Resolution No. 13-196

BOARD OF COUNTY COMMISSIONERS
COUNTY OF EL PASO, STATE OF COLORADO

RESOLUTION TO RECOGNIZE AND ADOPT THE HAEGLER RANCH DRAINAGE BASIN PLANNING STUDY AND TO ESTABLISH A DRAINAGE FEE AND BRIDGE FEE FOR THE BASIN (CHMS0200)

WHEREAS, the Board of County Commissioners of the County of El Paso ("Board") has the authority granted to it under the provisions of §§30-11-101, (1)(e), and 30-11-107, (1)(e), C.R.S., to represent the County and exercise its further powers to address concerns of the County in all cases where no other provisions are made by law; and

WHEREAS, a plan for the development of drainage basins of mutual concerns was adopted by the El Paso County Planning Commission as part of the County Master Plan on December 17,1984 and has been subsequently amended; and

WHEREAS, Section 30-28-133(11), C.R.S., authorizes counties to adopt subdivision regulations providing for the payment of a sum of money or proof of a line of credit or other fees in equitable contribution to the total costs of the drainage facilities in the drainage basin in which the subdivision is located; and

WHEREAS, Section 8.5.5 of the *El Paso County Land Development Code* provides for the assessment of drainage basin and bridge fees and for the repayment to a subdivider, from any surplus basin funds available, of any costs the subdivider incurs because of compliance with the plans for the development of drainage basins in excess of the sum of the drainage basin fees assessed against the subdivider's impervious acreage; and

WHEREAS, the Board of County Commissioners of El Paso County, Colorado, Resolution 87-178A, authorized creation of the *City of Colorado Springs/El Paso County Drainage Criteria Manual* to set forth provisions for drainage policies, criteria, finance, and administration; and

WHEREAS, said manual has been further modified by Resolutions Nos. 95-81, 99-383, 01-384 and others; and

WHEREAS, in accordance with the procedures outlined in the aforementioned *City of Colorado Springs/El Paso County Drainage Criteria Manual*, the El Paso County Public Services Department has reviewed the Haegler Ranch Drainage Basin Planning Study dated May 2009 as prepared by URS Corporation, a private consulting engineering firm; and

WHEREAS, the El Paso County Public Services Department has reviewed the aforementioned Drainage Basin Planning Study and associated Drainage Basin and Bridge Fees,

and finds them to be in substantial conformance with the procedures of the said *City of Colorado Springs/El Paso County Drainage Criteria Manual*; and

WHEREAS, the City County Drainage Board has recommended approval of the Haegler Ranch Drainage Basin Planning Study at their January 8, 2009 meeting; and

WHEREAS, the El Paso County Planning Commission approved the Haegler Ranch Drainage Basin Planning Study as an amendment to and component of the El Paso County Master Plan on May 5, 2009; and

WHEREAS, since the development of the Haegler Ranch Drainage Basin Planning Study in 2009 the El Paso County Board of Commissioners have adjusted the drainage and bridge fees in the amount of 6% in accordance with Resolution 11-449 (Reception No. 21129092) based upon various economic indexes for the region and the drainage fees of $7,633 and bridge fees of $1,126 per impervious acre calculated in the study should also be adjusted accordingly; and

WHEREAS, the Board having reviewed the Haegler Ranch Drainage Basin Planning Study has determined that it is in the best interest of the public to recommend adoption of this Study, which is attached hereto as Exhibit A, and incorporated herein by reference.

NOW THEREFORE BE IT RESOLVED by the Board of County Commissioners of El Paso County, Colorado finds that:

1. The Haegler Ranch Drainage Basin Planning Study and fee recommendations prepared by URS Corporation dated May 2009 shall be formally adopted as the Official Drainage Basin Planning Study for all properties lying within the boundaries of the Haegler Ranch Drainage Basin, Basin No. CHMS0200, as defined in said document.

2. Drainage Fees and Bridge Fees shall be established as $8,091 per impervious acre and $1,194 per impervious acre respectively.

3. This resolution shall become effective immediately and be applied to all development within the Haegler Ranch Drainage Basin boundaries in the County where the County has not accepted a final plat submittal as of the date of the adoption of this resolution.

BE IT FURTHER RESOLVED that Dennis Hisey, duly elected, qualified member and Chair of the Board of County Commissioners, or, Amy Lathen, duly elected, qualified member and Vice Chair of the Board of County Commissioners, be and is hereby authorized on behalf of the Board to execute any and all documents necessary to carry out the intent of the Board as described herein.

DONE THIS 2nd day of May 2013, in Colorado Springs, Colorado.

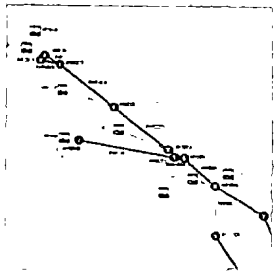
ATTEST:

By: _____
Wayne W. Williams, Clerk and Recorder

BOARD OF COUNTY COMMISSIONERS
OF EL PASO COUNTY, COLORADO

By: _____
Dennis Hisey, Chair

Resolution No. 13-196
Exhibit A



Hensley Ranch Basin

Drainage Basin Planning Study

May 2009

URS

NEW DOC

AMENDMENT TO THE COUNTY PLAN (Approved)

Approved
El Paso County
Planning Commission
This 2nd **day of** June **20** 09

Chair

Secretary

Commissioner Bracken moved that the following Resolution be adopted:

BEFORE THE PLANNING COMMISSION

OF THE COUNTY OF EL PASO

STATE OF COLORADO

RESOLUTION NO. MP-09-001

WHEREAS, the Department of Public Services, Transportation Division, URS Corporation and the El Paso County Planning Department requests approval of and amendment to the Master Plan by adoption of the Haegler Ranch Drainage Basin Planning Study within the designated areas of the unincorporated area of El Paso County; and

WHEREAS, a public hearing was held by this Commission on February 3, 2009 and May 5, 2009;

WHEREAS, based on the evidence, testimony, exhibits, study of the master plan for the unincorporated area of the county, comments of the El Paso County Planning Department, comments of public officials and agencies, and comments from all interested parties, this Commission finds as follows:

1. That proper posting, publication and public notice was provided as required by law for the hearing of the Planning Commission.

2. That the hearing before the Planning Commission was extensive and complete. that all pertinent facts, matters and issues were submitted and that all interested parties were heard at that meeting

3. That all data, surveys, analyses studies, plans, and designs as are required by the State of Colorado and El Paso County have been submitted, reviewed and found to meet all sound planning and engineering requirements of the El Paso County Subdivision Regulations.

4. That the proposal shall amend the Master Plan for El Paso County.

5. That for the above-stated and other reasons, the proposal is in the best interests of the health, safety, morals, convenience, order, prosperity and welfare of the citizens of El Paso County.

RECEIVED

JUN 1 1 2009

EPC DEVELOPMENT SERVICES

RECEIVED
JUN 0 8 2009
EL PASO COUNTY
CLERK TO THE BOARD

WHEREAS, Section 30-28-108 C.R.S. provides that a county planning commission may adopt, amend, extend, or add to the County Master Plan.

NQW, THEREFORE, BE IT RESOLVED that the amendment to the Master Plan for El Paso County be approved for the following described unincorporated area of El Paso County:

The Haegler Ranch (El Paso County Basin Number CHMS0200) flows to the southeast from north of Eastonville Road to McDaniels Road with a total of 16.6 sq mi in unincorporated El Paso County, Colorado.

BE IT FURTHER RESOLVED that the following conditions shall be placed upon this approval:

CONDITIONS OF APPROVAL

1. CRS 30-28-109 requires the Planning Commission to certify a copy of the Master Plan, or any adopted part or amendment thereof or addition thereto, to the Board of County Commissioners and to the Planning Commission of all municipalities in the County. The Planning Commission's action is to amend the Master Plan shall not be considered final until the applicant submits a minimum of ten (10) complete sets of the final documents to the Development Services Department and such documents are certified by the Chairman of the Planning Commission and distributed as required by law.

NOTATIONS

1. Certification of these documents to County municipalities pursuant to Condition 1 above is determined to be satisfied upon transmittal of summary information and maps along with a clear description of the locations where the complete documents are available for inspection, along with an offer to provide a given municipality a complete copy of the documents if requested. The transmittal may be in the form of digital copy.

2. Although this Drainage Basin Planning Study is adopted as a County Master Plan element pursuant to State Statute, the intent is not to use its land use assumptions as a justification for subsequent zoning decisions.

3. For currently undeveloped parcels without specific land use approvals, this Study bases assumptions for future land use on a generalized prediction for the year 2030. Because the timing of development and the ultimate density of this development are uncertain at this time, the overall land use assumptions for this basin will likely need to be comprehensively updated as patterns and trends emerge.

Commissioner Schanel seconded the adoption of the foregoing Resolution.

The roll having been called, the vote was as follows:

Commissioner Roulier	aye
Commissioner Schanel	aye
Commissioner Bracken	aye
Commissioner Powell	aye
Commissioner Vohland	aye
Commissioner Dickman	aye
Commissioner Hicks	aye
Commissioner Sery	aye
Commissioner Immel	aye

The Resolution was adopted by a unanimous vote of 8 to 0 by the Planning Commission of the County of El Paso, State of Colorado.

DATED: May 5, 2009

HAEGLER RANCH
DRAINAGE BASIN PLANNING STUDY

MAY 2009

Prepared for:

El Paso County
Department of Transportation
3460 N. Marksheffel Road
Colorado Springs, CO 80922

Prepared By:

URS

URS Corporation
9960 Federal Drive, Suite 300
Colorado Springs, CO 80921

URS Project No. 21711039

DISCLAIMER:

This report has been prepared based on certain key assumptions made by URS, which substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove true in the future. URS' conclusions and recommendations are conditioned upon these assumptions.

Background information, design bases, and other data have been furnished to URS by third parties, which URS has used in preparing this report. URS has relied on this information as furnished, and is not responsible for and has not confirmed the accuracy of this information.

The maps and photographs included in this report were developed for purposes of the El Paso County Department of Transportation (DOT) and are for internal use only. DOT makes no warranty, expressed or implied, as to the completeness, accuracy, or content of such products or any reproductions thereof. Any other use is not recommended and occurs at the risk of the user; such user is solely responsible and/or liable for the use of such products.

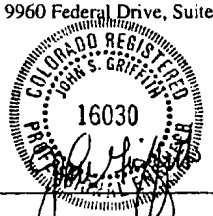
Regardless of the existence of purported copies of these official maps and photographs which may from time to time be made or published, there is only one set of official maps and photographs, which are those kept and maintained by DOT.

TABLE OF CONTENTS

Engineer's Statement:

The attached HAEGLER RANCH DRAINAGE BASIN PLANNING STUDY was prepared under my direction and supervision and is correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors, and omissions on my part in preparing this report.

URS, 9960 Federal Drive, Suite 300, Colorado Springs, CO 80921



5/19/09

John S. Griffith
Registered Professional Engineer
State of Colorado
No. 16030

Date

1.0 EXECUTIVE SUMMARY

1.1. Purpose and Scope

The purpose of the drainage Basin Planning Study (DBPS) is to identify a stormwater management plan for the existing and future stormwater and infrastructure needs within the Haegler Ranch Drainage Basin (Haegler Ranch). The scope of work for this DBPS includes:

- Obtain existing relevant data and general information from participating entities.
- Obtain current information for land use and future growth in Haegler Ranch.
- Gather information about right-of-way, known drainage problems, and proposed stormwater projects.
- Utilize the County policies, criteria, and applicable information wherever possible.
- Perform hydrologic and hydraulic analyses within Haegler Ranch at 2-, 5-, 10-, and 100-year intervals.
- Identify existing and potential stormwater and/or flooding problems.
- Develop improvement alternatives to reduce existing and potential flooding problems.
- Recommend and prepare a preliminary design for a selected alternative plan.
- Conduct an economic analysis of the preferred alternative.
- Develop drainage and bridge fees for Haegler Ranch.
- Prepare a written report discussing all items examined in the DBPS.

1.2. Location and Description

The Haegler Ranch Drainage Basin (Haegler Ranch) encompasses 16.6 square miles in unincorporated El Paso County, Colorado, and is a tributary to Black Squirrel Creek (see Figure 1-1). Haegler Ranch Basin is located in Sections 29, 32 and 33 of Township 12 South Range 64 West and sections 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 22, 23, and 24 of Township 13 South, Range, 64 West and sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34 of Township 13 South, Range 63 West and sections 2, 3, and 4 of Township 14 South, Range 63 West. Topography in the basin is rolling rangeland with poor vegetative cover associated with semi-arid climates. The Haegler Ranch consists of indistinct ephemeral streams that flow after storms for a short period of time, and the main stem of Haegler Ranch consists of dry natural grass swales with some poor quality riparian zones and small wetlands in the floodplains. The natural drainageways are generally shallow and wide, and flow paths are not well defined in many areas.

1.3. Land Use

As of July 2005, approximately 14 percent of the basin was developed. Much of this existing development consists of 2- to 5-acre lots and larger agricultural parcels south of US Hwy 24. Due to growth in the basin, land use is expected to change in the future with new low and medium density residential developments. Higher density residential developments such as Meridian Ranch, Santa Fe Springs, and Four Way Ranch are underway in the northwestern portions of the Haegler Ranch Basin. Meridian Ranch is in the north and Santa Fe Springs is in the central portion of the watershed. The area of Meridian Ranch within Haegler Ranch has high-density land uses of commercial and business, residential lots of 0.25 acres, and new paved roads with curb and gutter. Santa Fe Springs has a larger area in Haegler Ranch and a wider range of land uses including high density development such as commercial and business, residential lots of 0.125 acres, residential lots of 0.25 acres, schools, and new paved roads with curb and gutter as well as low density development such as residential large lots with 2% imperviousness, parks, and open space.

Future developed condition hydrology was modeled using proposed 2030 land uses from Colorado Springs Utilities Land Use Coverages (CSU 2005). The developed condition land uses are reasonably consistent with the Falcon Small Area Master Plan dated August 2008.

1.4. Hydrologic Analysis

As part of this study, hydrologic analyses for existing and future land use conditions were computed for the Haegler Ranch for 2-, 5-, 10-, and 100-year recurrence interval events using the USACE Hydrologic Engineering Center – Hydrologic Modeling System Version 2.2.2 (HEC-HMS). During the analyses, a portion of the original Haegler Ranch as delineated by the County map was found to be part of the Geick Ranch Drainage Basin at Judge Orr Road, due to the lack of a roadway culvert at the crossing. This area is excluded from the Haegler Ranch DBPS and is included as part of the Geick Ranch DBPS, per the County. Resulting flow rates and volumes are compared at key locations throughout the Haegler Ranch for both existing and future models. Generally, the largest flow and volume increases due to future development occur in the middle portion of the basin, assuming no detention. Since the future land use scenario does not include development in the lower portion of the watershed, potential increases in peak flows are attenuated and less at the mouth of the basin. The results indicate the most profound increases in peak flows due to development are in the more frequent, 2- and 5-year events.

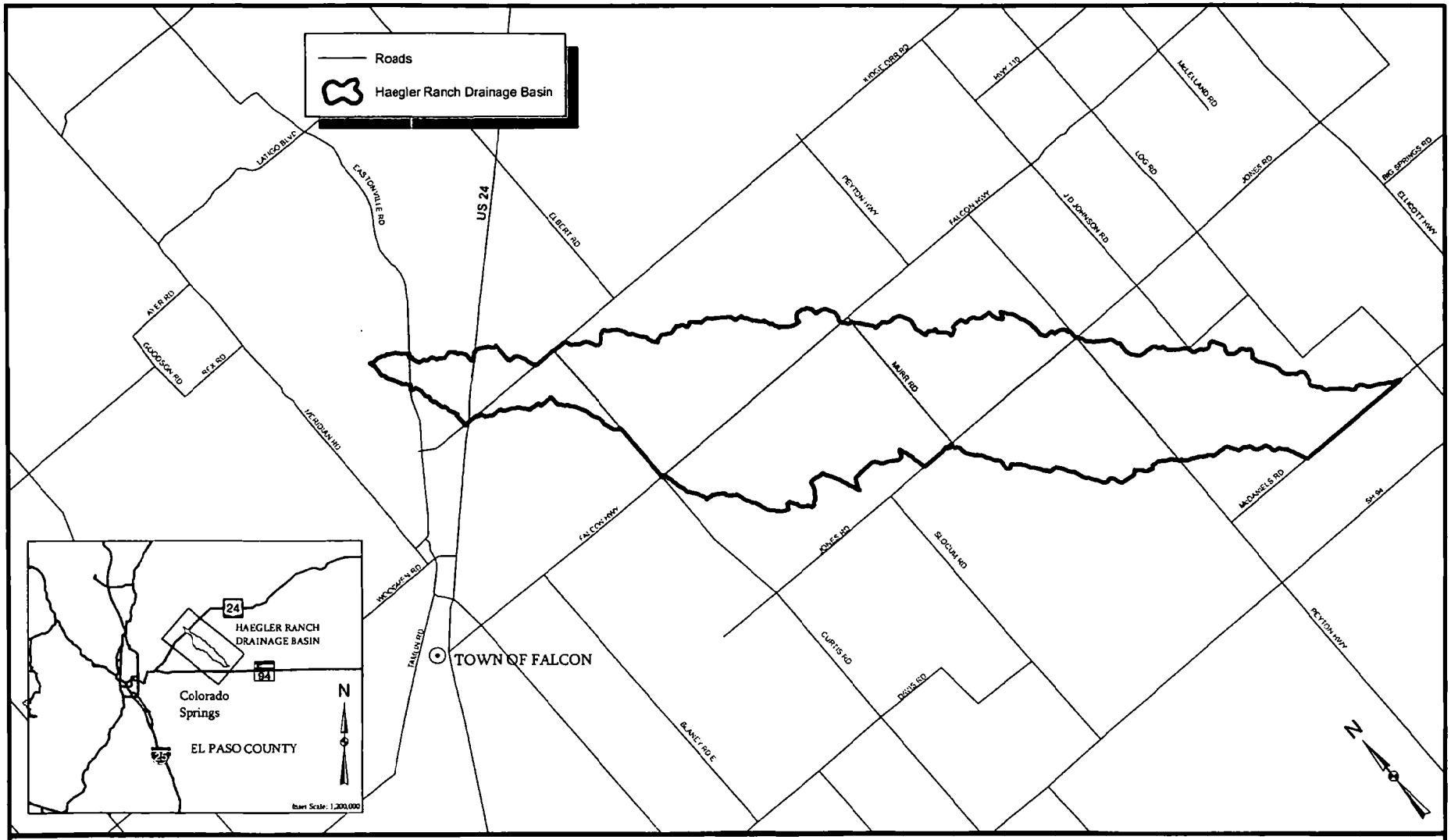
1.5. Hydraulic Analysis

Hydraulic analyses for existing conditions were then conducted for 8 channels within the Haegler Ranch Drainage Basin for the 2-, 5-, 10-, and 100-year recurrence interval floods using the USACE Hydrologic Engineering Center-River Analysis System Version 3.1.3 (HEC-RAS). The hydraulic analysis of Haegler Ranch main stem was performed by dividing the basin into several reaches covering approximately 31 miles from the headwaters near Eastonville Road to its confluence with the unnamed tributary of Geick Ranch Drainage Basin. As part of the field investigation, the size, type, and condition of bridges, culverts, channels, inlets, and pipes were recorded for the existing drainage facilities in the basin.

Using the results of the HEC-RAS modeling, floodplains for the 100-year existing condition flows were delineated. The approximate floodplain and profiles were used to assess where hydraulic inadequacies exist along the major drainageways. The approximate floodplain information was used primarily for the identification of flood prone areas along the major drainageways and to aid in the evaluation of alternative plans. The approximate floodplain data in this DBPS does not replace the information presented in the City of Colorado Springs and El Paso County Flood Insurance studies (FEMA 1999).

1.6. Flooding Problems

Results of the hydraulics analysis show that, of the 22 road crossings in the Haegler Ranch, only 2 crossings can safely pass the existing 100-year flow and 20 road crossings are overtopped. The floodplain areas include approximately 80 residential properties and additional structures.



URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

HAEGLER RANCH DRAINAGE BASIN

VICINITY MAP

FIGURE 1-1

DATE: 05/08

URS NO. 21711039

2.0 INTRODUCTION

2.1. Purpose and Scope

The purpose of the drainage Basin Planning Study (DBPS) is to identify a stormwater management plan for the existing and future stormwater and infrastructure needs within the Haegler Ranch Drainage Basin (Haegler Ranch). The specific scope of work for this DBPS includes the following tasks:

- Obtain existing relevant data and general information from participating entities.
- Solicit participating entities and other interested agencies or groups regarding alternate plans.
- Obtain current information for land use and future growth in Haegler Ranch.
- Gather information about right-of-way, known drainage problems, and proposed stormwater projects.
- Contact the County, citizens, and other agencies that have knowledge and/or interest in Haegler Ranch.
- Utilize the County policies, criteria, and applicable information wherever possible.
- Perform hydrologic and hydraulic analyses within Haegler Ranch for the 2-, 5-, 10-, and 100-year recurrence interval storm events.
- Identify potential environmental impacts to the Haegler Ranch from growth.
- Identify existing and potential stormwater and/or flooding problems.
- Propose measures to mitigate the impact of stormwater runoff upon environmentally significant areas along the surface waterway(s).
- Develop improvement alternatives to reduce existing and potential flooding problems.
- Examine the operation and maintenance aspects of feasible alternatives.
- Recommend and prepare a preliminary design for a selected alternative plan.
- Conduct an economic analysis of the preferred alternative.
- Develop drainage and bridge fees for Haegler Ranch.
- Prepare a written report discussing all items examined in the DBPS.
- Conduct presentations to public and private entities in order to define project goals and involve entities with specific interest to help define feasible alternatives.

2.2. Summary of Data Obtained

Relevant data were collected as part of this project to construct and complete the required hydrologic and hydraulic models. Data collection included topography, soils, land use, aerial photography, rainfall, and field survey data, along with previous hydrology and floodplain studies. A majority of the data was collected and utilized in a Geographic Information Systems (GIS) format. Local sponsors and government agencies provided the necessary data. Table 2-1 lists the major data collected along with the source:

Table 2-1 Major Data Sources and Data Obtained

Data Source	Data Obtained
Aero-Metric	Digital Terrain Model (DTM) with 2-ft contour intervals, and aerial photographs,
El Paso County	Existing land use, Future land use, and Major Transportation Corridors Plan
Federal Emergency Management Agency (FEMA)	Flood Insurance Studies (FIS), Conditional Letters of Map Revision (CLOMR)
National Oceanic and Atmospheric Administration (NOAA)	Rainfall data
Natural Resources Conservation Service (NRCS)	Soil Survey Geographic (SSURGO) data

In addition to the listed data, reports such as U.S. Army Corps of Engineers (USACE) study of *Black Squirrel Creek, El Paso and Pueblo Counties, Colorado: Hydrologic Analysis* (USACE 2003), City of Colorado Springs, and the County DBPS's were utilized. A number of drainage reports, sketch plans, preliminary and final design drawings, development plans, and existing drainage facility maps were collected from the County and other local agencies. A complete list of reports cited is located in Section 8.0.

Bridges, culverts, and other drainage structures were surveyed in the Haegler Ranch for the hydraulic analysis. Site visits were also conducted at select locations throughout the basin, and photographs were taken documenting the key drainage features.

2.3. Mapping and Surveying

Mapping used in the analysis for Haegler Ranch consists of aerial topographic mapping compiled in April 2004 by Aero-Metric Inc. (AME), AME project number 3040402. The aerial topographic mapping included 2-ft contours and was used in the hydraulic structures inventory (See Section 5.3), hydrologic and hydraulic analyses, and in the alternative planning phases of this project. The vertical datum used is North American Datum 83 (NAD 83).

The following general conditions have been placed upon the use of the aerial topographic mapping:

- Use of these products is restricted to the project for which the Facility Information Management Systems (FIMS) products were provided.
- Only the body content found within the neatline of the borrowed maps may appear in any report/publication developed for the DBPS. Also, the labeling that appears on any photographs provided shall not appear in any such report/publication.
- All FIMS products provided to contractors involved in the subject DBPS shall be retrieved by said department upon conclusion of the DBPS and either returned or destroyed.
- The report(s) developed in which the FIMS products are used shall include the disclaimer statement that is on the Disclaimer page at the beginning of this report.

2.4. Project Coordination

Throughout the course of the DBPS preparation, meetings were held with representatives of the County, State, and Federal agencies as well as adjacent developers, public citizens with an interest in stormwater

3.0 AREA DESCRIPTION

The Haegler Ranch (El Paso County Basin Number CHMS0200) is an unnamed tributary to Ellicott Consolidated Drainage Basin unnamed tributary, which is a tributary of Black Squirrel Creek. Haegler Ranch lies in the central portion of El Paso County. Figure 1-1 shows the location of the Haegler Ranch in respect to El Paso County, Colorado. Haegler Ranch Basin is located in Sections 29, 32 and 33 of Township 12 South Range 64 West and sections 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 22, 23, and 24 of Township 13 South, Range, 64 West and sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34 of Township 13 South, Range 63 West and sections 2, 3, and 4 of Township 14 South, Range 63 West.

3.1. Basin Description

The Haegler Ranch flows to the southeast from north of Eastonville Road to McDaniels Road with a total of 16.6 sq mi in unincorporated El Paso County, Colorado. In 2005, approximately 14% of the basin was developed. Much of the existing development consists of 2- and 5-acre (ac) residential lots surrounded by open space range land used for agriculture and large parcels with homes south of U.S. Highway 24 (US 24). High-density residential developments are being planned in the northern portions of the basin.

The maximum basin elevation is approximately 7,054 ft in the headwaters and falls to approximately 6,085 ft at the downstream confluence of the basin. The basin is typified by rolling rangeland with poor vegetative cover associated with semi-arid climates.

3.2. Climate

This area of El Paso County can be described as high plains with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, while the springs and summer receive a majority of this precipitation in the form of rainfall. The average precipitation ranges from 14 to 16 in. per year. Thunderstorms are common during the summer months and are quick-moving low-pressure cells that draw moisture from the Gulf of Mexico into the region. The County has an average temperature ranging from a low of 14°F in the winter to a high of 81°F in the summer. The relative humidity ranges from 25% in the summer to 45% in the winter (SCS 1981).

3.3. Soils and Geology

Soils within the Haegler Ranch are classified according to the NRCS soil classification system. The predominant soils are in the Blakeland soil series, which consist of deep, somewhat excessively drained soils that formed in sandy alluvium and sediment on uplands. The soil series has high infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. Figure 3-1 shows the soil distribution map for the Haegler Ranch (SCS 1981). The bedrock geology is predominately flat lying sandstone and siltstone, some of which is covered with recent alluvium.

3.4. Property Ownership and Land Use Information

Property ownership along the major drainageways within the Haegler Ranch varies from public to private. Along recent developments, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. A portion of Haegler Ranch has already been developed with 2- and 5-ac residential lots. The drainageways in the lower part of the basin remain under private ownership with no delineated drainage right-of-way or easements. A drainage easement or right-of-way must be granted to the County in order for DOT to perform any recommended improvements.

Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin. The locations of roadways were obtained from the El Paso County Major Transportation Corridors Plan dated September 21, 2004 (EPC 2004). The El Paso County Rock Island Trail System runs parallel along the north side of US 24. The trail follows the abandoned Chicago and Rock Island Railroad between Falcon and Peyton, Colorado.

Land use information for the existing and future conditions models was obtained from El Paso County Planning Department in 2005. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of stormwater facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the basin. Presented in Figure 3-2 and Figure 3-3 are the land use maps used for the evaluation of impervious land densities discussed in Section 4.0. These figures are not intended to reflect the future zoning or land use policies of the County.

3.5. Environmental Analysis

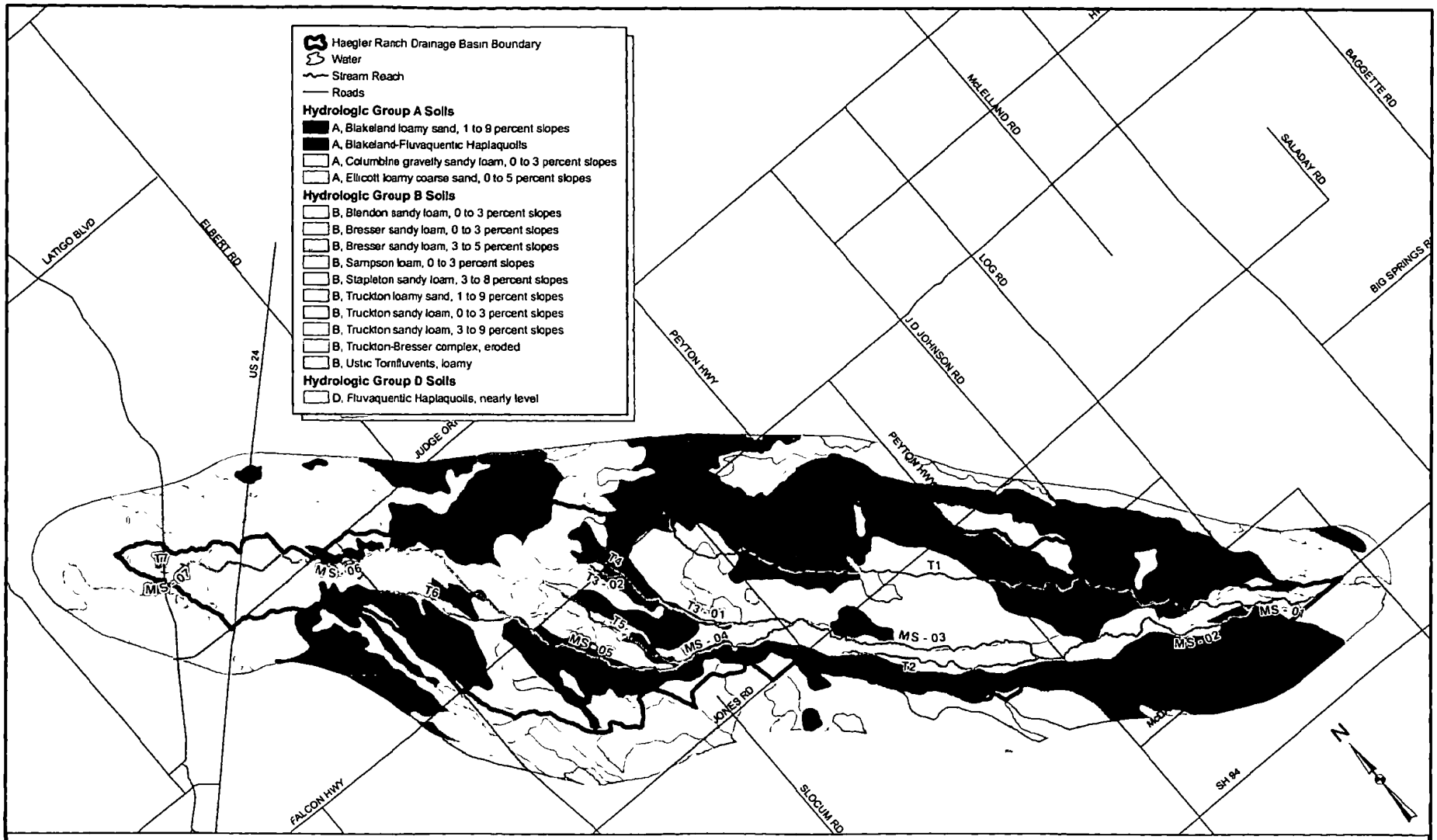
An environmental analysis was conducted for this DBPS to assess the present condition of the biological and environmental resources in the Haegler Ranch. Site visits were conducted to study these elements of the basin. Particular attention was paid to the drainageways and spring/seep areas to determine biological resources in riparian zones and wetlands.

The Haegler Ranch consists of indistinct ephemeral streams that flow after storms for a short period of time. The main stem of Haegler Ranch consists of dry natural grass swales with some poor quality riparian zones and small wetlands in the floodplains. Most of the wetlands surround stock reservoirs and are heavily grazed in some of the rangeland pastures. As a result, the wetlands and riparian drainageways have been degraded in vegetative cover and ecological value. The existing wetlands are neither large nor extensive, and are mostly discontinuous. In their present condition, the wetlands are not a significant habitat resource within the basin. Figure 3-4 and Figure 4-4 show and potential wetlands that may require further study.

Most of the open space is used for agriculture or rangeland. Drainageways have been channelized principally only at roadway crossings. These areas of concentrated flow have defined channels that tend to become indistinct as they flow downstream. Vegetation in the Haegler Ranch in the open space does not vary dramatically. Vegetation patterns generally follow the physiographic region of the plains dominated by a short- to mid-height prairie grass with a few shrubs and sporadic trees such as cottonwoods. Wetlands consist of rushes and sedges such as little bluestem, grama grasses, needle and thread and western wheat grass.

Wildlife and animal species common to the open plains inhabit the basin. They consist of animals that tolerate the presence of roads and people including large and small mammals such as deer, antelope, coyotes and rodents, and several species of birds such as killdeer and red-winged blackbirds. Preliminary review indicates that the DBPS will not affect any threatened or endangered species or critical habitat.

Because of the sensitivity of wetlands, riparian areas, and wildlife to stormwater runoff, sedimentation and erosion should be evaluated and planned for in the alternatives. Wetland and riparian areas provide a habitat resource that should be preserved during the alternative development. These areas can be protected and enhanced to improve ecological value.



URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

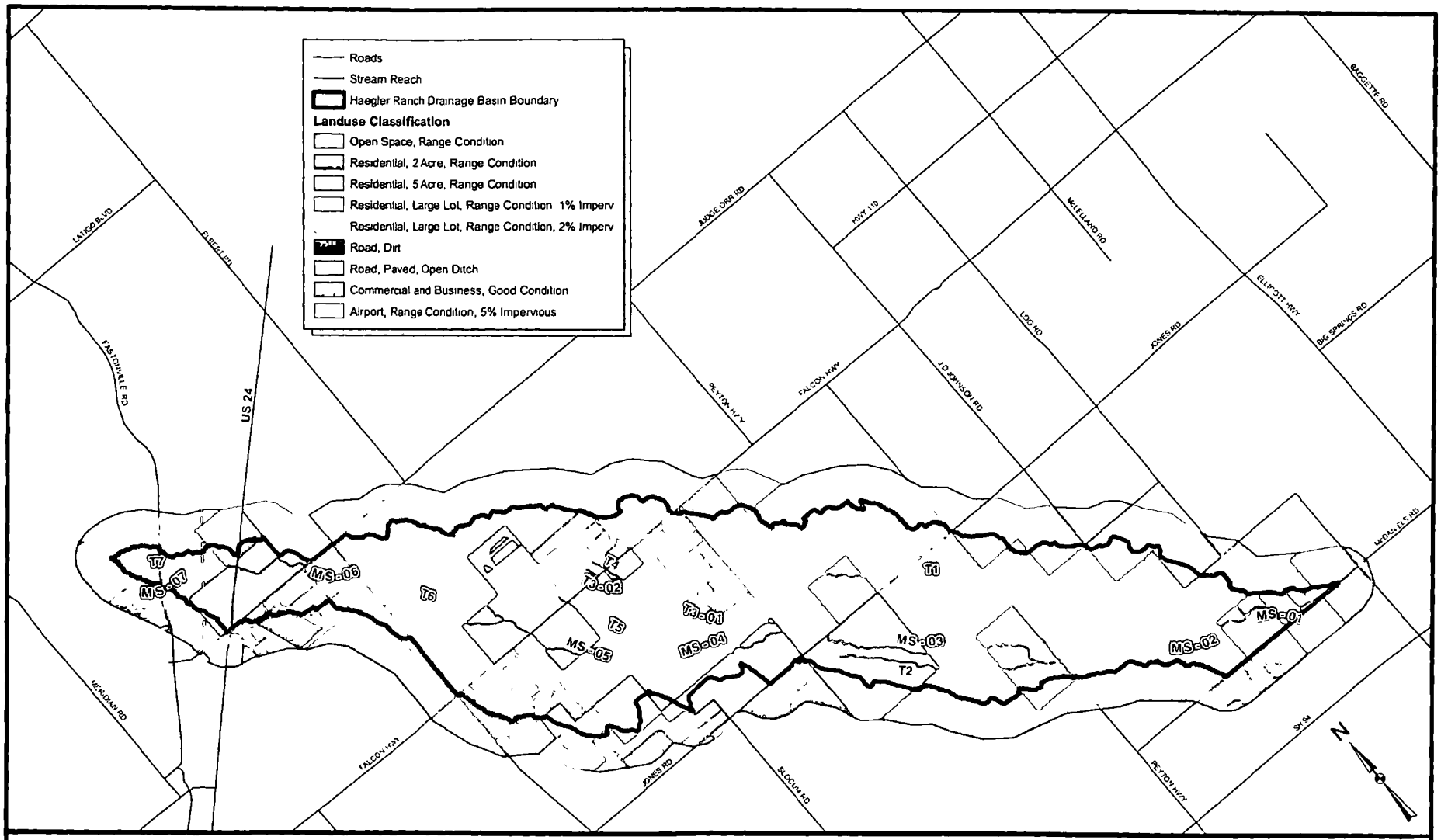
HAEGLER RANCH DRAINAGE BASIN

SOILS

FIGURE 3-1

DATE: 09/08

URS NO. 21711039



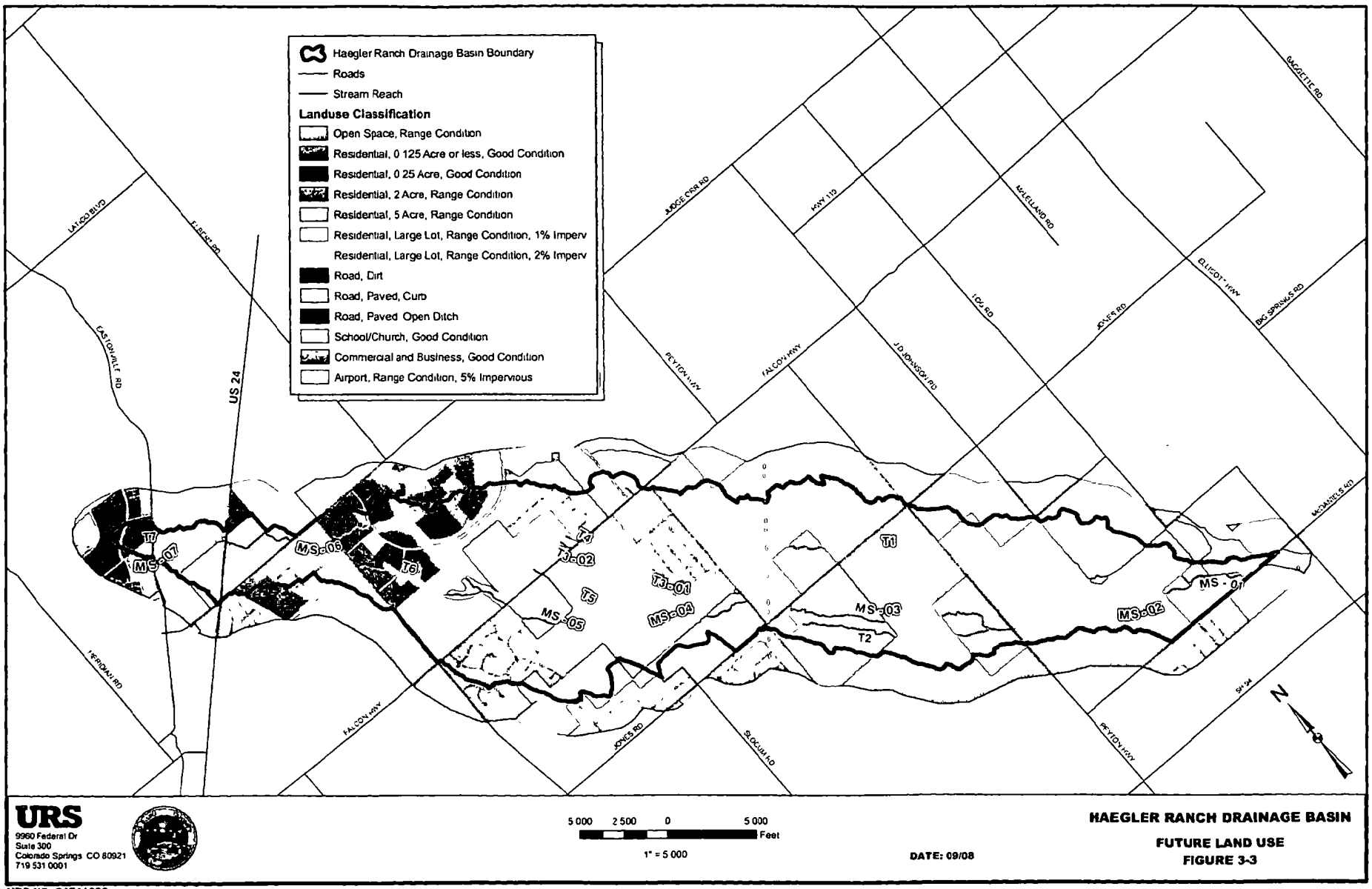
URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

