 foot	50% of area raised 1 foot

Incremental damages for each of the various flood events were then estimated. The present worth of each annual incremental damage was then calculated. The present worth was calculated for both a zero and five percent inflation rate utilizing an interest rate of ten percent. Additional flood damages associated with construction of a 500-foot viaduct versus a 1000-foot viaduct would range from 5 to 10 million assuming inflation would vary from 0 to 5 percent. Total cost of both Alternates "A" and "B" including flood damages are summarized in Table 28.

TABLE 28

TOTAL BRIDGE COSTS

Alternate	Construction Cost (million)	Additional Flood Damage (million)	Total Costs (million)
A	3.5 to 4.7	--	3.5 to 4.7
B	2.2 to 2.9	5 to 10	7.2 to 12.9

Alternate A, the 1000-viaduct utilizing the prestress option, is recommended for the Truckee River crossing for the following reasons:

1. Based upon the estimated additional damages for the various flood events, the 1000-foot viaduct would be more cost effective; and

2. Although the cast in place reinforced concrete box girder option is approximately 1.16 million less costly than the prestress option, it could cause serious construction problems during the high water season. False work necessary to support the curing concrete would cause a dam effect during runoff with the possiblity of flooding to the surrounding area. Since it is unlikely to complete the construction in one season, the risk to the area and the damage that might be caused is real but difficult to assess and therefore the prestress option is recommended.

Other Considerations

Slope protection was included at the abutments and back along the fill slopes. Although the scour velocities were low, it would be prudent to provide a measure of protection to structures of this cost range.

As the most economical substructure arrangement, the piling would be extended above the ground to a reinforced concrete cap, and encased in a concrete diaphragm only on the bents in the live channel area.

UTILITIES

Utility information was obtained from Nevada Bell, Sierra Pacific Power Company, and Washoe County to determine any potential conflicts with the proposed roadway alignment. No major utility relocations are anticipated with the exception of portions of the City of Reno's Southside sanitary sewer interceptor.

Minor relocation of existing power poles is anticipated at various portions of the alignment, primarily in the southern end of the alignment at Mt. Rose Highway and at the intersection of Pembroke Drive northward to the Sierra Pacific Power Company substation. The eight inch gas line in the southern end of the project will be affected by the new reinforced concrete box crossing of Steamboat Creek just east of Mt. Rose Highway. In addition to this gas line, the 14 inch water line and 4-1/2 inch gas line in Pembroke Drive will have to be mitered under the proposed Pembroke reinforced concrete box crossing of the Steamboat Creek.

A sewerline crosses the alignment at the southern end of the project at Stations 31± to 45±. Approximately 2,650 feet of the City of Reno southside interceptor will have to be relocated due to conflicts with portions of the relocated Steamboat Creek. This reconstruction of the interceptor is primarily restricted to two locations:

1. Approximately 1,750 feet of interceptor south of Pembroke Drive between roadway Station 391± to Station 402±; and

2. Approximately 900 feet of interceptor just south of Kimlick Lane between roadway Station 454± to Station 465±.

When the proposed roadway is constructed, future crossings for sanitary sewer, power, water, and telephone should be provided at strategic locations as indicated by the utility companys. In addition to these crossings, signal conduits should be placed at all major intersections for future signalizations.

RIGHT-OF-WAY

The use of the land for this alignment comes under two general categories--right-of-way and easements.

Right-of-Way

Right-of-way should be acquired for the full cross section right-of-way improvements. These improvements, including graveled shoulders, will require a 120 feet wide right-of-way (see attached drawings). Where special conditions exist additional right-of-way may be required. An example of a special condition is at intersections where the right-of-way flares to accomodate right turn only lanes and other facilities (see sheets 13 and 14 of the attached drawings).

The right-of-way requirements for proposed intercepting roads has not been established. From information developed during this study it would appear that Zolezzi Lane and Mays Lane would require 120 foot rights-of-way west of Taphoe-Pyramid Link. State Highway 341, (Geiger Grade) Rio Poco, Mira Loma, and Pembroke roadways would require 80 feet of rights-of-way. These right-of-way widths should be reviewed in more detail when master plans are submitted by private interests or upon the extension of these roads due to public need.

Costs associated with right-of-way acquisition has not been included within the cost estimates in this report.

Easements

The alignment dictates the relocation or location of other facilities. These may include existing facilities such as drainage ways for Steamboat Creek, Whites Creek, or Boynton Slough. It is apparent it will be necessary to also relocate portions of existing sanitary sewer collection lines. In addition, it may be necessary to obtain permanent cut or fill slope easements from the adjacent property owners.

Drainage easements requirements for the alignment of Steamboat Creek are estimated at 125 feet south of the confluence of the Boynton Slough and 150 feet wide north of the confluence of the Boynton Slough. The sanitary sewer realignment easement can be accomodated by a 20 foot permanent easement.

At present the utility companies are not aware of major new facility alignment requirements which cross the proposed road alignment. There is the need to realign existing facilities for power and gas which may dictate the need for additional utility easements. These should be reviewed with the utility when construction is imminent.

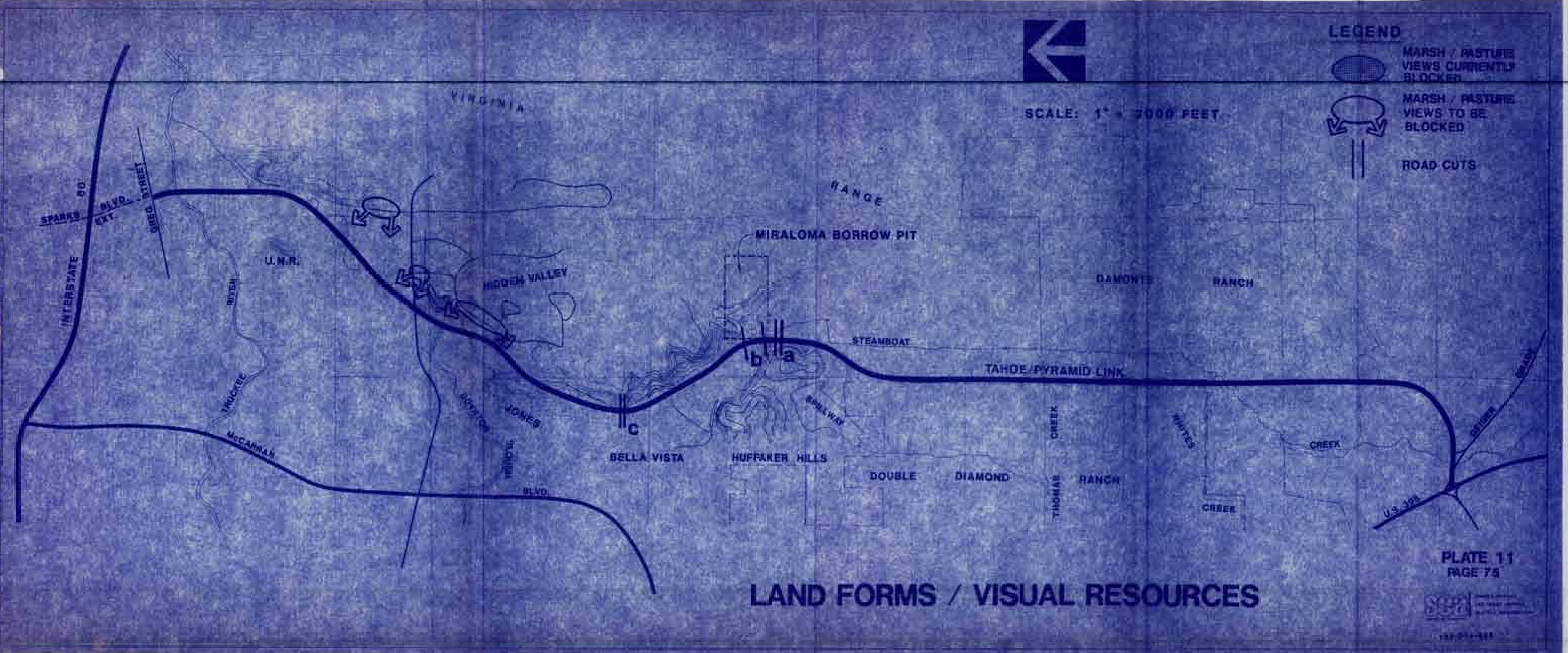
Location Much of this report deals with water: water quality, water dynamics, and water habitats. For this reason, descriptions of physical setting, impacts, and in some cases mitigation measures will proceed from "upstream" at the intersection of Interstate 395 and Mt. Rose Highway north to Greg Street. Reference points along the 9 mile link are, from south to north, the southern reach of Steamboat Creek, the "narrows," the Steamboat Marsh (the wetlands), the confluence of Steamboat Creek and Boynton Slough, and the meeting of Steamboat Creek with the Truckee River (Plate 11).

Landforms The eastern Truckee Meadows lands in the project area are shaped much like an hourglass tilted slightly toward the north. The ranch land along the southern stretch of Steamboat Creek slopes gradually toward the narrows formed by the Huffaker Hills and slopes of the Virginia Range. To the north, near Hidden Valley, is a low wetland basin and mostly flat agricultural lands lying adjacent to the foothills of the Virginia Range. Most soils along the alignment are resistant to erosion (U.S. Federal Highway Administration/Nevada State Highway Department, 1976).

Visual resources are primarily of two types: wetland and pasture scenery viewed from the residences of Hidden Valley and hillside panoramas from Reno and Sparks. Plate 11 shows the general vantage points of the Hidden Valley subdivision; some views are already blocked by earthworks. Most of the slopes along the alignment are visible from Reno and Sparks.

Principal waterways along the alignment are shown in Plate 11. The proposed alignment crosses Steamboat Creek in about 14 locations. Many portions of the creek have been channelized for agricultural use, especially upstream from the Huffaker Narrows. Man-made portions of Whites and Thomas Creeks are also under the alignment.

Downstream from the narrows, Steamboat Creek flows into a marsh formed in part by a small dam. This marsh has a core of permanent standing water surrounded by seasonally inundated marsh. The proposed align-



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LAND FORMS / VISUAL RESOURCES

ment covers an eastern portion of this area. Downstream, Steamboat Creek is fed by Boynton Slough before meeting the Truckee River.

This system of creeks is polluted by urban and agricultural runoff, as well as minerals from the Steamboat Hills. Steamboat Creek carries loads of phosphorus, nitrates, nitrites, suspended solids, and other pollutants to the Truckee River and thus increases the base level of pollutants in that rivers. This affects the ability of the Reno-Sparks joint Water Pollution Control Plant to meet downstream water quality standards. During storms, urban runoff to Steamboat is increased, water quality declines, and creek waters require more treatment downstream.

The Washoe Council of Governments (WCOG) has prepared the 208 Water Quality Management Plan as a blueprint to achieve federal, state, and local goals. Among other things, the plan identifies state water quality standards (including Steamboat Creek), discusses ways to control pollutant discharge (including non-point sources), and identifies agencies responsible for plan implementation.

To control runoff pollutants, the 208 plan identifies the Steamboat Marsh as a potential sedimentation pond because of the marsh's natural ability to remove suspended solids, BOD, and nitrates. (The 208 plan also recognizes the need to handle Boynton Slough in the same manner.) In addition, if it is approved and implemented, the Army Corps' planned flood control project will incorporate this marsh/detention basin as part of the region's waste water treatment system (Hallock, 1983). It should be remembered that a marsh's cleansing capacity can be exceeded by particularly toxic inorganic substances or by high concentrations of suspended solids, BOD, nitrates, etc.

Groundwater

Sediments in the Truckee Meadows groundwater basin are pervious and, in many locations, allow percolation to area wells supplying water for agricultural and domestic uses. Generally, however, the water table is high along the alignment, especially at the Steamboat Marsh and in the ranchland south of the narrows where springs bubble at the surface. In these areas, groundwater is discharged to streams, and to the air through evaporation and plant transpiration. (Washoe Council of Governments, 1978.)

Groundwater along much of the alignment is of poor quality, especially at increased depths (SEA, 1979). Drainage to the ranch land south of Huffaker Hills is high in minerals, particularly arsenic and boron. Groundwater quality north of Huffaker Hills is better, although arsenic has been found in some wells during periods of excessive pumping. (U.S. Environmental Protection Agency, 1980.)

Biota

Much of the eastern Truckee Meadows is given to cultivation of alfalfa and other crops, or is open fallow land covered by sedges, baltic rush, bluegrass, and assorted introduced grasses. These habitats support small birds (blackbirds, starlings, etc.) and mammals (field mice, gophers, etc.).

More important wildlife habitats are the riparian and marsh formations. A few cottonwood trees remain along upstream Steamboat Creek and willows line portions of Steamboat Creek and Boynton Slough. Small mammals such as the longtail vole inhabit streambanks, and about 16 bat species subsist on streamside insects. Many larger animals descend from hillside sagebrush habitats to feed along the waterways. Typical birds which use riparian habitat are the belted kingfisher, Say's phoebe, and the yellow warbler. Steamboat Creek is also a tributary to habitat for the endangered Cui-ui and the threatened Lahonton cutthroat trout.

Bulrush, baltic rush, spikerush, cattail, and various sedges structure the wetlands habitat which supports microflora and fauna, various amphibians and insects, as well as numerous wildlife species. In fact, Steamboat Marsh is an important habitat for various migratory species (the Piedbilled grebe, the Canadian goose, the Pintail duck, the Mallard Duck, the Rough-legged hawk, etc.).

These riverside and marsh habitats are rare locally. There are only about 290 acres of riparian habitat in the area, and the only other wetland of comparable significance is at the south end of Washoe Lake (Hallock, 1983). The marsh has been identified as an important regional waterfowl nesting and shore bird wintering area by the U.S. Fish and Wildlife Service and the Nevada Department of Wildlife.

The Army Corps of Engineers' Recreation and Fish and Wildlife Plan recommends enlarging the marsh habitat to 120 acres (about twice its current size). The plan also envisions plantings along Steamboat Creek from Pembroke Lane to the Truckee River for an added 19.4 acres of riparian habitat. (The federal government is offering 100 percent of land acquisition and other habitat improvement costs if local agencies participate.)

The waterways on the private Truckee Meadows ranches are seldom visited by the general public; one small duck club has permission to enter the Jones Ranch and visit Steamboat Marsh. But the potential of recreation centering around aquatic resources is demonstrated by the popularity of Truckee River parks. Indeed, most of the meadow along the alignment is designated as open space preserve by the Washoe Council of Governments (WCOG, Reno, Sparks, and Washoe County, 1974.) The Damonte Ranch and Double Diamond Ranch development plans propose active recreation uses such as golfing, fishing, and hiking along streams on their lands.

In addition, the Army Corps of Engineers has a recreation plan for the Steamboat Marsh and downstream waterways. Under the plan the marsh would be expanded to create a 120 acre nature area. This plan is important since the only other significant wetlands (at Washoe Lake) is more distant from the Reno-Sparks population centers. In addition, downstream Steamboat Creek would be planted and bike paths, walkways, fishing access, and picnic sites would be added. The federal government will supply 50% of the improvement costs if local agencies support the plan. (The plan is tied to the Army Corps' proposed flood control project.)