HAEGLER RANCH DRAINAGE BASIN

EXISTING LAND USE
FIGURE 3-2

DATE: 09/08

URS NO. 21711039



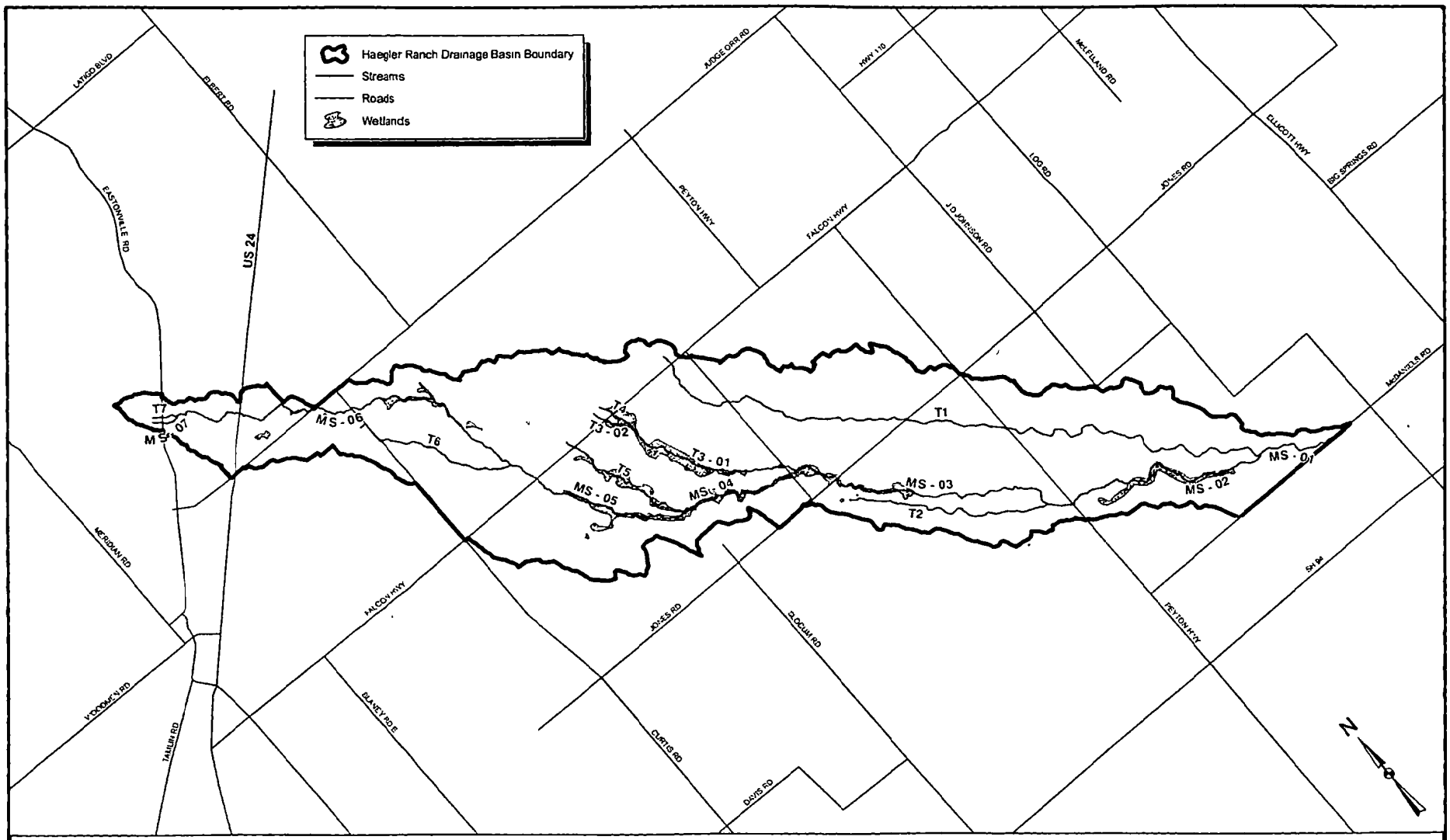
URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

HAEGLER RANCH DRAINAGE BASIN

FUTURE LAND USE
FIGURE 3-3

DATE: 09/08

URS NO. 21711039



URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719.531.0001

HAEGLER RANCH DRAINAGE BASIN
WETLANDS
FIGURE 3-4

DATE: 09/08

URS NO. 21711039

4.0 HYDROLOGIC ANALYSIS

4.1. Project Basin

Hydrologic analyses for existing and future conditions were computed for the 68 subbasins within the Haegler Ranch for the 2-, 5-, 10-, and 100-year recurrence intervals Sub-basin delineations and study reaches are shown in Figure 4-1

The main stem in the Haegler Ranch is an unnamed tributary located within the Chico Creek basin in central El Paso County, Colorado The Haegler Ranch's headwaters are on the southeastern slope of the Black Forrest The main stem flows to the southeast in the eastern plains of the County to the confluence with Geick Ranch Drainage Basin north of Ellicott Bennet Ranch and Solberg Ranch Drainage Basins bound the Haegler Ranch to the west, Geick Ranch Drainage Basin to the east, and Telephone Exchange and Ellicott Consolidated Drainage Basins to the south The Haegler Ranch has a contributing drainage area of approximately 16 6 sq mi at its confluence with the Geick Ranch Drainage Basin on the north side of McDaniels Road

A portion of the original Haegler Ranch as delineated by the County map was found to be part of the Geick Ranch Drainage Basin at Judge Orr Road, due to the lack of a roadway culvert, as seen in Figure 4-1 This area is excluded from the Haegler Ranch DBPS and is included as part of the Geick Ranch DBPS, per the County

4.2. HEC-HMS Modeling

Hydrologic modeling was completed using the USACE Hydrologic Engineering Center – Hydrologic Modeling System Version 2 2 2 (HEC-HMS) Each component of this model is described in detail following this section A geospatially referenced basin model was generated in the USACE Hydrologic Engineering Center – Geospatial Hydrologic Modeling System Extension Version 1 1 (HEC-GeoHMS) Using HEC-GeoHMS, subbasin and stream reach physical characteristics including area, longest hydraulic flowpath, reach length, slope, and topological connectivity were extracted for calculation of hydraulic parameters such as time of concentration Hydrologic parameters were calculated as outlined below and automatically populated to the basin and meteorological components of the HEC-HMS model A summary of selected methodologies for each HEC-HMS model component is provided in Table 4-1

Table 4-1 HEC-HMS Model Components

Model Component	Selected Methodology
Meteorological Model	User Gage Weighting Method
Infiltration Loss	SCS Runoff Curve Number Method
Runoff Transformation	SCS Unit Hydrograph Method
Channel Routing	Muskingum-Cunge Standard Method

Notes
HEC-HMS = U S Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System
SCS = Soil Conservation Service (since renamed NRCS)

The User Gage Weighting Method was chosen to model the Type IIa storm based on the City of Colorado Springs and El Paso County Drainage Criteria Manual (DCM) (1991) The Soil Conservation Service (SCS) Type IIa 24 hour hypothetical rainfall distribution was imported into the HEC-HMS precipitation gage manager Rainfall depths for each subbasin were then entered in the meteorological model Rainfall was modeled with an areal reduced uniform spatial distribution based on the size of the basin

Infiltration and runoff volumes were modeled using the SCS (now renamed NRCS) Runoff Curve Number (runoff CN) Loss Method The composite runoff CN was calculated for each subbasin and imported into HEC-HMS For modeling purposes, initial infiltration loss rates were automatically calculated as functions of composite runoff CNs by HEC-HMS

The transformation of runoff volume to a runoff hydrograph was modeled using the SCS Unit Hydrograph Method Subbasin lag times were calculated from the time of concentration as computed using the method outlined in the DCM

The Muskingum-Cunge Method was selected to develop the channel routing component of the HEC-HMS model This method was chosen to represent the travel time in the channel because it is based on channel physical measurements such as width, depth, and slope Channel dimensions and Manning's roughness coefficients (n values) were imported into HEC-HMS

4.3. Basin Delineation

Basin delineation and stream network definition were completed in an ArcView® GIS environment using HEC-GeoHMS The subbasin boundaries and stream network were refined using 2-ft contours, aerial photography, field survey, and site visit data

The Haegler Ranch was divided into 68 subbasins with areas ranging from 0 02 sq mi up to 0 65 sq mi, as seen in Figure 4-1 and Figure 4-4 Subbasin slopes range from 0 16% to 8 0% Subbasins were delineated at tributaries, major road crossings, changes in slope, and other drainage features For the SCS Runoff CN Loss Method, the subbasins should be larger than 0 156 sq mi (100 ac) if possible For some areas, the subbasins are smaller to accurately represent road crossings or detention A schematic of the connectivity of the subbasins, junctions, and reaches can be seen in Figure 4-5

4.4. Hydrologic Soil Group

Soils are classified into hydrologic soil group (HSG) by the NRCS for hydrologic modeling HSG is a parameter assigned to each soil series by the NRCS to reflect the relative rate of infiltration of water into the soil profile NRCS *Technical Release 55* (*TR-55*) (1986) defines HSG into A, B, C, and D as follows

HSG A - soils have low runoff potential and high infiltration rates even when thoroughly wetted They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission

HSG B - soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures These soils have a moderate rate of water transmission

HSG C - soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture These soils have a low rate of water transmission

Table 4-4 Runoff Curve Numbers for Haegler Ranch Drainage Basin

Land Use and Hydrologic Condition	Average % Impervious Area	Use HSG B for Regraded HSG A	Runoff Curve Numbers for HSG			
			A	B	C	D
Impervious Area and Water	100%	No	98	98	98	98
Open space (lawns, parks, golf courses, etc)[1]						
Poor Condition (grass cover <50%)	0%	No	68	79	86	89
Range Condition (grass cover ≈ 40%)	0%	No	58	73	82	86
Fair Condition (grass cover 50% to 75%)	0%	No	49	69	79	84
Good Condition (grass cover >75%)	0%	No	39	61	74	80
Roads						
Dirt	55%	Yes	72	82	87	89
Paved, Open Ditches	75%	Yes	83	89	92	93
Paved, Curb & Storm Sewer	100%	Yes	98	98	98	98
Good Condition[2]						
Urban Districts						
Commercial and Business	85%	Yes	89	92	94	95
School/Church	65%	No	77	85	90	92
Residential districts by average lot size						
1/8 ac or less (multifamily)	65%	Yes	77	85	90	92
1/4 ac	38%	Yes	61	75	83	87
1/3 ac	30%	Yes	57	72	81	85
1/2 ac	25%	Yes	54	70	80	85
Range Condition[2]						
Urban Districts						
Airport	5%	Yes	60	74	83	87
Residential districts by average lot size						
1 ac	20%	No	66	78	85	88
2 ac	12%	No	63	76	84	87
5 ac	5%	No	60	74	83	87
Large (160 ac, two or three structures)	2%	No	59	74	82	86
Large (160 ac, single structure)	1%	No	58	73	82	86

Notes
% = percent
HSG = Hydrologic Soil Group
ac = acre
[1] Range Cover of 40% is based on field observations and discussions with the County The selected curve numbers based on Figure S-3 from "Procedures for Determining Peak Flows in Colorado" by Soil Conservation Service March 1984 Based on Figure S-3 and the *TR-55* CN Table, poor condition is 15% cover, fair condition is 55% cover and good condition is 85% cover
2 The average percent impervious area shown was used to develop the composite CN s Other assumptions are as follows impervious areas are directly connected to the drainage system impervious areas have a CN of 98 and pervious areas are considered equivalent to open space with the respective hydrologic condition

The runoff CN for urban residential developments smaller than 1 ac, multifamily homes, commercial and business sites with good conditions for the pervious area based on regrading irrigation, and lawn maintenance was taken directly from the DCM For residential areas 1 ac and larger, the pervious area was considered range condition based on large lots that will only have a small percentage of the lot irrigated For the large residential lots with range condition pervious areas, the runoff CN was calculated based on Figure 2-3 from the *TR-55* manual The composite runoff CN is calculated as the percent pervious multiplied by a pervious runoff CN, plus the percent impervious multiplied by the pervious runoff CN for open space, range condition

Runoff CNs were developed for both existing and future conditions within the Haegler Ranch Any areas in HSG A that have been regraded as part of development were calculated as HSG B for runoff CNs

Within an ArcMap® GIS environment, discrete combinations of soil mapping units and land uses were developed Assuming average AMCs, runoff CNs were determined for each unique soil/land use combination using runoff CNs in Table 4-4 A runoff CN grid for the entire basin was then developed for both the existing and future conditions, as shown in Figure 4-2 and Figure 4-3 Using HEC-GeoHMS, composite runoff CNs were calculated and assigned to each subbasin

The overall runoff CN for the basin is expected to increase between the existing and future conditions with an area-weighted average of 66 and 68, respectively The changes in future land use are concentrated to two major developments, Meridian Ranch in the north and Santa Fe Springs in the central portion of the watershed Runoff CNs for the basin are summarized in Table 4-5

Table 4-5 Runoff Curve Number Summary for the Haegler Ranch Drainage Basin

	Existing Runoff CN	Future Runoff CN
Minimum	58	58
Maximum	98	98
Average	66	68

Notes
Runoff CN = runoff curve number

4.7. Time of Concentration

The time of concentration was calculated by summing the travel time for overland sheet flow, shallow concentrated flow, and channel flow segments along the longest flowpath as outlined in *TR-55* The longest flow path was automatically delineated using HEC-GeoHMS, and then the longest flow paths were manually modified where appropriate to match the drainage patterns in the subbasins based on roads and culvert crossings Overland flow was assumed to occur within the first 300 ft and may end before 300 ft if development is encountered, based on the *TR-55* Shallow concentrated flow occurs after 300 feet of overland flow Channel flow occurs after shallow concentrated flow when a channel is apparent in the aerial photo or contours, which transports runoff to the outlet of the subbasin

Times of concentration calculations were completed for each of the 68 Haegler Ranch subbasins using sheet and channel flow segments A summary of the time of concentration values for the Haegler Ranch is provided in Table 4-6

Table 4-9 Flood Summary Comparison for the Haegler Ranch Drainage Basin

Annual Percent Chance Flood Event	Recurrence Interval	Peak Flow (cfs)						
		Existing Conditions DBPS Model	Future Conditions DBPS Model	USGS Regression Analysis, Plains Region[1]	CWCB Regression Analysis, ARK - 5[2]	FEMA / UDFCD Gages[3]	USACE Black Squirrel Creek Model[4]	Haegler Ranch Drainage Basin Composite Basin[5]
50%	2-year	190	550	150	---	---	360	96
20%	5-year	570	1,300	600	---	---	1,200	270
10%	10-year	950	2,000	1,100	---	---	1,900	420
1%	100-year	3,200	5,600	4,900	6,800	7,200	5,000	1 200

Notes
cfs = cubic feet per second
% = percent
DBPS = Drainage Basin Planning Study
USGS = U S Geological Survey
CWCB = Colorado Water Conservation Board
FEMA = Federal Emergency management Agency
UDFCD = Urban Drainage Flood Control District
USACE = U S Army Corps of Engineers
[1] USGS Regression Analysis equations are from "Analysis of the Magnitude and Frequency of Floods in Colorado' Water-Resources Investigations Report 99-4190 The Plains Region covers the eastern plains below an elevation of about 9 000 ft Drainage areas for the study ranged from 5 to 1 000 sq mi
[2] CWCB Regression Analysis equations are from "Guidelines for Determining 100-Year Flood Flows for Approximate Floodplains in Colorado" by the Department of Natural Resources Colorado Water Conservation Board, June 2004 ARK-5 includes the Chico Creek basin with the boundary along the eastern boundary of the basin Equations are only valid for tributaries between 4 and 75 sq mi
[3] Tabulation of 42 stream gages in the Plains Region for the Urban Drainage and Flood Control District (UDFCD) in Denver that was provided by FEMA
[4] "Black Squirrel Creek El Paso and Pueblo Counties Colorado Hydrologic Analysis" study by USACE 2003
[5] Composite Basin for in HEC-HMS using the area-weighted average runoff CN and total time of concentration

The existing condition flows for the DBPS hydrologic model are lower than the USGS regression analysis CWCB regression analysis, UDFCD gages, and USACE Black Squirrel Creek Model, but the flows are higher than the composite basin for Haegler Ranch Assumptions and applicability of each method are as follows

- USGS Regression Analysis, Plains Region
  - Uses area as only input parameter
  - Does not account for rainfall, basin slope, or soil type
  - Based on very limited gaging station in eastern plains and none within the Black Squirrel Creek basin
  - Margin of error is 300% for 100-year storm event
- CWCB Regression Analysis, ARK-5
  - Uses area as only input parameter
  - Does not account for rainfall, basin slope, or soil type
  - Based on study results and not gage data
- FEMA/UDFCD Gages
  - Uses rainfall, area, and basin shape
  - Based on regional characteristics including Kansas
  - Not specifically intended for Colorado
- USACE Black Squirrel Creek Model
  - Uses State Soil Geographic (STATSGO) database which is generalized soil data
  - Based on regression equation to calculate lag time
  - Employs SCS Type II storm
  - Obtained landue from National Land Cover Dataset (NLCD) circa 1992
  - Uses higher imperviousness for existing low density development (20-30%)
  - Delineated basins and stream from 20-ft contours for a basin area of 18 8 sq mi
- Haegler Ranch Drainage Basin Composite Basin
  - Merges subbasins form DBPS into one large basin
  - Uses TR-55 to calculate lag time from the top of the basin along the river to confluence with Geick Ranch
  - Averages curve number from DBPS

The USGS regional regression equation flows are about 50% higher than the flows from the DBPS, but these regression equations have a large standard error The CWCB regression equation flow is more than twice as high as the DBPS flow Both regression equations have higher flows than the DBPS and neither regression analysis accounts for high rates of infiltration that occur in Haegler Ranch

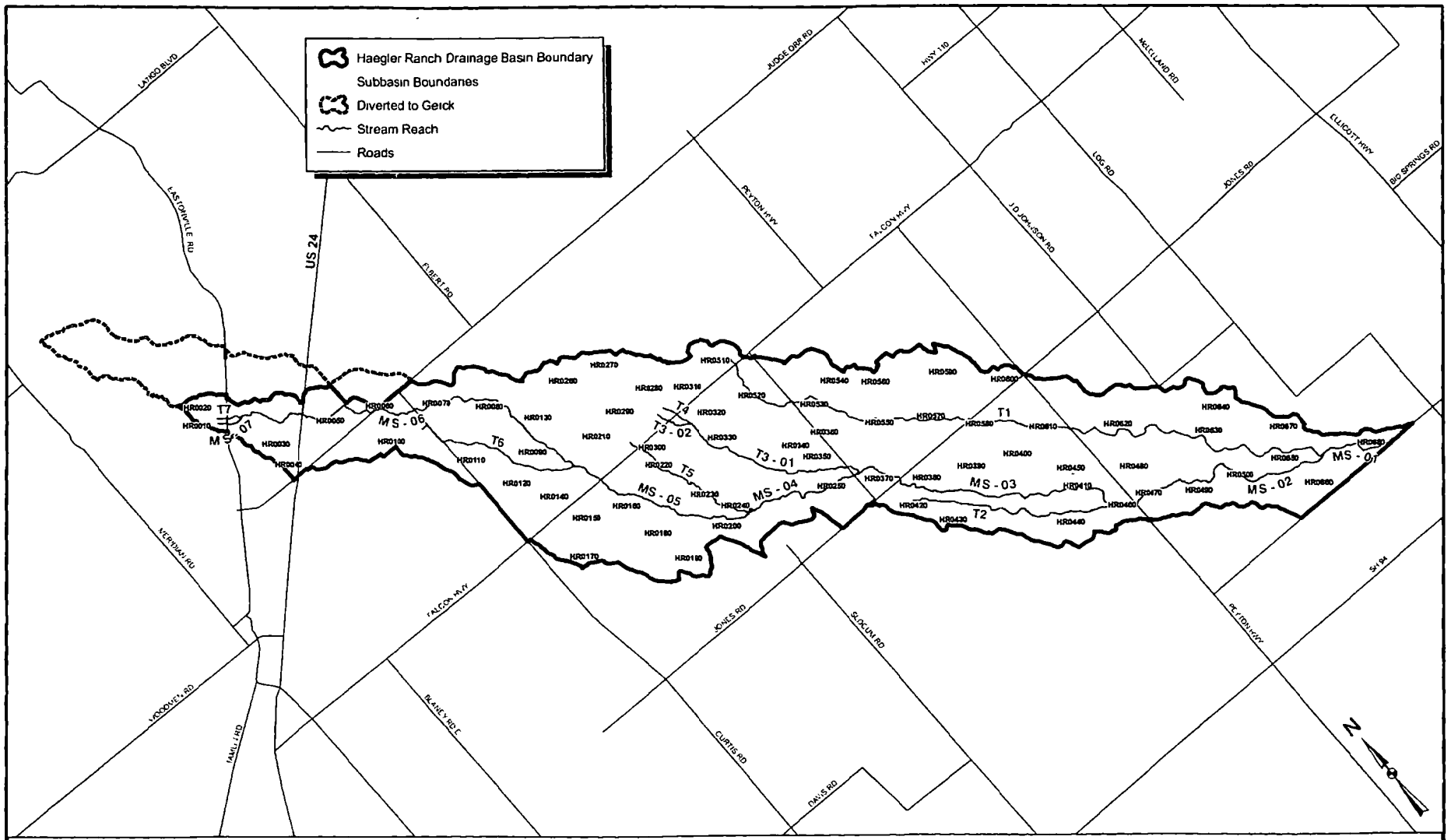
As part of a large basin study, the USACE Black Squirrel Creek Study (Black Squirrel) modeled the flow for the Haegler Ranch The flows from the Black Squirrel model are higher than the flows for the DBPS This is due to assumptions made in both models Black Squirrel used 20-ft contours while the DBPS used 2-ft contours to delineate subbasins Black Squirrel used National Land Cover Dataset (NLCD) data based on satellite imagery circa 1992 while the DBPS used existing data form the County Black Squirrel used a regression equation to calculate the lag time while the DBPS used channel measurements Black Squirrel used the initial abstraction for calibration of the large basin while the DBPS used uncalibrated flows with no gage data The scale of the models also affects these flows Black Squirrel is 724 sq mi while the DBPS is only 16 6 sq mi

The Haegler Ranch composite basin was modeled using the average runoff CN of 66 and a total lag time of 376 minutes The lag time was calculated based on 300 ft of overland flow, followed by shallow concentrated flow, and channel flow from the upper portions of the basin to the confluence The channel slope and Manning's roughness coefficients for the channel are the average values for each, 1 20% and 0 49 respectively All recurrence interval flows for the composite basin model are less than the existing conditions DBPS model This is due to lack of detail since the subbasins and flows are not routed throughout the basin

The existing condition DBPS modeled flows are higher than the regional regression equations, the flow curve from gage data, and the Black Squirrel Creek study Due to existing development and the methodology used to develop the other methods, the flows vary Due to differences and reliability of the comparisons, no action was taken to calibrate the DBPS model

4.12. Results

Peak flows for all the subbasins, reaches, and junctions calculated throughout the Haegler Ranch are shown in Figure 4-4 HEC-HMS models for existing and future basin conditions are in Appendix A



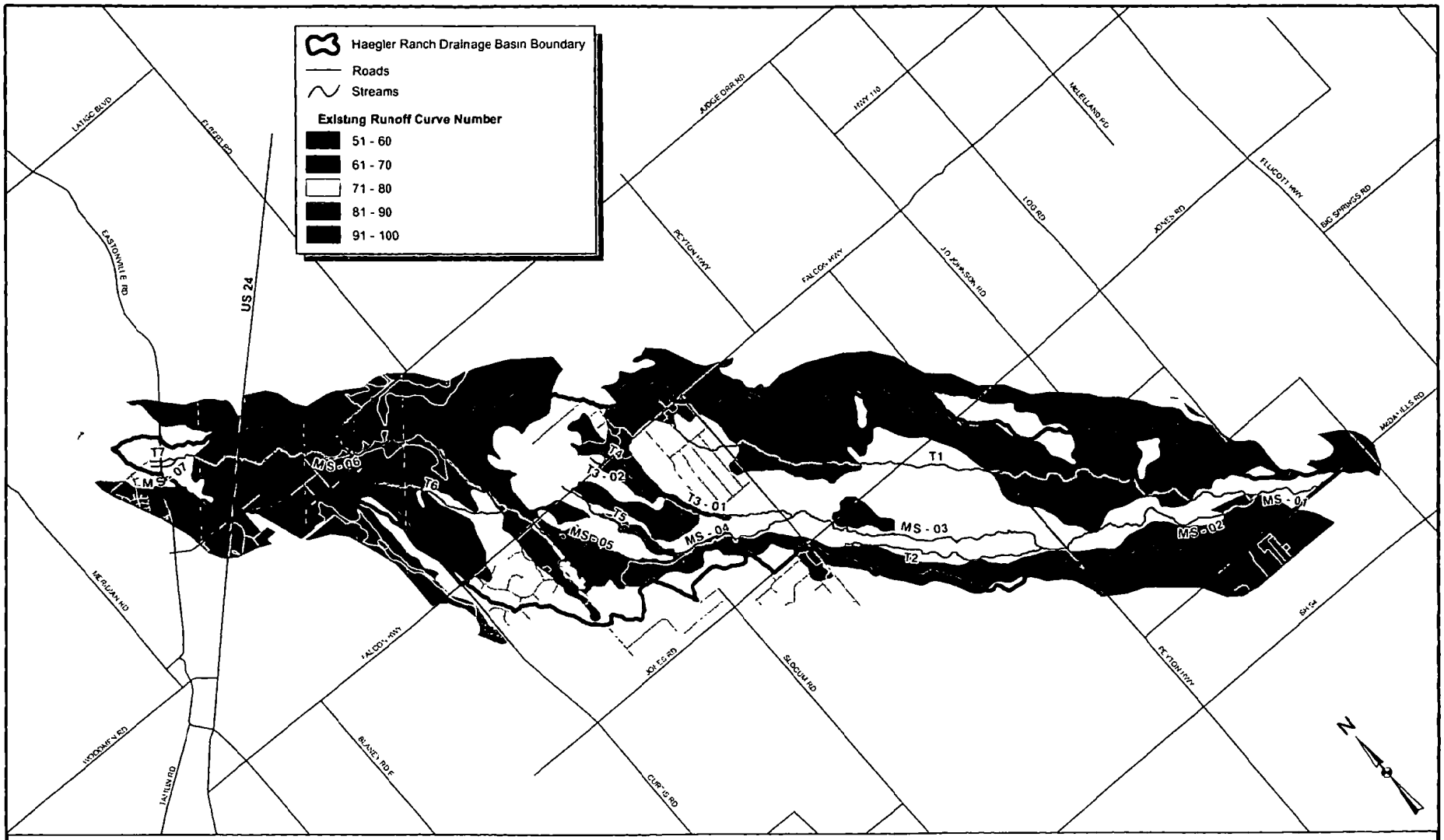
URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

5 000 2 500 0 5 000 Feet
1" = 5 000

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN
SUBBASIN DELINEATION
FIGURE 4-1

URS NO. 21711039

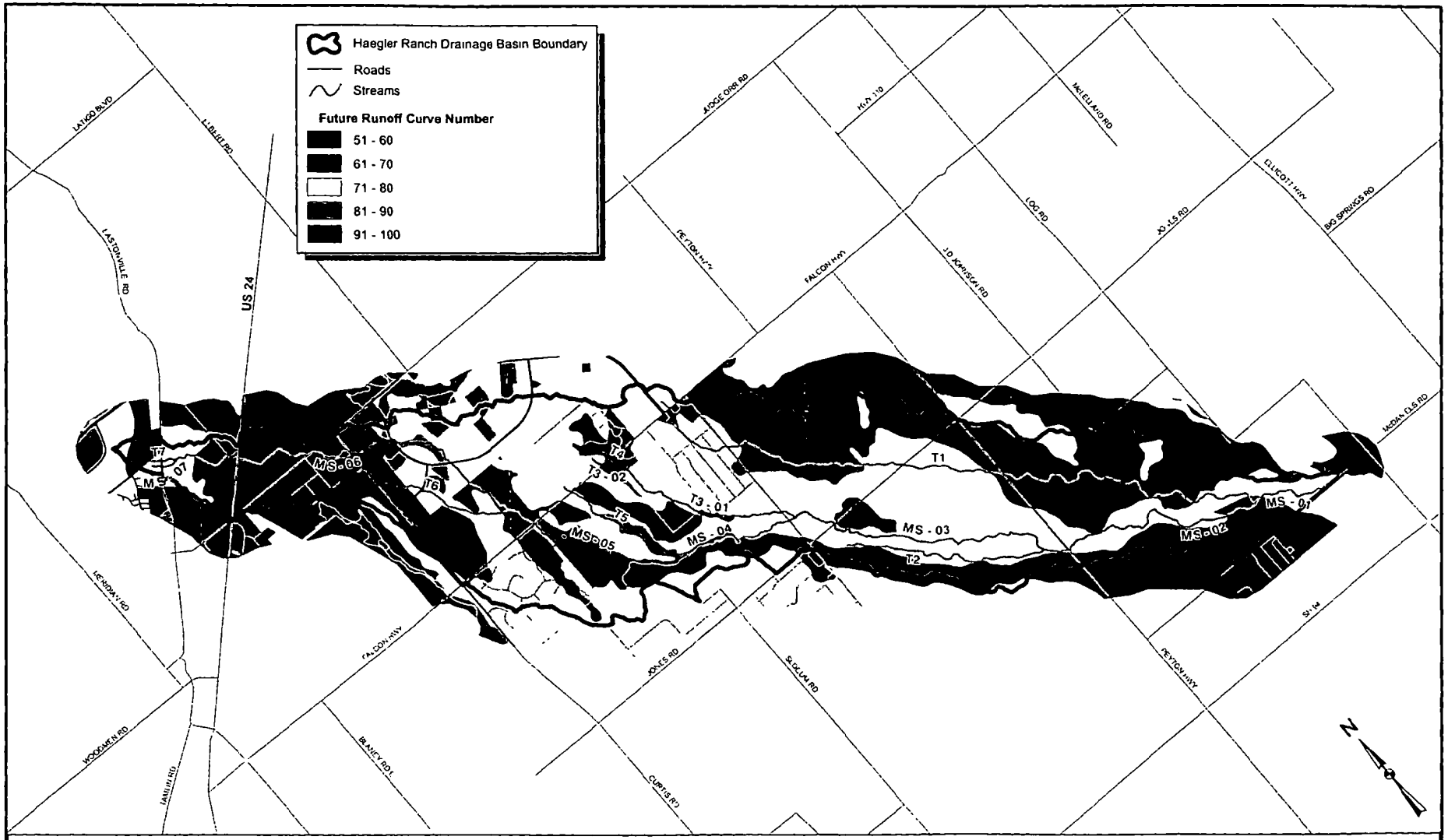


URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719 531 0001

HAEGLER RANCH DRAINAGE BASIN
EXISTING RUNOFF CURVE NUMBERS
FIGURE 4-2

DATE: 09/08

URS NO. 21711039



URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719 531 0001

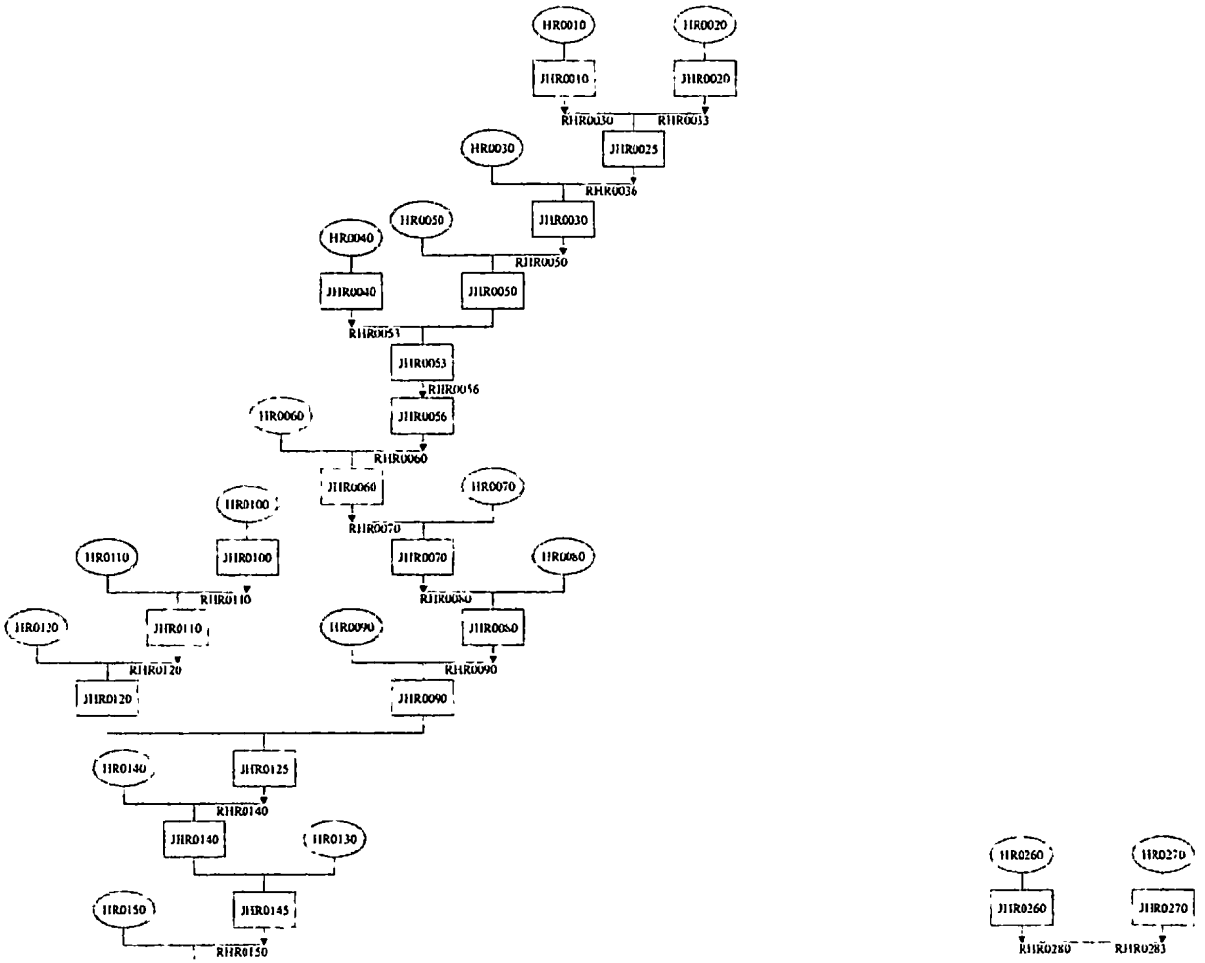
HAEGLER RANCH DRAINAGE BASIN
FUTURE RUNOFF CURVE NUMBERS
FIGURE 4-3

DATE: 09/08

URS NO. 21711039

Figure 4-4 Existing and Future Conditions Hydrologic Model

SEE MAP POCKETS IN BACK OF REPORT



URS
9980 Federal Dr
Suite 300
Colorado Springs, CO 80921
719 531 0001

URS NO. 21711039

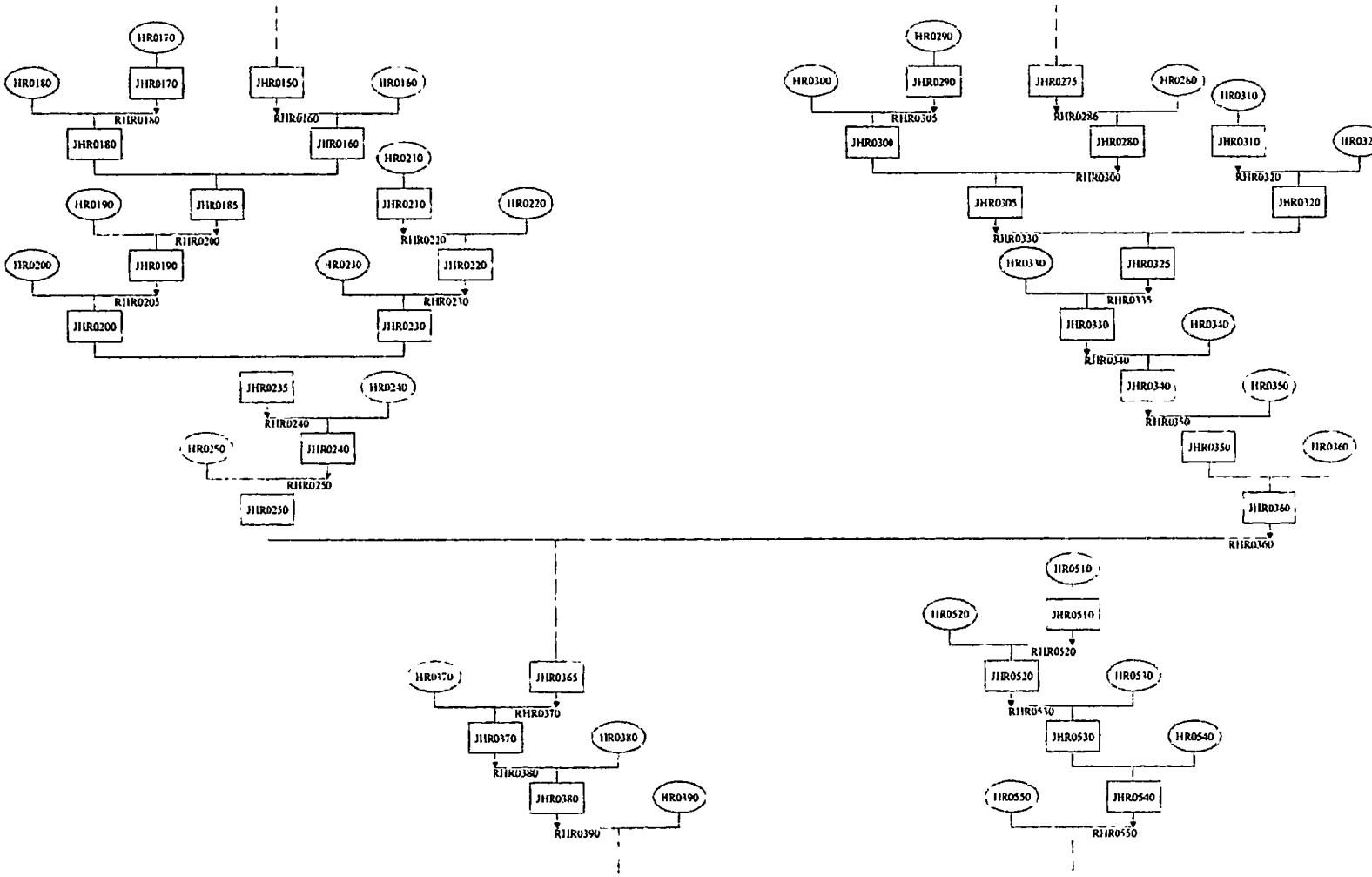
DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