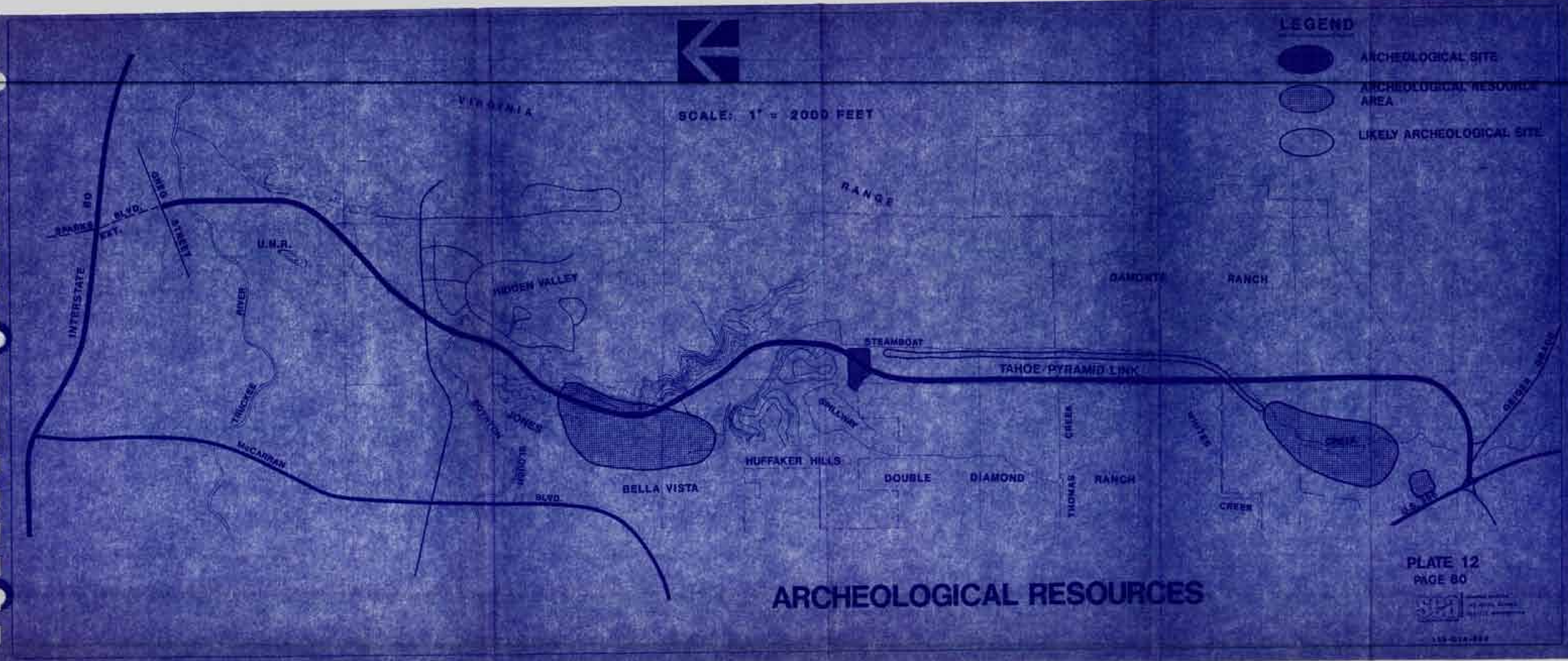
The Truckee Meadows was an important winter home for the semi-nomadic Washoe Indians, who took advantage of the area's fish and wildlife populations and the waters of Steamboat Springs and Creek. Two general archaeological resource areas have been identified along Steamboat Creek in the project area (Federal Highway Administration/ Nevada State Highway Department, 1976). And, more specifically, the Double Diamond Development Master Plan identifies an archaeological site (no. 1480) part of which is in the line of the Tahoe-Pyramid Link. (Collins, Ryder and Watkins Consulting Engineers/The Depner Association Planning, 1980) (See Figure 12.) The entire area has not been studied and it is likely that other sites exist along the alignment. For example, one study cites most of Steamboat Creek from Huffaker Hills to the Mt. Rose Highway as an area of likely archaeological sites (Collins, Ryder and Watkins Consulting Engineers/The Depner Association Planning, 1980).

IMPACTS

Land Forms

A principal impact of the roadway will be the creation of a new land form on the low lying Truckee Meadows. The pavement level will vary between 2 and 12 feet above the existing ground level on a berm of dirt and rock fill. During construction, erosion of cleared lands and recently established berms ,au occur. Erosion could result in an increase in airborne particulates, in silt deposition in fields and channels along the alignment, and in increased creek sediments, which may in turn undermine stream banks in other locations. Mitigation measures are included in this report to minimize these potential impacts.

Roadcuts are lettered a-c on Plate 11. From south to north, road cuts are anticipated in the Huffaker Hills (a), in the unnamed hills near the narrows (b), and in the same hills abutting Steamboat Marsh (c). Estimated cut dimensions are: (a), 250 feet in length and up to 6 feet in height; (b), 850 feet in length and up to 20 feet in height;



ARCHEOLOGICAL RESOURCES

PLATE 12
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(c), 160 feet in length and up to 7 feet in height. The stability of these cuts are discussed in the Design Critera section of this report. Very little erosion is expected from the cuts because of their course, rocky composition.

Fill material will be removed from the Mira Loma Borrow Pit. The State of Nevada Department of Highways has submitted a mining plan to the Bureau of Land Management to remove 1,700,000 cubic yards of earth from this existing federal pit (about 2,800,000 cubic yards of usable material are available). Water may be used to pretreat surfaces and to wash excavated materials; some runoff of sediment laden, turbid water is expected. In addition, new surfaces will need to be disturbed to expand the pit. In submitting the plan, the Department of Highways agrees to follow state and federal regulations controlling these impacts.

Visual Resources

Cuts a and b (see Plate 11) will be seen from parts of the nearby Donner Creek subdivisions and a few other locations in Reno. Most sections of Sparks will not have views of these cuts. Cut c will be more visible from residences in Reno and Sparks, but because of its small scale, the visual impact will not be great. For the most part, the alignment will avoid the Virginia foothills which are a prominent feature in the local scenery.

Views from the opposite direction, from the Hidden Valley homes westward, will be impacted. Plate 11 depicts an approximate assessment of the affected areas. Homes in the designated zones will lose some of their existing view of the marsh and agricultural land because of the roadway's height above existing ground. Some views are currently blocked by existing earthworks (Plate 11). Residents on higher ground will not lose their views of the meadows, but will look over a major thoroughfare.

The excavation of the Mira Loma Borrow Pit is not expected to have a significant visual impact since it involves a site that has already been disturbed and that is not highly visible from activity centers.

The site will, however, be visible from planned developments south of the Huffaker Hills and from the proposed Tahoe-Pyramid roadway.

Surface Water The dynamics of the project's area hydrology have been discussed in other sections of this report; here water quality is the principal consideration.

The proposed alignment will necessitate rechannelization along portions of Whites, Thomas, and Steamboat Creeks. High levels of sedimentation can be expected during construction. Effects of siltation commonly include increased turbity and decreased light penetration. Stream flow and stream bed features will be changed after construction; in particular, replacing a meandering stream with a straight channel will increase water velocity, cause further erosion and sedimentation, and raise water temperatures. (Additional dark sediments will absorb more solar energy.)

Much of Steamboat Creek is to be straightened, although portions of the original stream can be retained (e.g. a curving section downstream from the Boynton Slough--Steamboat Creek confluence). Impacts in other locations can be mitigated by incorporating the design measures included in the following mitigation section.

Sedimentation can also affect the Steamboat Marsh since it is fed by Steamboat Creek. If erosion is not controlled during and after construction, deposited silts may change the bottom conditions and hydrology of the wetlands. Resultant impacts to marsh inhabitants are described in the next section.

Additional construction related water quality degradation can occur if defoliants are used. Chemicals applied in any part of the marsh will likely be transmitted by the high water table and seasonal waters to the permanent body of water. Destruction of marsh reeds will reduce the marsh's natural cleaning capacity and allow further decreases in water quality. Resultant impacts on the ecology are discussed in the next section.

Longer term impacts will occur from roadway runoff. Contaminants will include oil, gasoline, asbestos (from brake linings), and heavy metals, and may include sodium chloride from de-icing salts and toxic substances from roadway accidents. These pollutants are difficult and expensive to remove through water treatment. If all runoff is directly channeled into Steamboat Creek, making it more difficult for the water treatment plant. Pollutant flows to the Truckee would increase if planned catch basins are designed to allow percolation, they will alleviate some of this burden, but the basins will have to be periodically cleaned (Crowe, 1983). Other mitigation measures are discussed in the following section.

Finally, there will be slight long term impacts on the marsh hydrology. Vegetation under the proposed alignment indicates that this eastern portion of the wetlands receives seasonal inundation. These seasonal waters, however, will be displaced to the western fringes of the marsh, and no change in elevation is anticipated (Westoff, 1983).

Groundwater

Because most of the alignment is in lands of high water table downslope from the majority of high quality groundwater reserves, and because many highway pollutants are incorporated into the upper layers of soil, no significant impacts to groundwater supplies are anticipated.

Biota

Destruction of terrestrial habitat by roadway construction will displace and probably eliminate some small animals. It is difficult to predict whether local species diversity will be affected. In many locations agricultural activities have reduced plant and animal diversity. However, the roadway would act as a barrier to the movement of animals from other habitats to water sources.

Construction impacts on aquatic habitats will be more serious. Direct habitat destruction will kill some plants and animals of the species listed in the Appendix (e.g. fish kills in emptied sections of Steamboat Creek), and may even cause some temporary local extinctions. Loss of habitat along approximately 3.1 miles of Steamboat Creek will be offset to some degree by the creation of about 2.6 miles of straight channel. These linear measures fail to fully convey the balance between habitat destruction and creation; proper design of the new channel could create more riparian habitat than previously existed by expanding planted area and by meandering the channel length. (See Mitigation Measures.) A net loss of aquatic habitat will be serious since many migratory species are present. Some species use both the streams and the marsh, and others primarily inhabit the wetlands.

At least 6 acres of marsh habitat will be eliminated by road construction over the eastern portion of the wetlands; additional marsh would be lost when the proposed Mira Loma Street Drive extension is built to tie into the Tahoe-Pyramid Lind. Aside from direct kills of plants and animals, the loss of marsh may disrupt flight and feeding habits of migratory species, depending on the net loss of marsh land. (New marsh may be created by displaced seasonal waters.)

The endangered species peregrine falcon and southern bald eagle have made casual appearances in the marsh area. This habitat may become more important for these species as alternate locations are lost to urbanization, (Hallock, 1983).

Habitat disruption will occur due to noise from road construction and operation. Some animals will be displaced from their ranges, and will die due to lack of alternate territory. Disruption of bird and mammal breeding behavior will also occur.

Finally, decreased water quality will adversely impact aquatic habitats. Increased sediment loads during and shortly after construction may smother benthic (bottom dwelling) organisms and increased stream temperatures will impact fish species in Steamboat Creek and downstream in the Truckee River. If defoliants are applied for construction purposes, marsh reeds may be destroyed and this could reduce the complexity of the habitat and could reduce insect food sources for fish and birds. And heavy metals, if delivered directly into waterways from roadway runoff, will be incorporated into the food chain, and could contaminate game species.

It is difficult to predict the effect of project pollutants on the threatened Lahonton cutthroat trout and the endangered cui-ui which exist downstream. However, if long term sediment impacts can be mitigated, the project presents an opportunity to aid the reestablishment of the Lahonton cutthroat trout by lowering Steamboat Creek temperatures. Liberal streamside tree plantings, recommended in the following section, would shade the creek and lower temperatures (U.S. Army Corps of Engineers, 1982).

The presence of endangered, threatened, and migratory species will likely trigger the Environmental Impact Statement (EIS) process if any federally funded construction is undertaken. In addition, the Army Corps of Engineers will require permits for channelization of Steamboat Creek and/or fill of marshland. The permit process would open the project to federal environmental impact statement requirements and to comment by individuals as well as local, state and federal agencies. (e.g., U.S. Fish and Wildlife Service) (Champ, 1983).

Recreation

The presence of a major roadway along Steamboat Creek will reduce the potential of the area waterways for recreation. Noise and visual impacts will reduce the site's inherent tranquility. Rechannelization of Steamboat Creek may or may not be compatible with the Army Corps' plan to add bike paths, plantings, etc. This impact will depend on the design of the new channel and roadway berm (see Mitigation Measures section).

Archaeological Resources

Roadway construction in archaeological resource areas could cover sites used by the Washoe Indians for food processing and hunting. Construction through mapped site number 1480 would likely entail the loss of archaeological artifacts. Because the Truckee Meadows area had one of the highest aboriginal populations in what is now the Western United States, and because many of the local sites have been lost to urbanization, those sites remaining are important. (Elston, 1983).

MITIGATION MEASURES

Introduction

The two major components of the project are roadway construction and stream rechannelization. Mitigation measures to reduce the impacts of these actions can be separated into two categories:

1. Construction procedures to reduce impacts during construction.

2. Design measures to reduce impacts after construction.

These mitigation measure categories are discussed in this section with specific techniques suggested.

Types of mitigation measures related to impacts on Steamboat Marsh and Steamboat Creek, which are the most critical environments to be impacted, vary in their necessary emphasis at various stages of road construction. Relative emphasis that should be given early and later in the project are shown in the following graph. Most of the mitigation measures suggested are in the categories of impact minimization or restoration/ replacement of areas to be altered by the project. Avoidance has been addressed in the first alignment phase by skirting the wetland. Complete avoidance would, of course, site the corridor elsewhere.

Key objectives in the mitigation of adverse impacts on wetlands are as follows:

- Maintain existing water regimes and/or improve flow into wetland areas.

- Create a shallow surface water supply where none existed previously.

- Facilitate animal migration into and out of wetlands.

- Protect wetland animals and control their movement.

- Divert potential toxic spills.

- Control erosion.

- Control sedimentation.

- Control chemicals which may leach into wetlands and affect them adversely.

- Reduce noise impacts on wetland species.

- Minimize the impact of crossing wetland areas.

Source: FHA, Highways and Wetlands

Mitigation measures must be designed and implemented with the ecological dynamics of the wetland in mind and should be guided by a qualified wetland ecologist. It must also be remembered that mitigation measures should be monitored during and after construction for their effectiveness and to identify malfunctions or needs not previously identified.

High priority mitigation measures are *asterisked.

ROADWAY IMPACT-CONSTRUCTION

Impacts to the wetland during construction center around sediment and chemical runoff as discussed previously. The potential for these impacts will be greatly reduced by summer construction though without adequate revegetation by fall and winter rains, the impacts could still be severe. The following mitigation measures should be utilized where appropriate:

Sedimentation Control ***Temporary retention ponds and/or straw bale sediment barriers to control runoff should be constructed.

Silt fences should be used where straw bales or sediment basins will not be effective.

Dust Control	Water, stable oil emulsion, organic crusting agents, or plastic sheeting should be used to control dust during construction. No dust control agent should be used that will impact stream or marsh animals.
	"Off-limits" areas should be designated where no personnel or vehicles are allowed once grading is done and a dust control agent has been applied. Parking of private and construction vehicles should be controlled. Once a designated area (equipment yard or job site) is treated with a dust control agent, only that area should be allowed for parking and vehicle traffic. Designated routes of access to particular structures or job sites should be used. Tarps and careful loading of fill should be utilized to control spillage from trucks.
Erosion Control	*** Clearing should be limited to only the area where immediate work will be done. Flagging or temporary fencing should be used to designate off-limits areas. Such barrier placement should be under the direction of a wetland ecologist.
	Netting, straw, or other effective mulch should be used on bare slopes to control erosion prior to seeding.
	Stockpiles of soil or fill material should be protected from wind and water erosion. Temporary flumes to divert runoff from stockpiles away from the wetland can also be used.
	Mechanical removal of vegetation rather than soil sterilants should be used.
Noise	Amount of noise from construction activity cannot easily be reduced. Reducing activities during the spring nesting season would be an important mitigation measure.

To Protect Wetland Animals

Yard and accessory construction activities should be placed away from the wetland and limited to only the necessary area. Off-limits areas should be delineated as described previously.