HYDROLOGIC CONNECTIVITY

SHEET 1

FIGURE 4-5



URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719 531 0001

URS NO. 21711039

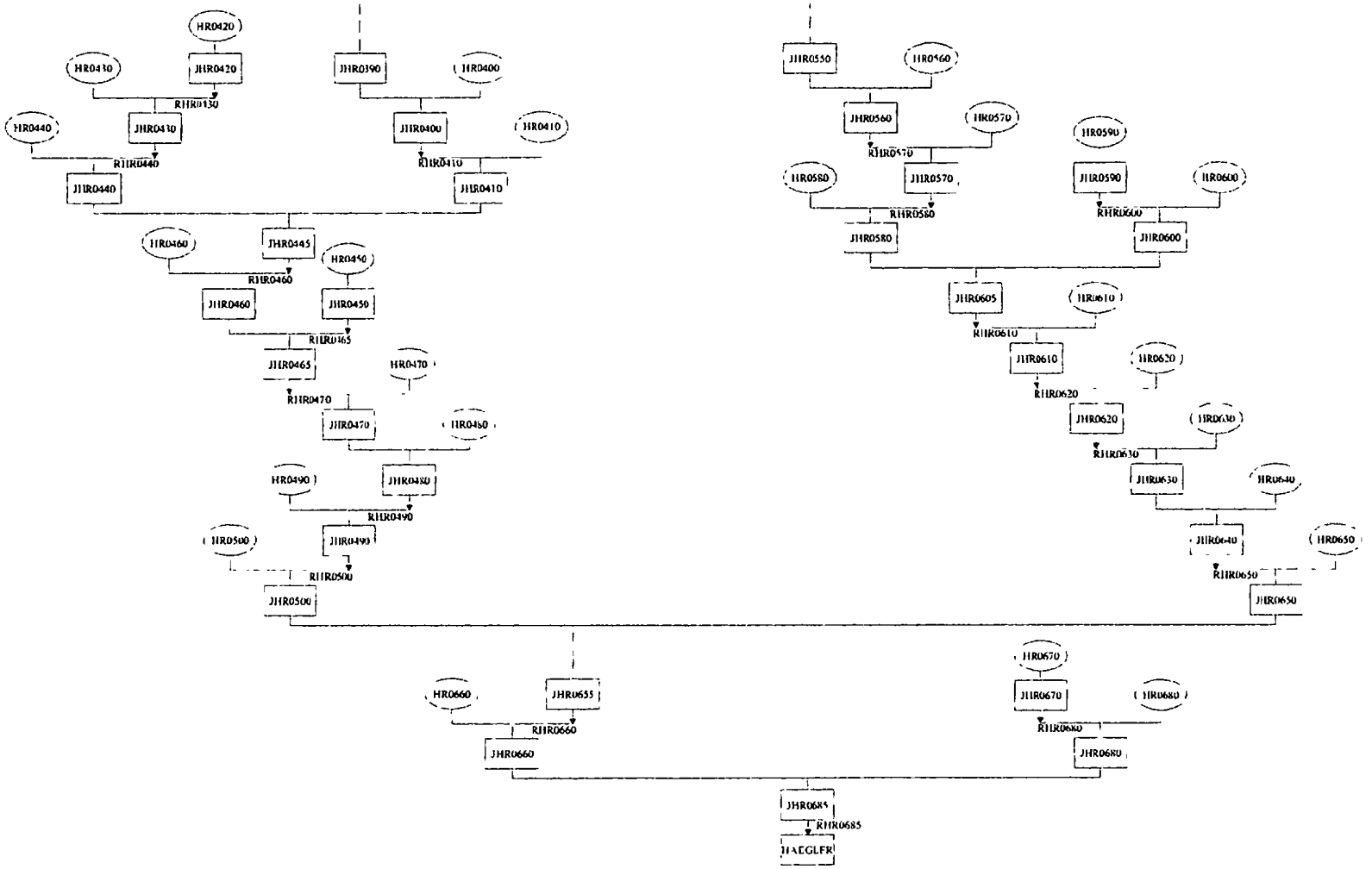
DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

HYDROLOGIC CONNECTIVITY

SHEET 2

FIGURE 4-5



URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

URS NO. 21711039

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

HYDROLOGIC CONNECTIVITY

SHEET 3

FIGURE 4-5

5.0 HYDRAULIC ANALYSIS

5.1. Overview

Hydraulic analyses for existing conditions were computed for the 8 channel reaches within the Haegler Ranch Drainage Basin to model the flood events for the 2-, 5-, 10-, and 100-year recurrence interval flows Hydraulic reaches studied are shown in Figure 5-1 Hydraulic analyses were conducted using the USACE Hydrologic Engineering Center-River Analysis System Version 3 1 3 (HEC-RAS) The employed methodology, models characteristics, and input data used in the hydraulics models are described in this section

The hydraulic analysis of Haegler Ranch main stem was performed by dividing the basin into several reaches, which cover approximately 31 miles from the headwaters near Eastonville Road to its confluence with the unnamed tributary of Geick Ranch Drainage Basin The Haegler Ranch main stem is primarily a grass-lined swale, with defined channels near road crossings that dissipate as the flow moves downstream

5.2. Flood History

During the 1999 calendar year, a precipitation record was set for the Colorado Springs area Haegler Ranch Drainage Basin also experienced this record precipitation The 1999 flood event in Haegler Ranch Drainage Basin was caused by long periods of rainfall coupled with brief but intense storms Several significant rainfall events occurred between March and August 1999 (FEMA 1999) The most pronounced event occurred April 28 to May 1 with a total of 5 59 in (National Weather Service gauge, Colorado Springs Airport), only three days after a slightly smaller storm with a total of 1 79 in At Meridian Road, Falcon Highway and East Blaney Road, culverts washed out and roadway embankments were damaged

The spring of 1995 was extremely wet, with 7 8 in of rain in June Major flooding also occurred in spring 1965 when events very similar to the 1999 flood event took place In 1965, 5 47 in of rain was recorded at the Colorado Springs Airport in four days immediately after a series of ongoing, smaller events Residents said that the 1965 storm centered more north and east of Falcon than the 1999 storm, and Ellicott Highway was completely washed out (FEMA 1999) These flood events clearly show the potential for severe flooding in the Haegler Ranch Drainage Basin

5.3. Hydraulic Structure Inventory

As part of the field investigation, existing drainage facilities were inventoried The size, type, and condition were recorded for the bridges, culverts, channels, inlets, pipes, and miscellaneous drainage features in the basin An inventory of the major structures is presented in Figure 5-2 and Figure 5-3

5.4. HEC-RAS Modeling

Hydraulic modeling was completed using HEC-RAS to perform one-dimensional, steady flow hydraulic calculations for each reach and a geospatially referenced river model in USACE Hydrologic Engineering Center – Geospatial River Analysis System Version 4 1 (HEC-GeoRAS)

In ArcMap®, the stream centerlines, banks, flow paths, cross-sections, and Manning's roughness coefficients were defined for the basin The stream centerline follows the channel thalweg to define the reach network The banks differentiate the 2-yr low flow channel from the floodplain channel The flowpaths identify the centroid of the flow in the left overbank, main channel, and right overbank in order to determine the respective reach lengths The cross-sections use the topography to acquire information along the reach The Manning's roughness coefficients are defined for the channel and floodplains for the cross-section data Cross-section topography data was obtained by using the 2-ft contour referenced earlier in Section 2 3 (AME 2004) From the 2-ft contours, a triangulated irregular network (TIN) was created for the digital terrain model in HEC-GeoRAS A HEC-GeoRAS import file that contained three-dimensional coordinates for the stream centerlines and cross-sections, as well as reach stations, bank stations, reach lengths, stream topology, and Manning's roughness coefficients was imported into HEC-RAS

Bridges, culverts, levees, and ineffective flow were added to the HEC-RAS model after import from HEC-GeoRAS For the culvert and bridge crossings, a field survey was conducted to get detailed cross-section data Physical parameters for surveyed structures were incorporated into the hydraulic model using HEC-RAS bridge/culvert and cross-section data editors Structures were modeled as if they were free of any major obstructions to reflect properly maintained conditions However, many of the culverts have reduced capacities due to sedimentation, vegetation growth, and the accumulation of debris Cleaning and maintenance of these culverts is required to restore their flood flow capacities Levees were defined in the cross-sections to represent disconnected low lying areas using the HEC-RAS cross-section data editor Ineffective flow areas were defined to represent areas that contain water in a flood event but do not effectively convey flow

5.5. Reach Delineation

Reaches were delineated for channels of Haegler Ranch Drainage Basin for areas that drain at least 100 ac and channels that include stormwater improvement projects The reaches were evaluated based upon the existing topography, physical condition of the channel, and the floodplains along the major drainageways The delineated reaches shown in Figure 5-1 are described as follows

- Main Stem (MS-01) – This channel extends from the confluence of the main stem and Tributary 1 in subbasin HR0660 to the outlet of the Haegler Ranch in subbasin HR0680 on the north side of McDaniels Road The channel is a grass swale that flows into a grass-lined ditch on the north side of McDaniels Road
- Main Stem (MS-02) – This channel extends from the confluence of the main stem with Tributary 2, just northwest of Peyton Highway in subbasin HR0460, to the confluence of the main stem and Tributary 1 in subbasin HR0660 The channel is a grass swale with one culvert crossing at Peyton Highway
- Main Stem (MS-03) – This channel extends from the confluence of the main stem with Tributary 3, just east of Murr Road in subbasin HR0370, to the confluence of the main stem with Tributary 2, just northwest of Peyton Highway in subbasin HR0460 The channel is parallel to T2, and varies between a grass swale and an alluvial sand bed with one culvert crossing at Jones Road
- Main Stem (MS-04) – This channel extends from the confluence of the main stem with Tributary 5 in subbasin HR0240 to the confluence of the main stem with Tributary 3, just east of Murr Road in subbasin HR0250 The channel is a grass swale with one culvert crossing at Murr Road

cross section area was abrupt, such as at bridges and culverts, contraction and expansion coefficients of 0 3 and 0 5, respectively, were used

5.8. Levees and Ineffective Flow

Levees were used to describe portions of a cross-section in which water does not actively flow Levees represent physical barriers, that may be either man-made or naturally occurring, that prevent the flow from reaching a low-lying area outside the channel Once the levee is overtopped, the flow outside the levee is ineffective flow.

Ineffective flow areas are used to describe portions of a cross section in which water in not actively flowing This ineffective flow can be in a side channel or on the upstream or downstream cross sections of a structure All ineffective flow is considered as permanent, and will not flow once the levee or structure is overtopped

5.9. Bridges and Culverts

The field survey data and the TIN were combined to create upstream and downstream cross-sections for bridges and culverts along the reaches The highest energy answer was selected for low flow methods For bridges, the deck/roadway, pier, and sloping abutments were input where appropriate For culverts, the shape and dimensions were input

Entrance loss coefficients estimate the amount of energy lost as the flow enters into culverts and is used to determine the upstream headwater elevation for outlet control computations Entrance loss coefficients for different types of culverts were selected from Tables 6 3 6 4, and 6 5 of HEC-RAS Hydraulic Reference Manual (Version 3 1, November 2002) Exit losses are set to 1 0 for a typical culvert with sudden expansion as per the Reference Manual

5.10. Steady Flow and Boundary Conditions

Steady flow data were entered for all reaches based on the results of the hydrologic model as outlined in Section 4 0 Steady flow data corresponding to recurrence intervals of 2-, 5-, 10-, and 100-years for existing conditions for each reach were determined at different locations used in the HEC-RAS model

Water surface elevation boundary conditions were determined using the normal depth method at the upstream end and downstream end of all reaches This boundary condition requires input of the energy grade line slope, which is assumed to be bed slope, at the downstream and upstream boundaries for the mixed-flow regime and can be approximated from contour data The upstream and downstream boundary conditions were entered into the HEC-RAS model

5.11. Flow Regime

The HEC-RAS model was run in a mixed flow regime to observe areas of subcritical flow, supercritical flow, hydraulic jumps, and draw downs The model was then run using only subcritical flow, which was then used to delineate the 100-year floodplain

5.12. Approximate Floodplains

Approximate floodplains for the 100-year existing condition flow have been delineated for Haegler Ranch Drainage Basin using HEC-RAS and HEC-GeoRAS Floodplain limits and profiles for the 100-year storm event can are shown in Figure 5-4 The approximate floodplain limits and profiles were used to assess where hydraulic inadequacies exist along the major drainageways

The approximate floodplain information shown on the plans can be used for identification of flood prone areas along the major drainageways and to aid in the evaluation of alternative plans The approximate floodplain data contained herein is not intended to replace the information presented in the City of Colorado Springs and El Paso County Flood Insurance studies (FEMA 1999), but should be used as a planning tool for drainageway development projects

The structures identified as being in the approximate floodplain shown in Figure 5-4 are listed in Table 5-2 This table has been prepared using available survey and aerial photo graphic data, but it has not been field verified

5.13. Existing Deficiencies and Upgrades

Hydraulic capacities were estimated for the 19 culverts, 1 bridge crossing, and 2 road crossings with no culvert or bridge along the 8 channels in the hydraulic models, to determine the existing deficiencies The hydraulic capacity of a road crossing was assumed to be exceeded when the hydraulic grade line reached the road surface for the 100-year HEC-RAS model A summary of the road crossings evaluated can be found in Table 5-3

Of the 22 road crossings, 20 roads are overtopped and 2 crossings have existing 100-year flow capacities For the 20 crossing that are currently insufficient, the facilities necessary to provide 100-year conveyance were determined, as listed in Table 5-3 These necessary facilities are based on approximate culvert capacity calculations in Appendix B

Table 5-2 Structures in the Approximate Floodplain

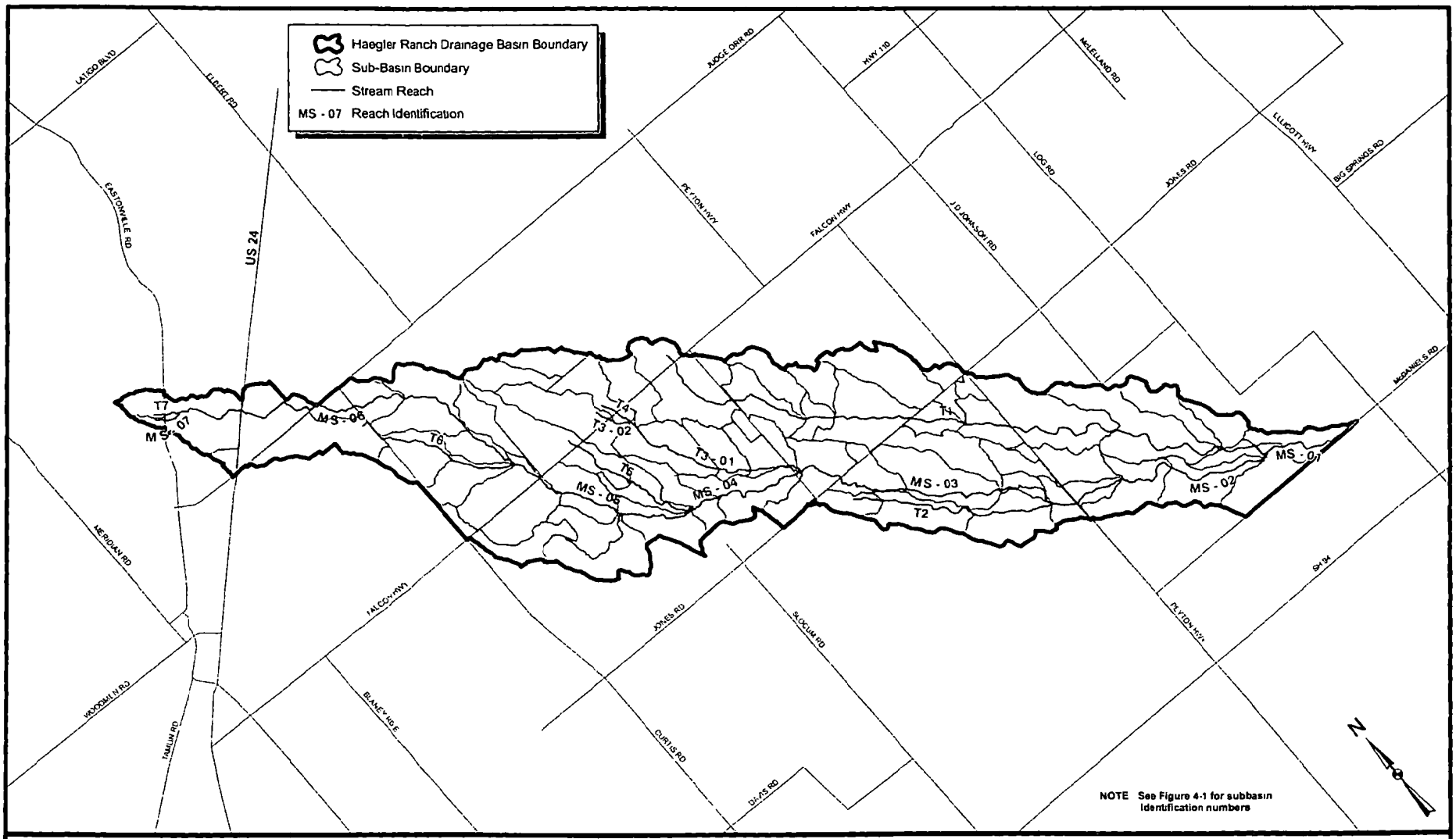
Structure No.	Description	Location	Reach	Nearest Cross-Section	Approximate Flooding Depth, ft
43	home	HR0520	T1	36351	2 9
44	garage	HR0520	T1	36721	<1
45	home	HR0520	T1	36721	2 8
46	sm barn	HR0520	T1	36721	<1
47	home	HR0570	T1	36721	<1
48	garage	HR0520	T1	36971	<1
49	home	HR0140	MS-05	52834	<1
50	shop	HR0140	MS-05	52834	<1
51	med barn	HR0140	MS-05	53369	<1
52	med shed	HR0140	MS-05	53369	<1
53	med barn	HR0140	MS-05	53369	<1
54	lg shed	HR0140	MS-05	53369	<1
55	sm shed	HR0140	MS-05	53369	<1
56	sm shed	HR0130	MS-06	55426	<1
57	home	HR0130	MS-06	54855	<1
58	shop	HR0130	MS-06	55883	<1
59	home	HR0100	T6	7733	<1
60	lg shed	HR0100	T6	7994	<1
61	OMIT- NOT FLOODED				
62	med barn	HR0060	MS-06	66759	<1
63	med shed	HR0060	MS-06	66759	<1
64	mobile home	HR0220	T5	8074	<1
65	med shed	HR0220	T5	8074	<1
66	med shed	HR0220	T5	8074	<1
67	med shed	HR0520	T1	36200	<1
Propane Tanks					
111	p tank w house1	HR0680	MS-01	1931	<1
112	p tank w house6	HR0680	MS-01	2426	1 1
113	p tank w house9	HR0680	MS-01	2426	<1
114	p tank w house19	HR0520	T1	33123	<1
115	p tank w house20	HR0520	T1	33985	2 1
116	p tank w house30	HR0520	T1	35209	1 7
117	p tank w house35	HR0520	T1	35540	<1
118	p tank w house36	HR0520	T1	35540	<1
119	p tank w house39	HR0520	T1	35927	1 7
120	p tank w house43	HR0520	T1	36721	2 9
121	p tank w house47	HR0520	T1	36721	<1
122	p tank w house49	HR0140	MS-05	52834	<1
123	p tank w house57	HR0130	MS-06	54855	<1
124	p tank w house59	HR0100	T6	7733	1 5
125	p tank w house64	HR0220	T5	8074	<1

Table 5-3 Existing Hydraulic Deficiencies

Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency
606	Prospero Road	N/A	2-24" CMP	N/A	N/A
N/A	Falcon Highway	Tributary 1 (T1)	No Culvert	33	Overtops
607	Falcon Highway	N/A	18" CMP	N/A	N/A
608	Falcon Highway	N/A	24" CMP	N/A	N/A
609	Falcon Highway	Tributary 3 (T3-02)	18' CMP	180	Overtops
610	Falcon Highway	Tributary 4 (T4)	24" CMP	200	Overtops
611	Falcon Highway	N/A	18' CMP	N/A	N/A
612	Falcon Highway	Tributary 5 (T5)	24" CMP	150	Overtops
613	Bobby Court	N/A	2-36" CMP	N/A	N/A
614	Southfork Dr	N/A	36' CMP	N/A	N/A
615	Southfork Dr	N/A	2-36" CMP	N/A	N/A
616	Southfork Dr	N/A	30" CMP	N/A	N/A
617	Clifford Dr	N/A	24" CMP	N/A	N/A
618	Southfork Dr	N/A	30" CMP	N/A	N/A
619	Southfork Dr	N/A	18' RCP	N/A	N/A
620	Oil Baron Dr	N/A	30" CMP	N/A	N/A
621	Sue Ellen Dr	N/A	36' CMP	N/A	N/A
622	Sue Ellen Dr	N/A	48" CMP	N/A	N/A
623	Sue Ellen Dr	N/A	24" CMP	N/A	N/A
624	Sue Ellen Dr	N/A	18" CMP	N/A	N/A
625	Pamela Way	N/A	30" CMP	N/A	N/A
626	Southfork Dr	N/A	24" CMP	N/A	N/A
627	Crebs Dr	N/A	3-30" CMP	N/A	N/A
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	1 000	Overtops
629	Falcon Grassy Hts	N/A	24" CMP	N/A	N/A
630	Sagecreek Road	N/A	2-24" CMP	N/A	N/A
631	Sage Lake Court	N/A	18" CMP	N/A	N/A
632	Sagecreek Road	N/A	2-18' CMP	N/A	N/A

Table 5-4 Existing Conditions HEC-RAS Model

Key Location	Reach and Station	HEC-RAS Result	Recurrence Intervals			
			2-yr	5-yr	10-yr	100-yr
Main stem at US 24	MS-06 72276	Channel velocity (ft/sec)	1 1	1 63	1 98	2 92
		Water surface depth in channel (ft)	1 36	2 44	3 24	6 49
		Top width (ft)	18 23	24 85	29 7	255 62
Main stem at Judge Orr Road	MS-06 67666	Channel velocity (ft/sec)	3 33	4 09	1 76	3 48
		Water surface depth in channel (ft)	0 52	1 04	1 05	1 35
		Top width (ft)	174 53	534 34	535 52	569 34
Main stem at Falcon Highway	MS-05 52353	Channel velocity (ft/sec)	1 05	1 6	2 04	3 59
		Water surface depth in channel (ft)	1 79	3 69	4 96	5 74
		Top width (ft)	31 42	83 76	556 41	592 33
Main stem at Jones Road	MS-03 33189	Channel velocity (ft/sec)	2 45	3 7	1 27	2 51
		Water surface depth in channel (ft)	3 2	5 83	9 25	10 46
		Top width (ft)	47 98	105 51	580 28	667 17
Main stem at Peyton Highway	MS-02 18474	Channel velocity (ft/sec)	0 16	0 4	0 59	1 43
		Water surface depth in channel (ft)	4 14	4 35	4 51	5 15
		Top width (ft)	813 21	871 68	882 22	925 27
Southeast Tributary at Jones Road	T1 22297	Channel velocity (ft/sec)	0 62	1 02	1 47	3 2
		Water surface depth in channel (ft)	2 45	3 52	3 59	3 82
		Top width (ft)	197 35	345 68	351 74	372 17
Southeast Tributary at Peyton Highway	T1 16611	Channel velocity (ft/sec)	1 67	2 25	2 65	4 05
		Water surface depth in channel (ft)	0 08	0 17	0 24	0 51
		Top width (ft)	239 82	241 36	242 51	247 41
Southeast Tributary at Confluence with Main stem	T1 410	Channel velocity (ft/sec)	3 44	0 11	0 18	0 67
		Water surface depth in channel (ft)	1 69	2 01	2 01	2 01
		Top width (ft)	31 89	1169 3	1169 3	1169 3
At Confluence with Geick Basin	MS-01 82	Channel velocity (ft/sec)	2 68	3 85	19 89	17 33
		Water surface depth in channel (ft)	1 45	2 17	1 11	2 36
		Top width (ft)	75 88	255 32	60 67	262 84



URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

5,000 2 500 0 5 000 Feet

1" = 5 000

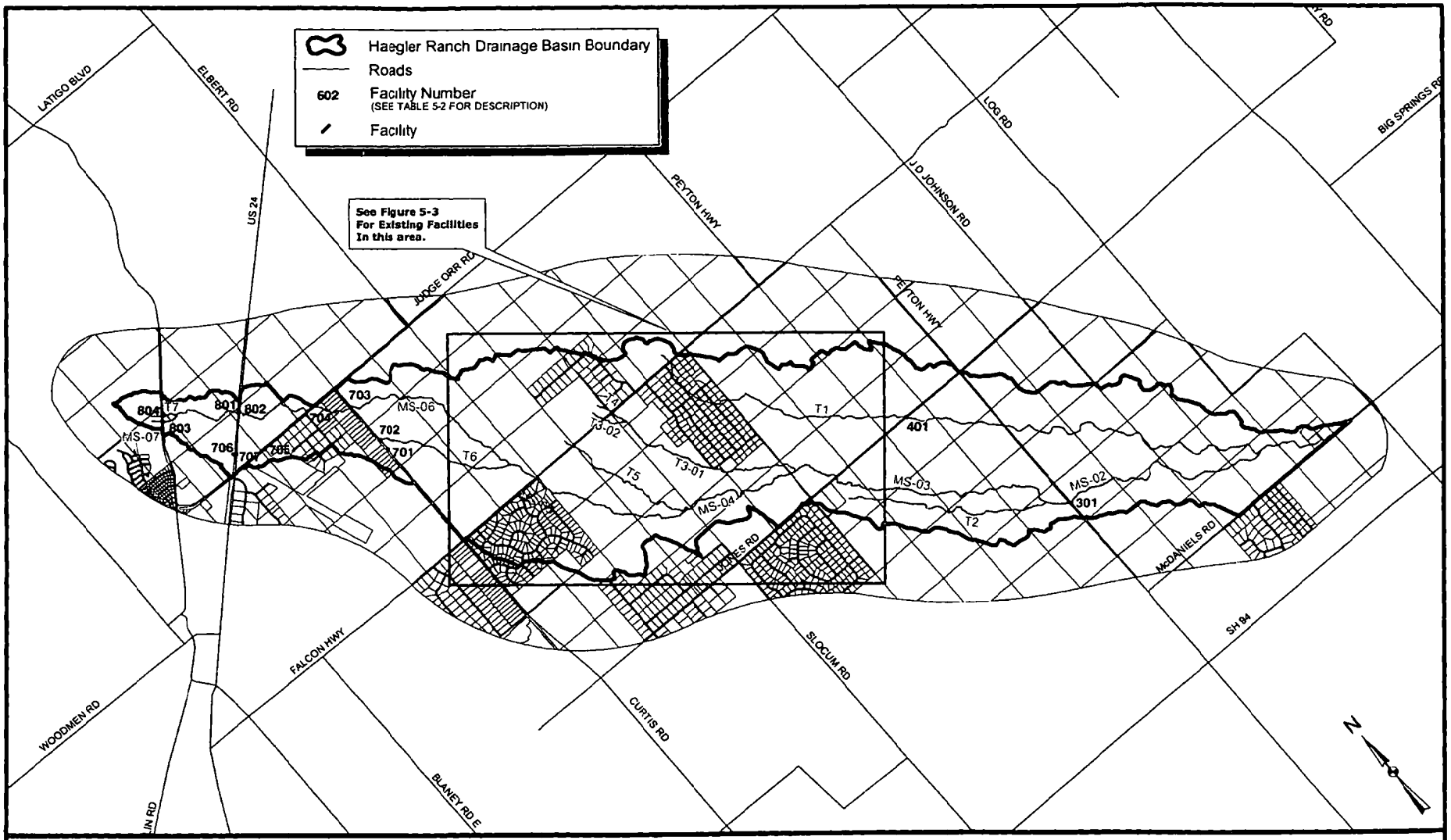
DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

HYDRAULIC REACHES

FIGURE 5-1

URS NO. 21711039



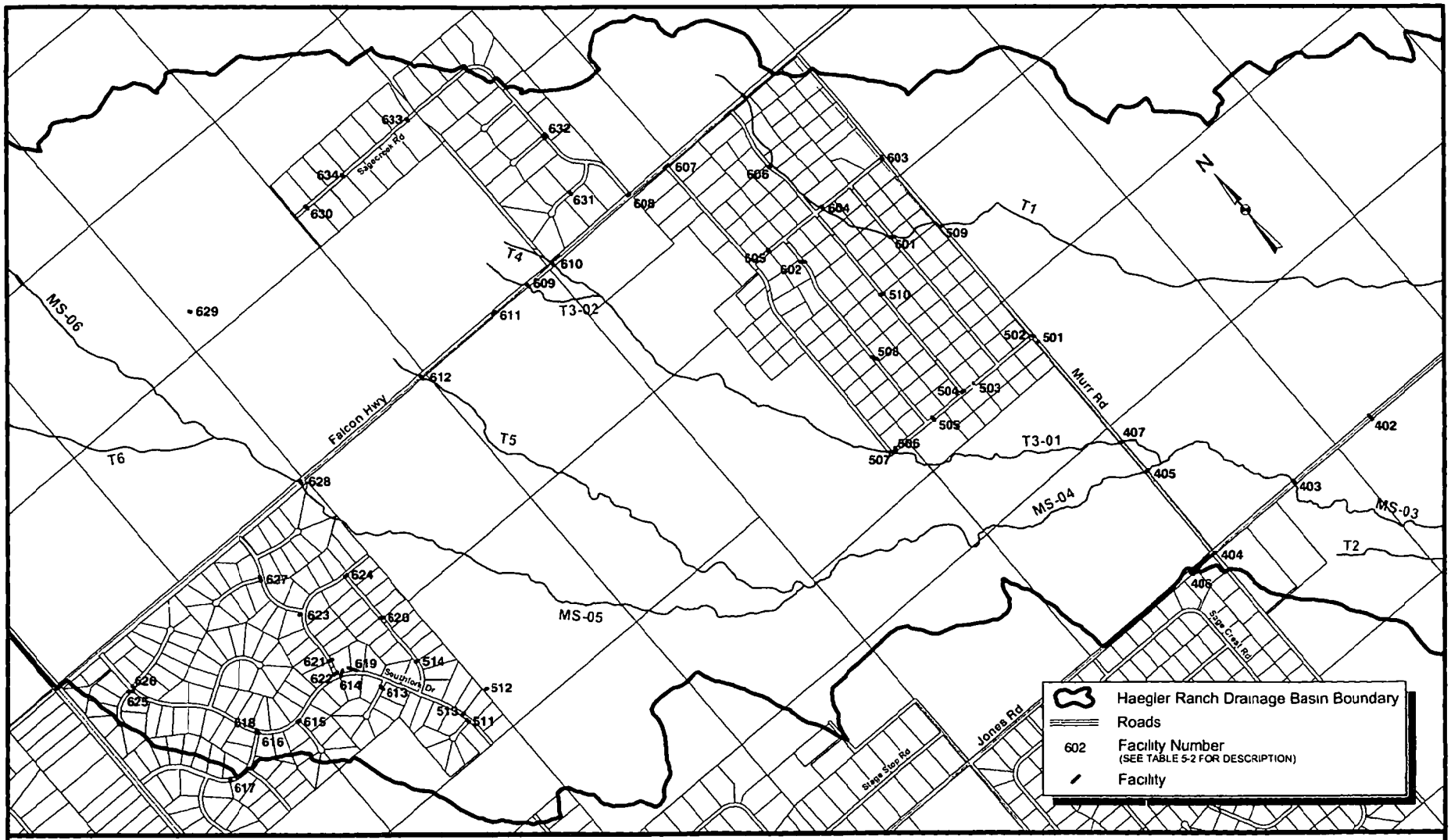
URS
9860 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

5 000 2 500 0 5 000 Feet
1" = 5,000

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN
FACILITY INVENTORY A
FIGURE 5-2

URS NO. 21711039



URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

1,500 750 0 1 500 Feet
1" = 1 500'

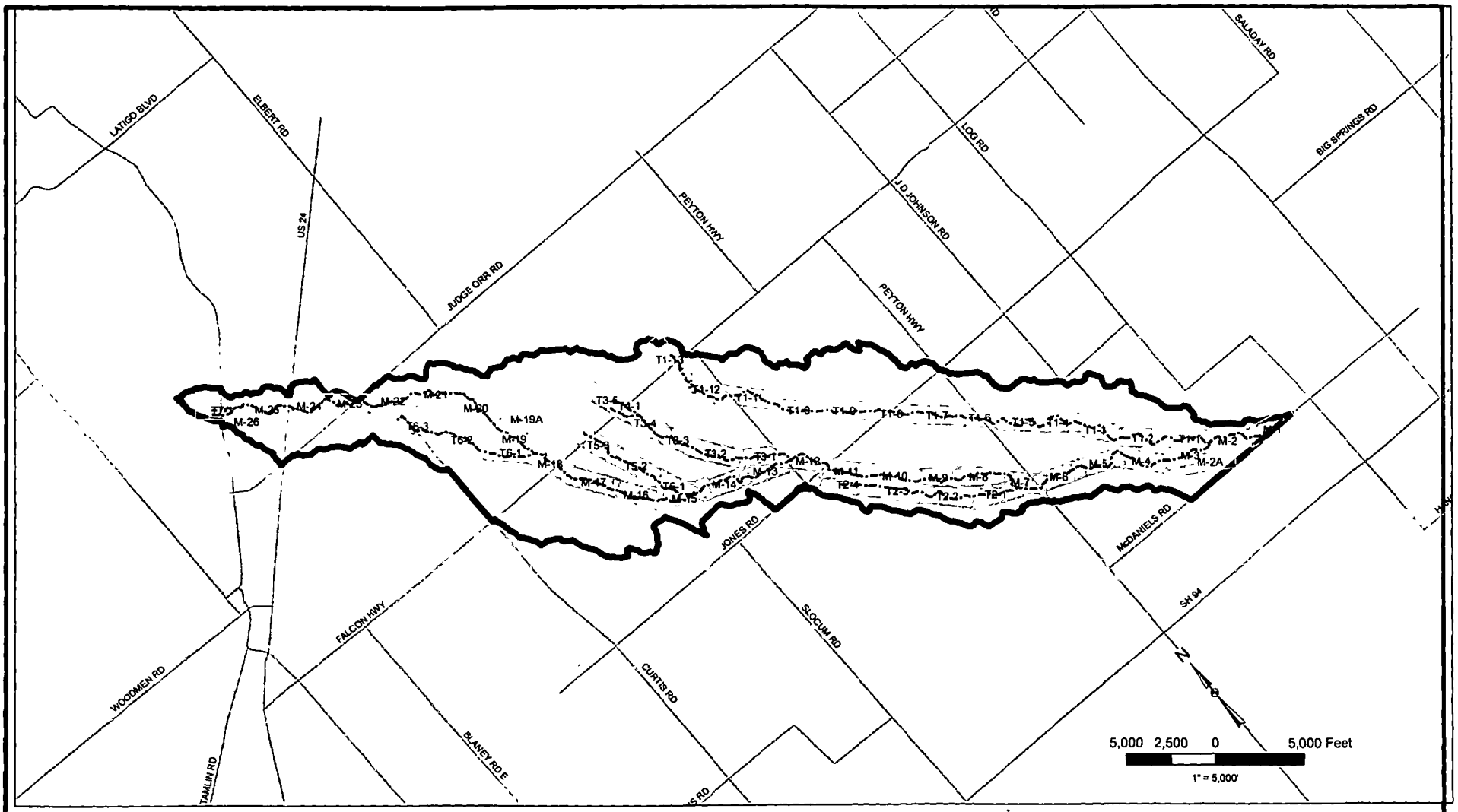
DATE: 09/09

HAEGLER RANCH DRAINAGE BASIN

FACILITY INVENTORY B

FIGURE 5-3

URS NO. 21711039

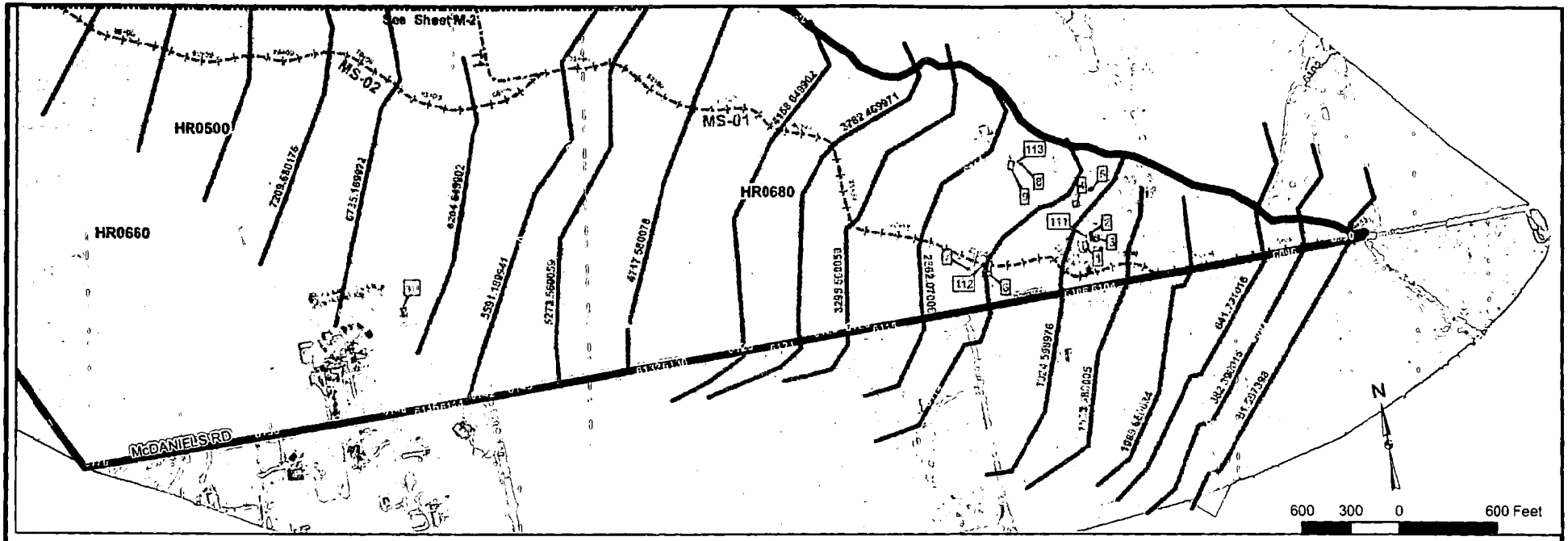


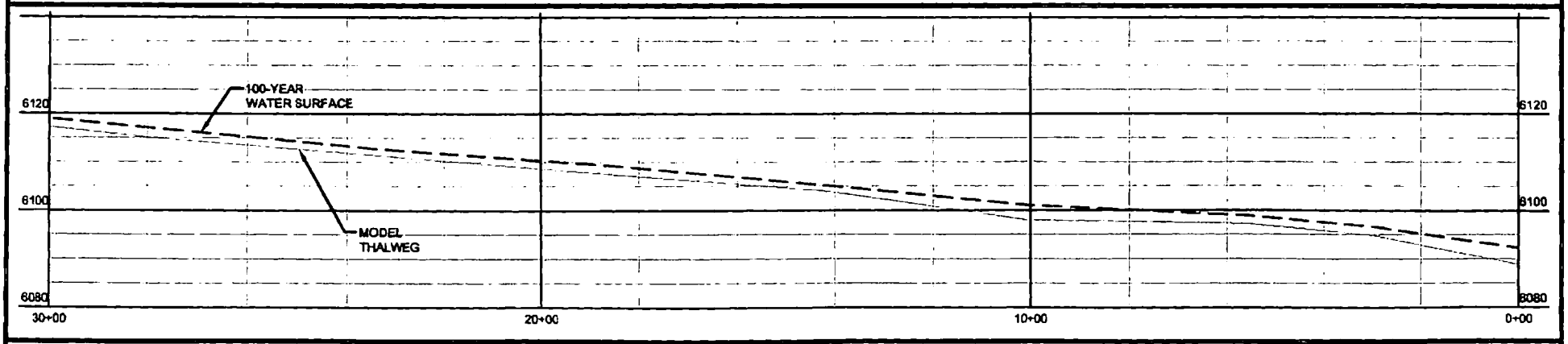
URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719 531 0001

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
100-YEAR FLOOD LIMITS
SHEET INDEX
FIGURE 5-4