DESIGN GUIDELINES

Impacts due to the design of the roadway also address the runoff of sediment and urban pollutants. The following mitigation measures are recommended:

Erosion Control

*** Shoulder and disturbed areas should be revegetated. Native top-soil removed should be saved and reapplied. The seedbed should then be prepared and hydromulched and hydroseeded. Vegetative planting of indigenous plant material should follow. A maintenance schedule should be adhered to until vegetation is reestablished and should include irrigation and fertilization though care should be taken in fertilizer application so that runoff will not contain excessive amounts of the chemical due to overfertilization.

Sedimentation Control

Permanent sediment retention ponds or infiltration trenches as appropriate should be incorporated into detailed drainage plans. The goal is to filter out pollutants, sediment, and deicing material to utilize the natural filtering capacity of the wetland without overburdening it and to decrease impact on the sewage treatment plant which cannot eliminate heavy metals and asbestos. These contaminants commonly incorporate into the top layers of soil, and oils and grease are consumed by soil bacteria. Generally, retention ponds should be used on the east side of the roadway. Infiltration trenches to collect sheet flow runoff should be placed in fill material where runoff could drain into Steamboat Marsh or Creek.

Control of Chemical Leaching

Herbicides should not be used during landscaping.

Maintain Existing Water Flow	Culverts should be placed under the roadway so that flow will not be obstructed. Design of culverts should include ecological and hydrologic considerations so that: - Water velocity is not too great, - a pool below the culvert is not created, - its distance to ground level is not too high, - catch basins allow percolation into the soil.
Toxic Spills	The sedimentation basins discussed earlier would also provide temporary retention of any potential toxic spills from the roadway.
Public Access	The design should be coordinated with concerned agencies to provide public access to Steamboat Creek and Steamboat Marsh per adopted open space and recreation plans. Access should include extension of the Steamboat bike path along the rechanneled stream planned by the Army Corps of Engineers.
Mining	Impacts of mining procedures, such as erosion, sedimentation, litering and land surface disturbance, will be mitigated by compliance with Section 106 of the Special Provisions of the State of Nevada Department of Highways, and with measures contained in the mining plan submitted to the Bureau of Land Management.
Visual	*** Cut hillsides should be recontoured to soften edges. *** Slope benching should be used where recontouring cannot be achieved to reduce uninterrupted slope and provide stability, drainage, and vegetation shelves. Cut hillsides should be revegetated using best management practices. Fencing along the roadway should be placed to contain litter so that it will be easily retrievable from the roadway.

STREAM RECHANNELIZATION

Construction

*** No equipment should be operated in the live stream channel except as necessary to achieve the channel change and to construct crossings. When work in the stream is necessary, the flow should be diverted around the work area. Temporary fills should be constructed of nonerodible material and removed when work is completed.

If repeated crossings across the stream are necessary, a temporary bridge should be installed.

No construction debris or washings should be allowed to enter Steamboat Creek or Steamboat Marsh. Excess debris should be removed at completion of work.

Any construction affecting the stream channels should not take place during fall and spring spawning periods.

Diversion to the new channel should be done during low flow period.

Measures to protect fish life during diversion follow:

- Game fish should be transported from standing pools left in the old channel after diversion to the new channel.

Constant liaison should be maintained with fish and wildlife agencies.

Design

*** A meandering channel should be created to increase wildlife habitat and to reduce velocity of the stream.

*** Construction design of the new channel should include a "vegetation shelf" to aid quick revegetation and improve habitat. Energy dissipators should also be used to improve oxygenization and reduce scouring. Gabions and spawning gravels should be added to enhance fish habitat where appropriate. Channel stabilization where necessary should be consistent with the goal of retaining or improving wildlife habitat (such as the use of willow bundle wattling).

*** Revegetation of the stream channel should include introduction of cottonwood trees to improve wildlife habitat, stabilize banks, and reduce water temperature.

Bank erosion protection should be placed where vegetation cannot be expected to become reestablished or at high water velocity points.

*** Clean fill should be placed at the initial entry point of diverted water to the new channel to filter out silt and minimize turbidity during the diversion.

COST ESTIMATES

Previous discussions in this section have set forth the conditions of construction. These include providing for phased construction with full cross section or partial cross section improvements, and considering the length of bridges, the size of reinforced concrete boxes, the thickness of paved structural sections, the width of roadways, and improvements dictated by environmental considerations.

Utilizing this information, quantities were developed representing the major components of the construction improvements. Right-of-way costs and any associated relocation expenses, possible damage suites, and minor construction facilities, such as irrigation drainage structures or culverts, are not included. These estimates are based on today's costs. Final costs will depend upon more detailed design and appraisal work.

However, given the conceptual level of analysis performed the following cost estimates adequately describe the magnitude of the capital investment required.

These cost estimates include full cross section improvements (Table 29), partial cross section improvements (Table 30), and stage construction (Tables 31 and 32) Sequence "A" and "B" as described in the Project Design section of this report.

TABLE 29

PRELIMINARY COST ESTIMATE

FULL CROSS SECTION IMPROVEMENTS:
MT. ROSE HIGHWAY TO GREG STREET

ITEM	DESCRIPTION	QUANTITY	UNIT COST	TOTAL
1	Excavation & Embankment	30,800 CY	$ 2.00	$ 61,600
2	Imported Fill	857,000 CY	3.50	3,062,500
3	Rock Fill	325,000 CY	4.50	1,462,500
4	Channel Excavation	225,400 CY	2.25	754,650
5	8" CTB	166,000 SY	4.70	780,200
6	10" CTB	257,100 SY	5.85	1,504,035
7	11" CTB	59,350 SY	6.50	385,775
8	Gravel Base (Curbs)	257,000 SF	0.40	102,800
9	6" Agg. Base (Shoulders)	28,500 SY	3.60	102,600
10	Rock Rip-Rap	107,100 SY	10.00	1,071,000
11	Heavy Rock Rip-Rap	16,800 SY	15.00	252,000
12	3/4" Open Grade	478,900 SY	1.25	598,625
13	5" AC Paving	166,000 SY	6.75	1,120,500
14	6" AC Paving	312,900 SY	8.00	2,503,200
15	Median Curb	96,500 LF	4.00	386,000
16	Curb & Gutter	60,000 LF	4.50	270,000
17	Truckee River Bridge	LS	Lump Sum	4,704,000
18	Steamboat Creek Bridge	LS	Lump Sum	1,947,000
19	RCB Crossings	6 EA	300,000	1,800,000
20	Fence	92,000 LF	3.00	276,000
21	U.S. 395 Intersection	LS	Lump Sum	200,000
22	Sanitary Sewer Relocate	2,650 LF	125.00	331,250
			Subtotal	$23,496,235
			20% Contingencies	4,699,247
			Subtotal	28,195,482
			15% Engineering Fees	4,229,322
			Total	$32,424,804
			Use	$32,500,000

TABLE 30

PRELIMINARY COST ESTIMATE

PARTIAL CROSS SECTION IMPROVEMENTS: MT. ROSE HIGHWAY TO GREG STREET

ITEM	DESCRIPTION	QUANTITY	UNIT COST	TOTAL
1	Excavation & Embankment	30,800 CY	$ 2.00	$ 61,600
2	Imported Fill	815,000 CY	3.50	2,852,500
3	Rock Fill	325,000 CY	4.50	1,462,500
4	Channel Excavation	225,400 CY	2.25	754,650
5	8" CTB	107,240 SY	4.70	504,028
6	10" CTB	173,350 SY	5.85	1,014,098
7	11" CTB	40,000 SY	6.50	260,000
8	6" Agg. Base (Shoulders)	64,120 SY	3.60	230,832
9	Rock Rip-Rap	107,100 SY	10.00	1,071,000
10	Heavy Rock Rip-Rap	16,800 SY	15.00	252,000
11	3/4" Open Grade	313,540 SY	1.25	391,924
12	5" AC Paving	114,428 SY	6.75	1,772,389
13	6" AC Paving	199,112 SY	8.00	1,592,896
14	Truckee River Bridge	LS	Lump Sum	4,704,000
15	Steamboat Creek Bridge	LS	Lump Sum	1,947,000
16	RCB Crossings	6 EA	300,000	1,800,000
17	Fence	92,000 LF	3.00	276,000
18	U.S. 395 Intersection	LS	Lump Sum	200,000
19	Sanitary Sewer Relocate	2,650 LF	125.00	331,250
			Subtotal	$20,321,867
			20% Contingencies	4,064,373
			Subtotal	24,386,240
			15% Engineering Fees	3,657,936
			Total	$28,044,176
			Use	$28,050,000

TABLE 31

PRELIMINARY COST ESTIMATE CONSTRUCTION SEQUENCE "A"

Phase I: Construction of the Tahoe-Pyramid Link from the extension of Zolezzi Lane (Station 107+00) to future intersection with Rio Poco (Station 270+00). Construction of Rio Poco from intersection with Tahoe-Pyramid Link to existing Rio Poco at McCarran Boulevard.

Phase II: Construction of Tahoe-Pyramid Link from Rio Poco intersection (Station 270+00) to intersection of Greg Street and Sparks Boulevard (Station 505+).

Phase III: Construction Sequence "C"

Construct Tahoe-Pyramid Link from intersection of Mt. Rose Highway and U.S. 395 to intersection with Zolezzi Lane.

Associated Costs*

Full Improvements

Phase I:	$ 7,658,500
Phase II:	$21,881,000
Phase III:	$ 3,793,000

Partial Improvements

Phase I:	$ 5,087,700
Phase II:	$20,016,600
Phase III:	$ 2,836,500

* Estimated costs include 20 percent contingency and 15 percent engineering fees.

TABLE 32

PRELIMINARY COST ESTIMATE CONSTRUCTION
SEQUENCE "B"

Phase I: Construct Tahoe-Pyramid Link from intersection of Greg Street and Sparks Boulevard (Station 505±) to intersection with extension of Mira Loma Drive (Station 352+00). Construct Mira Loma Drive from Tahoe-Pyramid Link to existing Mira Loma at McCarran.

Phase II: Construct Tahoe-Pyramid Link from intersection with Mira Loma Drive (Station 352+00) to Zolezzi Lane (Station 107+00).

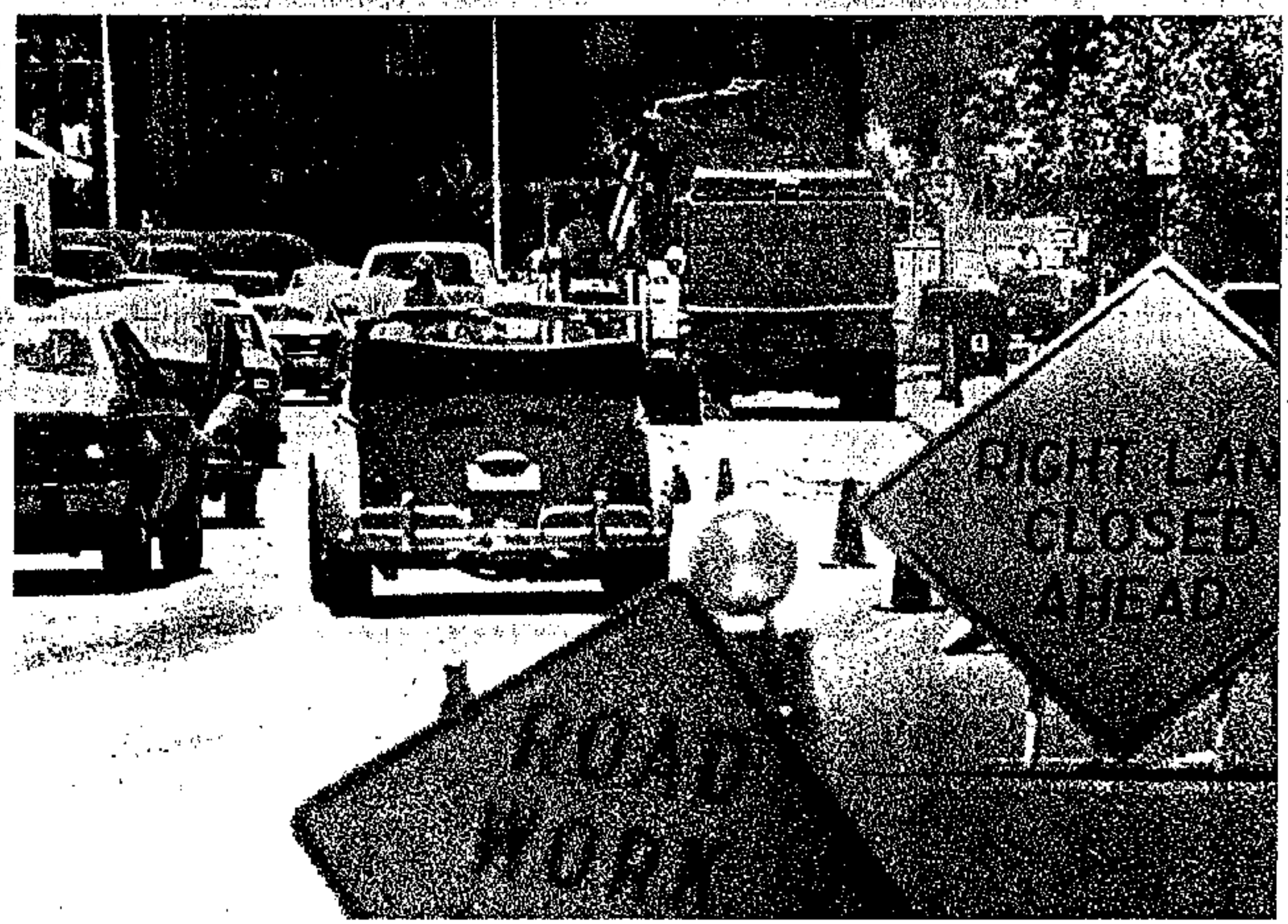
Phase III: Construction Sequence "C"

Construct Tahoe-Pyramid Link from intersection of Mt. Rose Highway and U.S. 395 to intersection with Zolezzi Lane.

Associated Costs*

Full Improvements		
	Phase I:	$18,733,400
	Phase II:	$10,728,100
	Phase III:	$ 3,793,000
Partial Improvements		
	Phase I:	$17,544,100
	Phase II:	$ 8,493,400
	Phase III:	$ 2,836,500

* Estimated costs include 20 percent contingency and 15 percent engineering fees.



RECOMMENDATIONS/ CONCLUSIONS

RECOMMENDATIONS / CONCLUSIONS

This study has focused upon a scope of work detailed in Section I. Each of the 8 items have been addressed and discussed in detail within the body of the report. Prior to the construction of all or portions of this work, additional steps in planning and refinement of criteria must be accomplished. It is the purpose of this section to summarize those conclusions arrived at under this study, and to recommend actions to be taken in the future.

These recommendations and conclusions are listed as follows:

1. The preliminary soils analysis indicates that very hard rock or very soft soils exist along the entire length of the alignment. Where the alignment is constructed on natural ground (principally south of the Huffaker Narrows) we suggest an R-value for roadway design of 12. Where the alignment is constructed on imported fill (principally north of the Huffaker Narrows) we suggest an R-value of 45. We recommend avoiding infringement upon the hill areas except where shown on Sheets 4 through 12 of the attached plans due to hard rock considerations. The use of the Mira Loma pit located in the center of the alignment is very convenient for the construction of the phases as delineated in the body of the report.

2. The vertical alignment of the road should be above the 100-year flood design level as set forth by the Corps of Engineers with their project.

3. All structures under the Tahoe-Pyramid Link should accommodate the 100-year design flood for the Steamboat or Truckee River flows. Connecting roads such as Pembroke Drive can be designed for lower design floods than the 100-year flood flow and the determination of which design flow set should be a function of the road's priority for traffic under these conditions.

4. Roadway criteria were determined to be as follows:

   a. Full cross section improvement design

      1. One hundred twenty (120) foot right-of-way
      2. Six (6) 12 foot traveled, two 10 foot emergency lanes
      3. Raised median with left turn pockets
      4. Fifty-five (55) mph design speed to Truckee River bridge

   b. Partial cross section improvements (ten-year projection)

      1. One hundred twenty (120) foot right-of-way
      2. Four 12 foot traveled lanes
      3. Graveled median with left turn pockets
      4. Fifty-five (55) mph design speed to Truckee River bridge
      5. Graveled shoulders
      6. Full intersection construction

5. General right-of-way has been detailed at 120 feet except where known intersections will occur. These area's right-of-ways will flare to accommodate the intersection. Detail property line surveys will be required for right-of-way acquisition.

6. The design set forth, both horizontally and vertically, meets the preliminary floodway criteria presently set by the Corps of Engineers. A master drainage plan must be developed for the entire Steamboat-Truckee floodways in order to refine the major

components of this suggested improvement. This master drainage plan would detail the hydraulics of the system and account for localized flows from adjacent property not considered in any studies conducted to date.

7. Based upon the Corps of Engineers' flood study and data, it is recommended there be a 1000-foot bridge structure constructed at the Truckee River, and a 300-foot bridge structure at the Steamboat Creek crossing near the Truckee River. All other structures crossing the Steamboat Creek can be multi-barreled reinforced concrete boxes. These structures are delineated in concept on Sheet 12 of the attached drawings accompanying this report.

8. The Steamboat Creek should be realigned where logical and necessary to reduce expensive crossings and to provide for existing capacity. The realigned Steamboat Creek should be contained within an easement acquired from adjacent property owners. The width of this easement is indicated to be 150 feet wide downstream of the confluence of the Boynton Slough and 125 wide upstream of the confluence of the Boynton Slough.

9. Existing sanitary sewer at Pembroke and Kimlick Lanes needs to be realigned to accommodate roadway and drainage facilities.

10. Future intersections, other than those addressed by this study, should be investigated thoroughly to determine the impact on traffic flow.

11. Particular care should be taken during construction to avoid environmental damage to existing stream beds and wetlands. Mitigation procedures outlined in Section III "Environmental Considerations" should be anticipated. It will also be necessary to make application to the Corps of Engineers for a permit to construct in the wetlands and to relocate the Steamboat Creek.

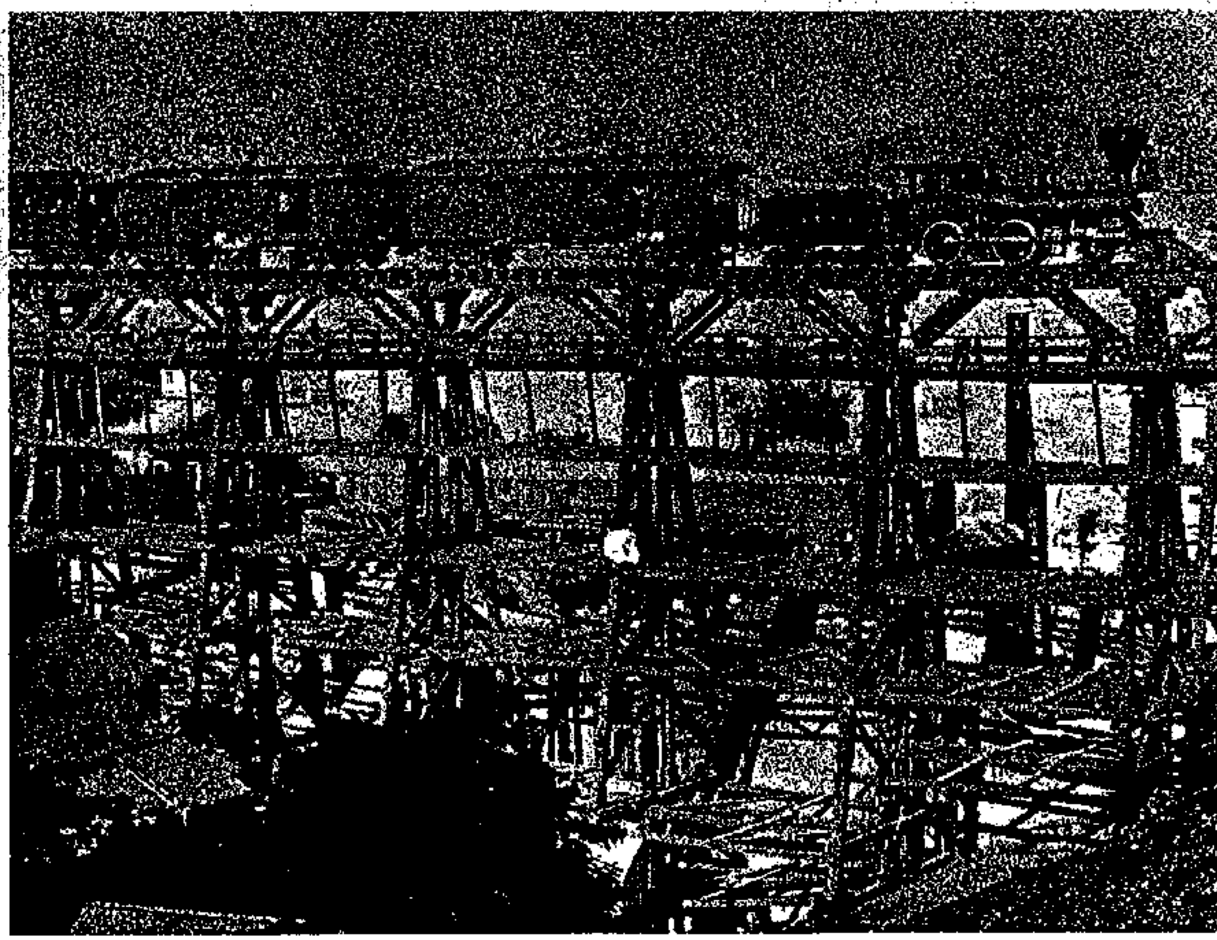
12. Determination of utility relocation or newly planned utility facilities should be coordinated with the utility companies. These include the Sierra Pacific Power Company, Bell Telephone, Cable Television, Southwest Gas, and Hidden Valley Water Company.

13. Phased construction can be accommodated with the suggested alternatives outlined in Section III - Project Design. Basic consideration for phasing will depend upon demand and economic considerations and may alter those presented in this report.

14. The cost estimate for full construction is $32,500,000. This includes 20 percent contingencies and 15 percent engineering fees. These estimates are for the major components listed under Section III - Project Design of this report, are for today's costs, and do not include right-of-way.

15. It is recommended the roadway follow the suggested horizontal and vertical alignment in accordance with this study, and that this alignment be adopted by the appropriate agencies.

16. It is further recommended that funding be sought to continue the planning and necessary engineering in anticipation of the demand for this road requiring either full or partial construction.



APPENDIX

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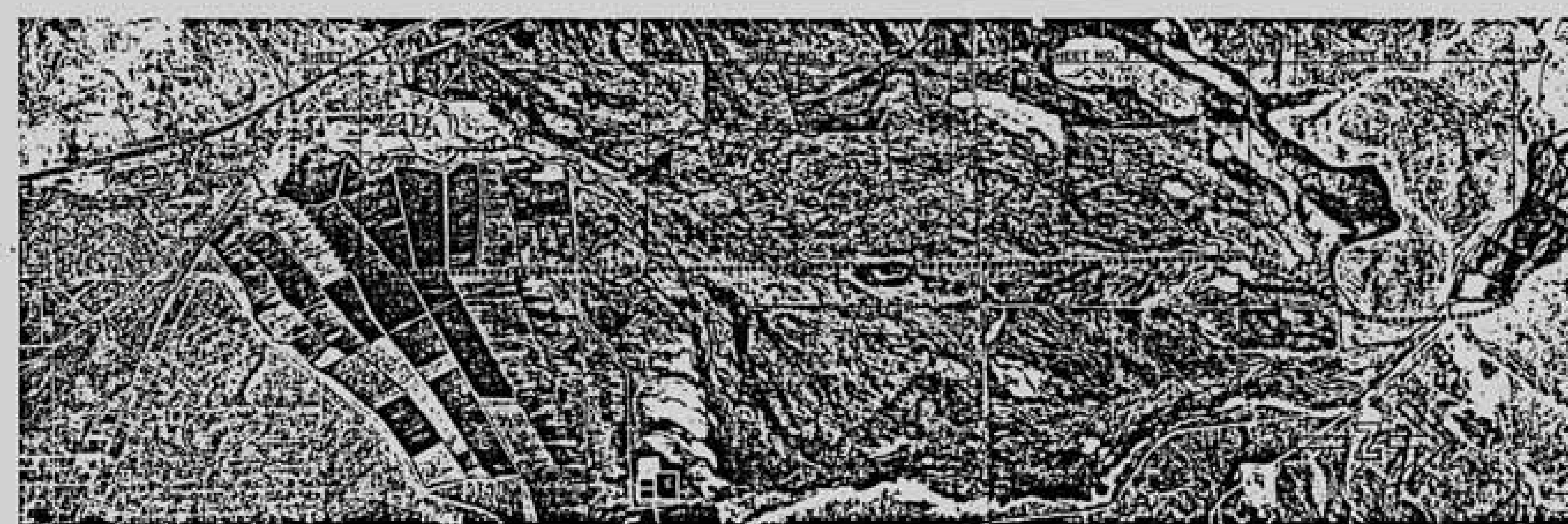
TAHOE/PYRAMID LINK

ALIGNMENT STUDY

Regional Transportation Commission



SCALE: 1" = 1000'

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INDEX OF SHEETS

DRAWINGS	SHEET NO.
COVER SHEET	1
ALIGNMENT MAP	2 & 3
PLAN AND PROFILE	4-12
INTERSECTION	13 & 14
TYPICAL SECTIONS	15
BRIDGE STRUCTURAL SYSTEM	16

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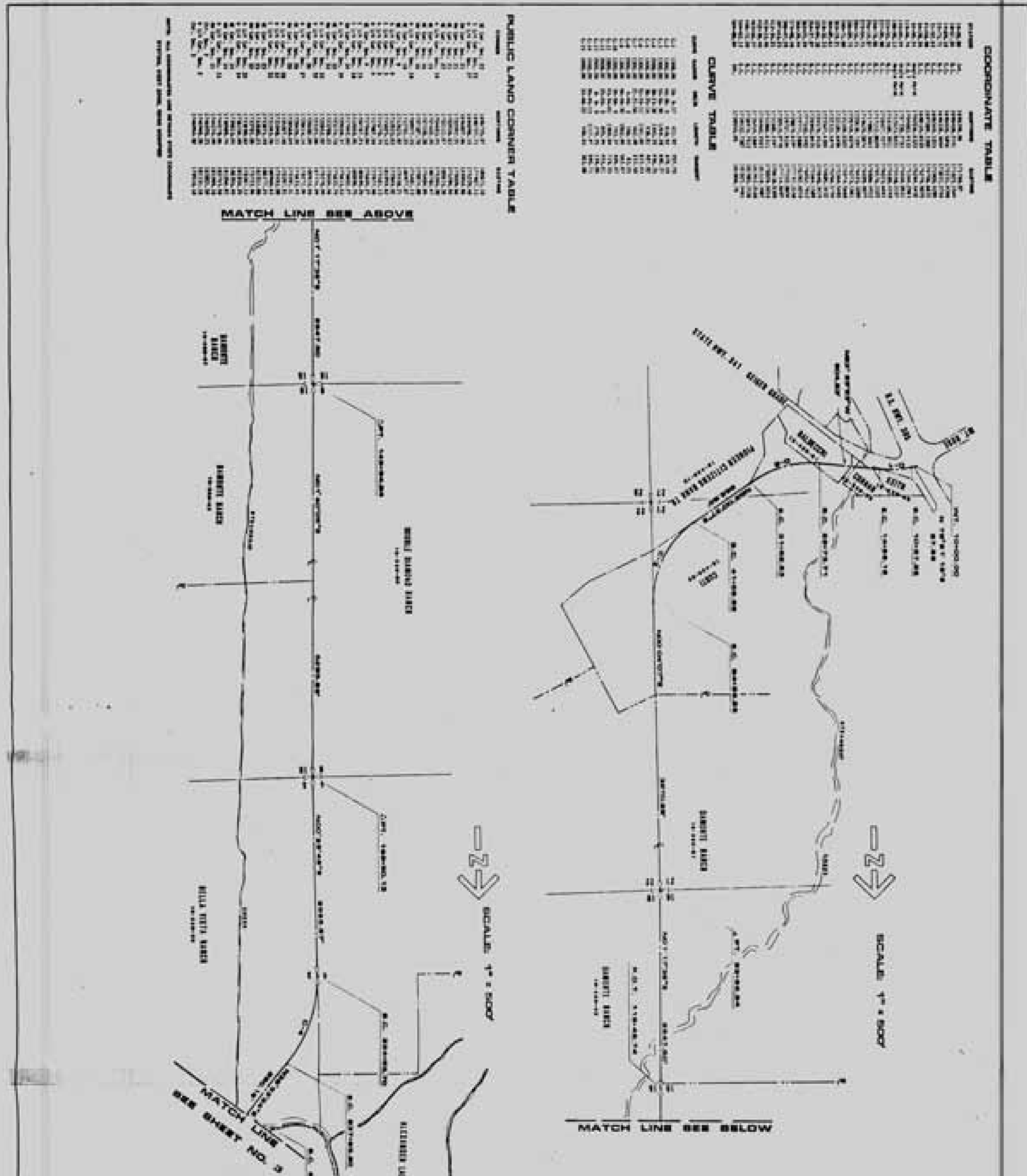
RONALD D. BYRD, P.E.
Principal in Charge