URS NO. 21711039





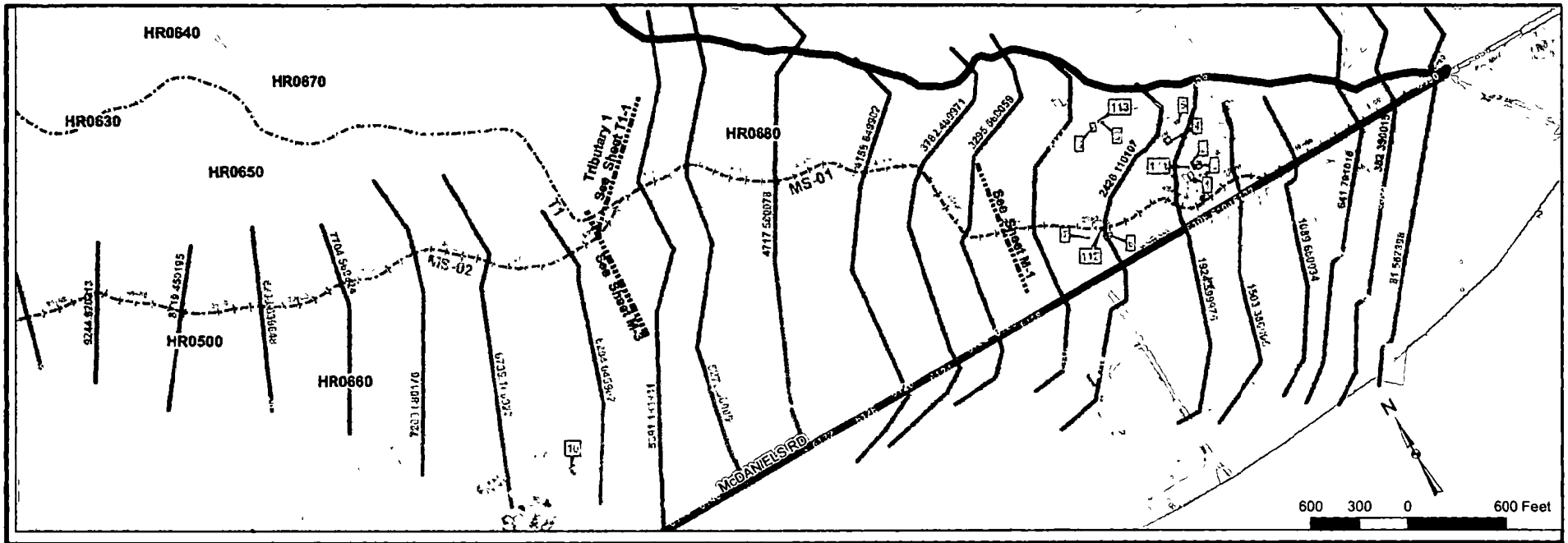
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

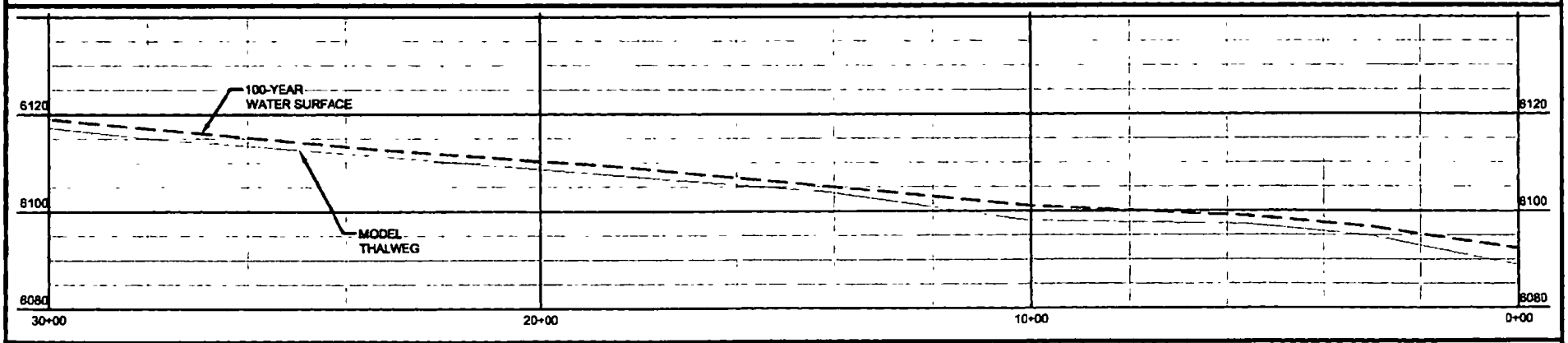
Haegler Basin Boundary
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 10/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-1
FIGURE 5-4

URS NO. 21711039





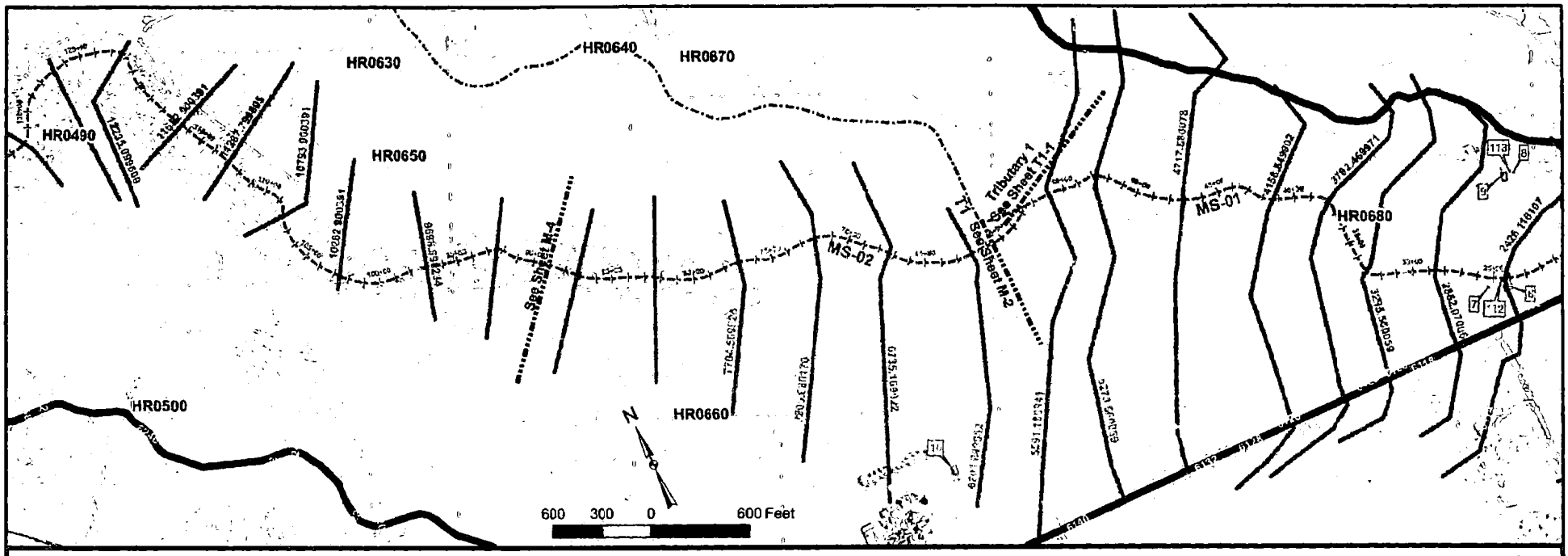
URS
9960 Federal Dr
Suite 300
Colorado Springs CO 80921
719 531 0001

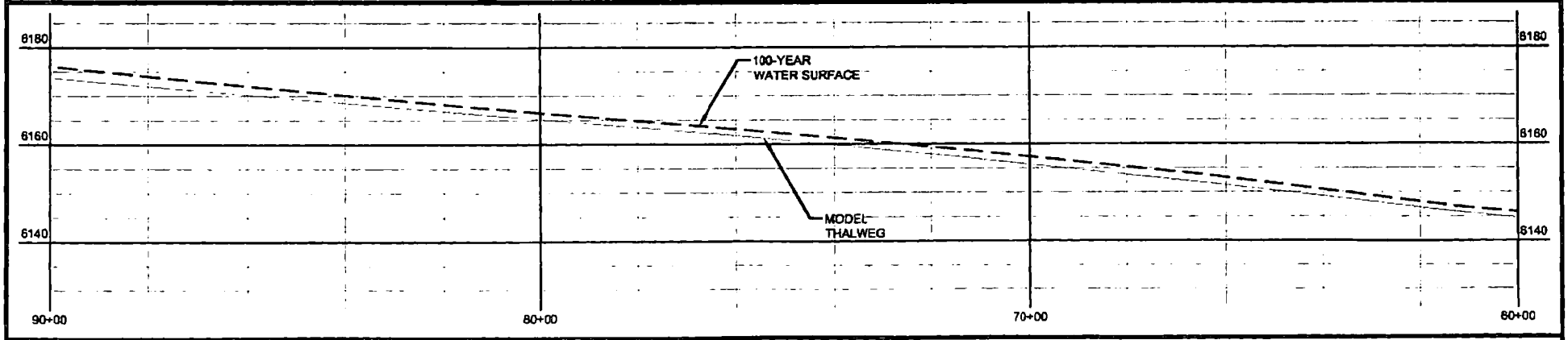
Haegler Basin Boundary
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 10/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-2
FIGURE 5-4

URS NO. 21711039





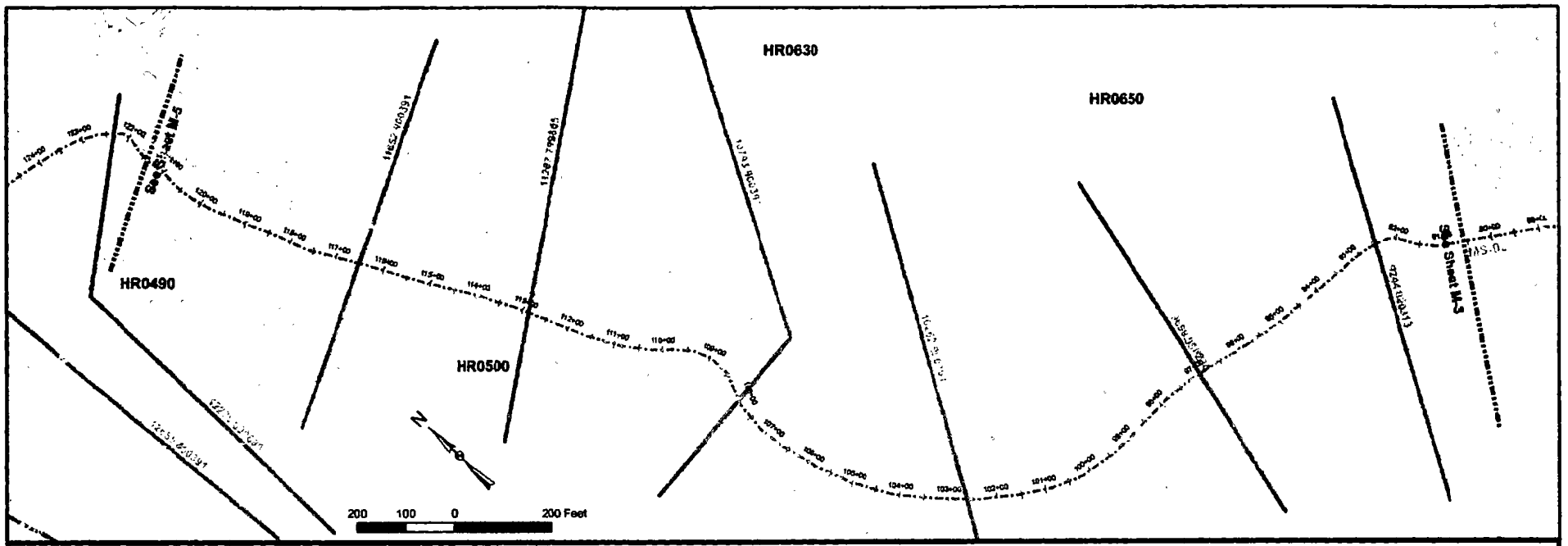
URS
9980 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

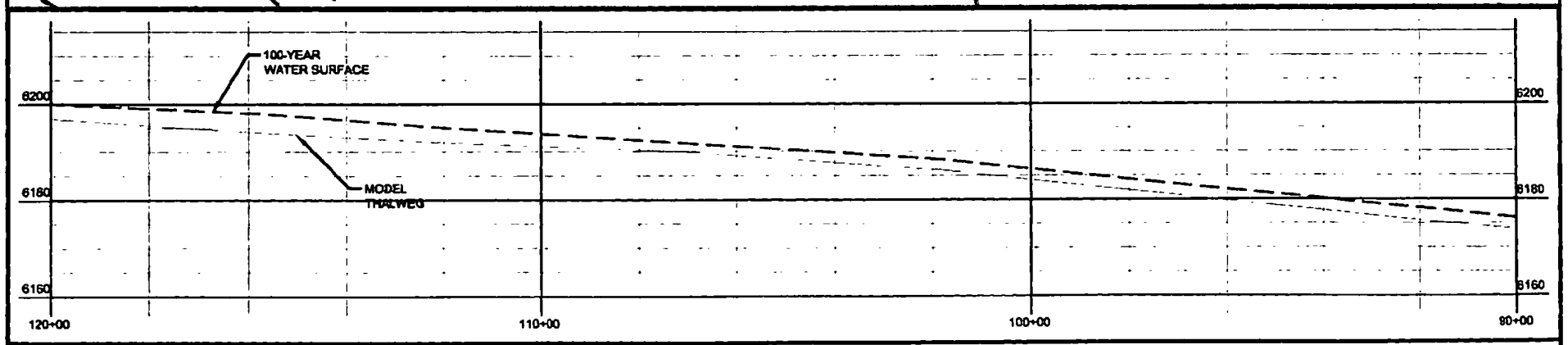
Haegler Basin Boundary
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 10/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-3
FIGURE 5-4

URS NO. 21711039





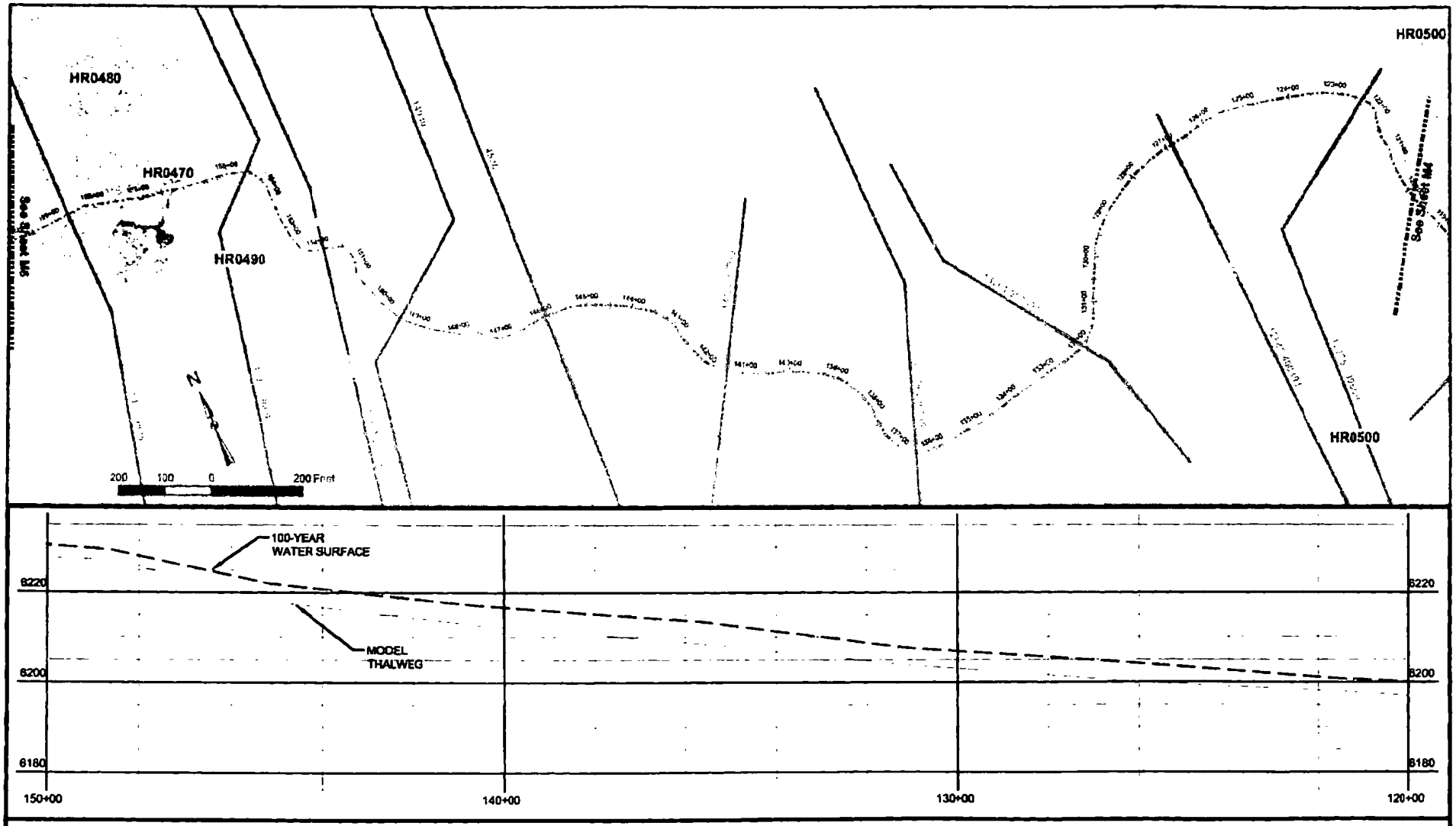
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-4
FIGURE 5-4

URS NO. 21711039



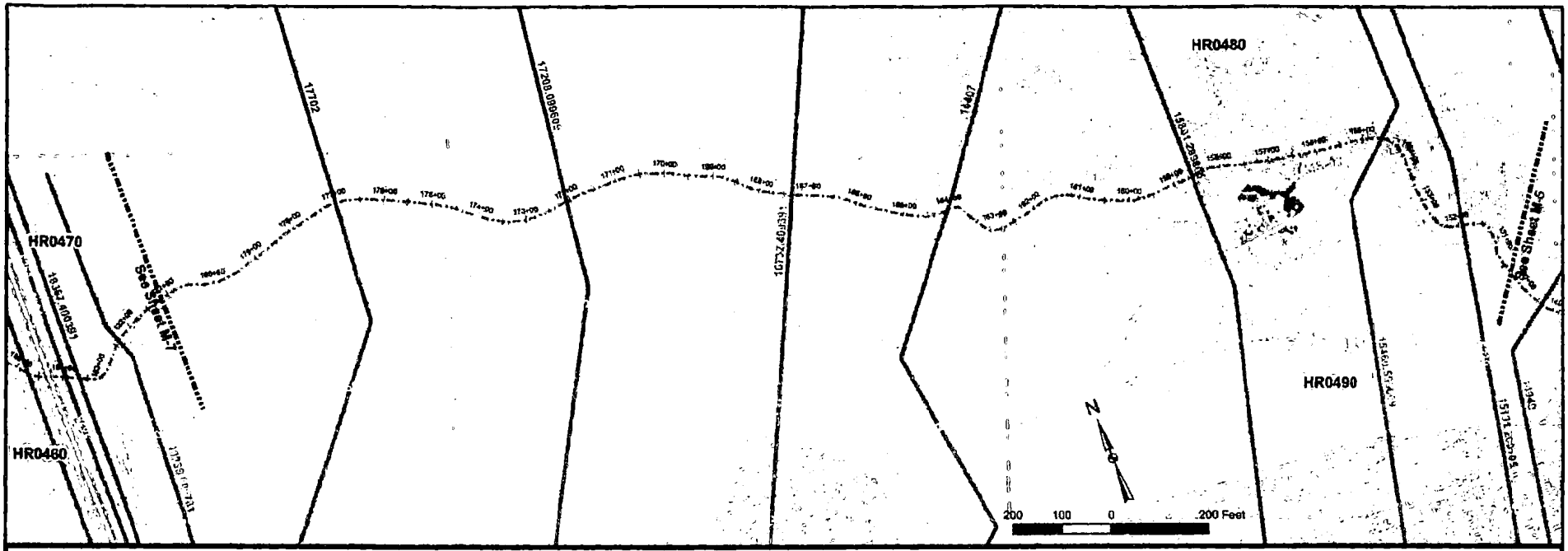
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

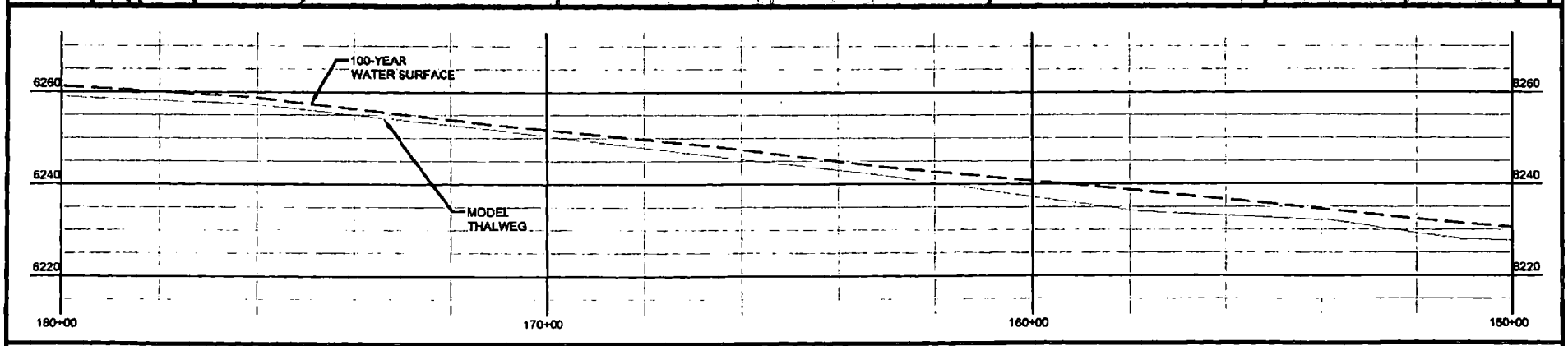
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-5
FIGURE 5-4

URS NO. 21711039





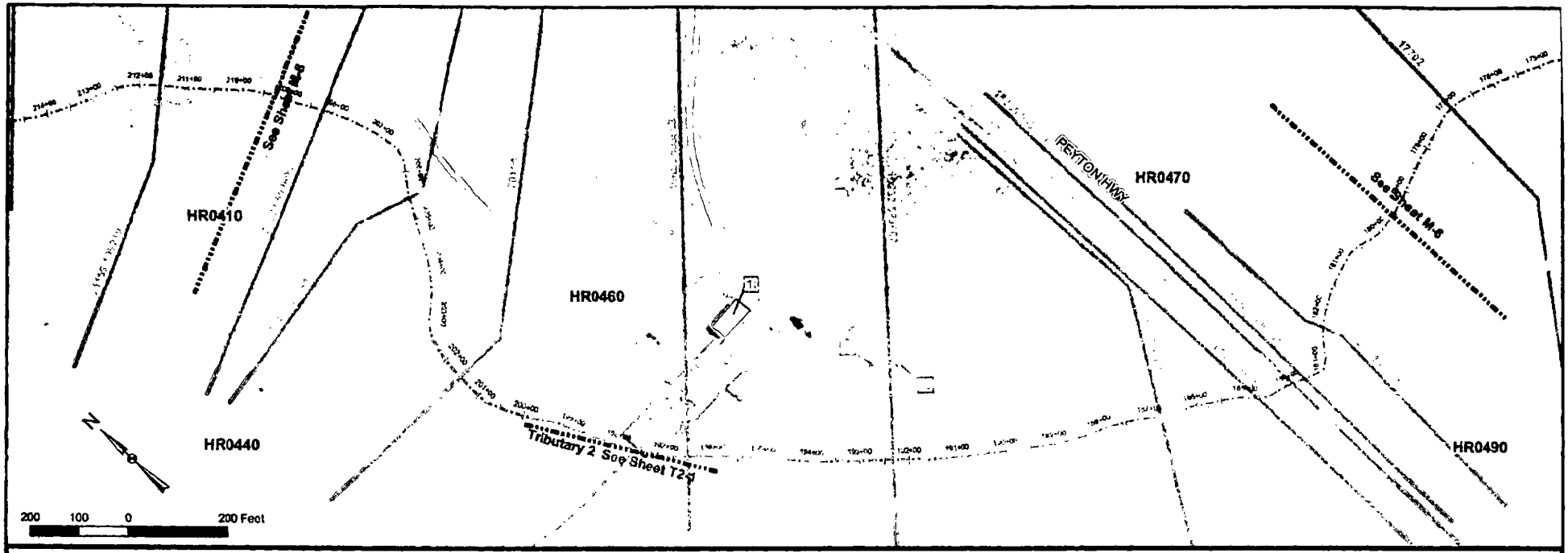
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

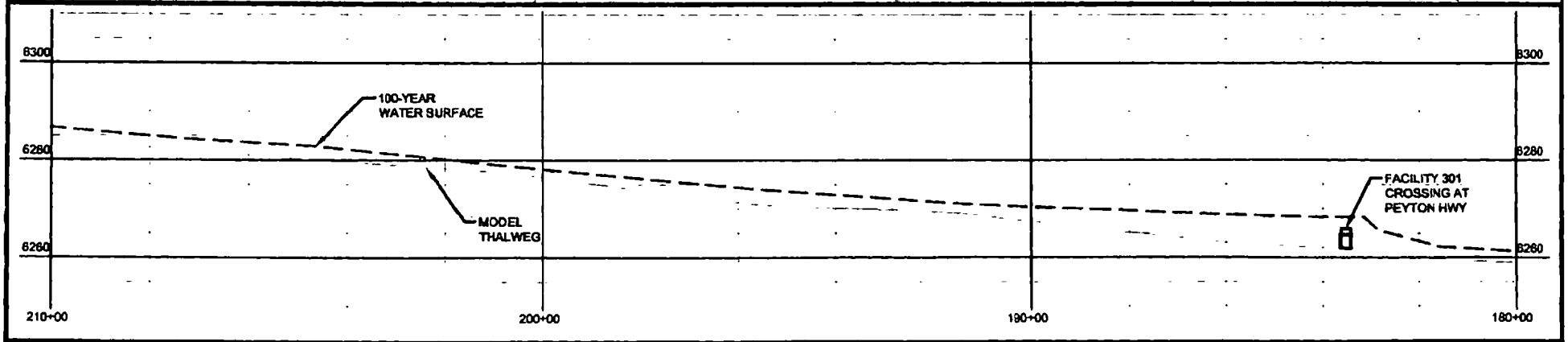
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-6
FIGURE 5-4

DATE: 05/08

URS NO. 21711039





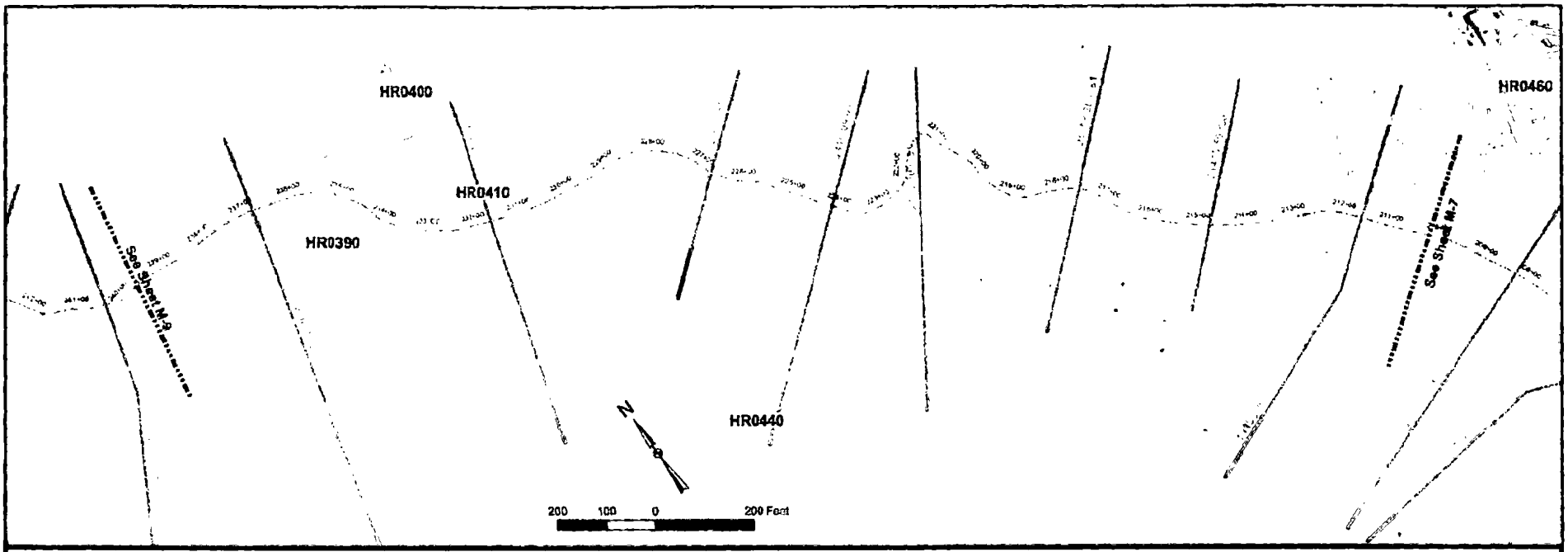
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

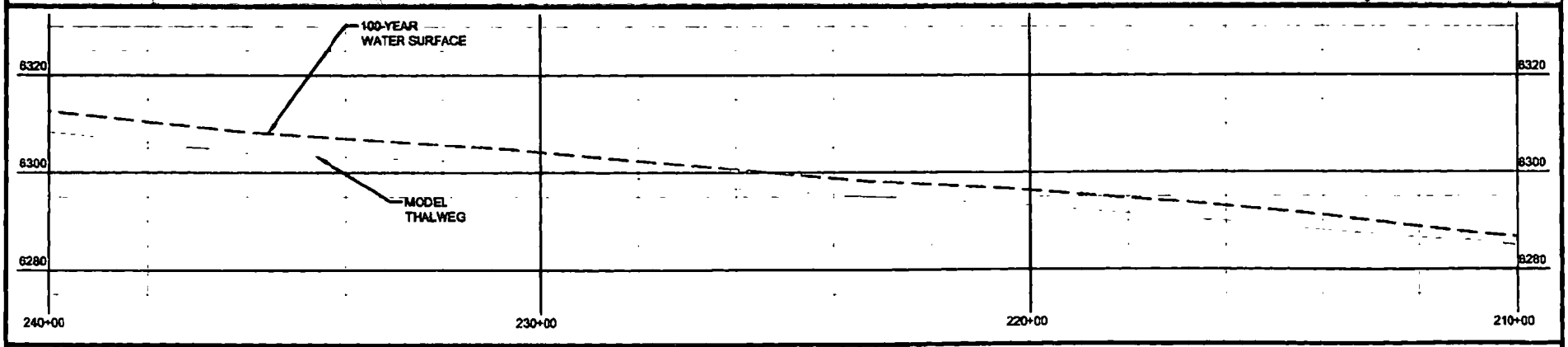
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-7
FIGURE 5-4

URS NO. 21711039





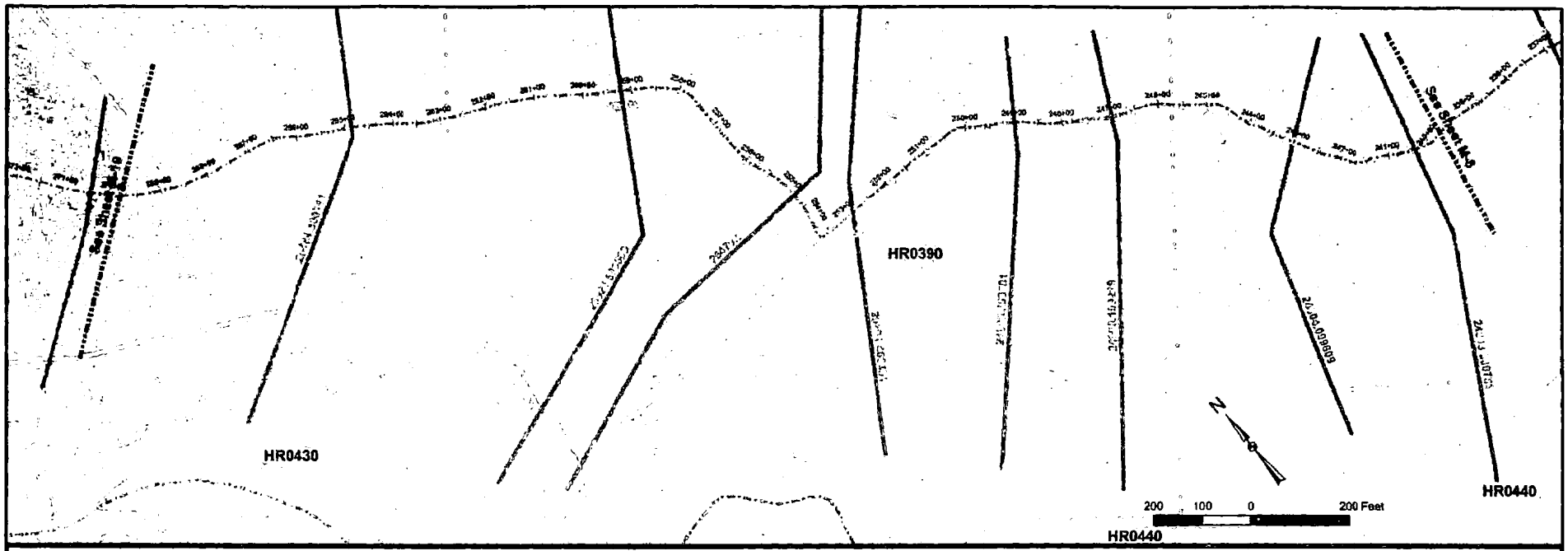
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

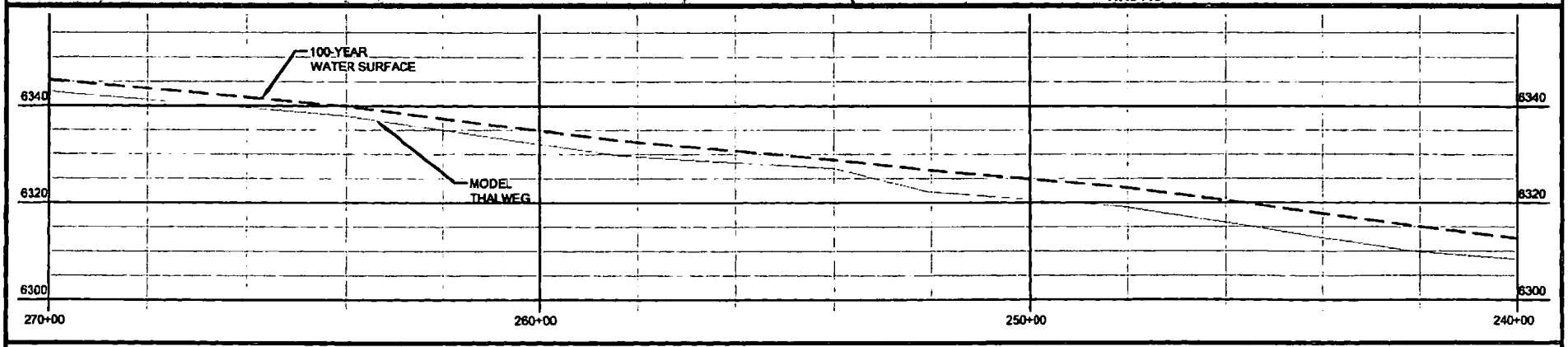
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-8
FIGURE 5-4

URS NO. 21711039





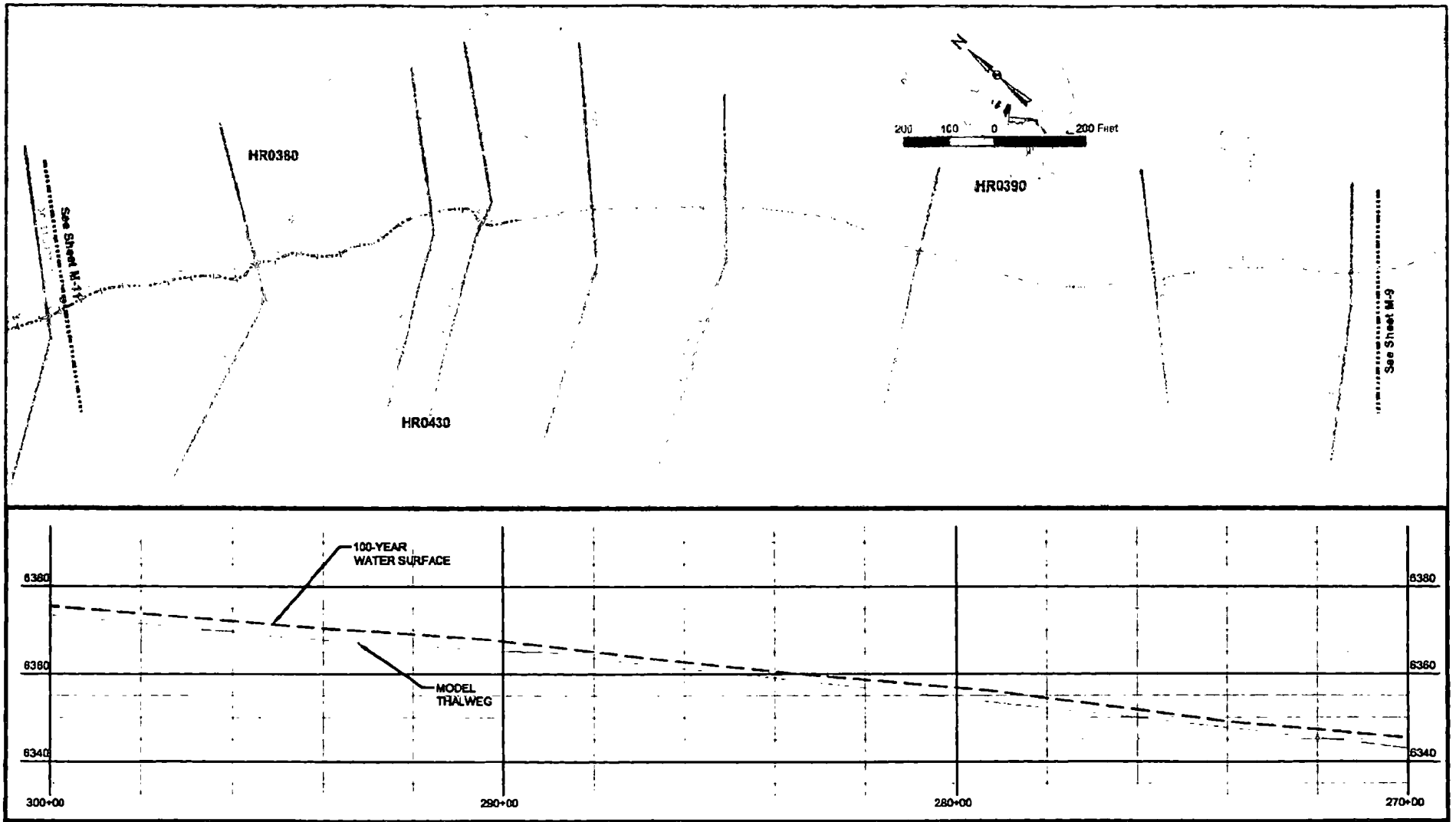
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-9
FIGURE 5-4

URS NO. 21711039



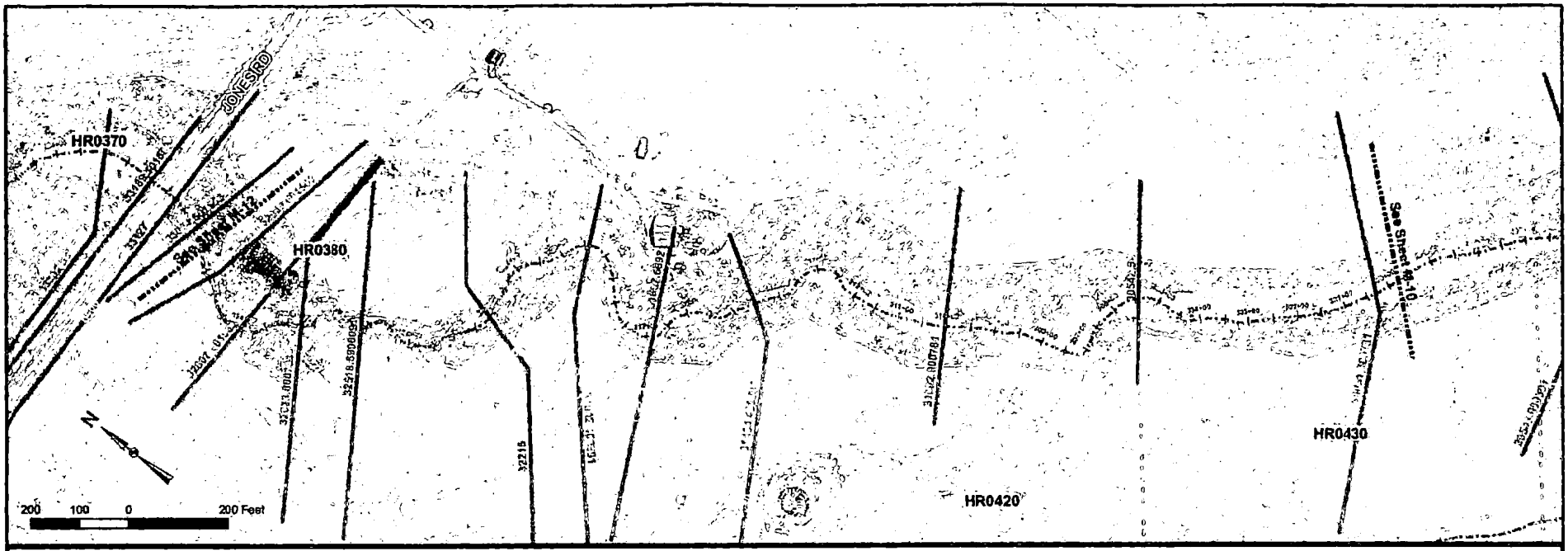
URS
6960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

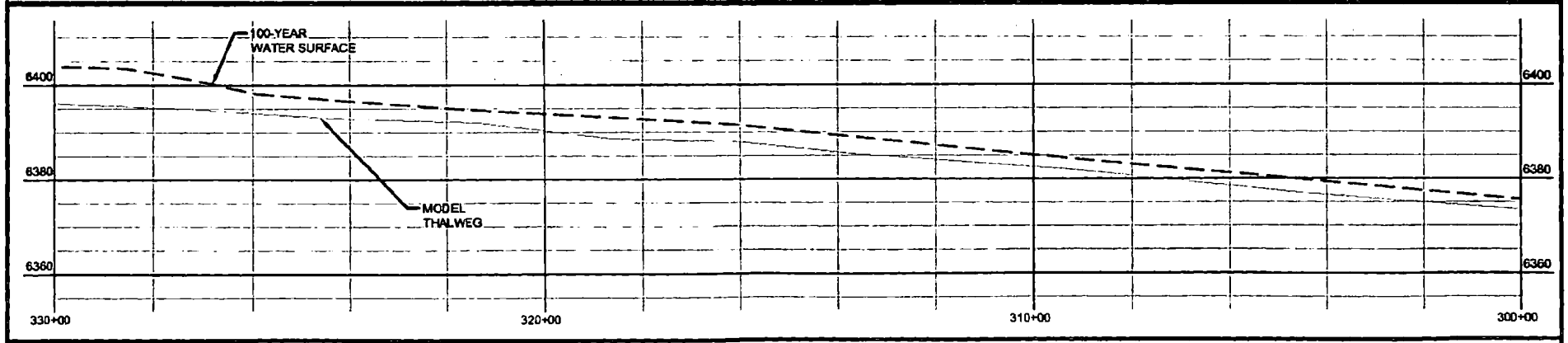
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-10
FIGURE 5-4

URS NO. 21711039





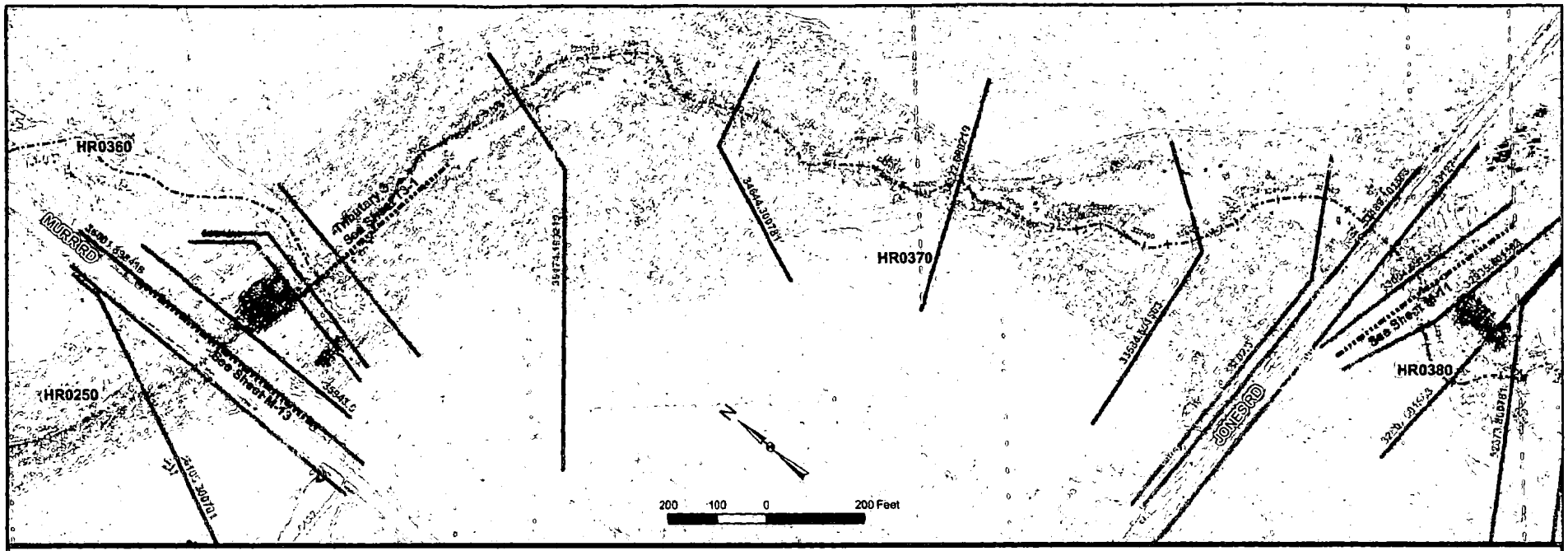
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

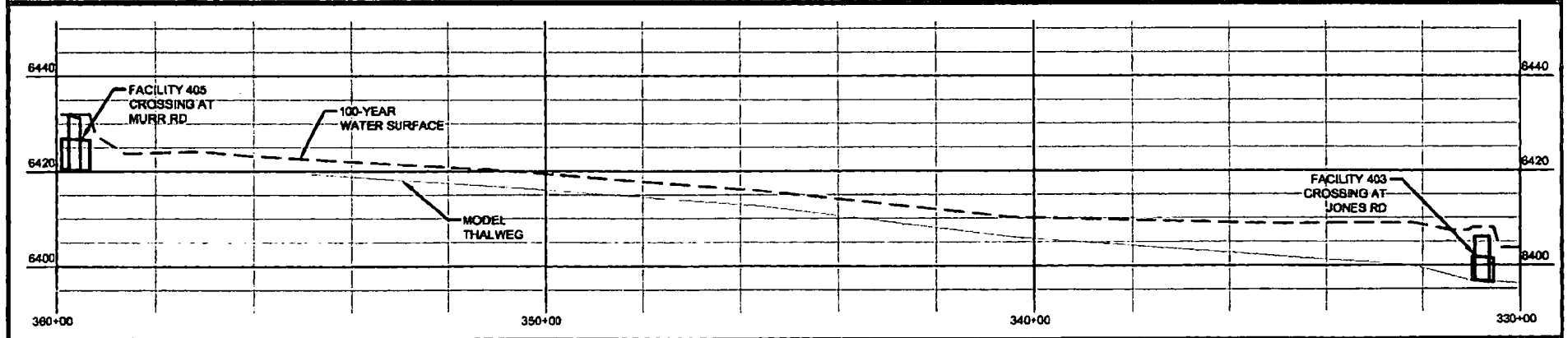
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-11
FIGURE 5-4

URS NO. 21711039





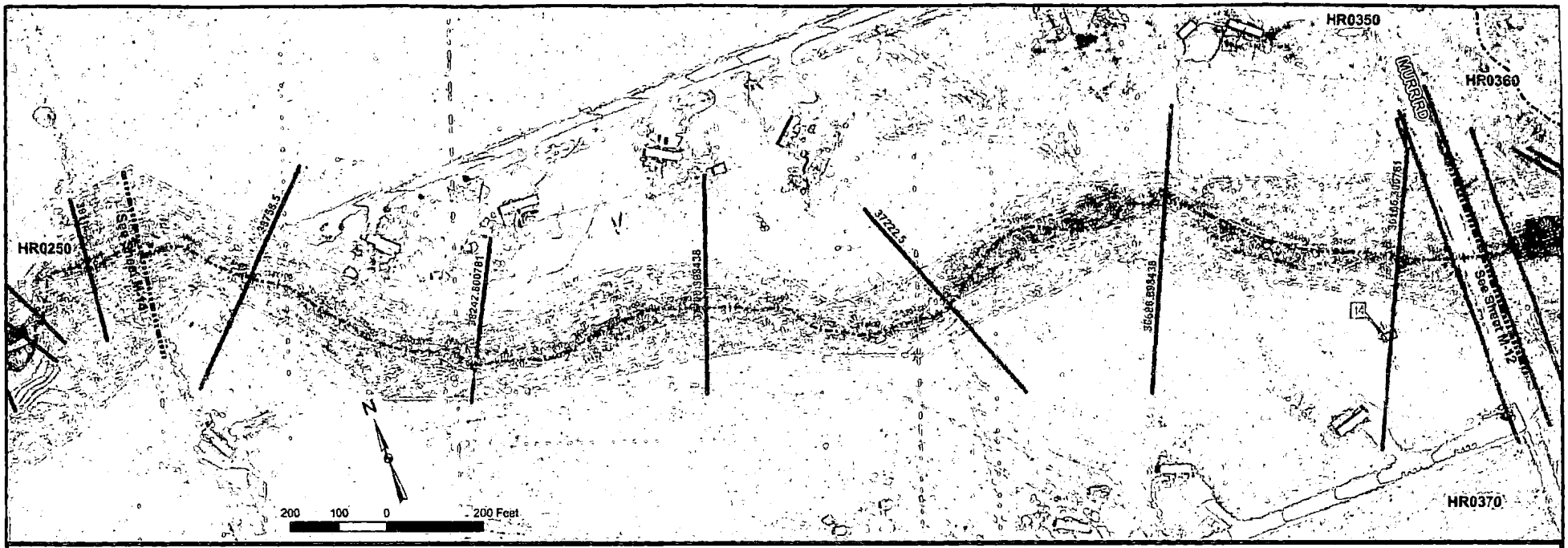
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

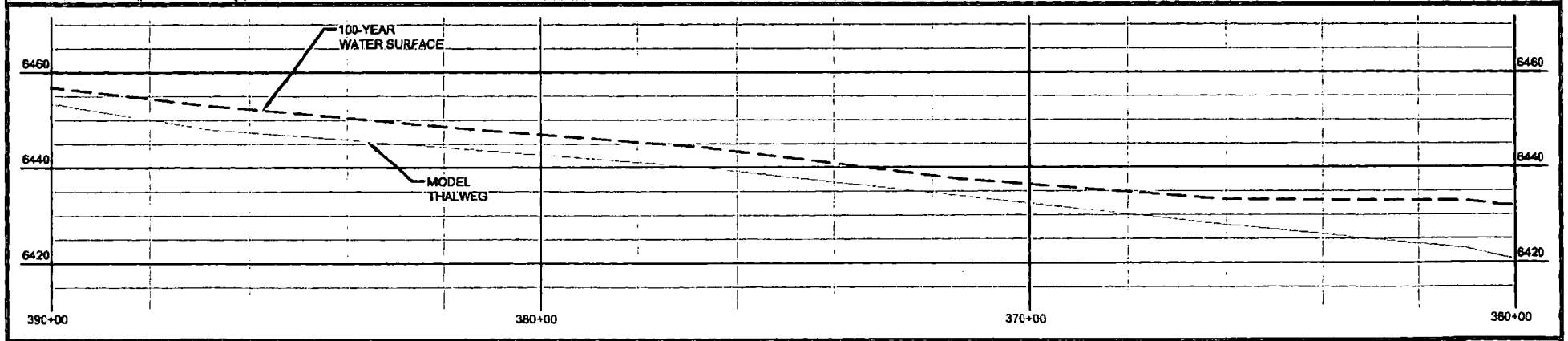
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-12
FIGURE 5-4

URS NO. 21711039





URS

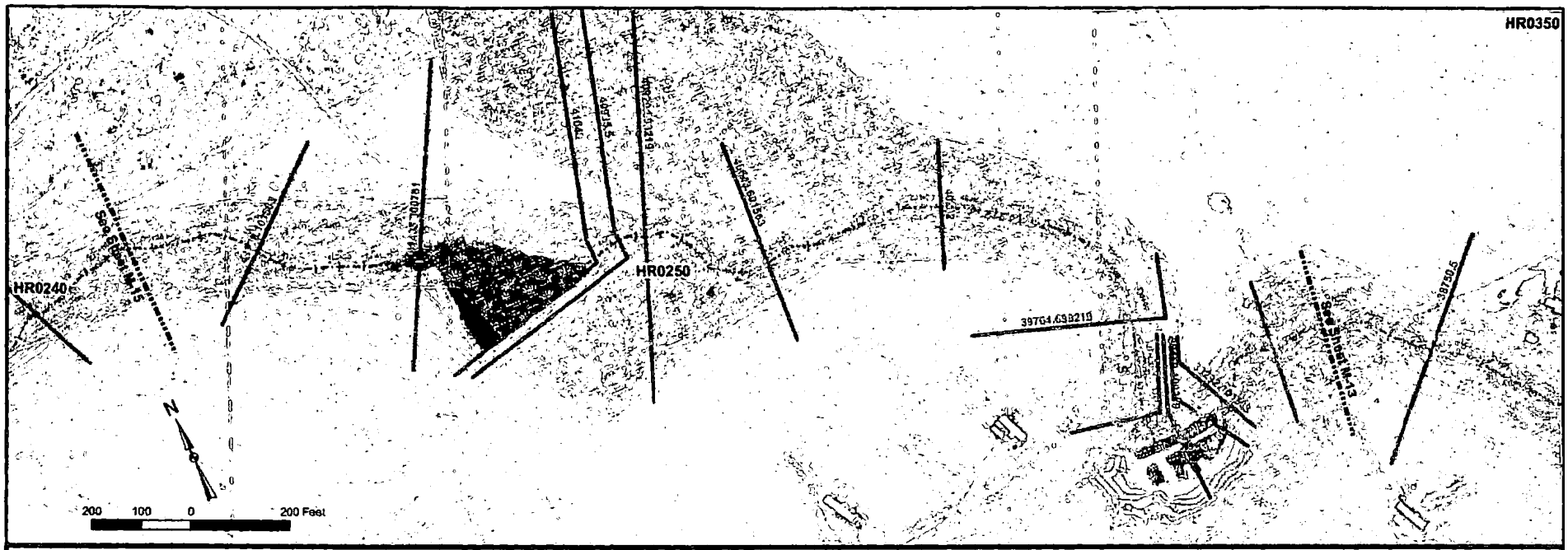
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

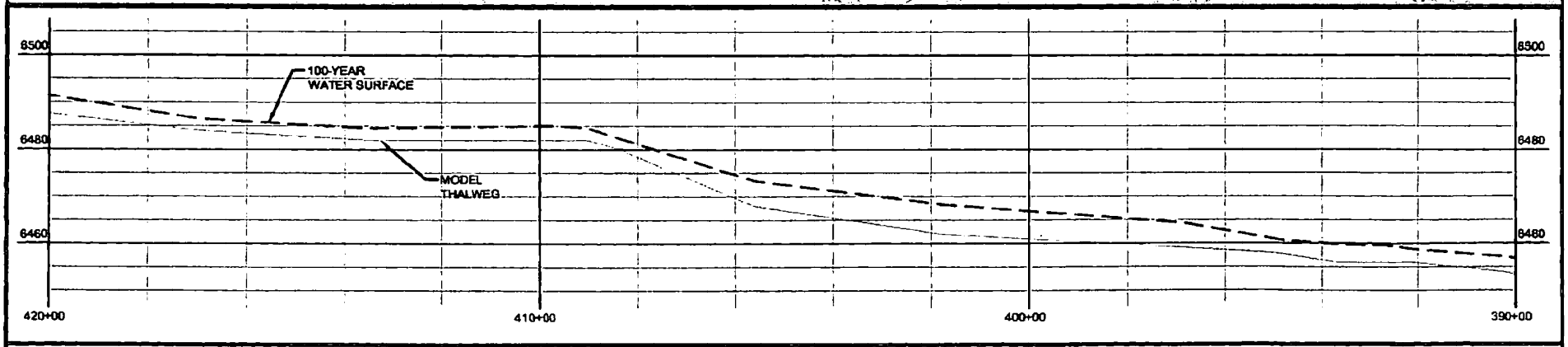
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-13
FIGURE 5-4

DATE: 05/08

URS NO. 21711039





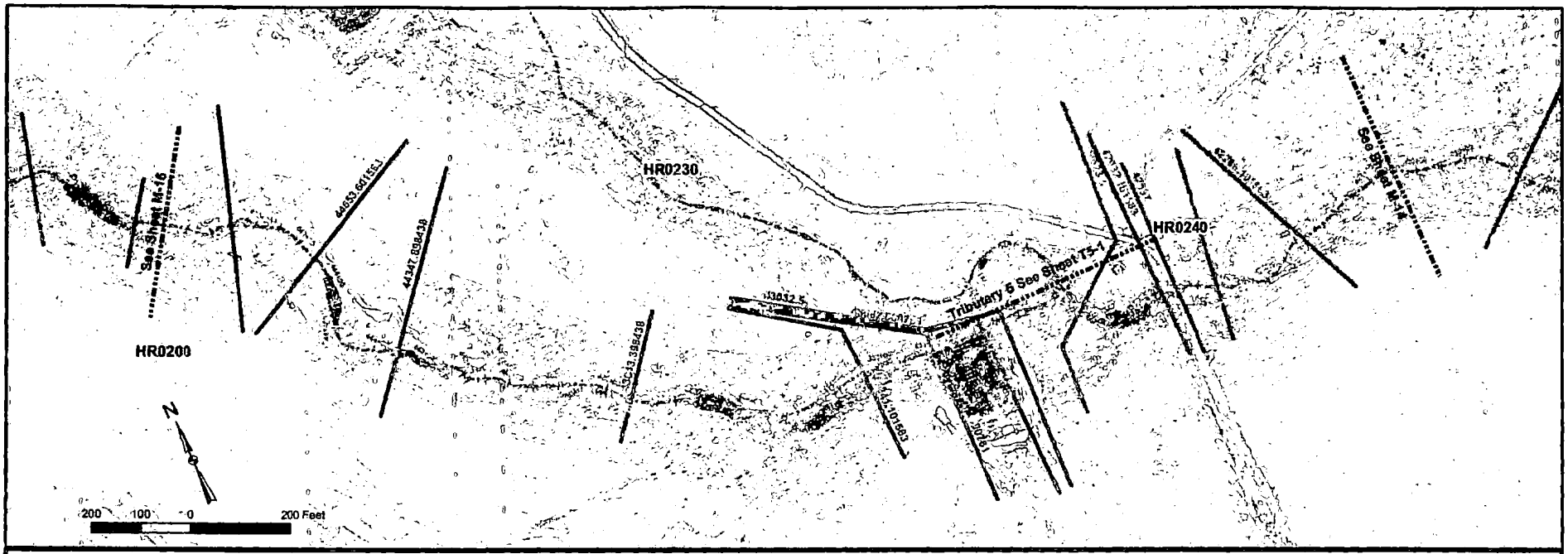
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

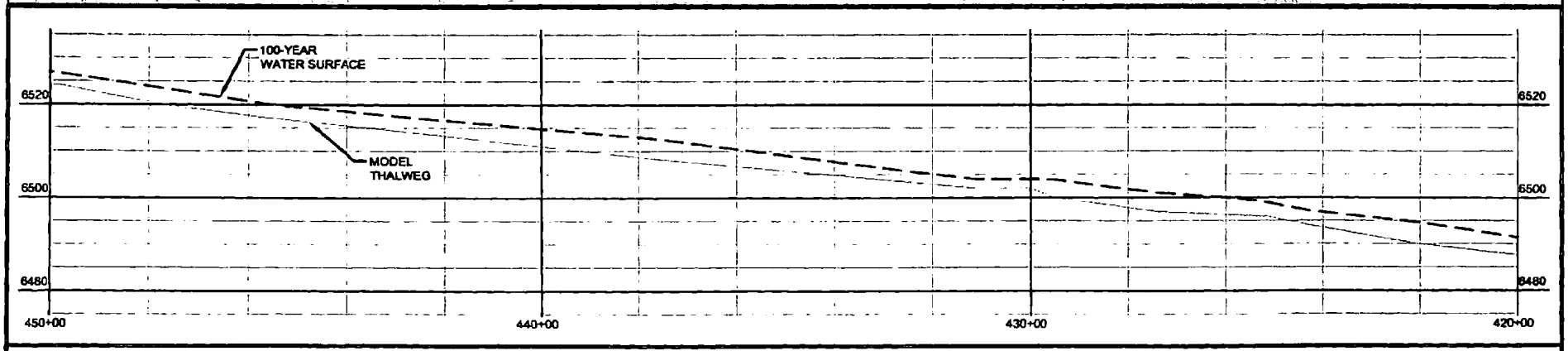
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-14
FIGURE 5-4

URS NO. 21711039





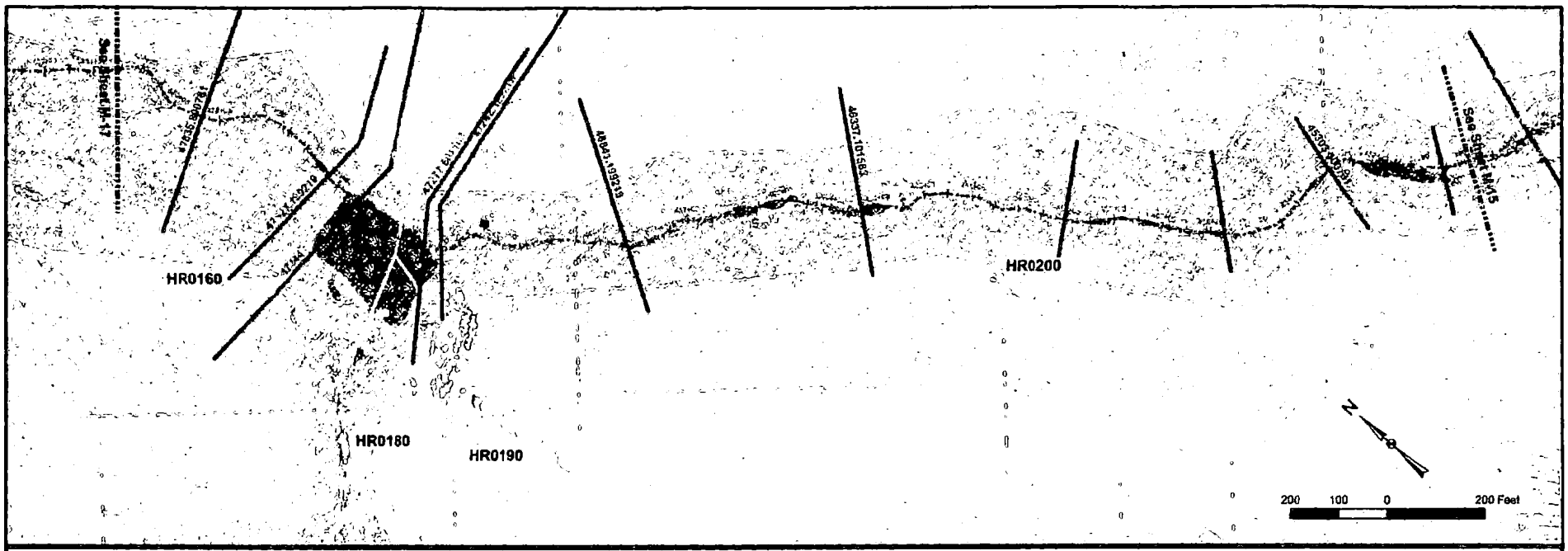
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

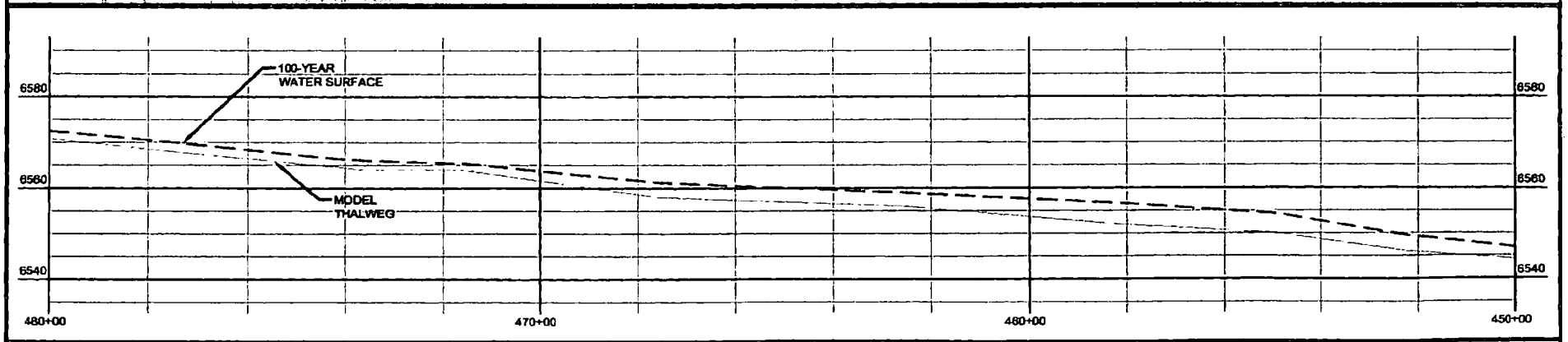
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-15
FIGURE 5-4

URS NO. 21711039





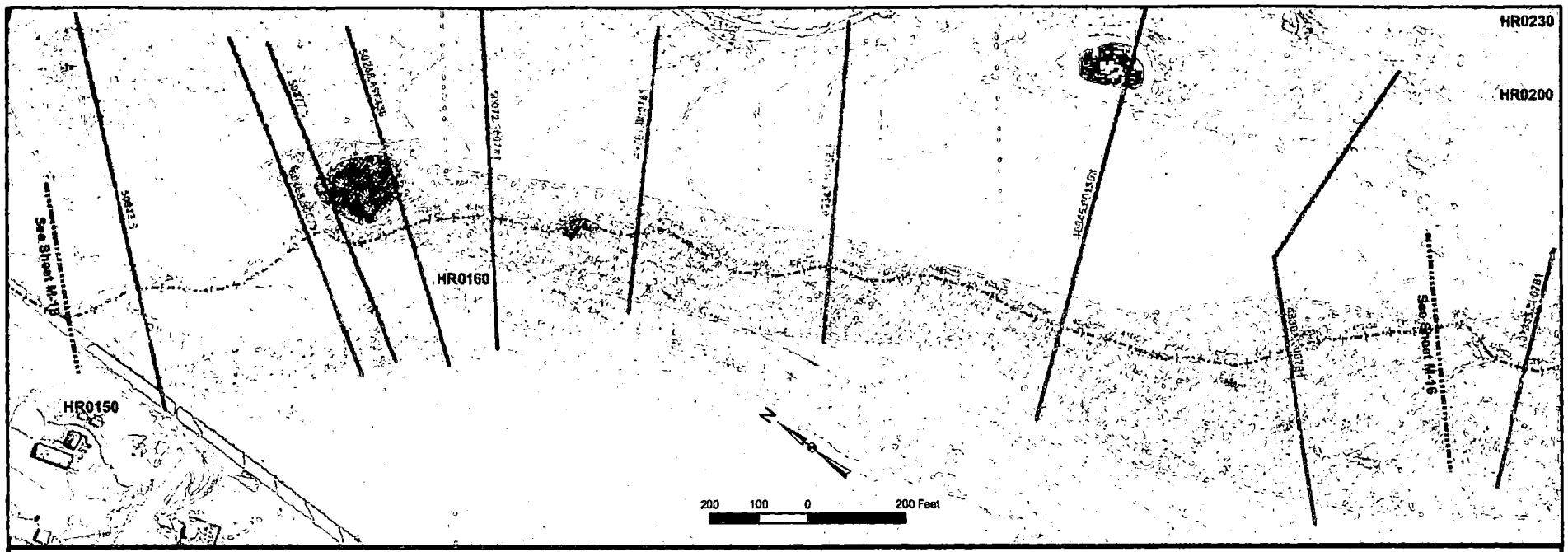
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

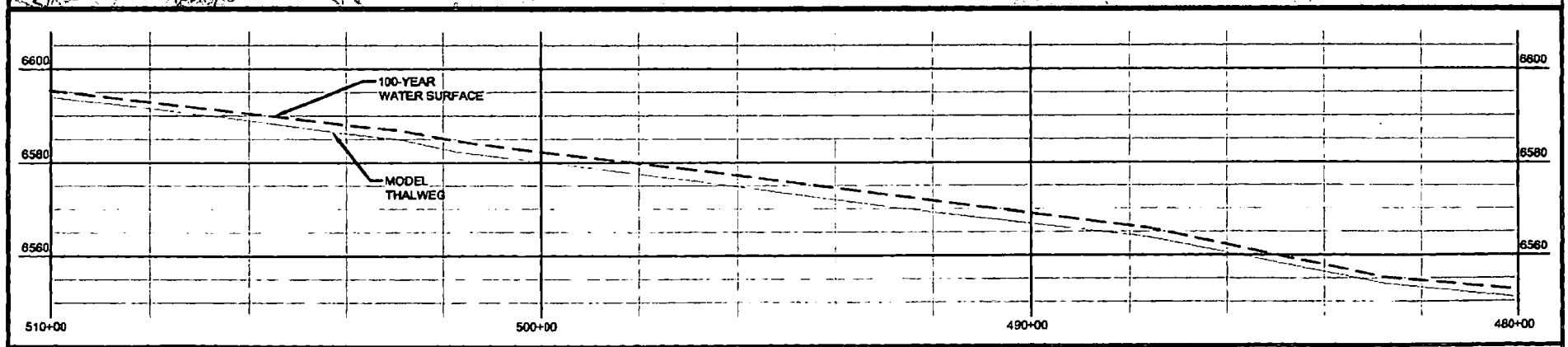
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-16
FIGURE 5-4

URS NO. 21711039





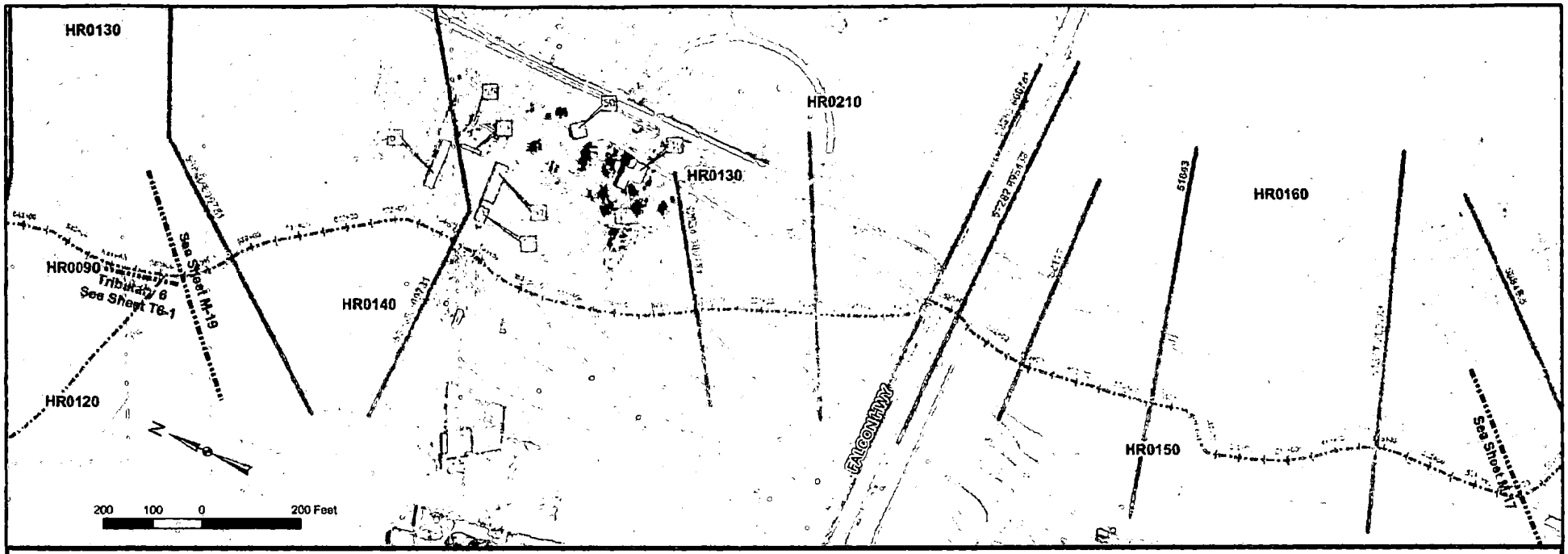
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

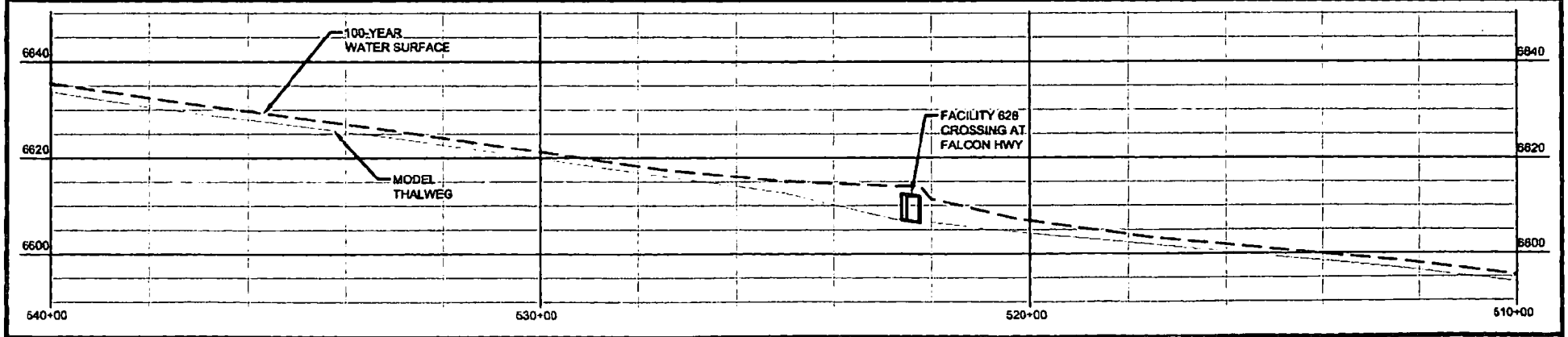
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-17
FIGURE 5-4

URS NO. 21711039





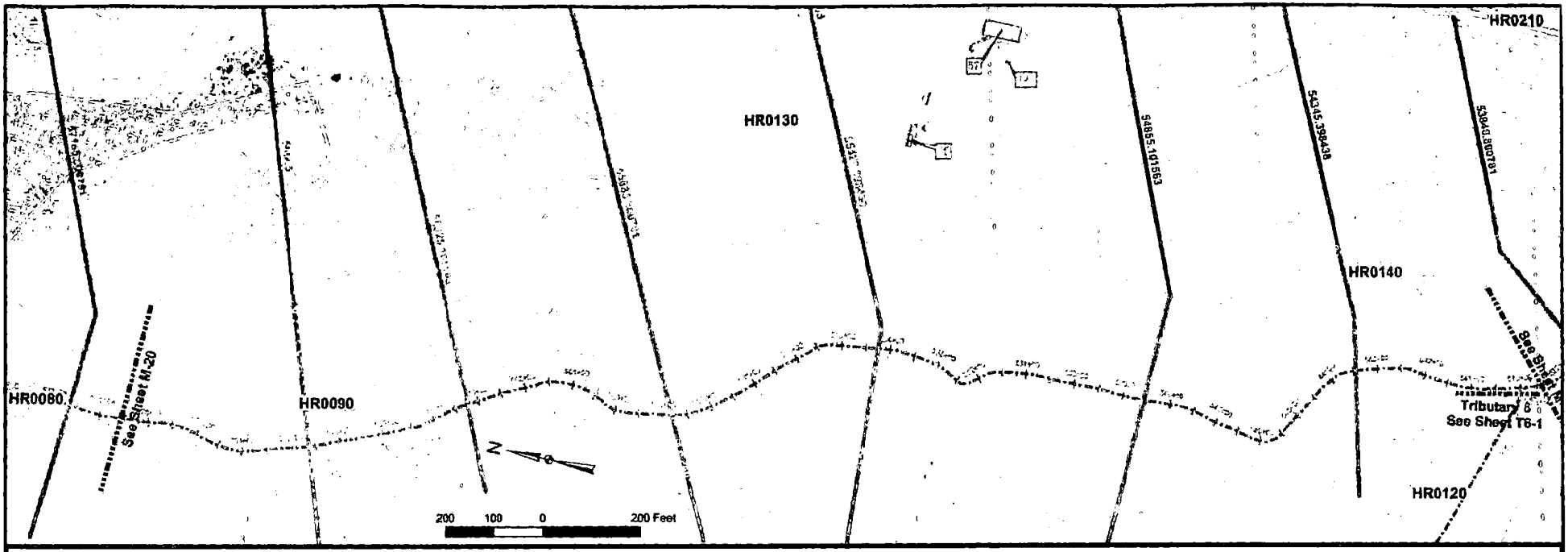
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

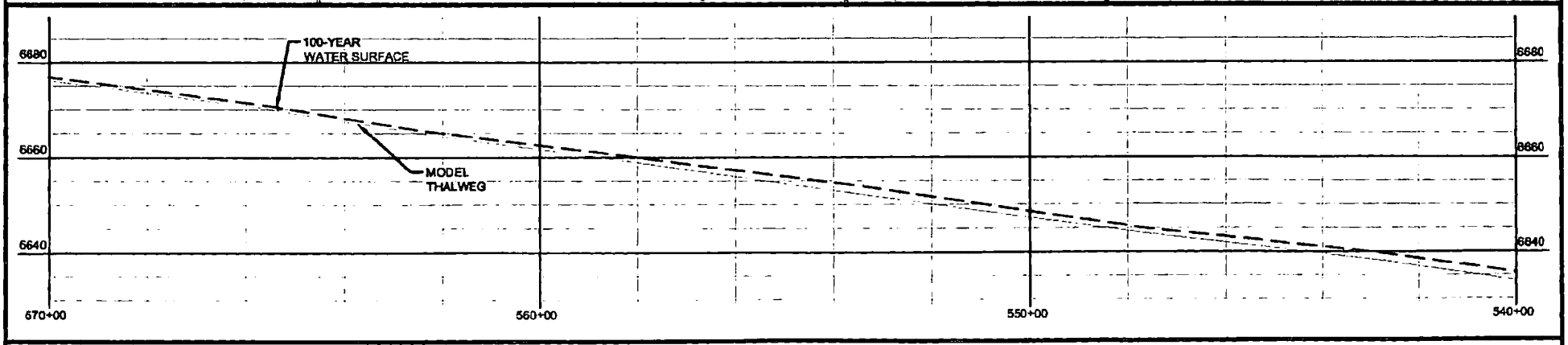
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-18
FIGURE 5-4