FRANKLIN D. ALVERSON II, P.E.
Engineer in Charge



ALIGNMENT MAP

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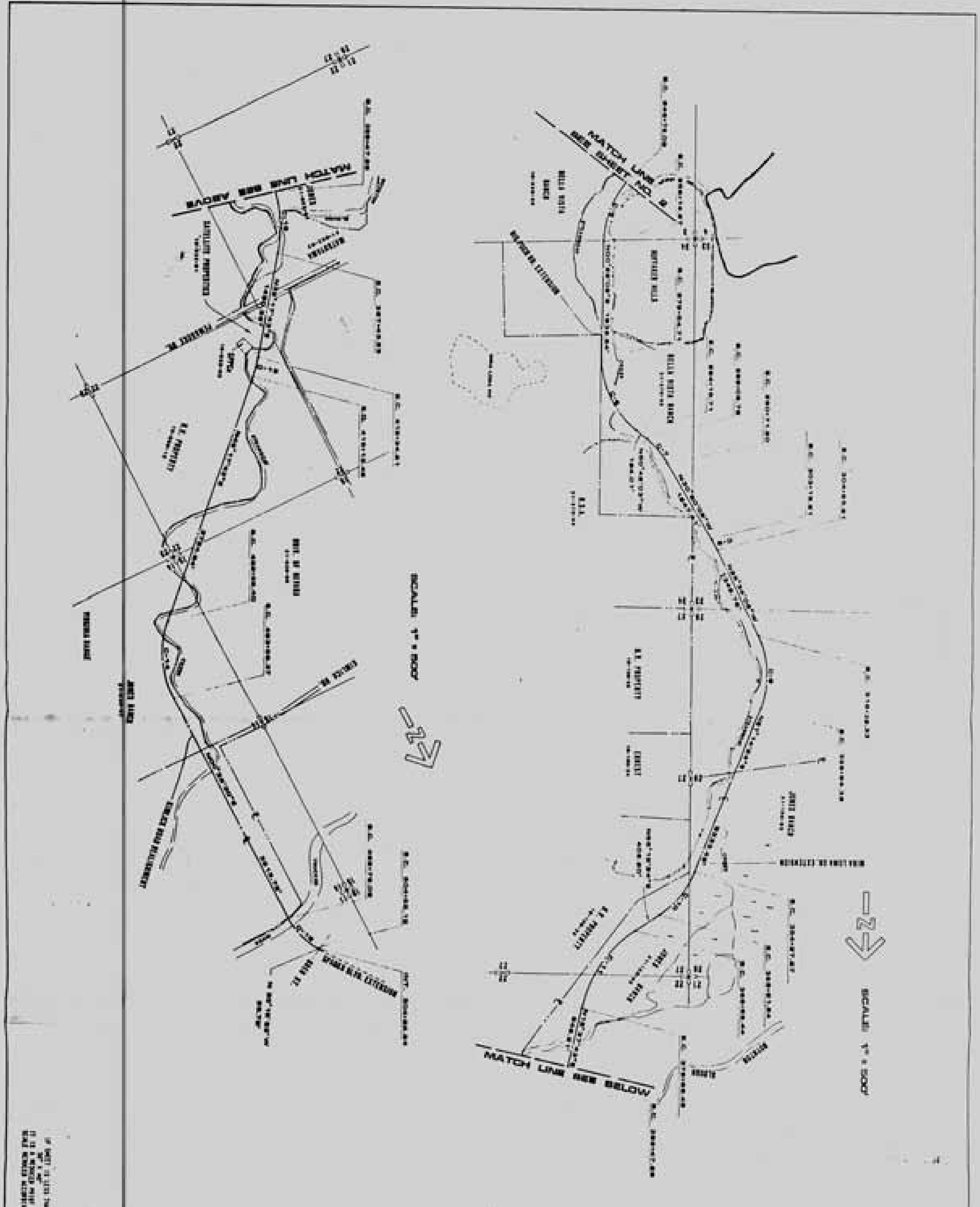

ALIGNMENT MAP

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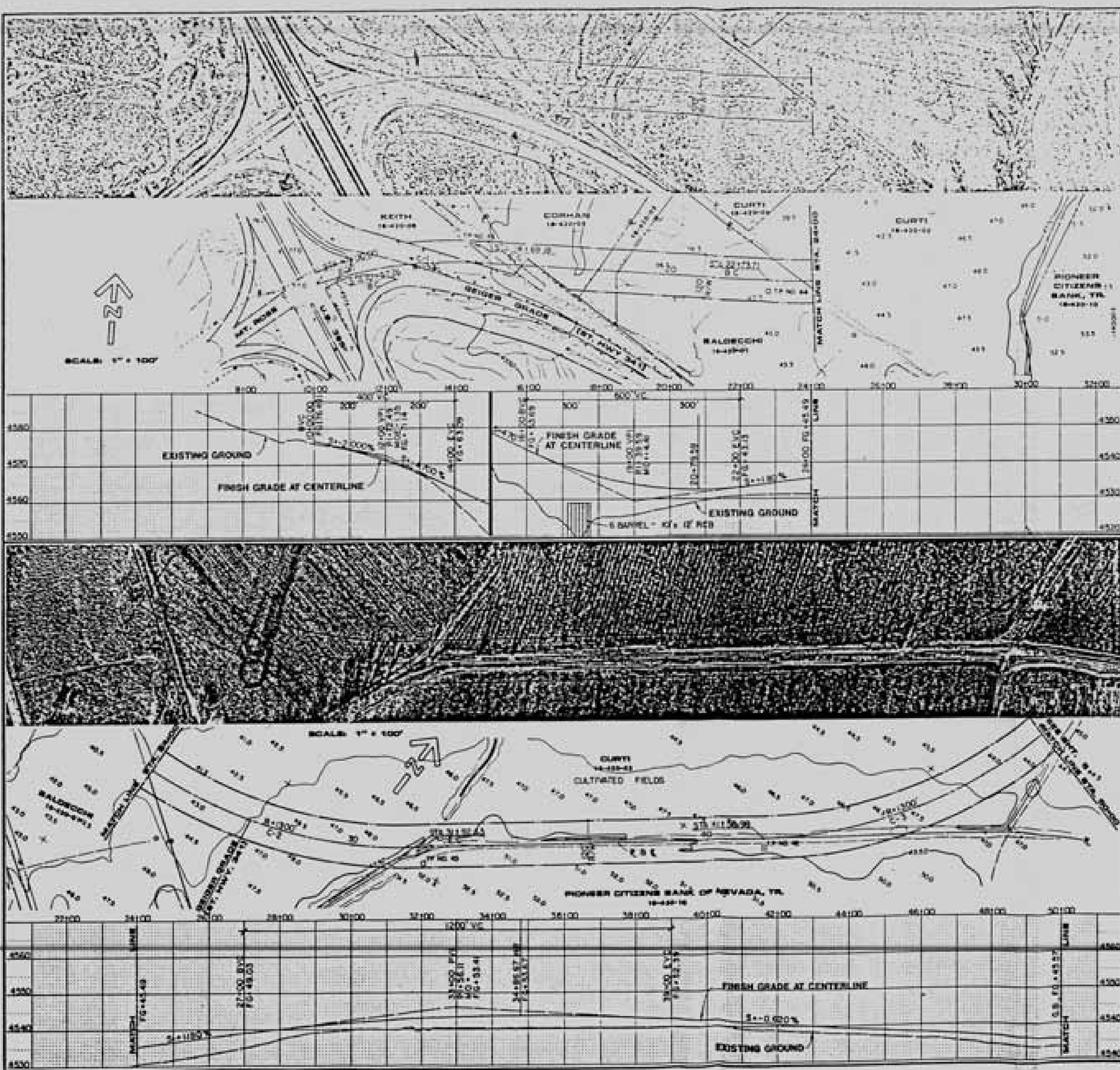

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LEGEND

- TP NO. 1 — TEST PIT LOCATION AND NUMBER
- B NO. 1 — BORING LOCATION AND NUMBER

℄ CURVE TABLE	
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L	1269.28'
T	690.37'

TOPOGRAPHIC MAPPING

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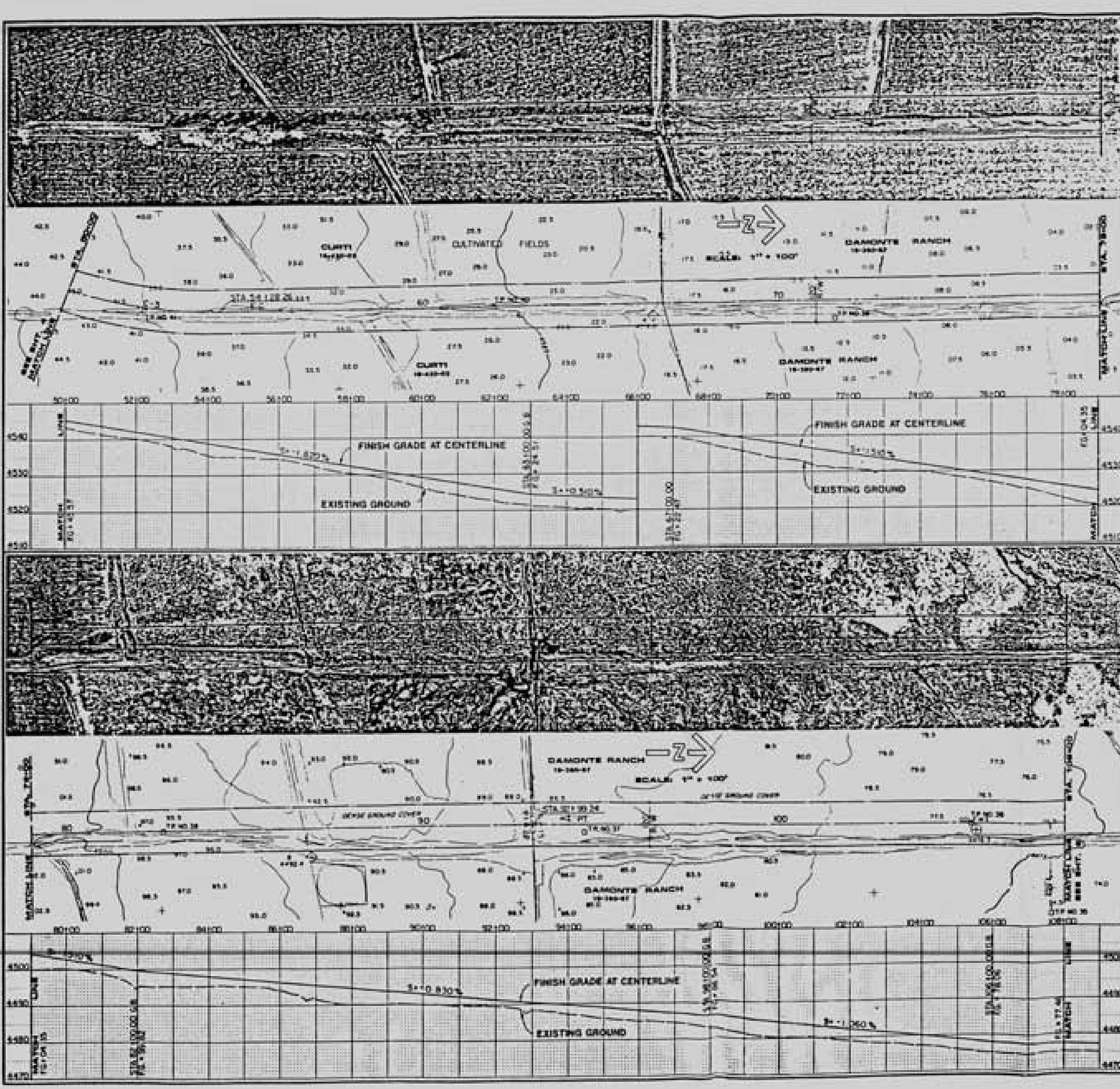

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L	1269.28
T	690.37

TOPOGRAPHIC MAPPING

PLAN AND PROFILE
TAHOE/PYRAMID LINK
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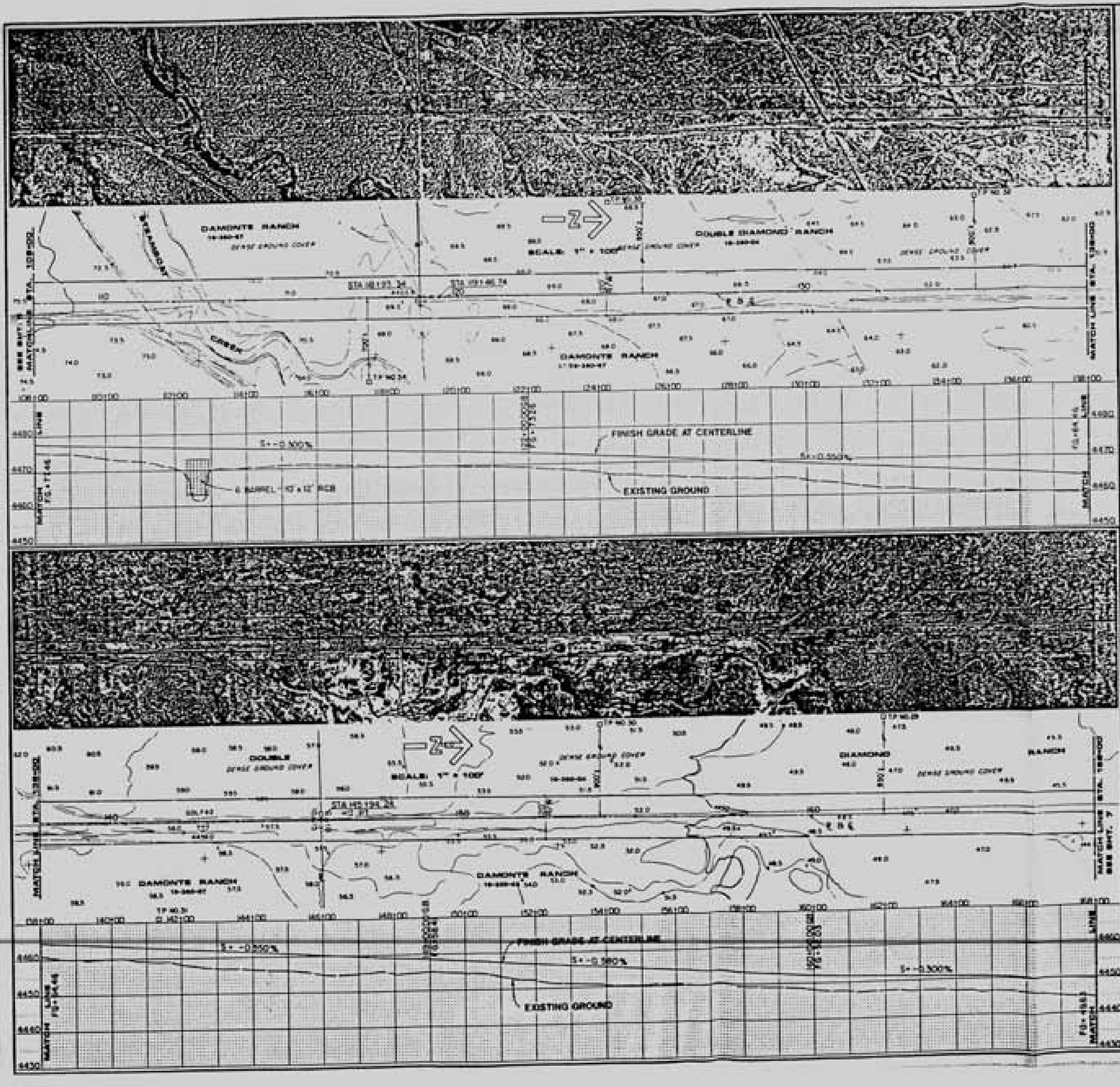