URS NO. 21711039





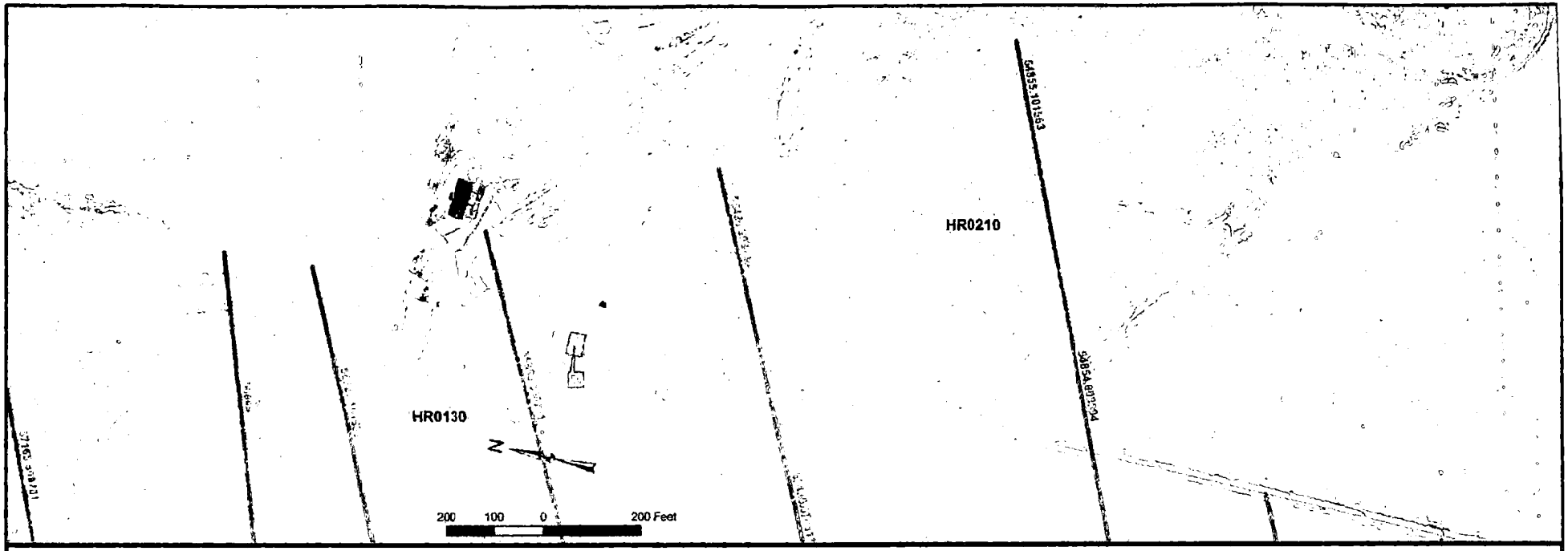
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

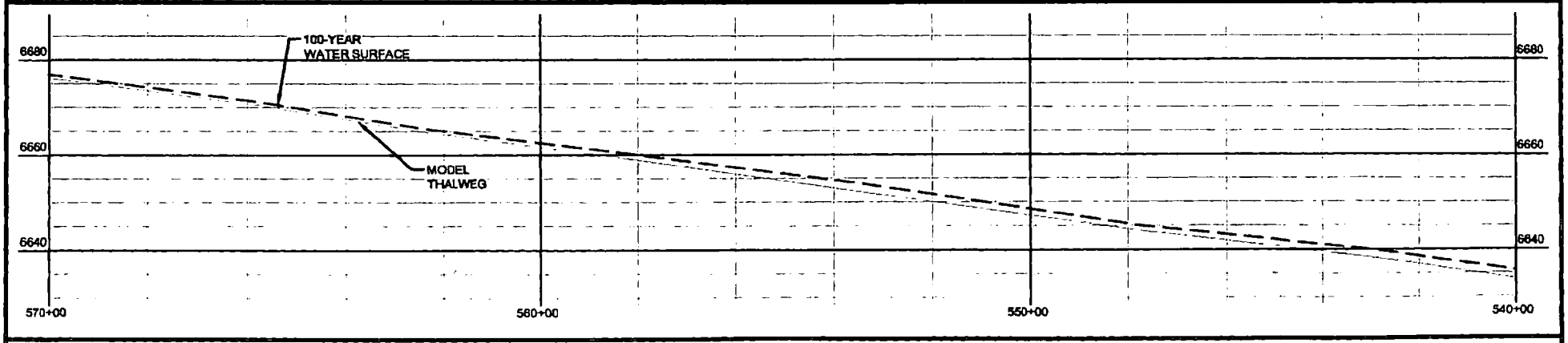
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-19
FIGURE 5-4

URS NO. 21711039





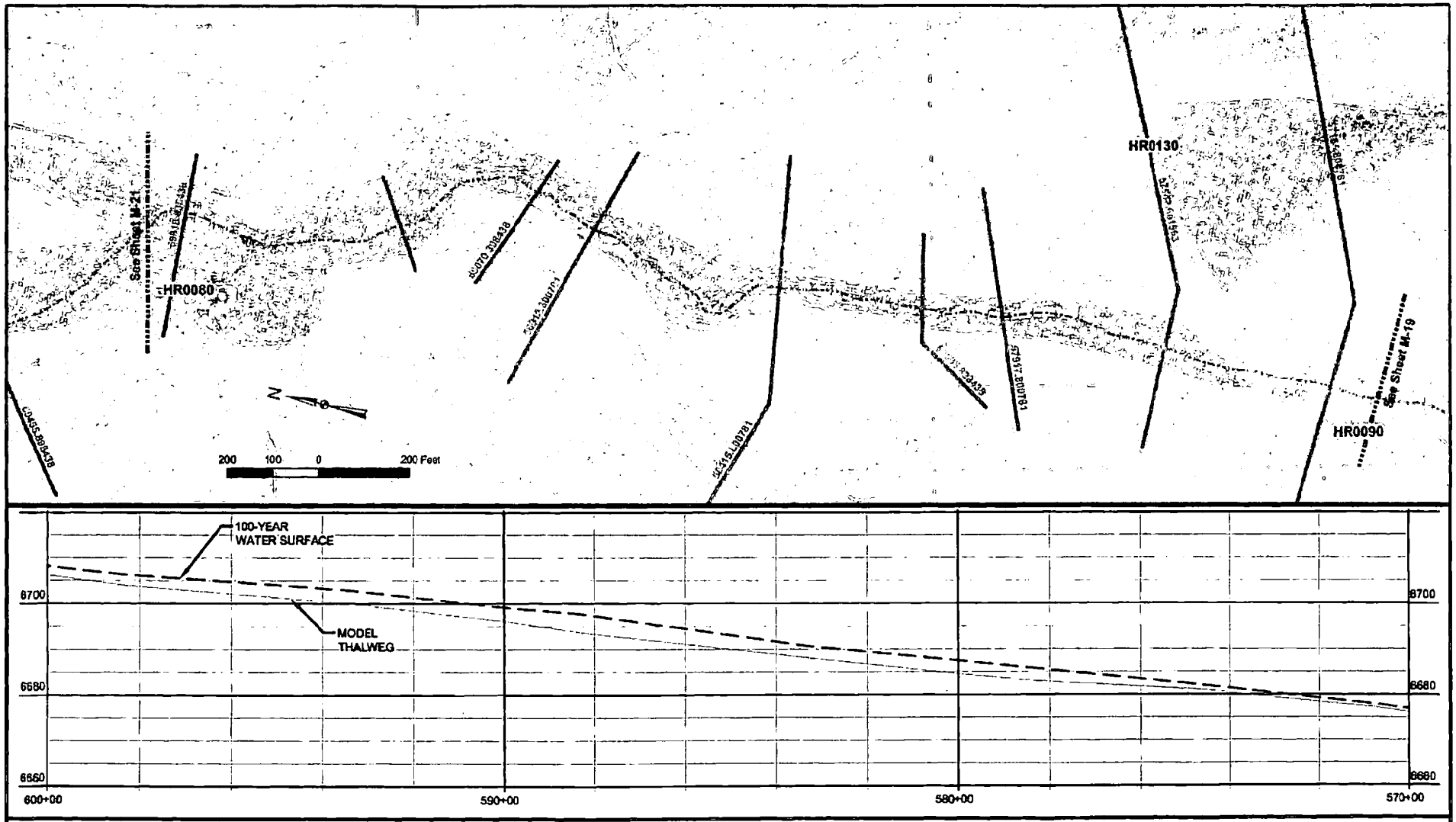
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-19A
FIGURE 5-4

URS NO. 21711039



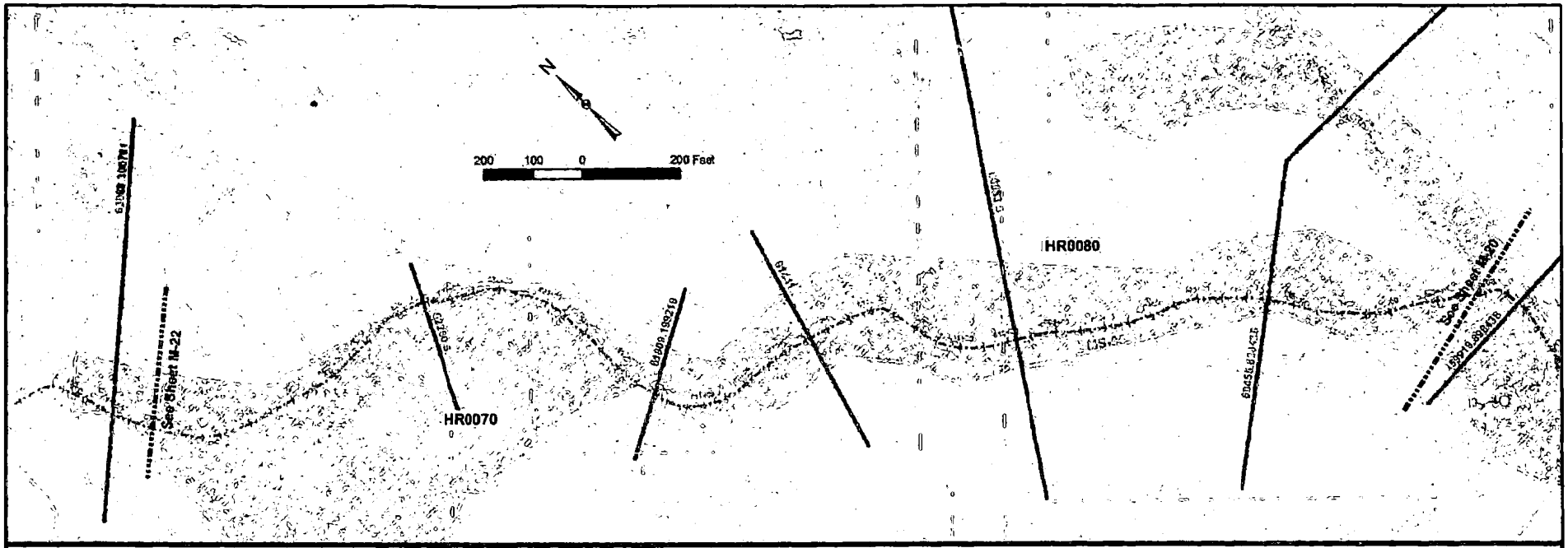
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

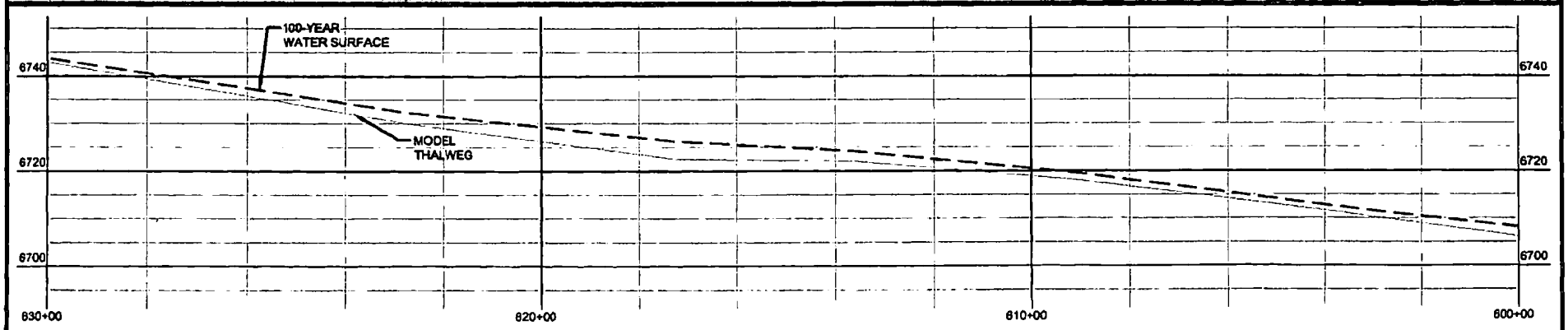
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-20
FIGURE 5-4

URS NO. 21711039





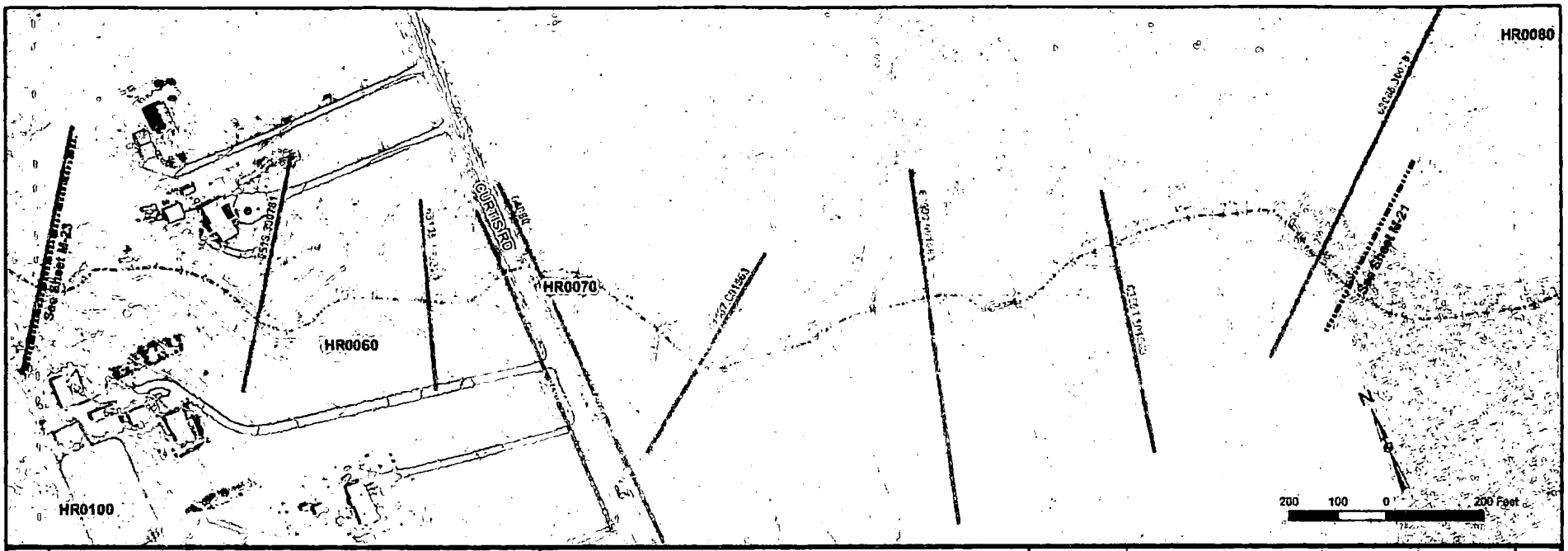
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

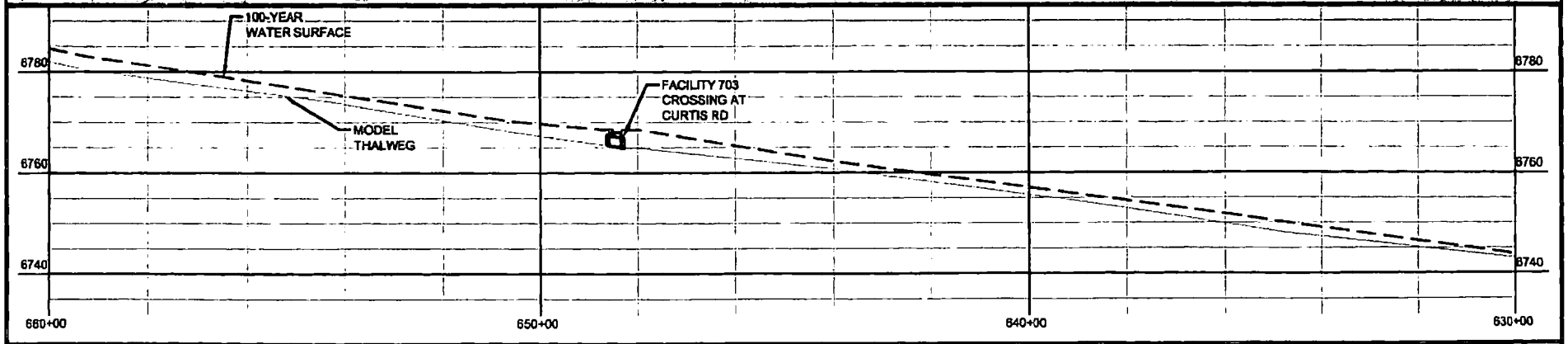
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-21
FIGURE 5-4

URS NO. 21711039





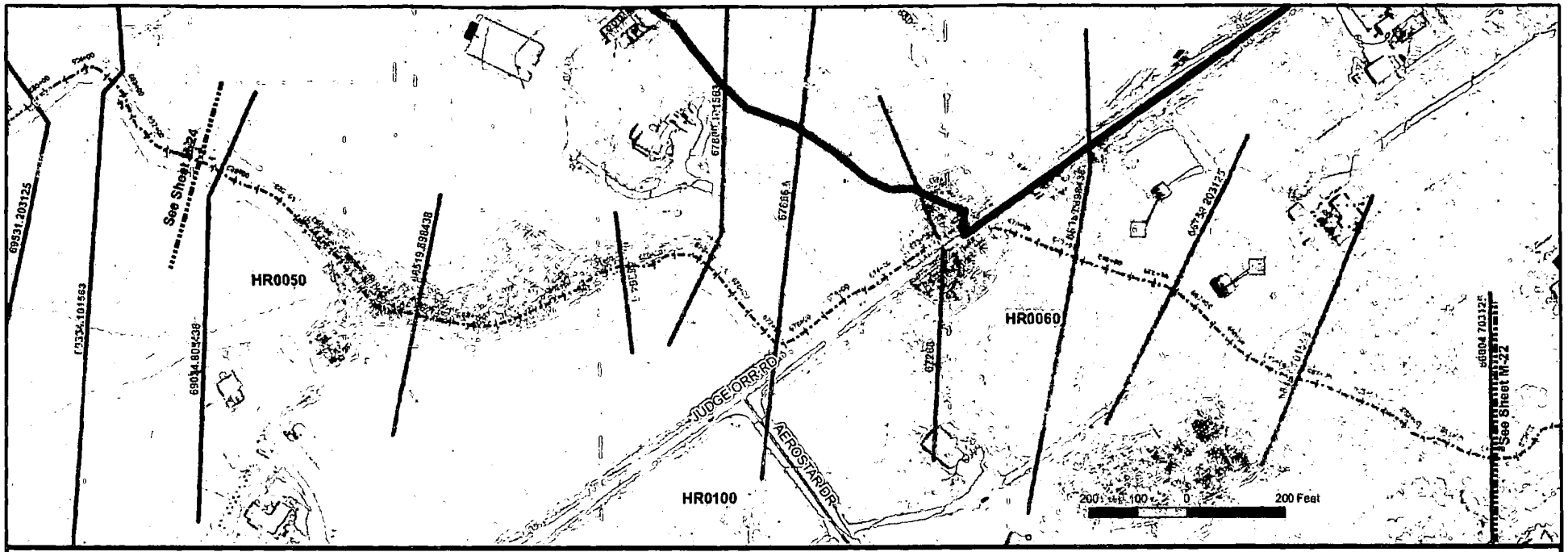
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

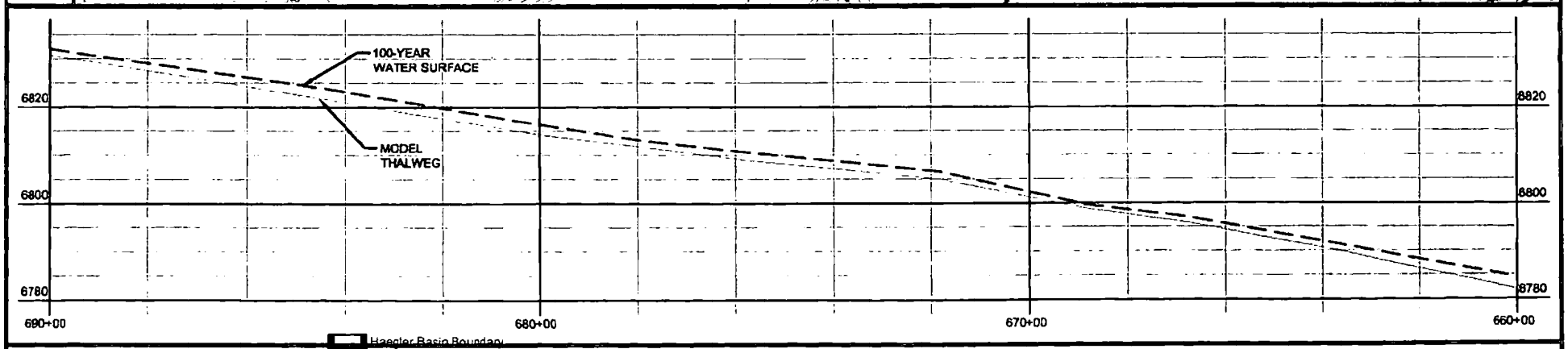
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-22
FIGURE 5-4

URS NO. 21711039





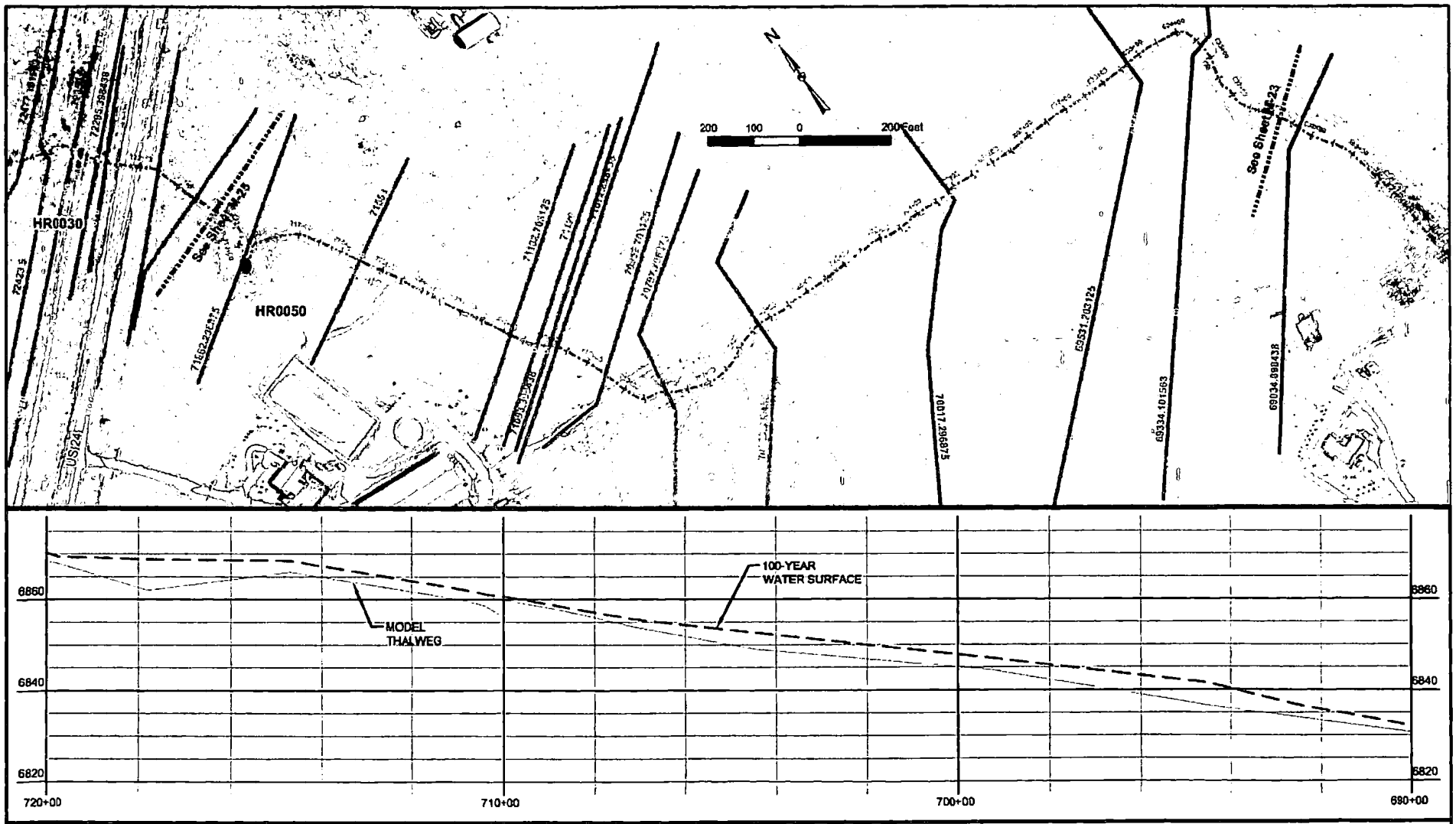
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Haegler Basin Boundary
2' Contours
Potential Wetlands
Subbasin Boundaries

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-23
FIGURE 5-4

URS NO. 21711039



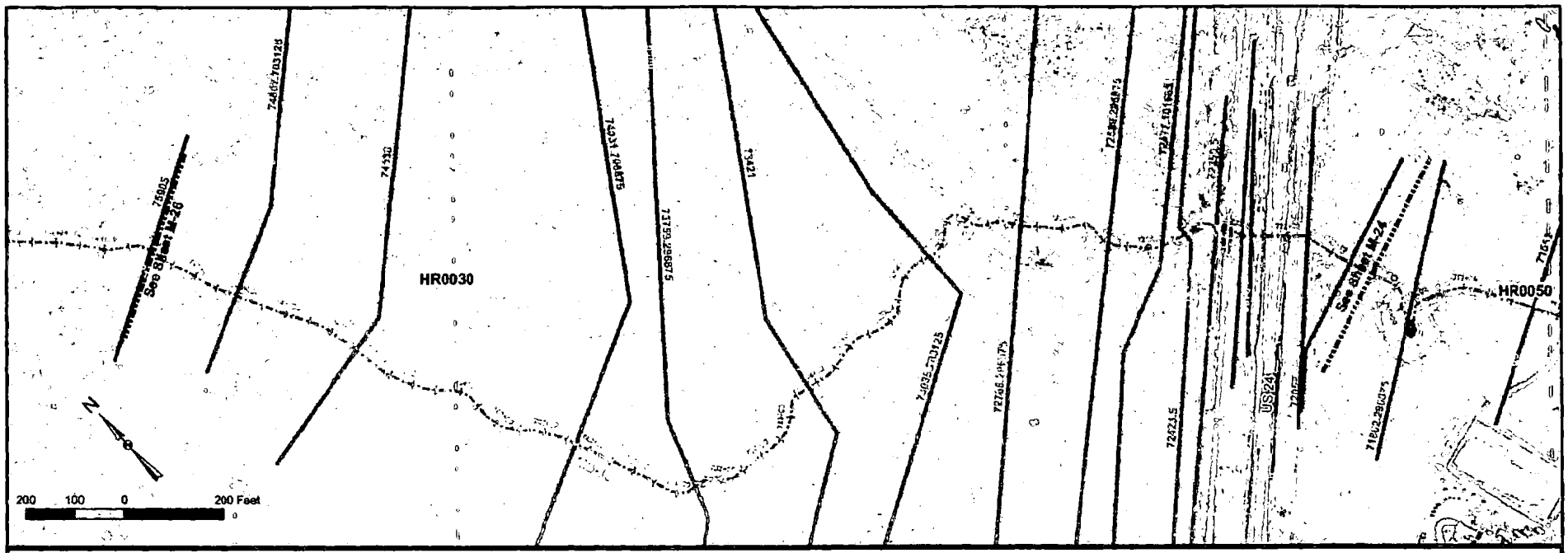
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

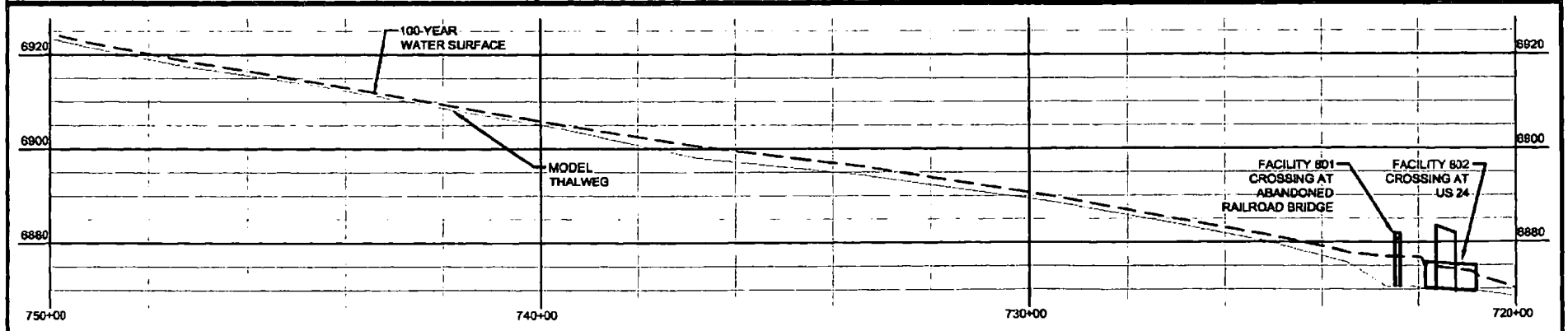
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-24
FIGURE 5-4

URS NO. 21711039





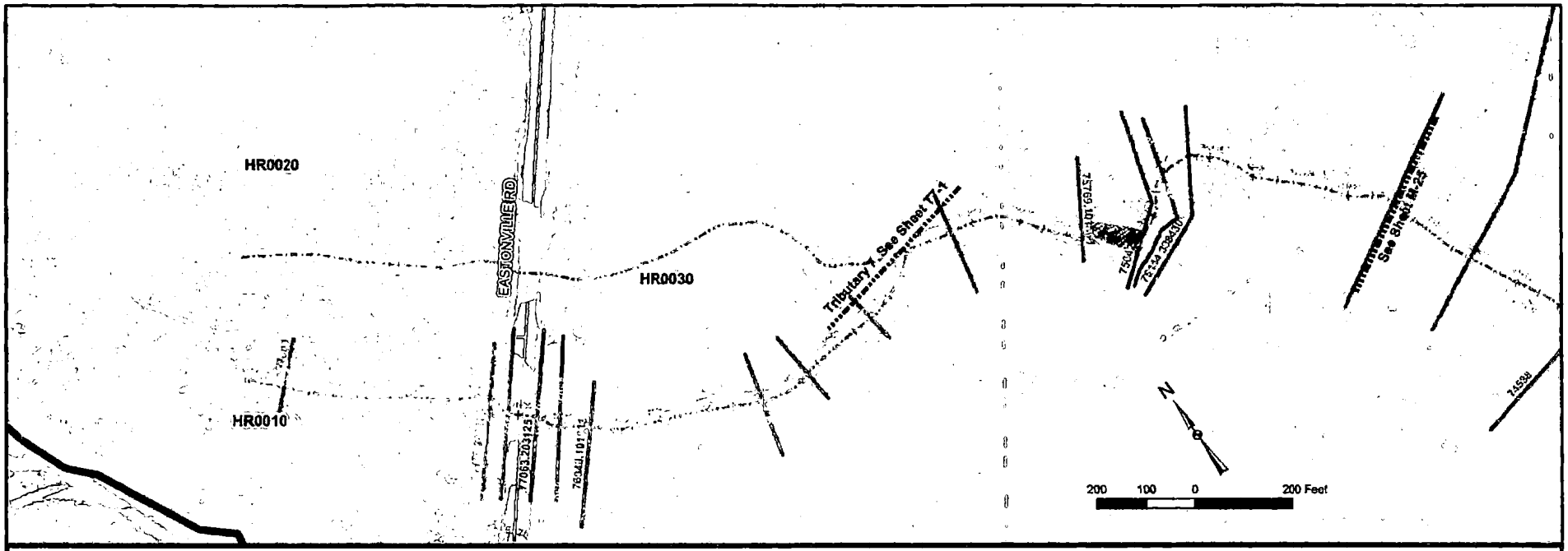
URS
8960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

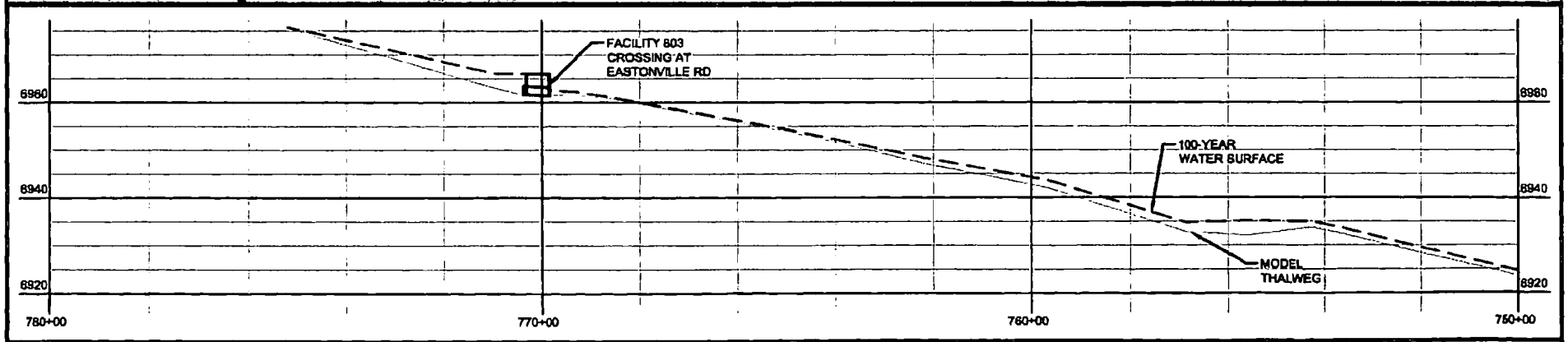
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-25
FIGURE 5-4

URS NO. 21711039





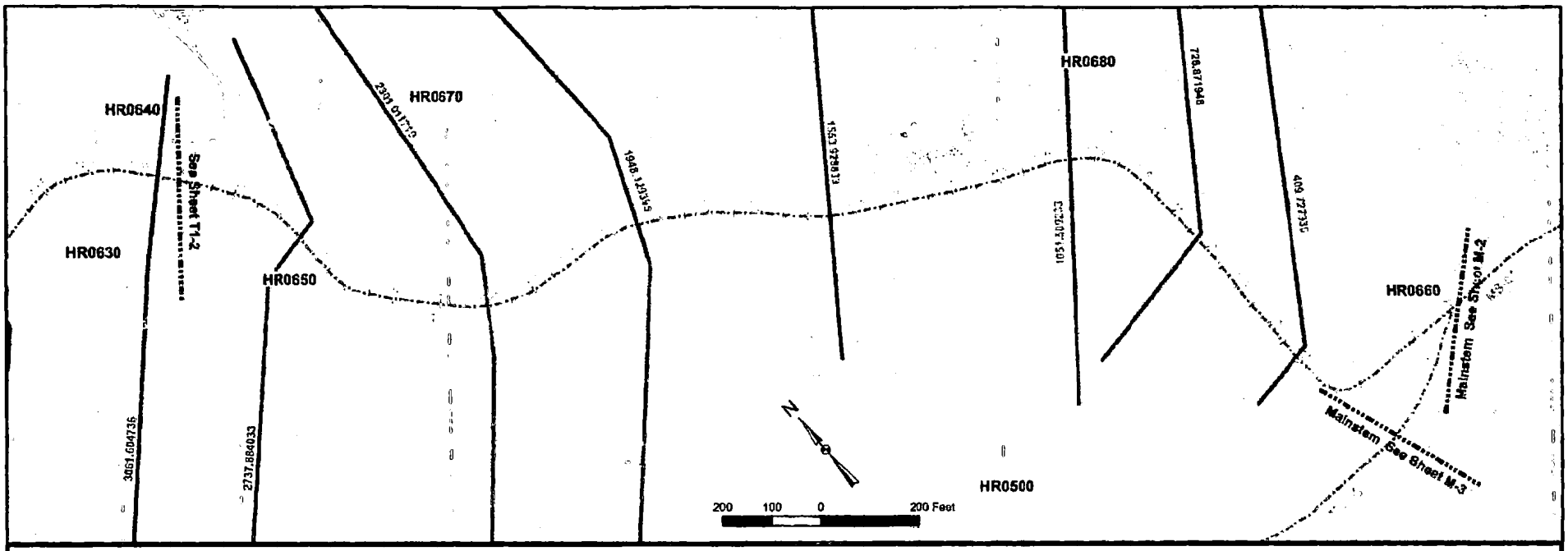
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

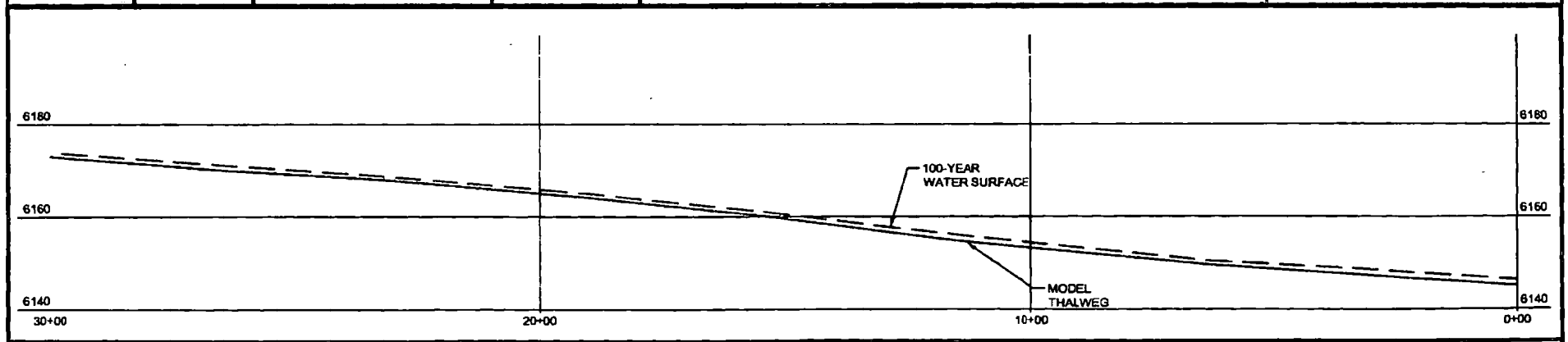
Haegler Basin Boundary
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET M-26
FIGURE 5-4

URS NO. 21711039





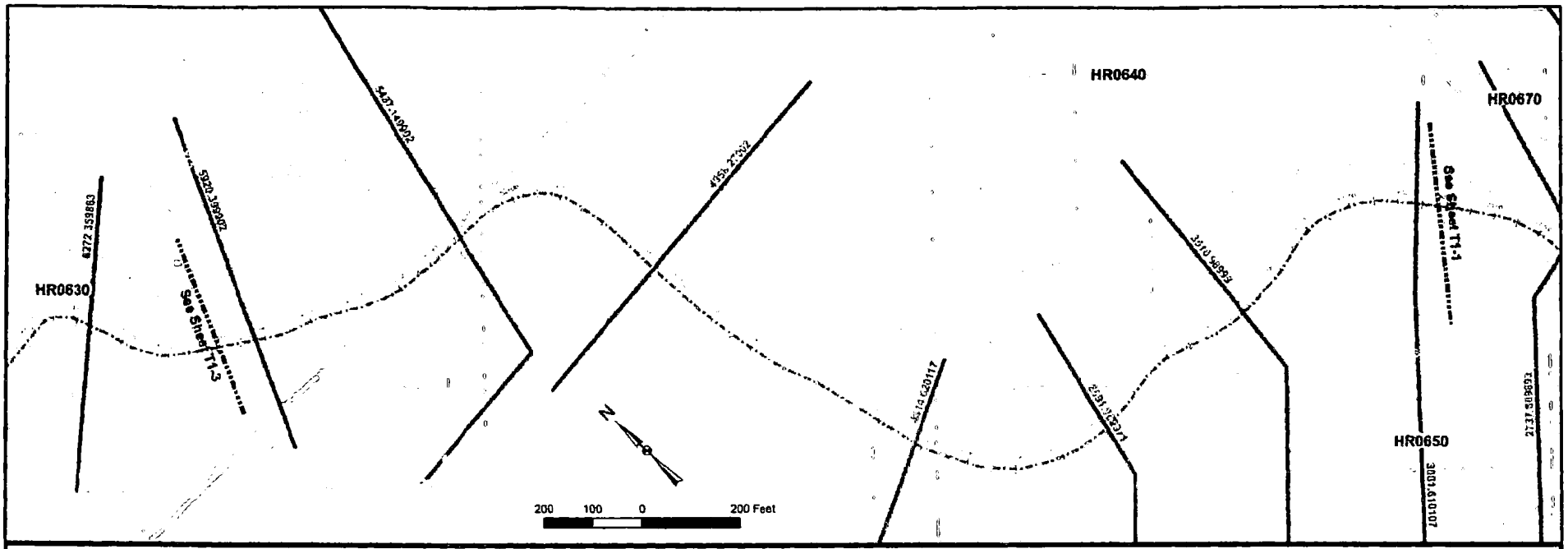
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

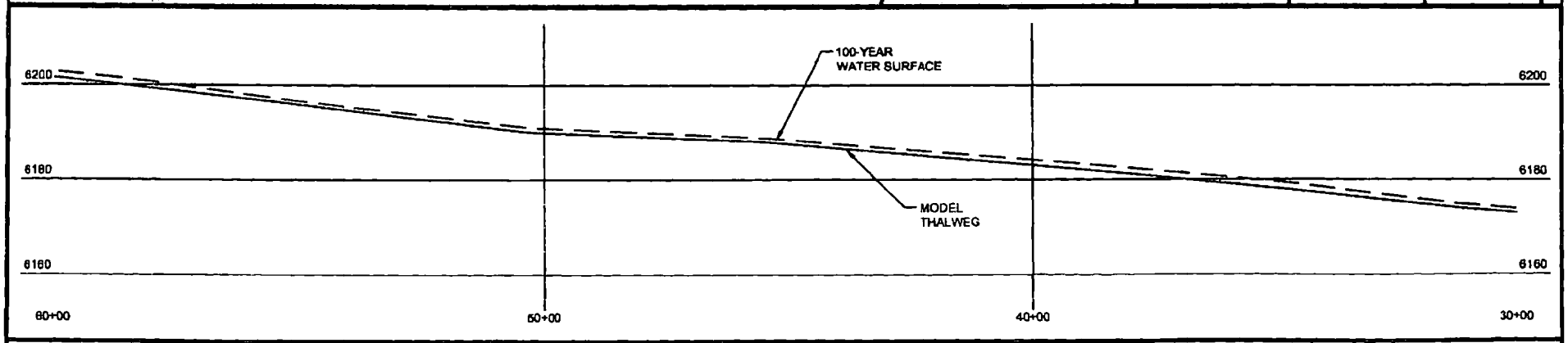
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-1
FIGURE 5-4

URS NO. 21711039





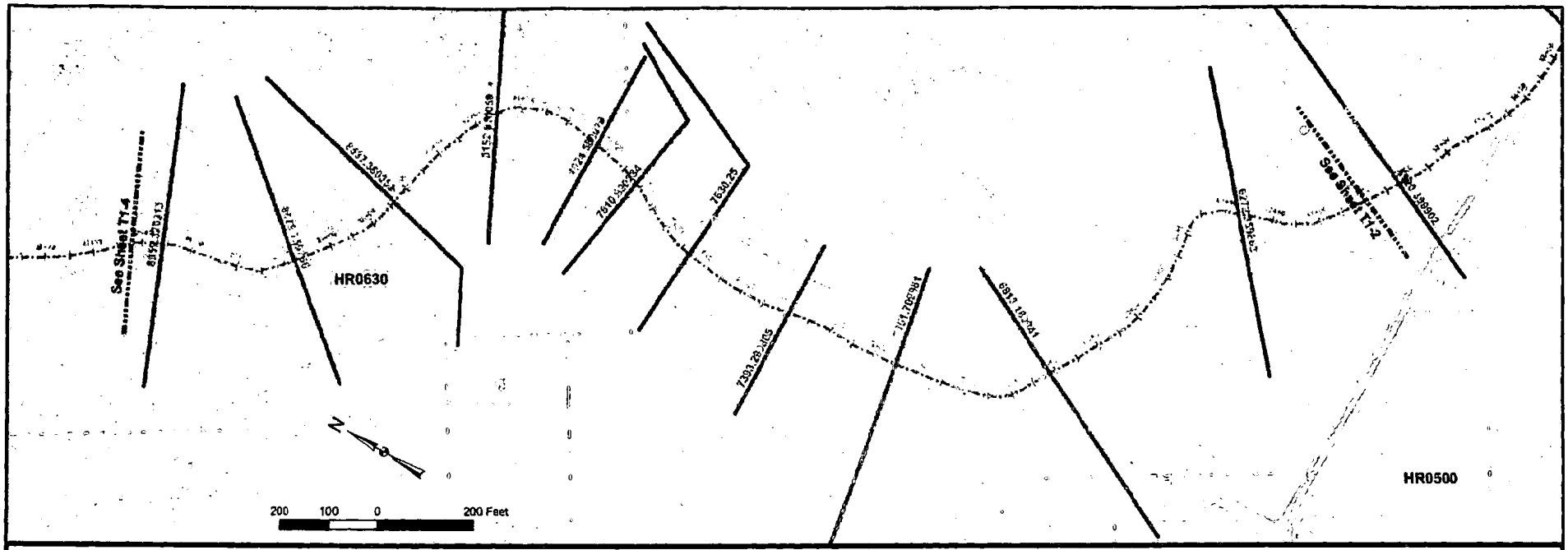
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

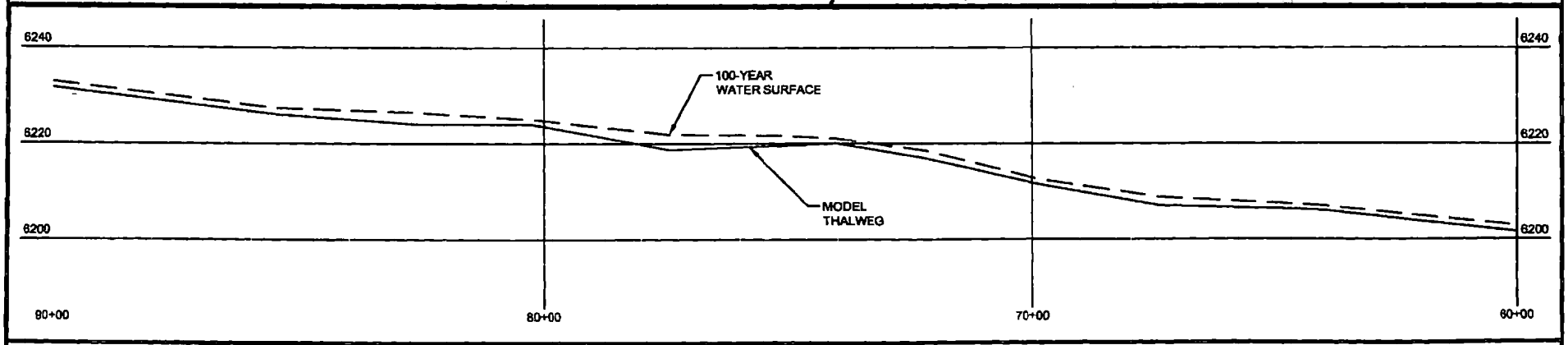
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-2
FIGURE 5-4

URS NO. 21711039





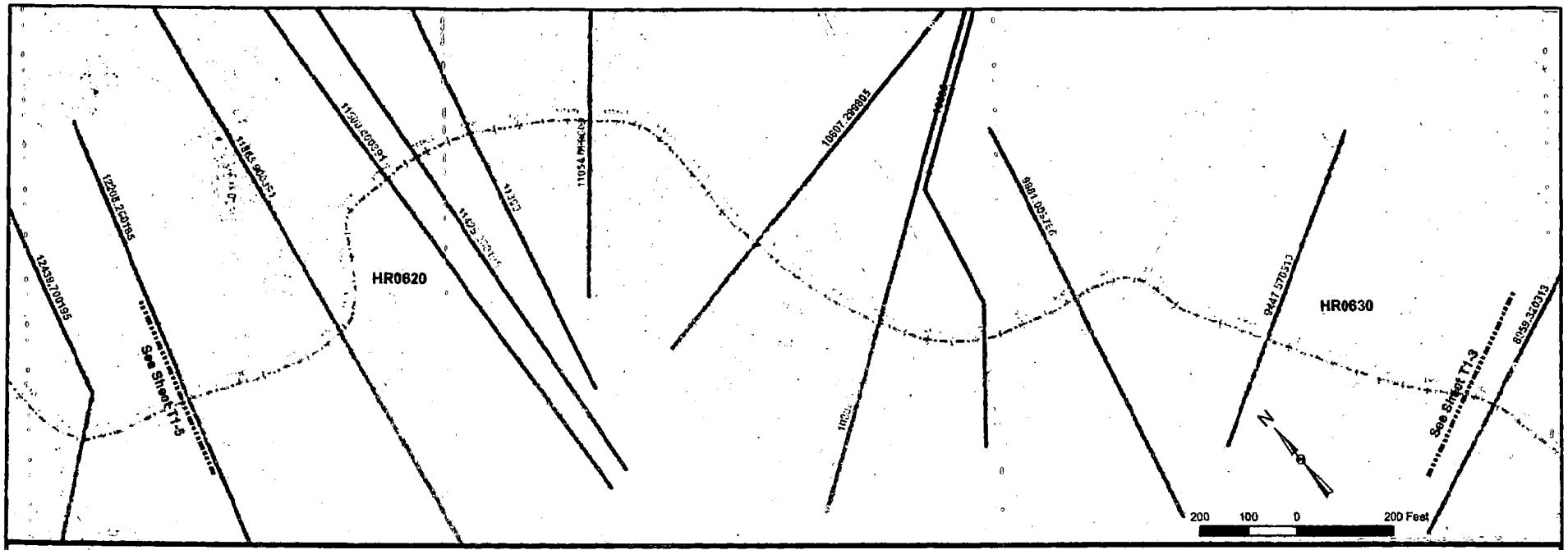
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

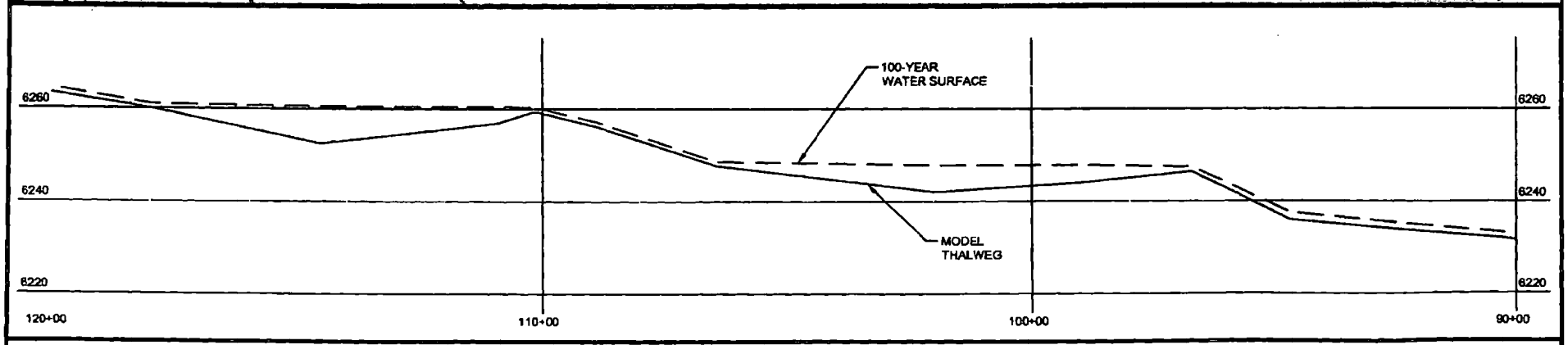
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-3
FIGURE 5-4

URS NO. 21711039





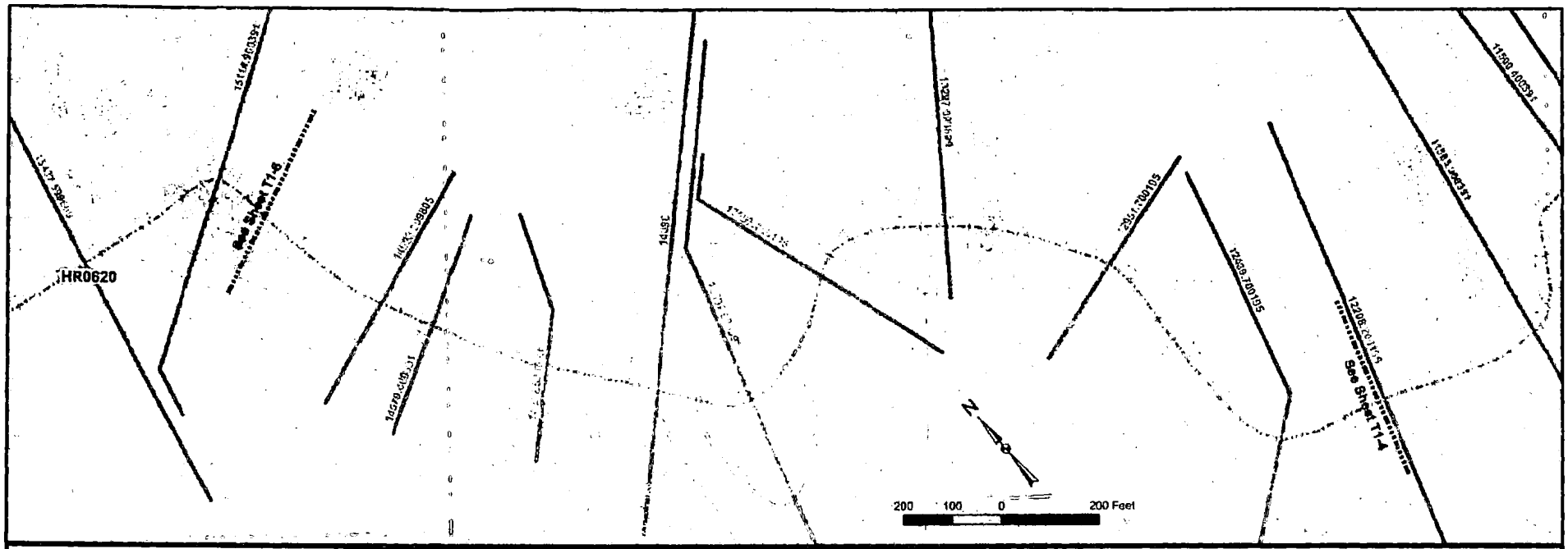
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

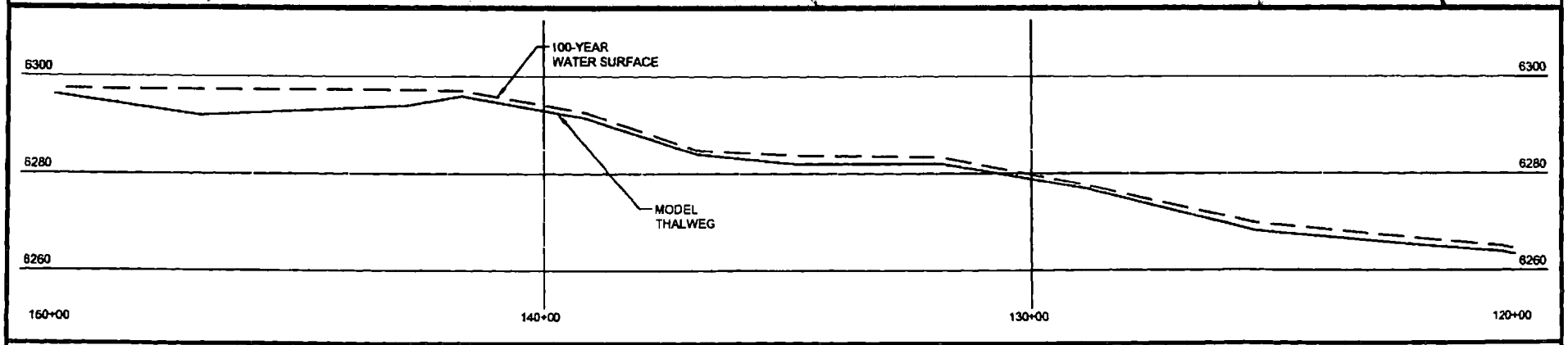
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-4
FIGURE 5-4

URS NO. 21711039





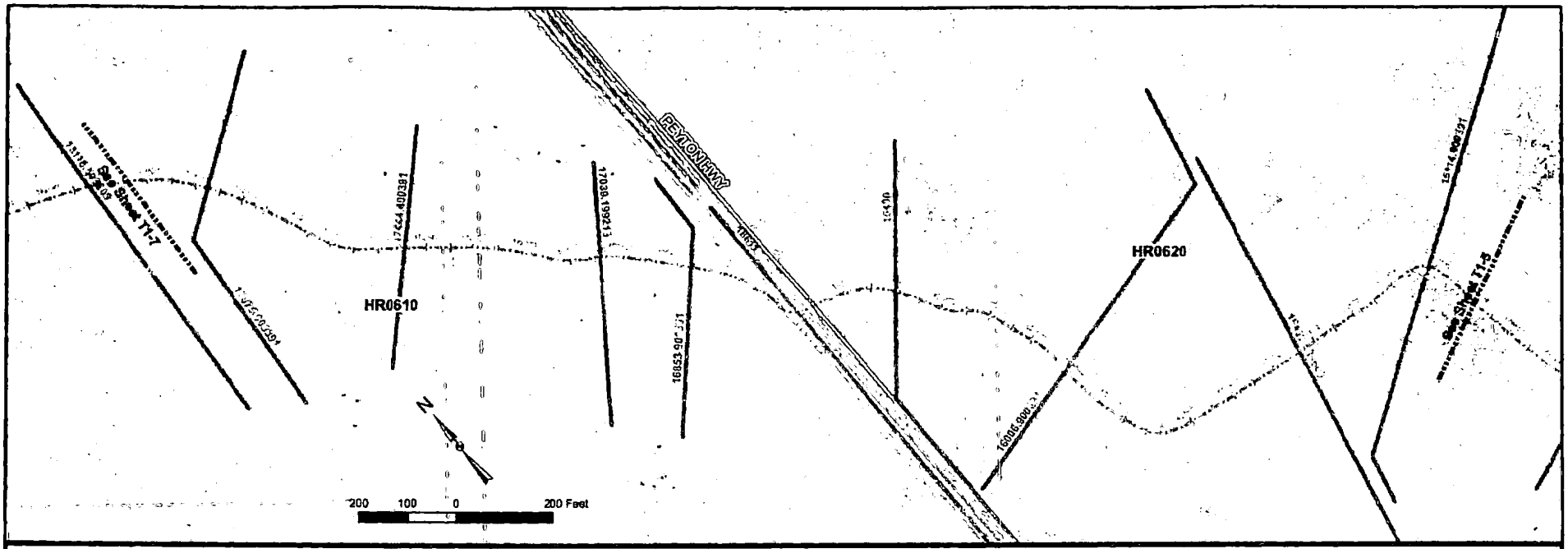
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

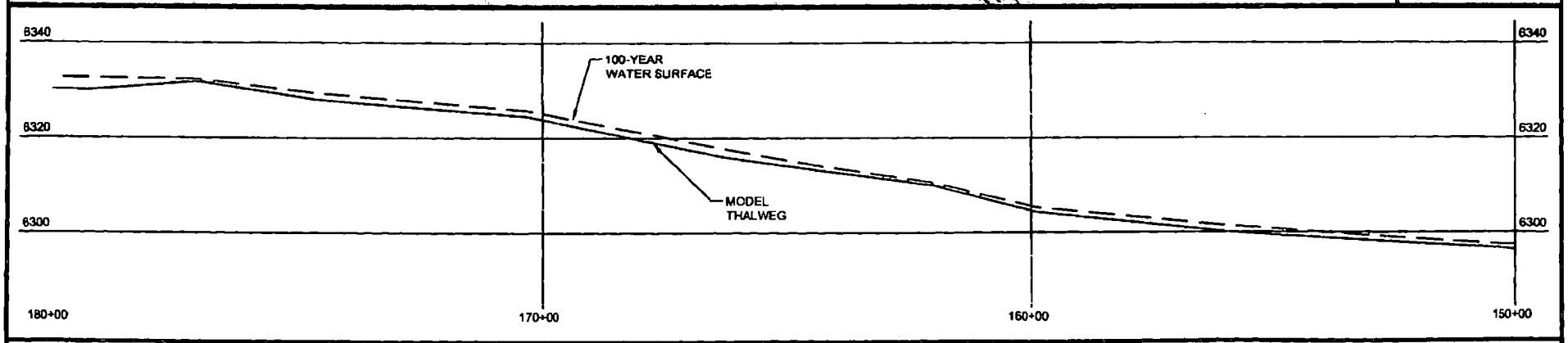
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-5
FIGURE 5-4

URS NO. 21711039





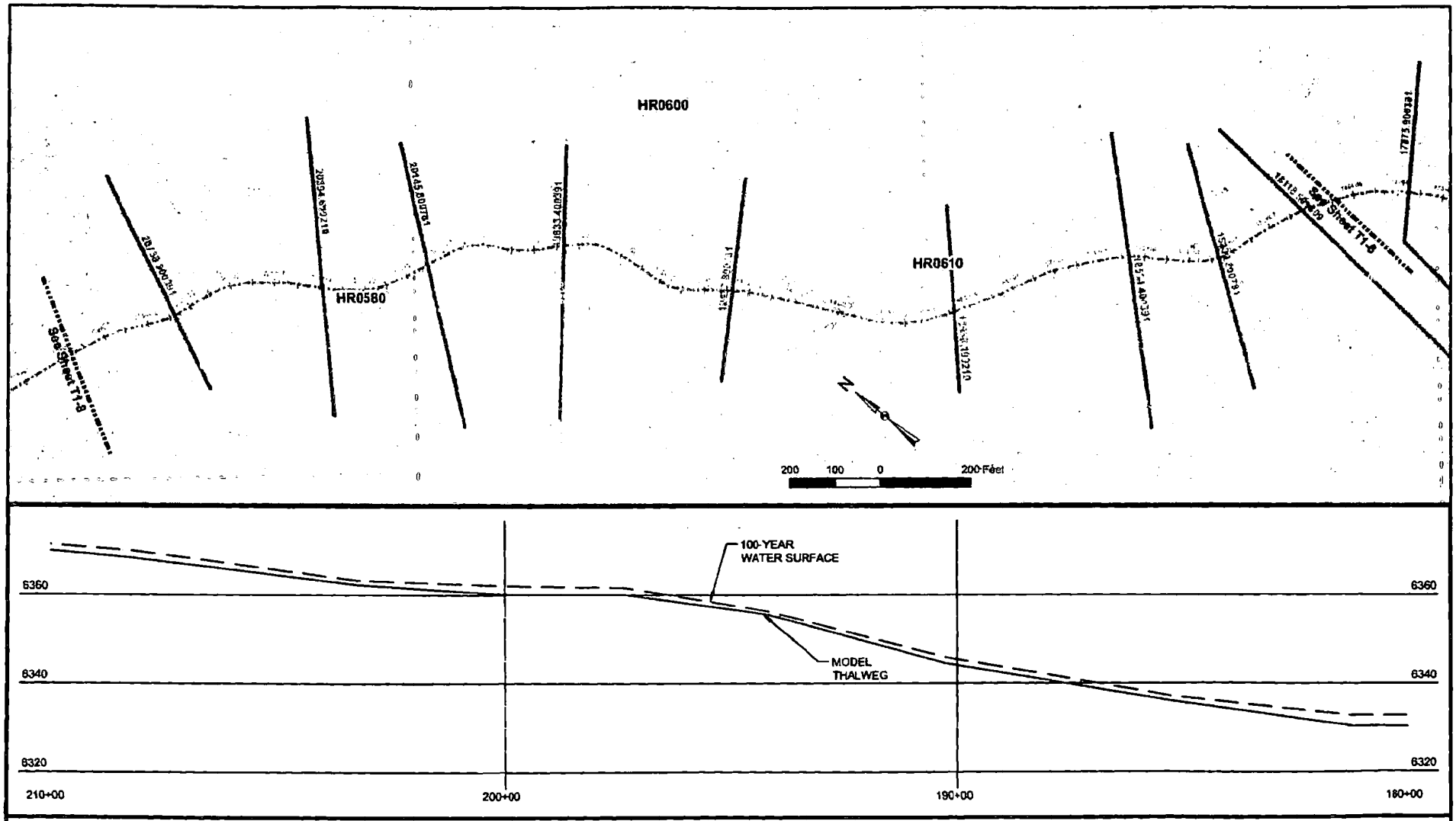
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-6
FIGURE 5-4

URS NO. 21711039



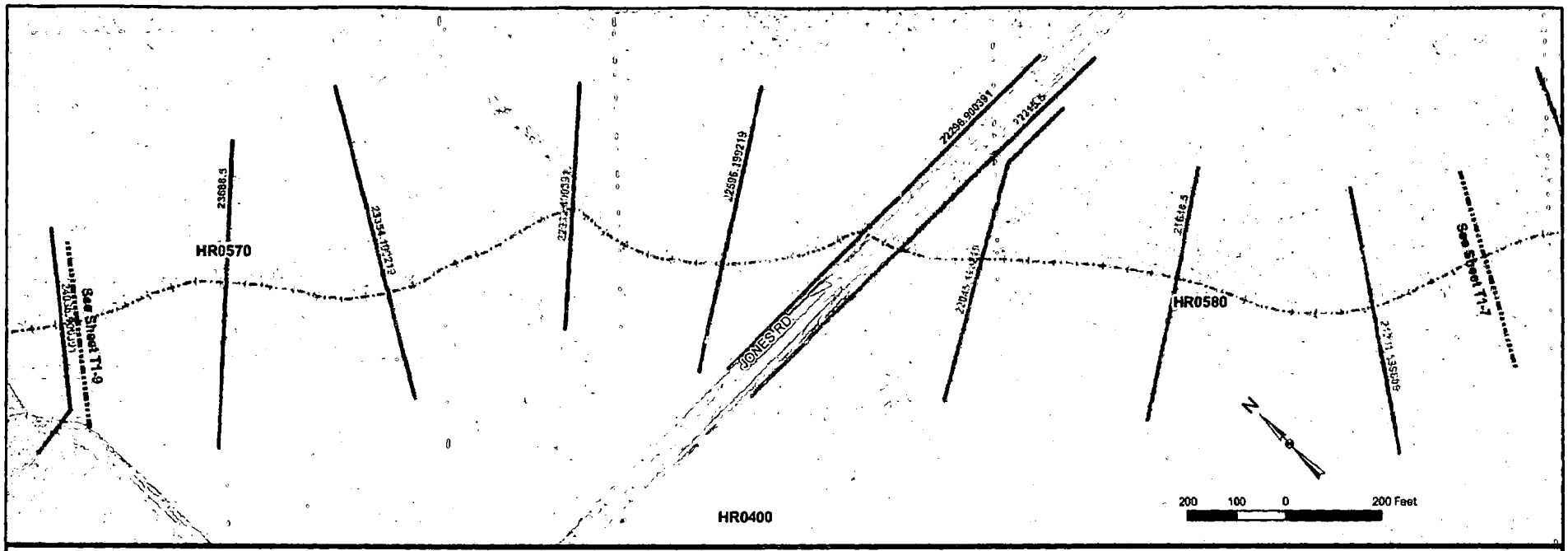
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

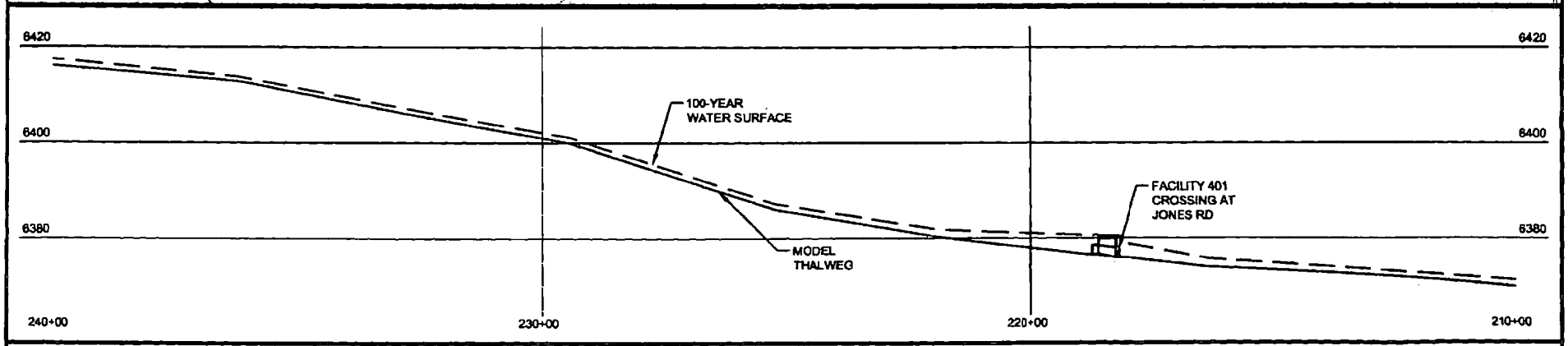
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-7
FIGURE 5-4

DATE: 05/08

URS NO. 21711039





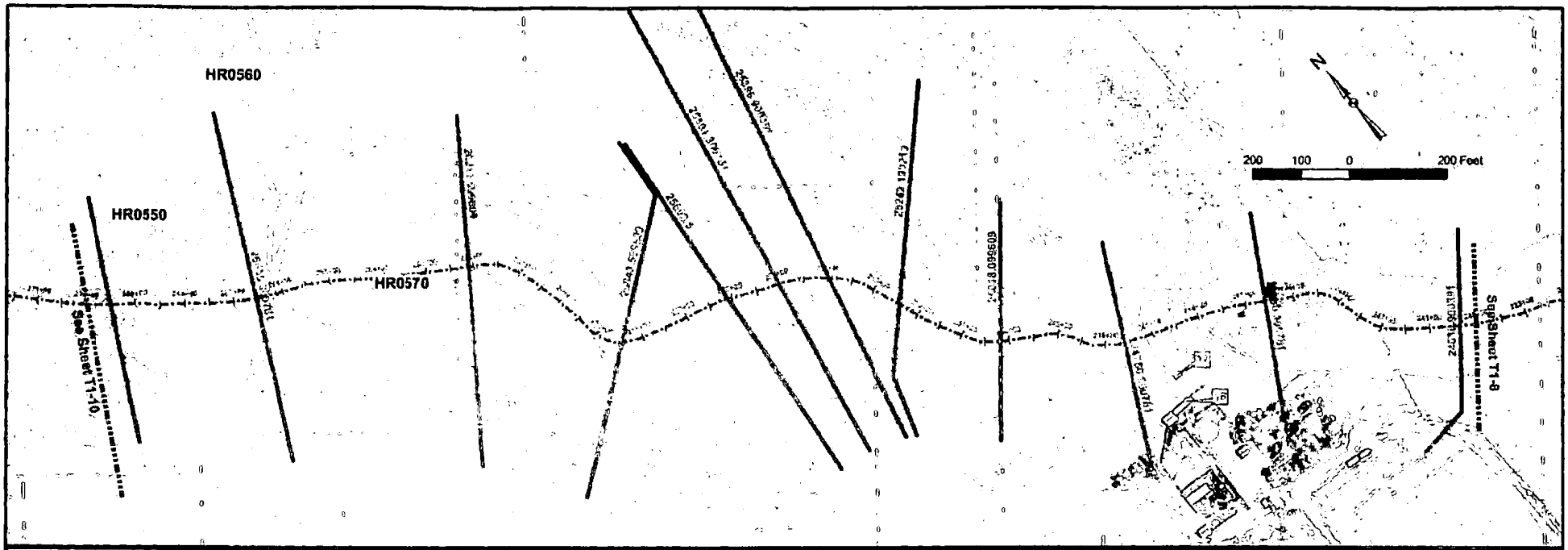
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

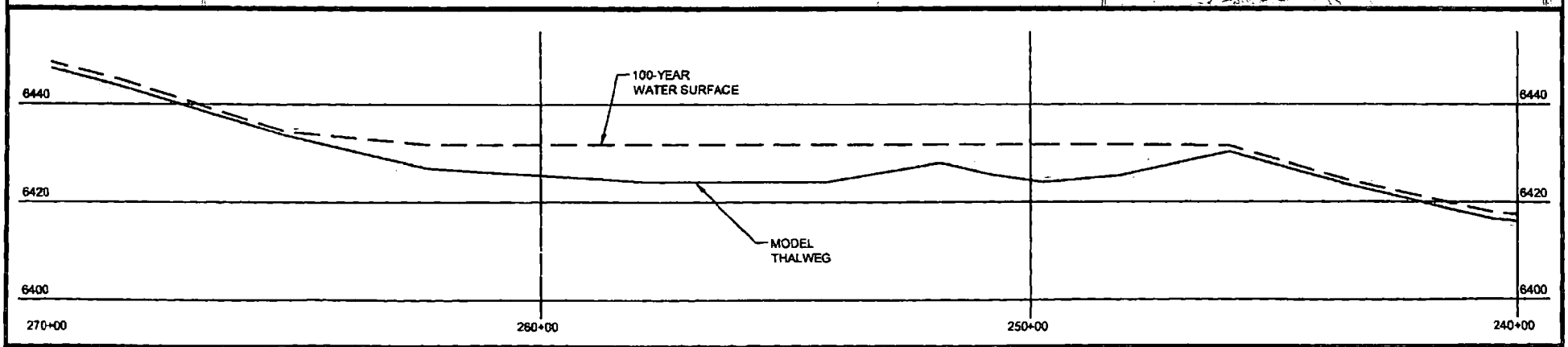
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-8
FIGURE 5-4

URS NO. 21711039





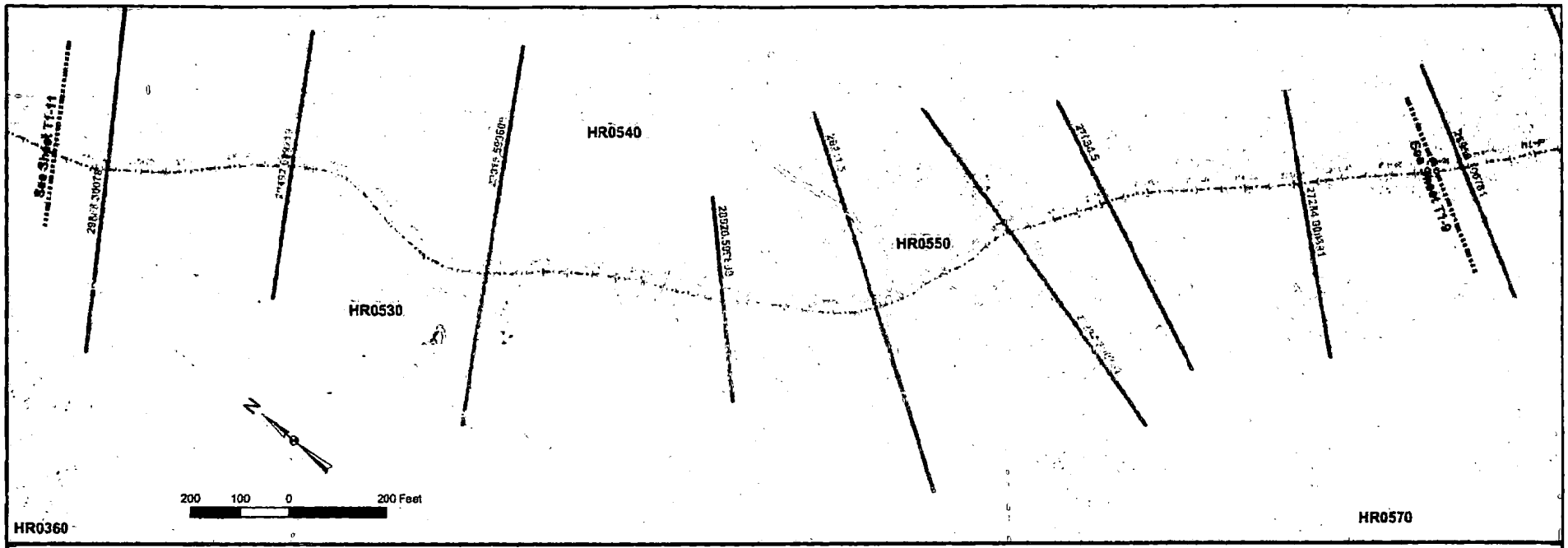
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

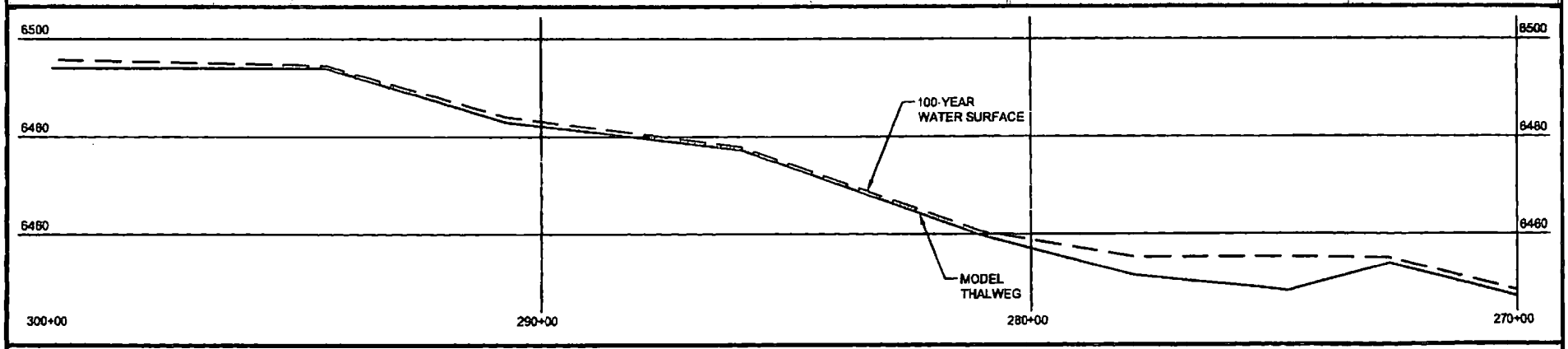
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-9
FIGURE 5-4