PLAN AND PROFILE

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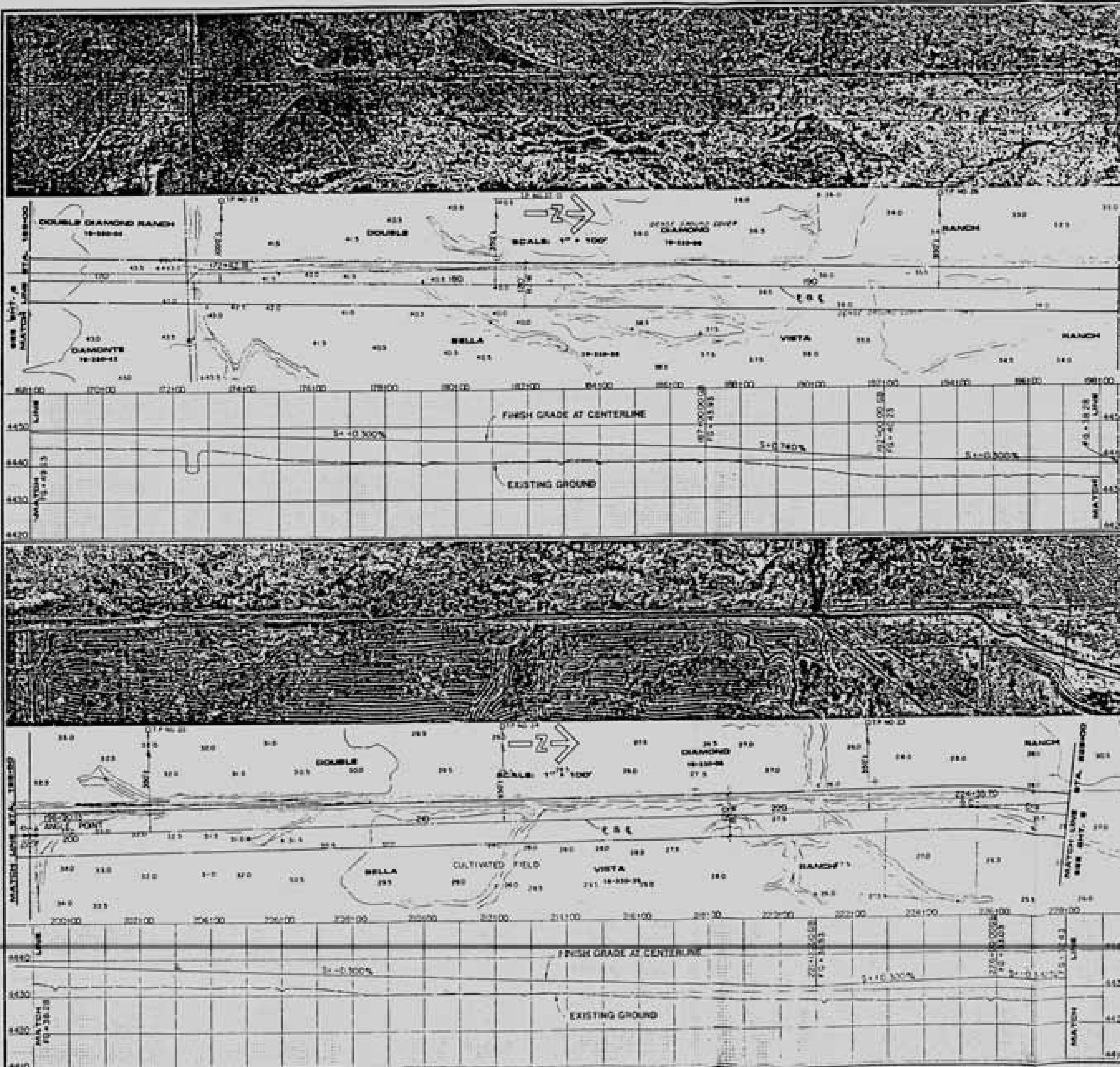

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T	696.35'

TOPOGRAPHIC MAPPING

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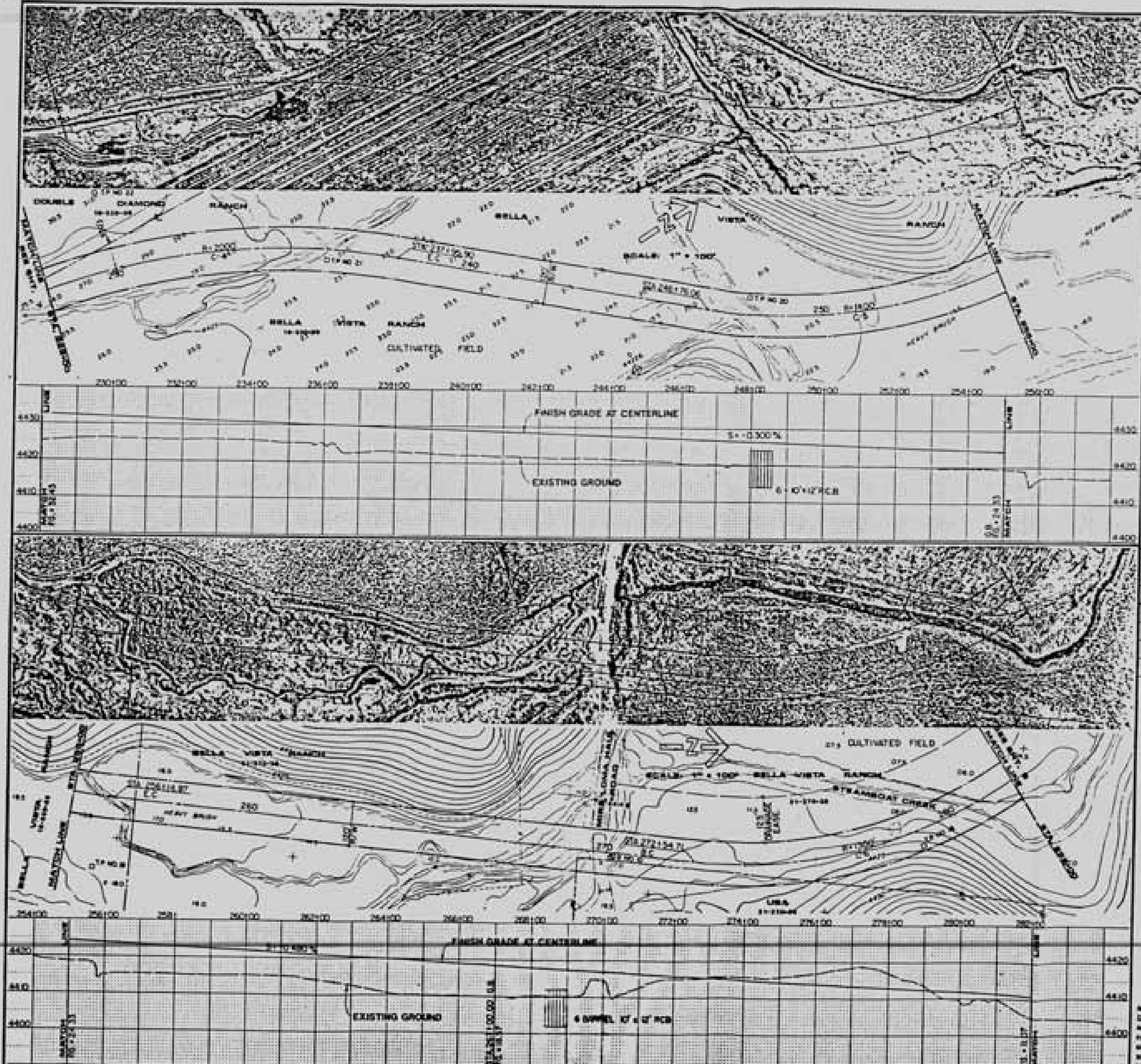

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T	696.35	487.82'

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IF SHEET IS LESS THAN 22" x 34" IT IS A REDUCED PRINT — SCALE REDUCED ACCORDINGLY

TOPOGRAPHIC MAPPING

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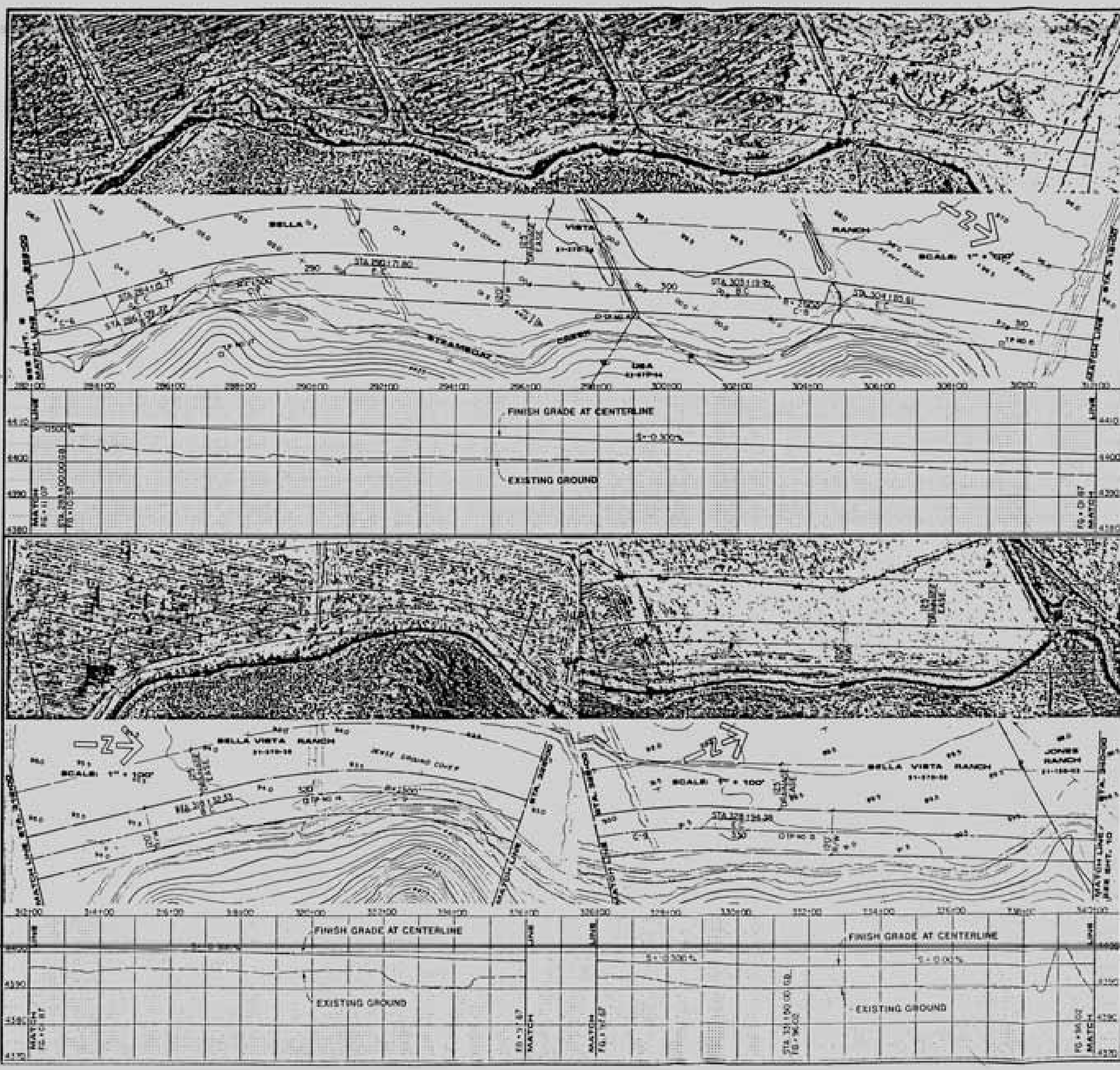

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L	1062.05'
T	562.67'

TOPOGRAPHIC MAPPING

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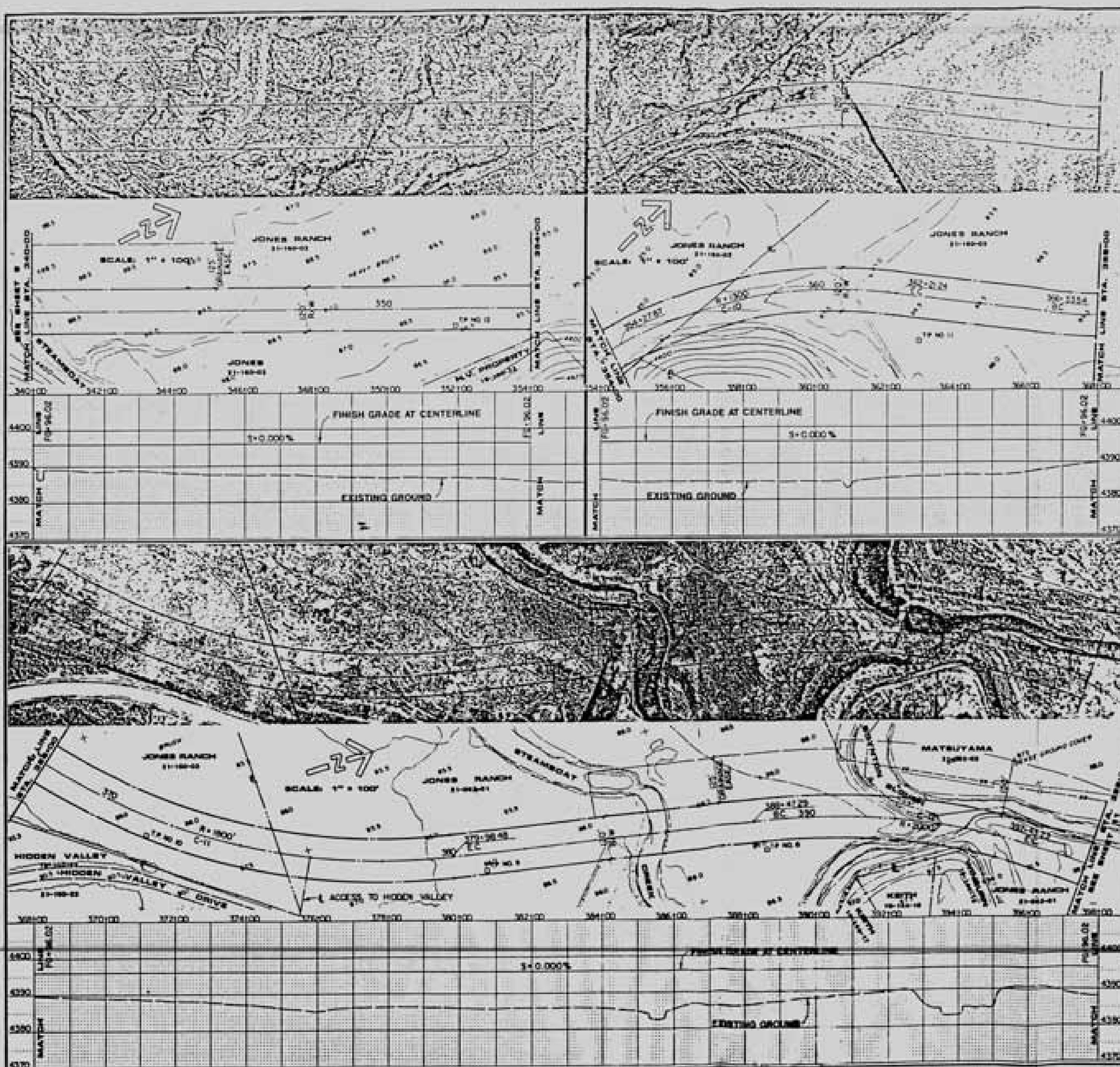

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TOPOGRAPHIC MAPPING

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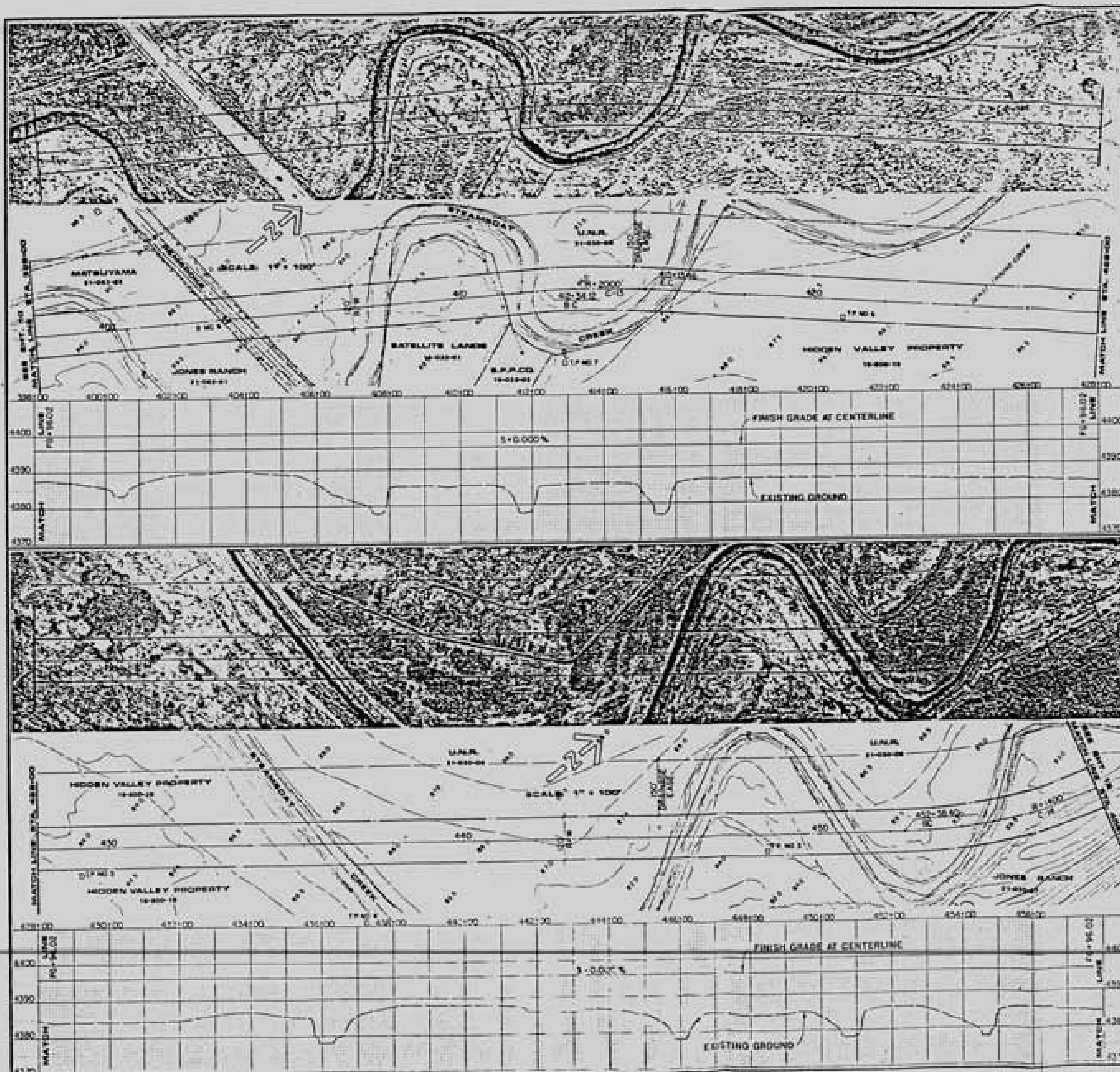

	D-13	D-14
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Δ	8°00'00"	45°45'13"
L	279.25'	1117.97'
T	139.85'	590.71'

℄ CURVE TABLE

TOPOGRAPHIC MAPPING

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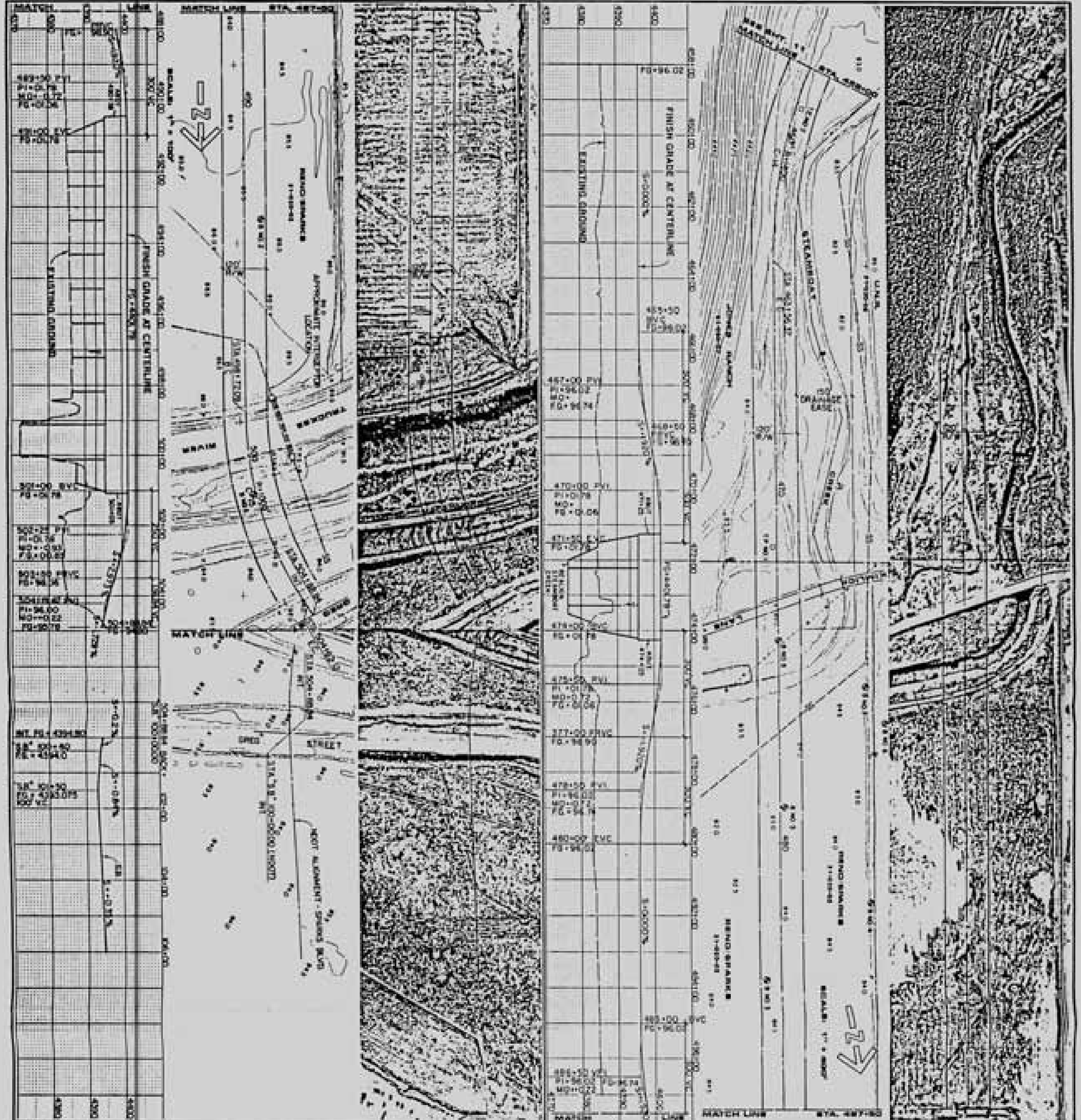

℄ CURVE TABLE	C-14	C-15
R	1400.00'	1000.00'
Δ	45°45'13"	33°48'22"
L	1117.91'	590.05'
T	590.71'	303.86'

PLAN AND PROFILE
TAHOE/PYRAMID LINK
A WASHOE COUNTY REGIONAL TRANSPORTATION COMMISSION PROJECT

WASHOE COUNTY

NEVADA

sea

SPARKS NEVADA
LAS VEGAS NEVADA
SEATTLE WASHINGTON

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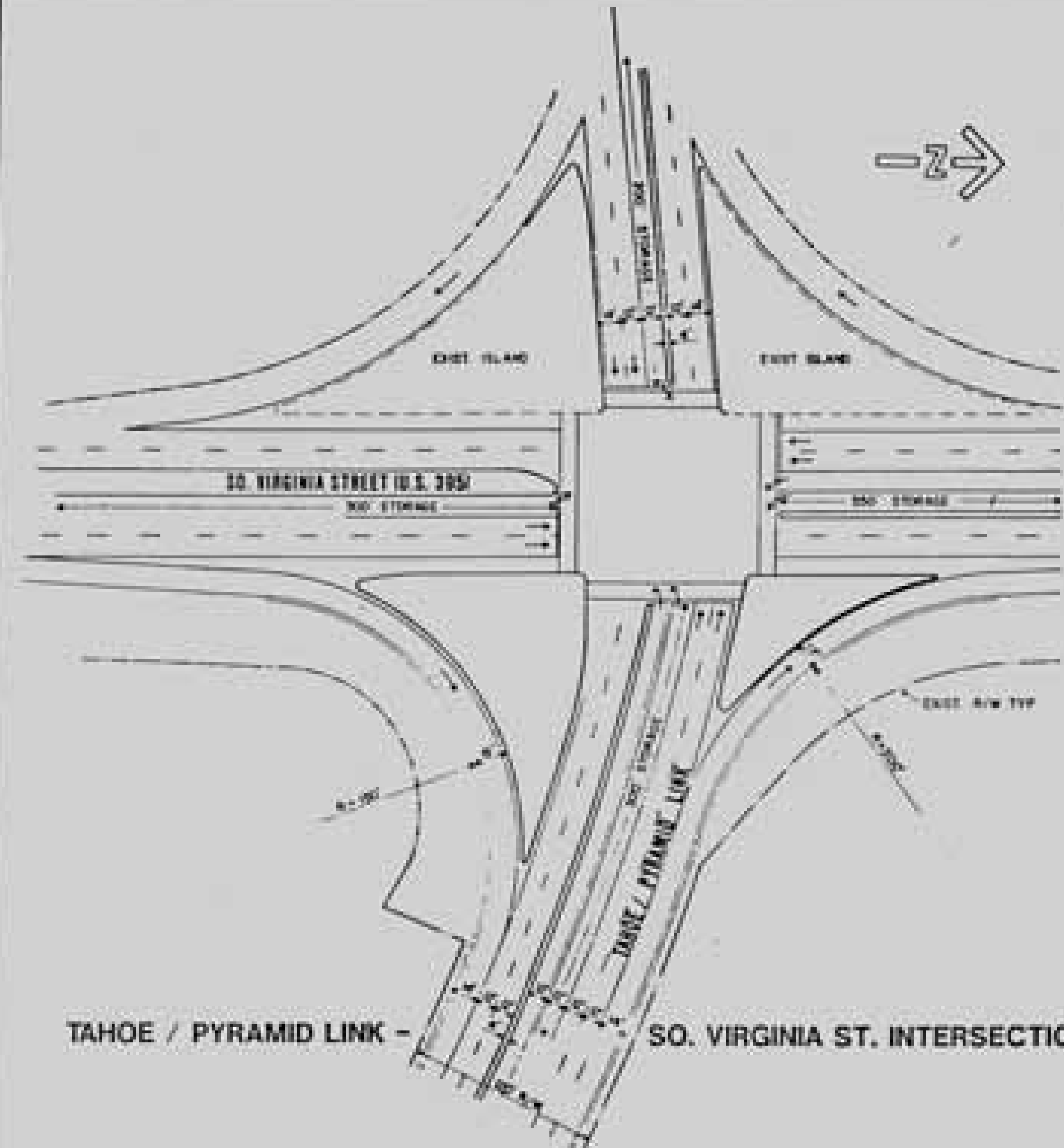
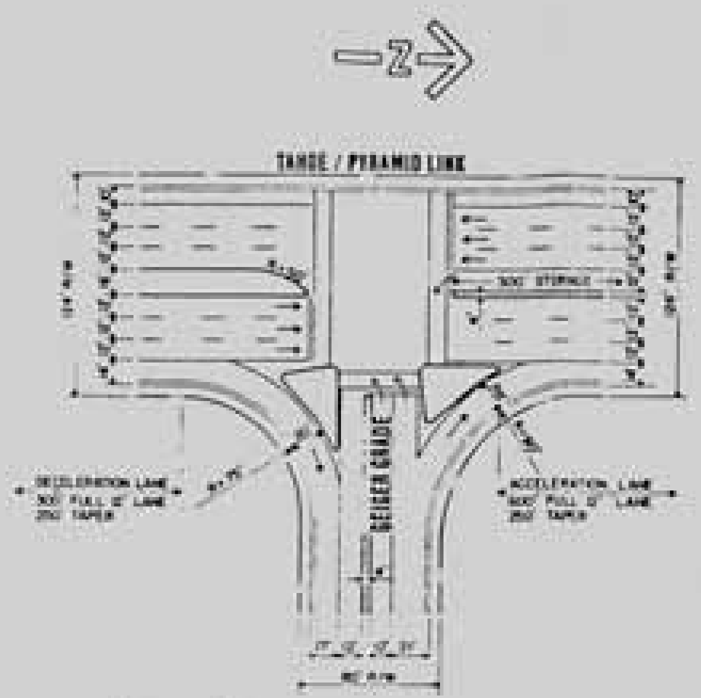
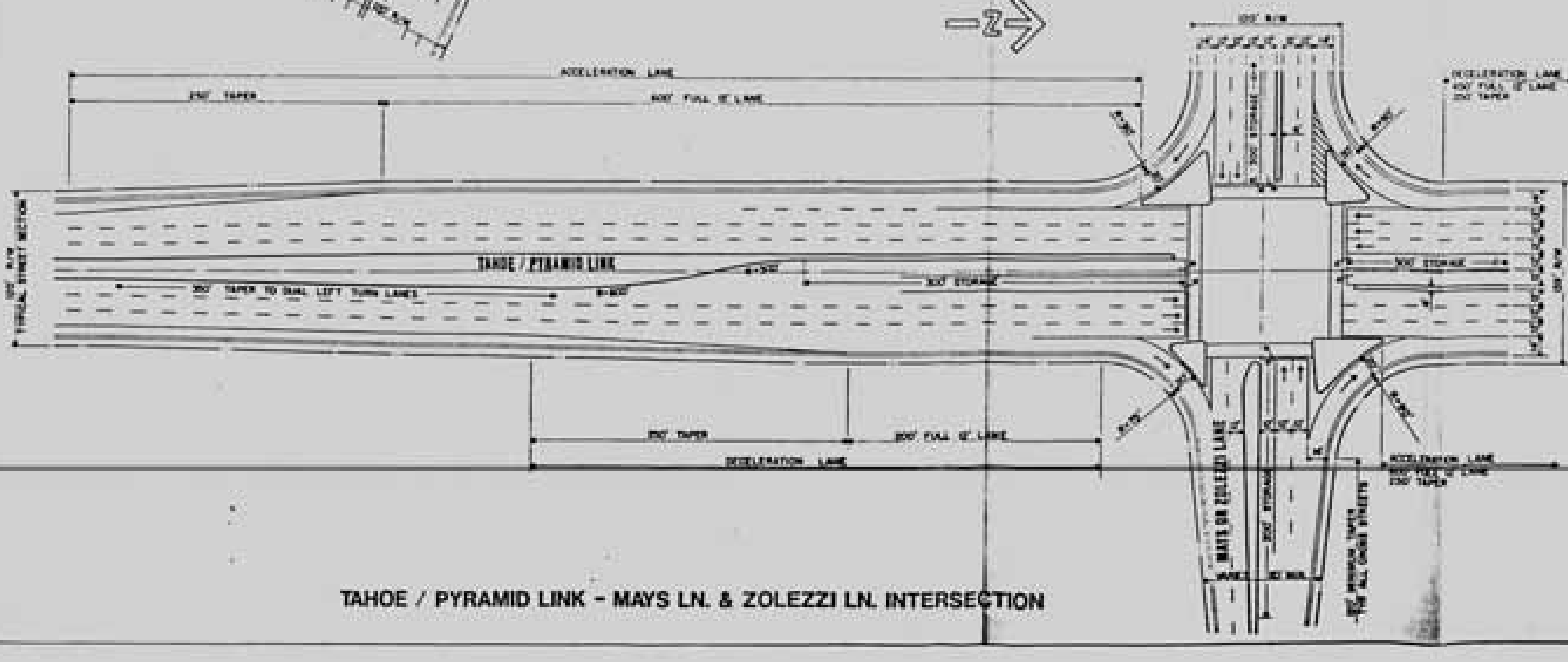


TAHOE / PYRAMID LINK – SO. VIRGINIA ST. INTERSECTION



TAHOE / PYRAMID LINK – GEIGER GRADE INTERSECTION



TAHOE / PYRAMID LINK – MAYS LN. & ZOLEZZI LN. INTERSECTION

INTERSECTIONS

TAHOE/PYRAMID LINK

A WASHOE COUNTY REGIONAL TRANSPORTATION COMMISSION PROJECT

WASHOE COUNTY NEVADA

SEA — SPARKS NEVADA, LAS VEGAS NEVADA, SEATTLE WASHINGTON

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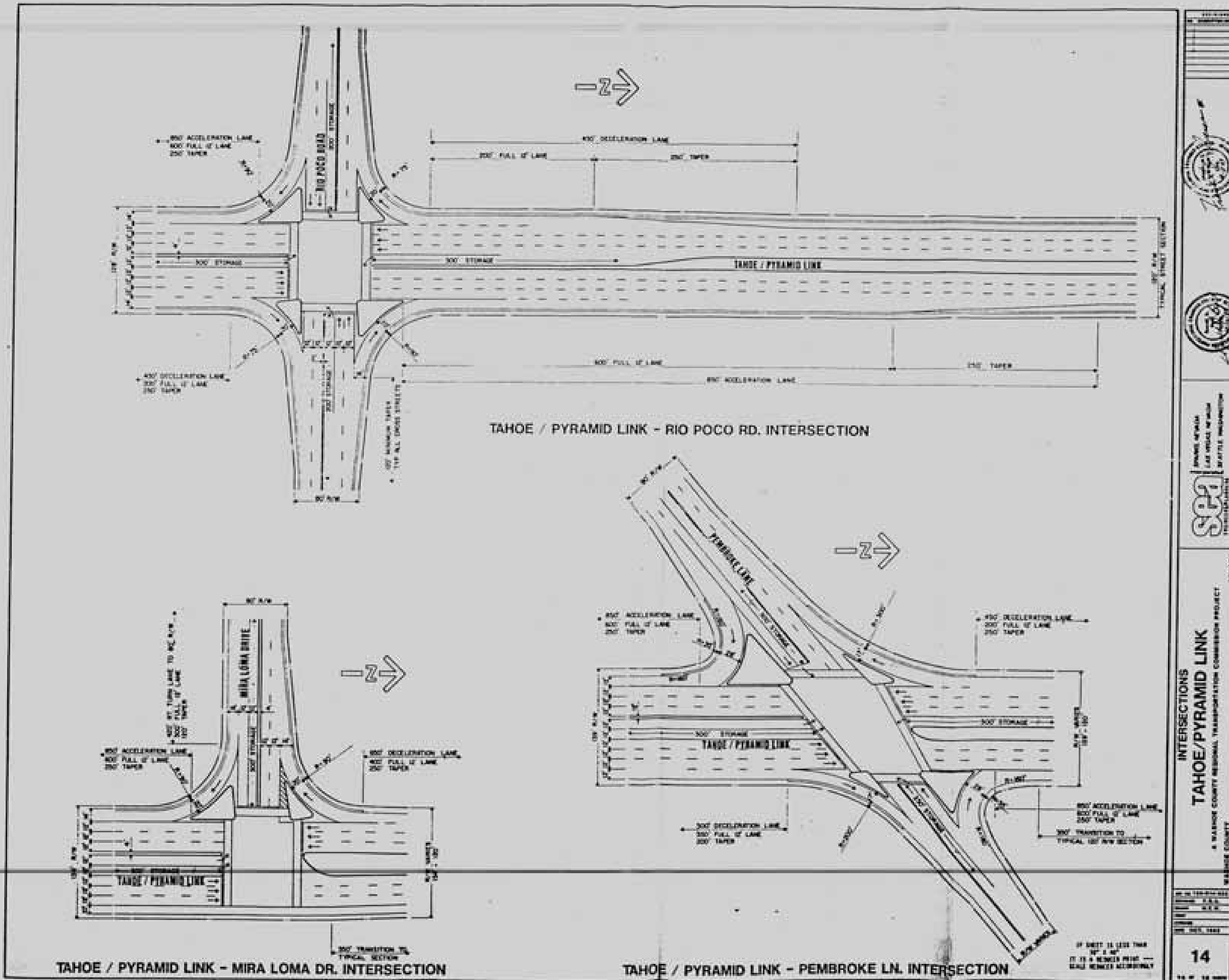
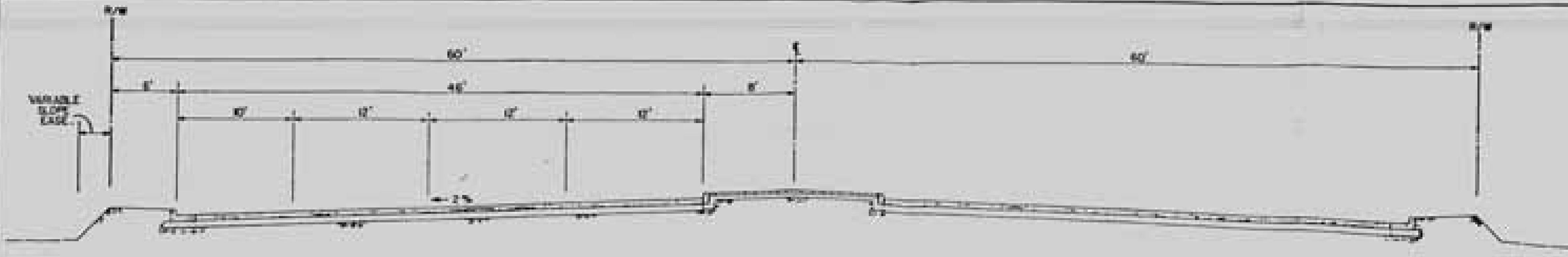
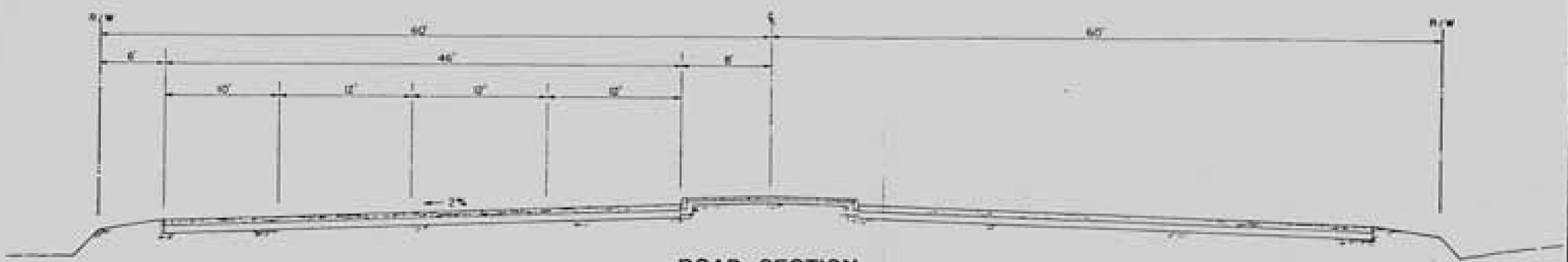

TAHOE / PYRAMID LINK - RIO POCO RD. INTERSECTION
TAHOE / PYRAMID LINK - MIRA LOMA DR. INTERSECTION
TAHOE / PYRAMID LINK - PEMBROKE LN. INTERSECTION
TAHOE / PYRAMID LINK
RIO POCO ROAD
MIRA LOMA DRIVE
PEMBROKE LANE
300' STORAGE
450' DECELERATION LANE
200' FULL 12' LANE
250' TAPER
850' ACCELERATION LANE
600' FULL 12' LANE
INTERSECTIONS
TAHOE/PYRAMID LINK
A WASHOE COUNTY REGIONAL TRANSPORTATION COMMISSION PROJECT
WASHOE COUNTY
NEVADA
14



ROAD SECTION

STA. 10 + 00 TO STA. 331 + 50

FULL CROSS SECTION IMPROVEMENTS



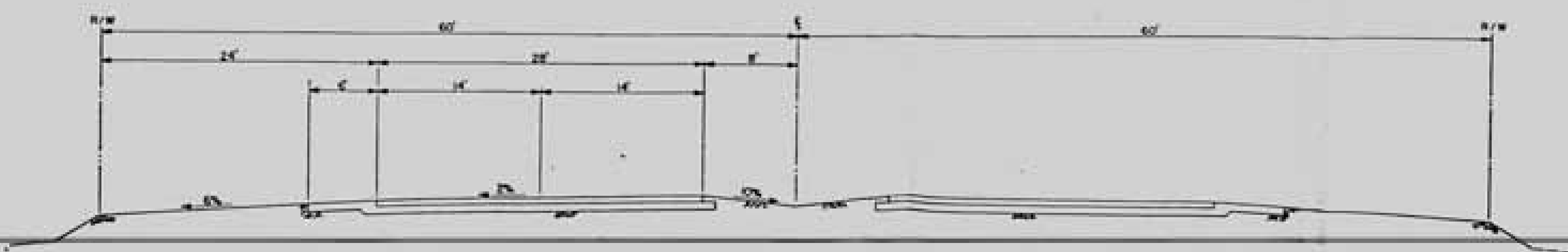
ROAD SECTION

STA. 331 + 50 TO STA. 471 + 50

STA. 474 + 00 TO STA. 491 + 00

STA. 501 + 00 TO STA. 504±

FULL CROSS-SECTION IMPROVEMENTS



ROAD SECTION

PARTIAL CROSS - SECTION IMPROVEMENTS

TYPICAL SECTIONS

TAHOE / PYRAMID LINK

A WASHOE COUNTY REGIONAL TRANSPORTATION COMMISSION PROJECT

WASHOE COUNTY

NEVADA

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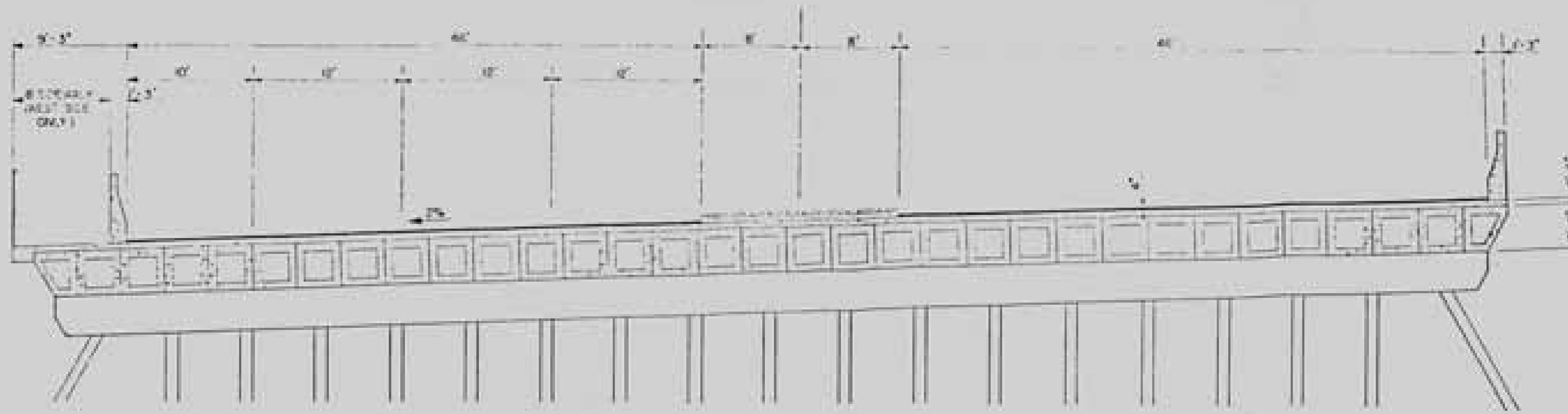
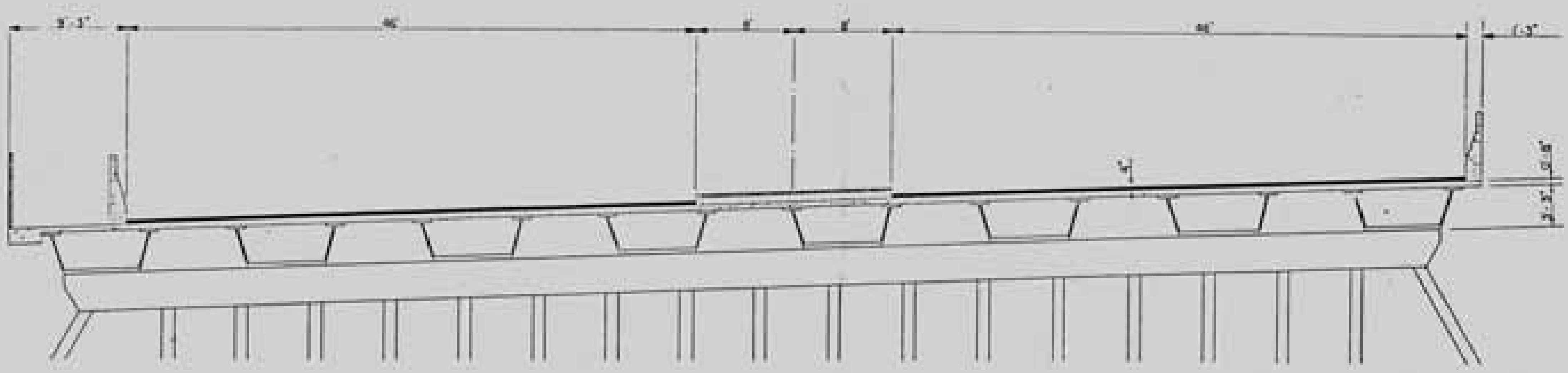
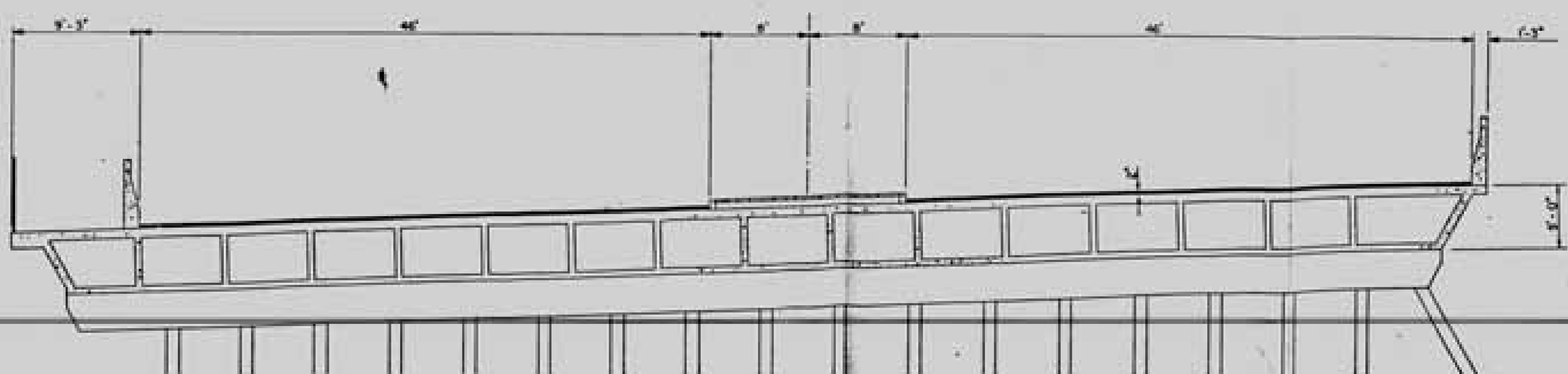


PRESTRESS CONCRETE BOX GIRDERS



STRUCTURAL STEEL



REINFORCED CONCRETE BOX GIRDER

BRIDGE STRUCTURAL SYSTEMS

TAHOE / PYRAMID LINK

A WASHOE COUNTY REGIONAL TRANSPORTATION COMMISSION PROJECT

WASHOE COUNTY

NEVADA

LAS VEGAS NEVADA
SEATTLE WASHINGTON

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