URS NO. 21711039





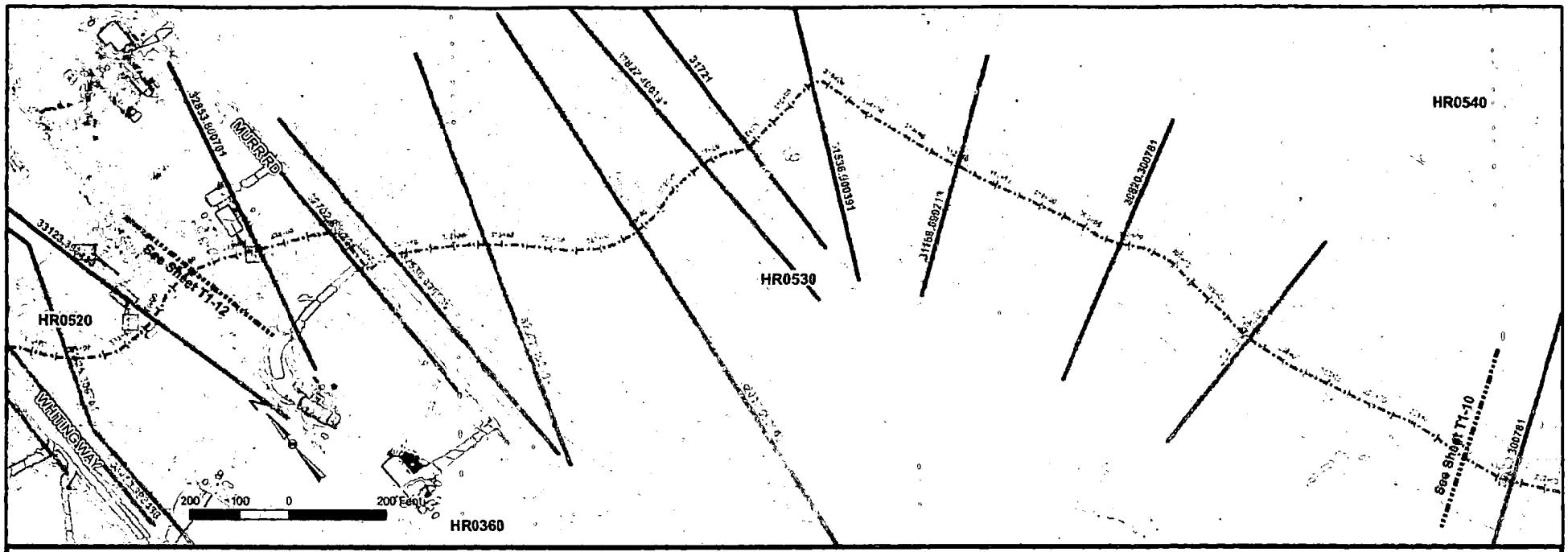
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

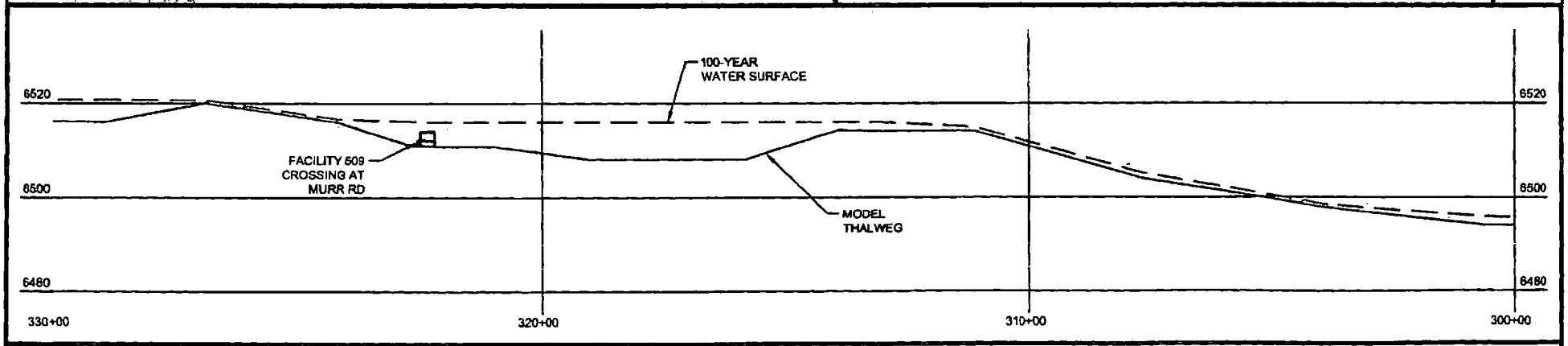
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-10
FIGURE 5-4

URS NO. 21711039





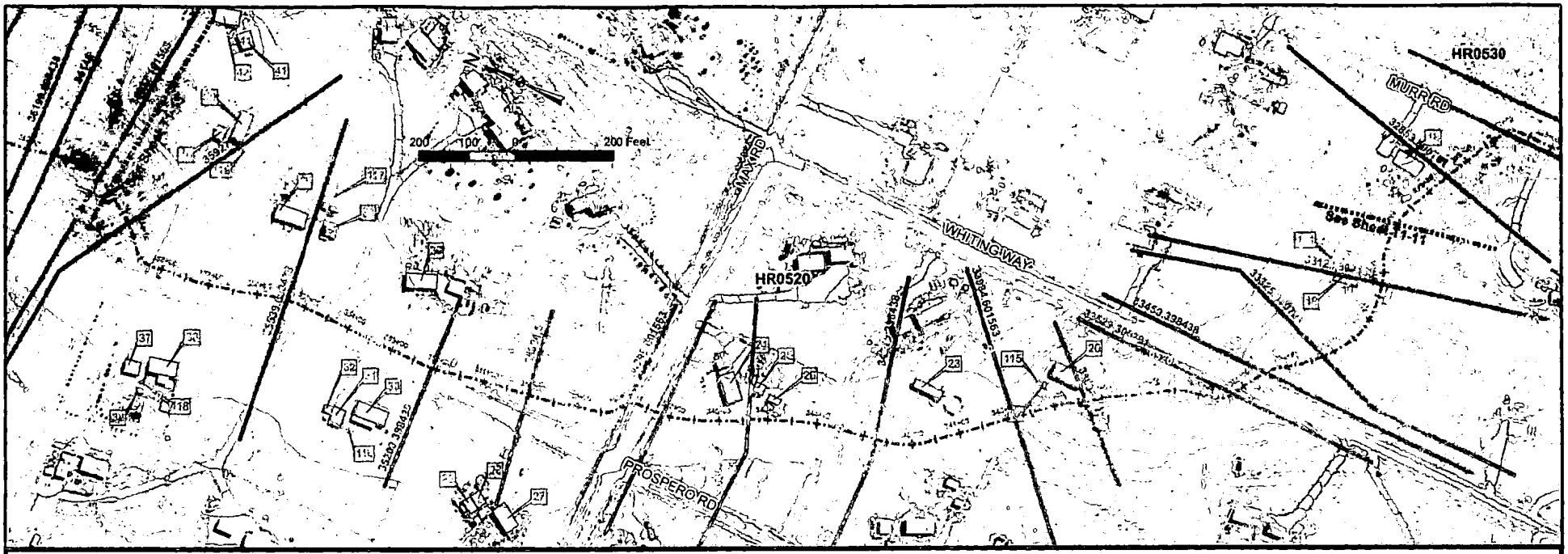
URS
9950 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

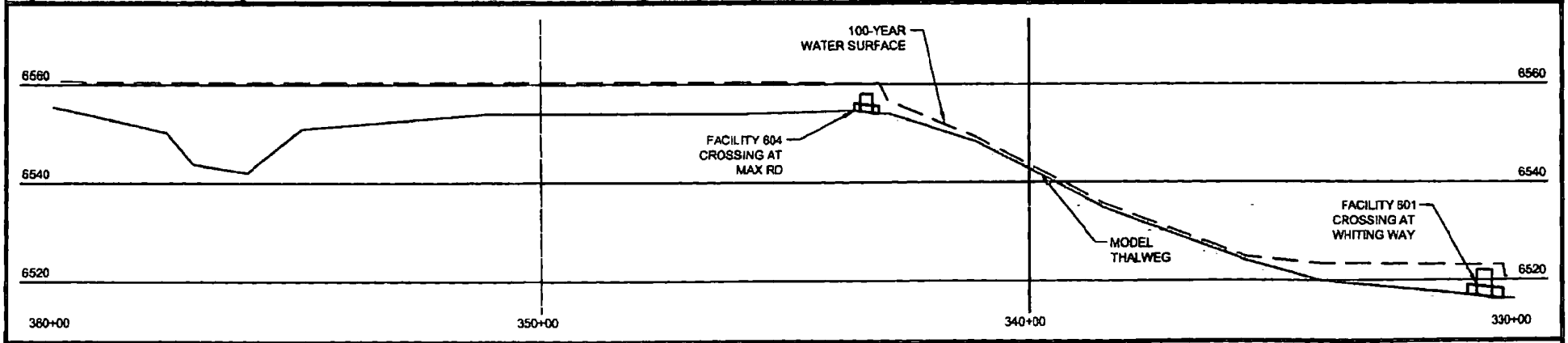
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-11
FIGURE 5-4

URS NO. 21711039





URS

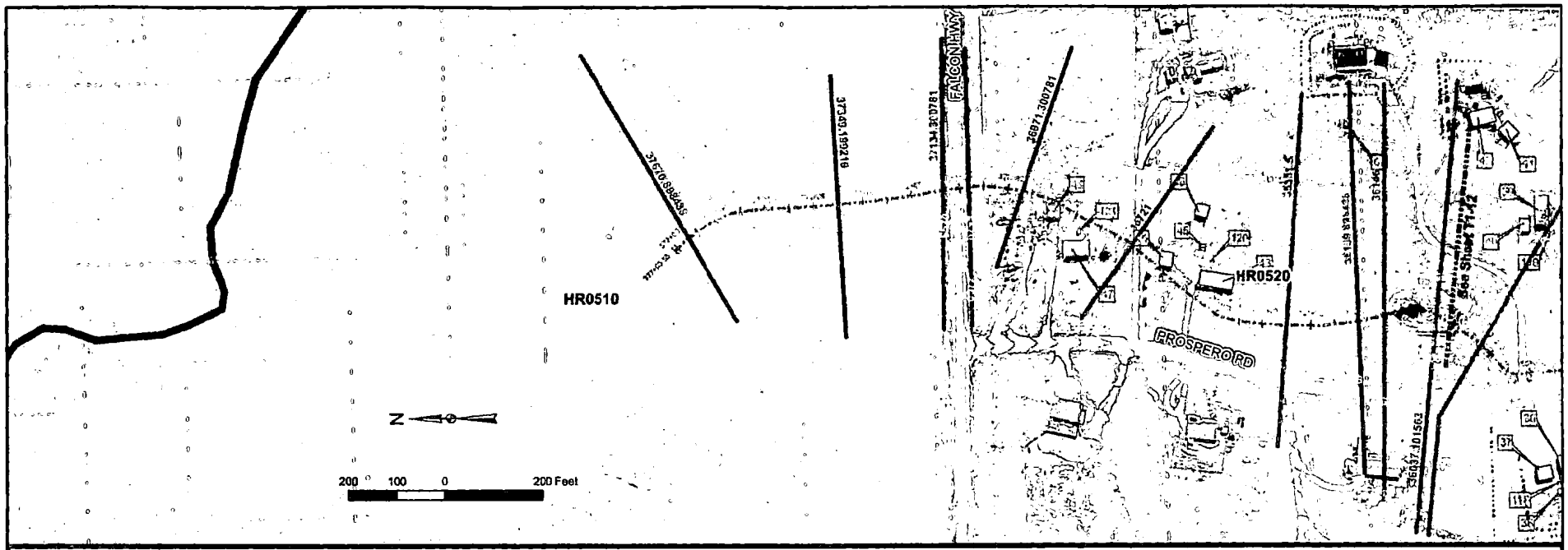
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

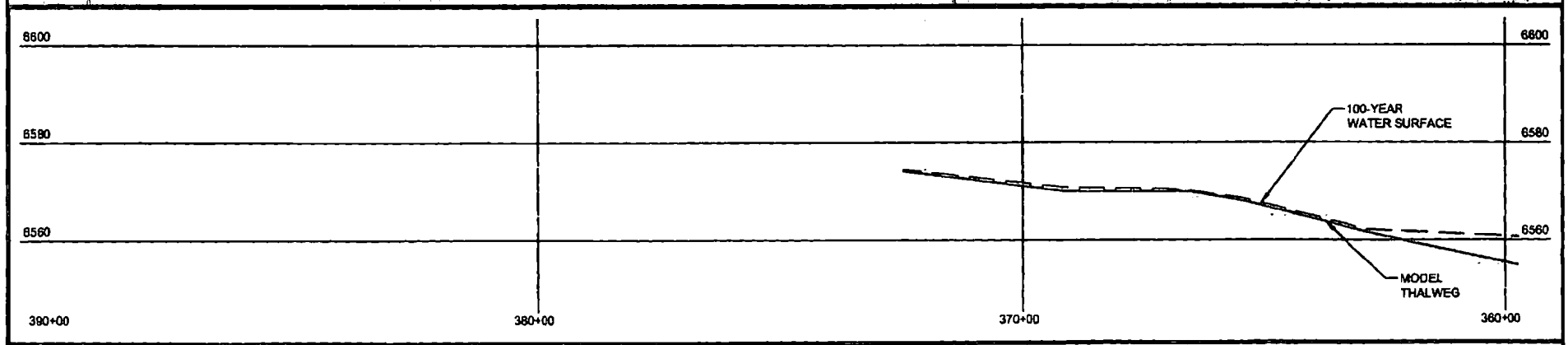
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-12
FIGURE 5-4

URS NO. 21711039





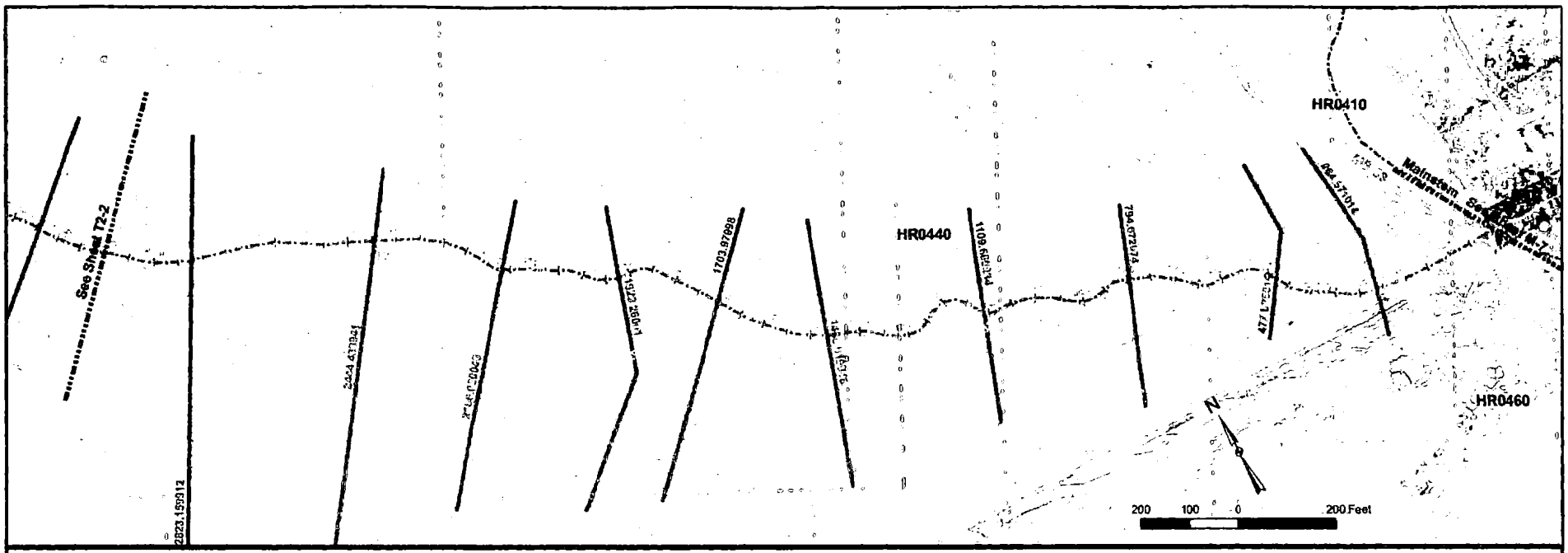
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

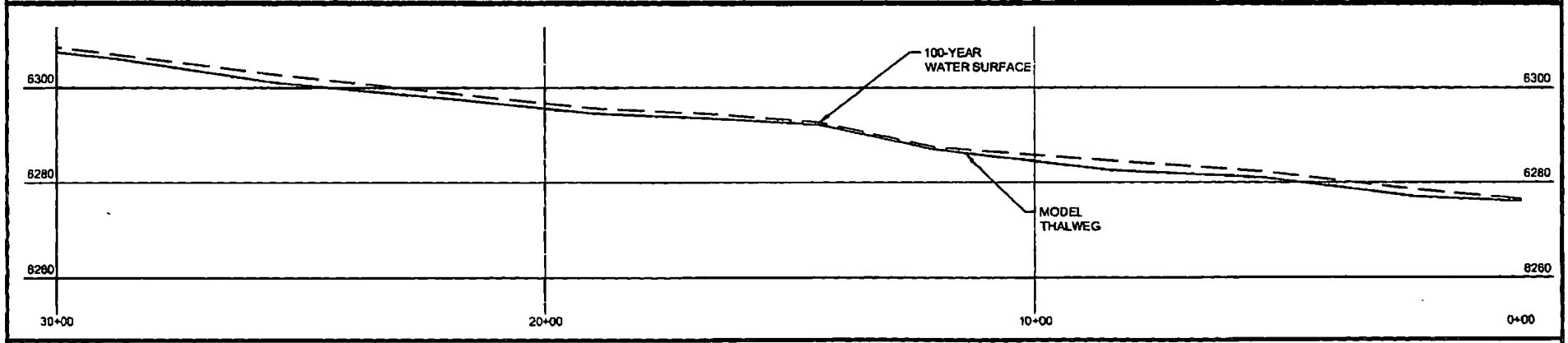
Haegler Basin Boundary
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T1-13
FIGURE 5-4

DATE: 05/08

URS NO. 21711039





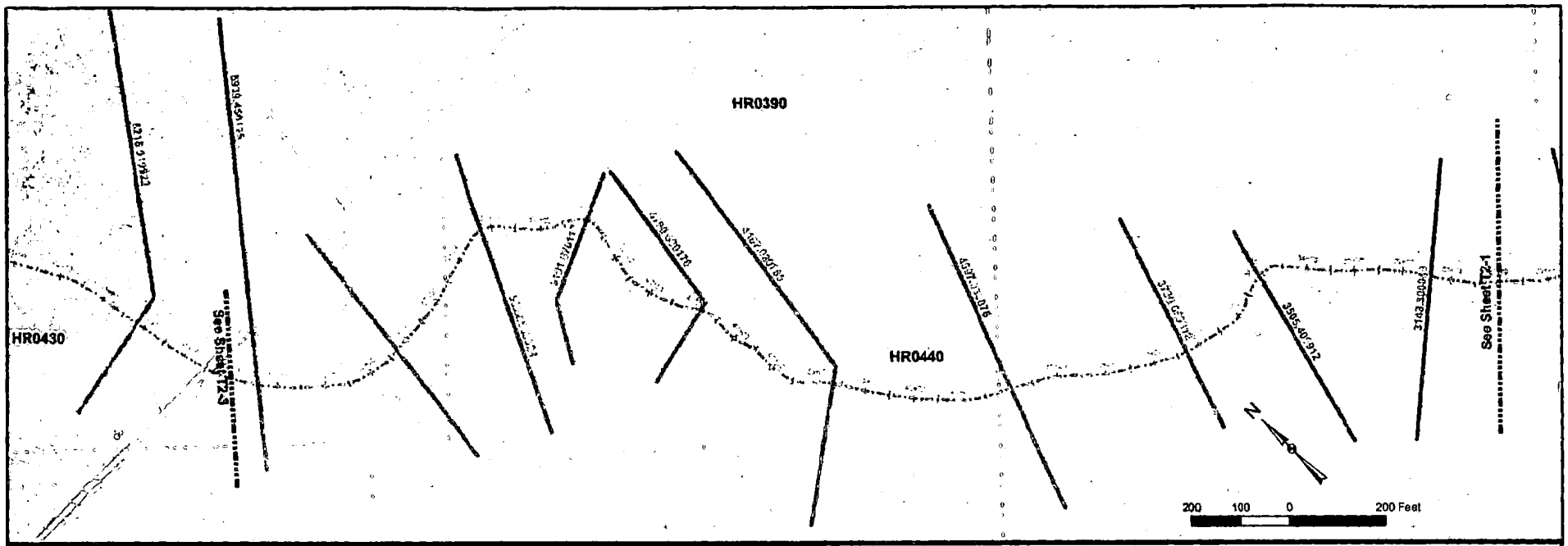
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

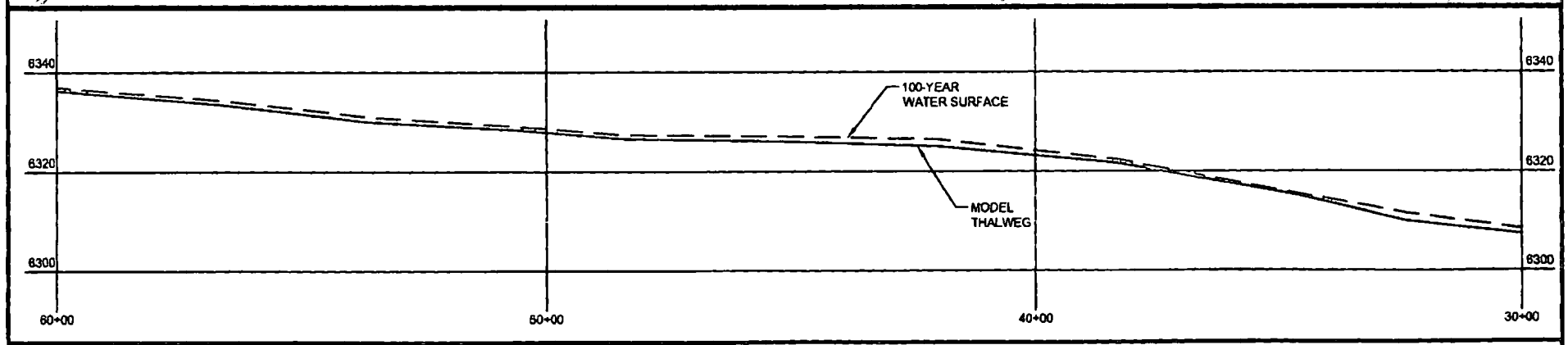
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T2-1
FIGURE 5-4

URS NO. 21711039





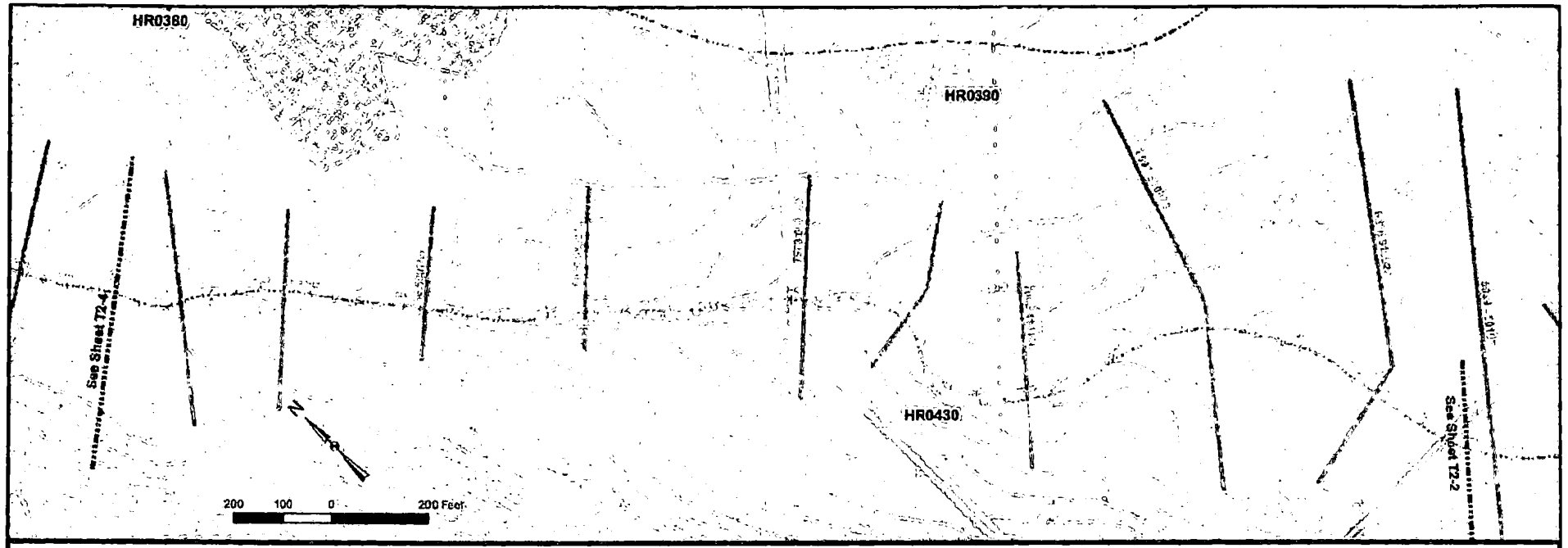
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

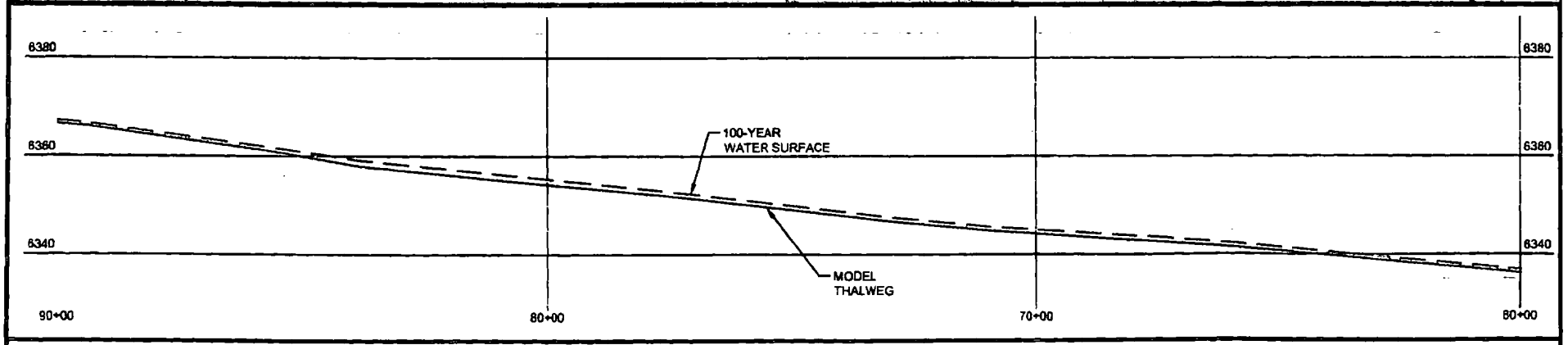
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T2-2
FIGURE 5-4

URS NO. 21711039





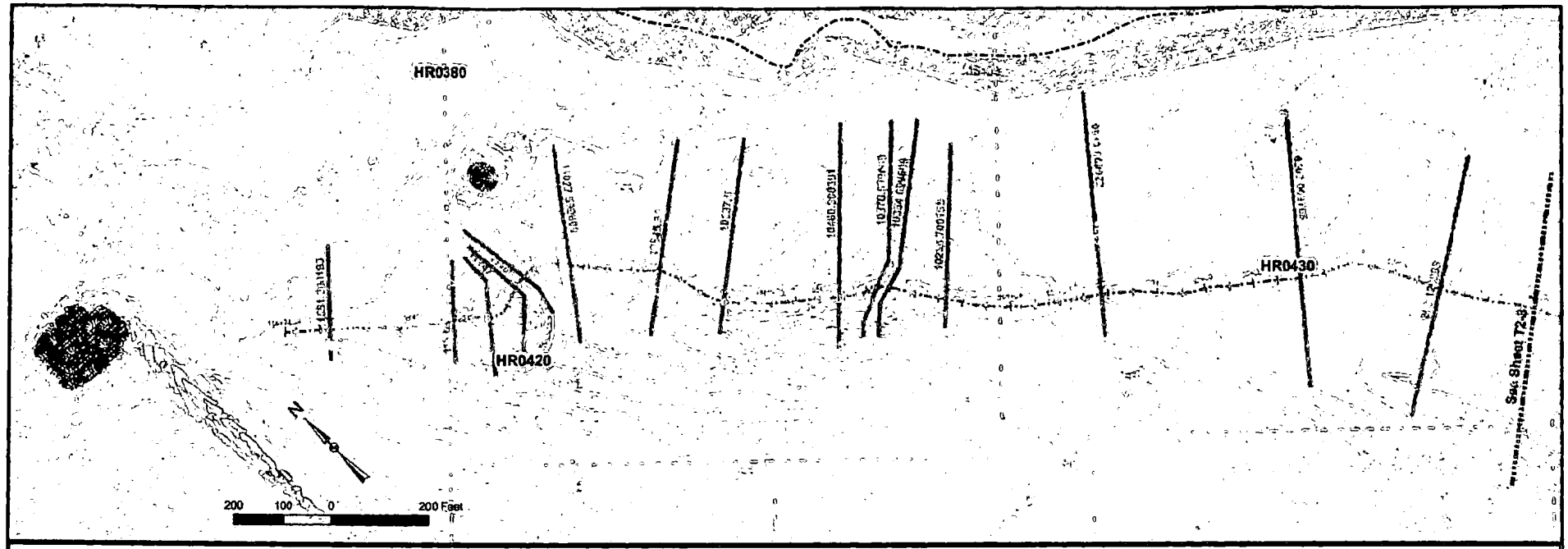
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

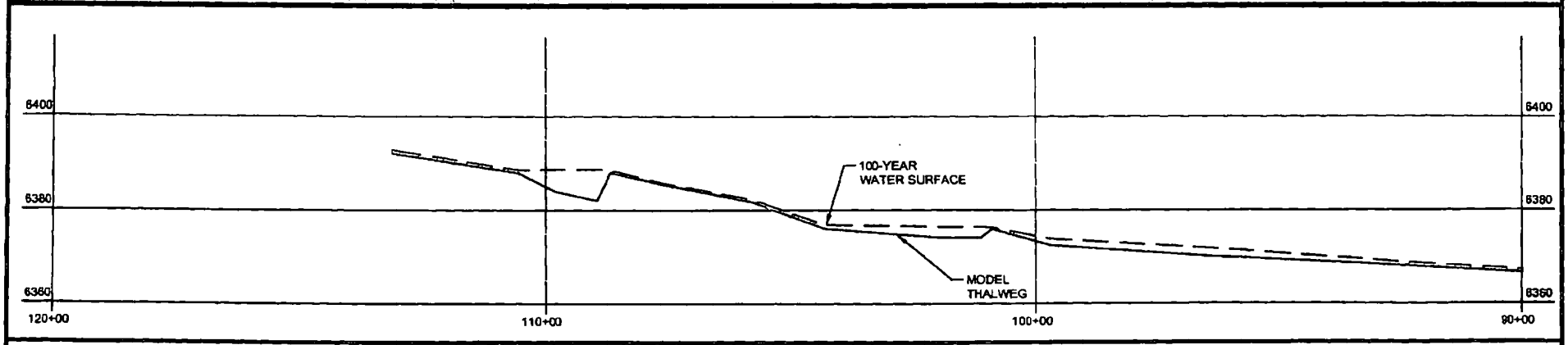
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T2-3
FIGURE 5-4

URS NO. 21711039





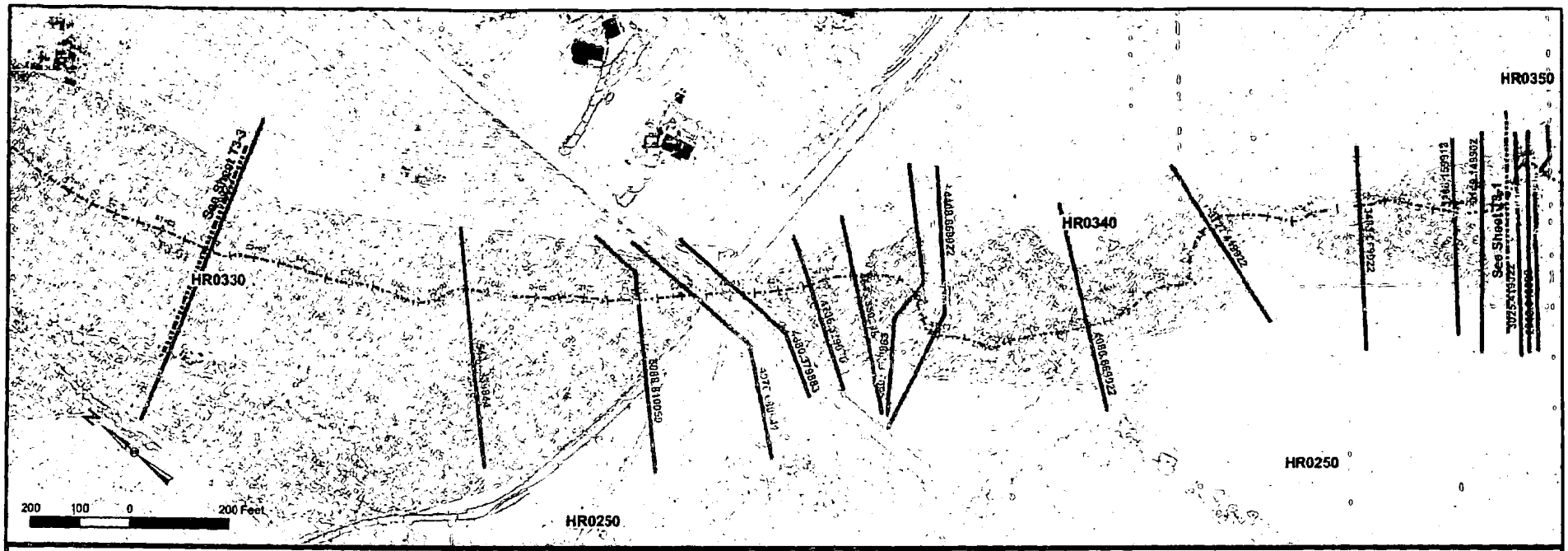
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

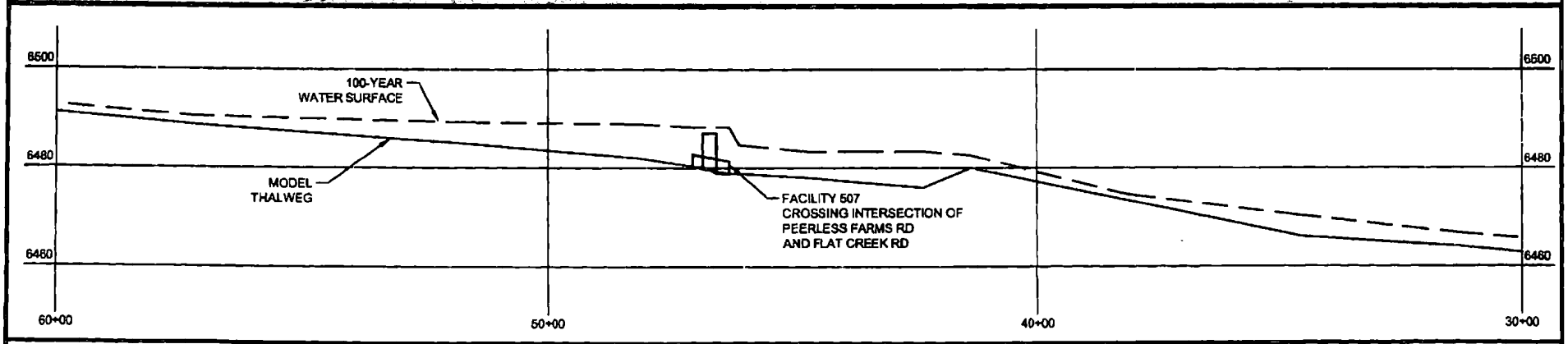
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T2-4
FIGURE 5-4

URS NO. 21711039





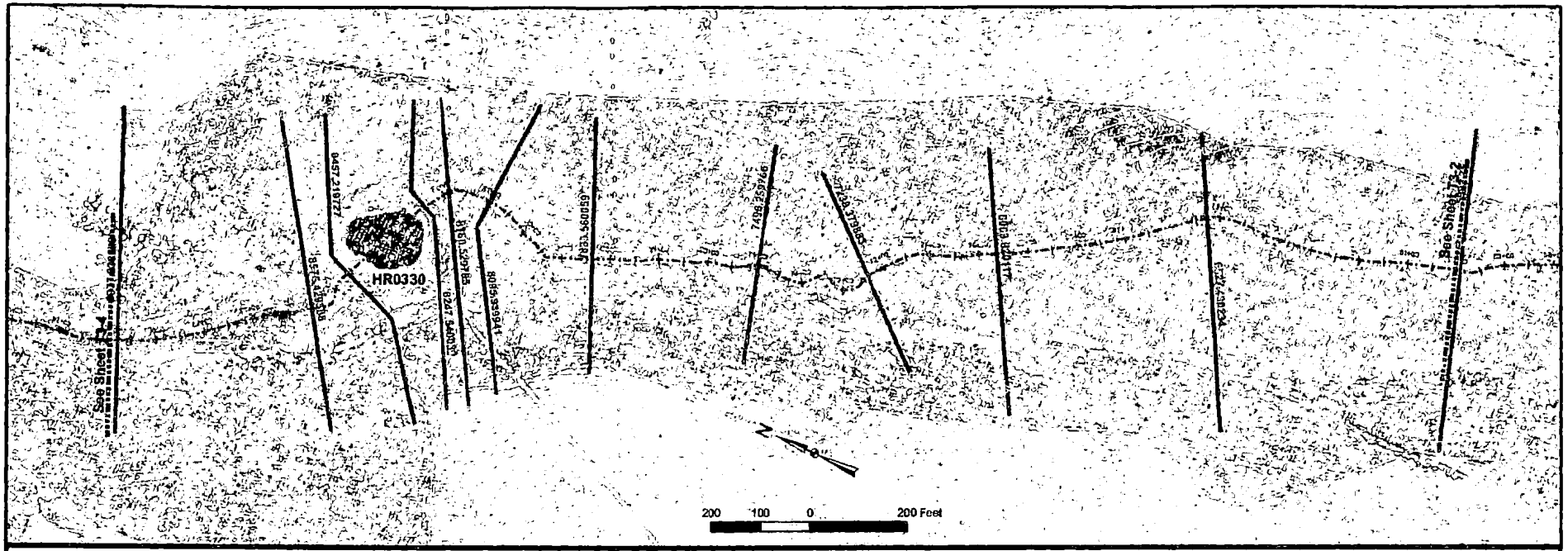
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

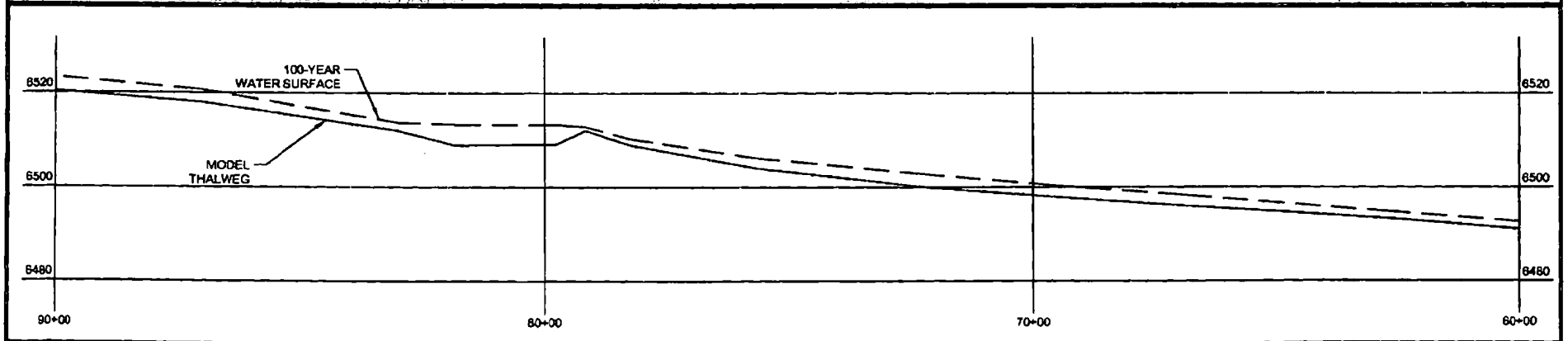
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T3-2
FIGURE 5-4

URS NO. 21711039





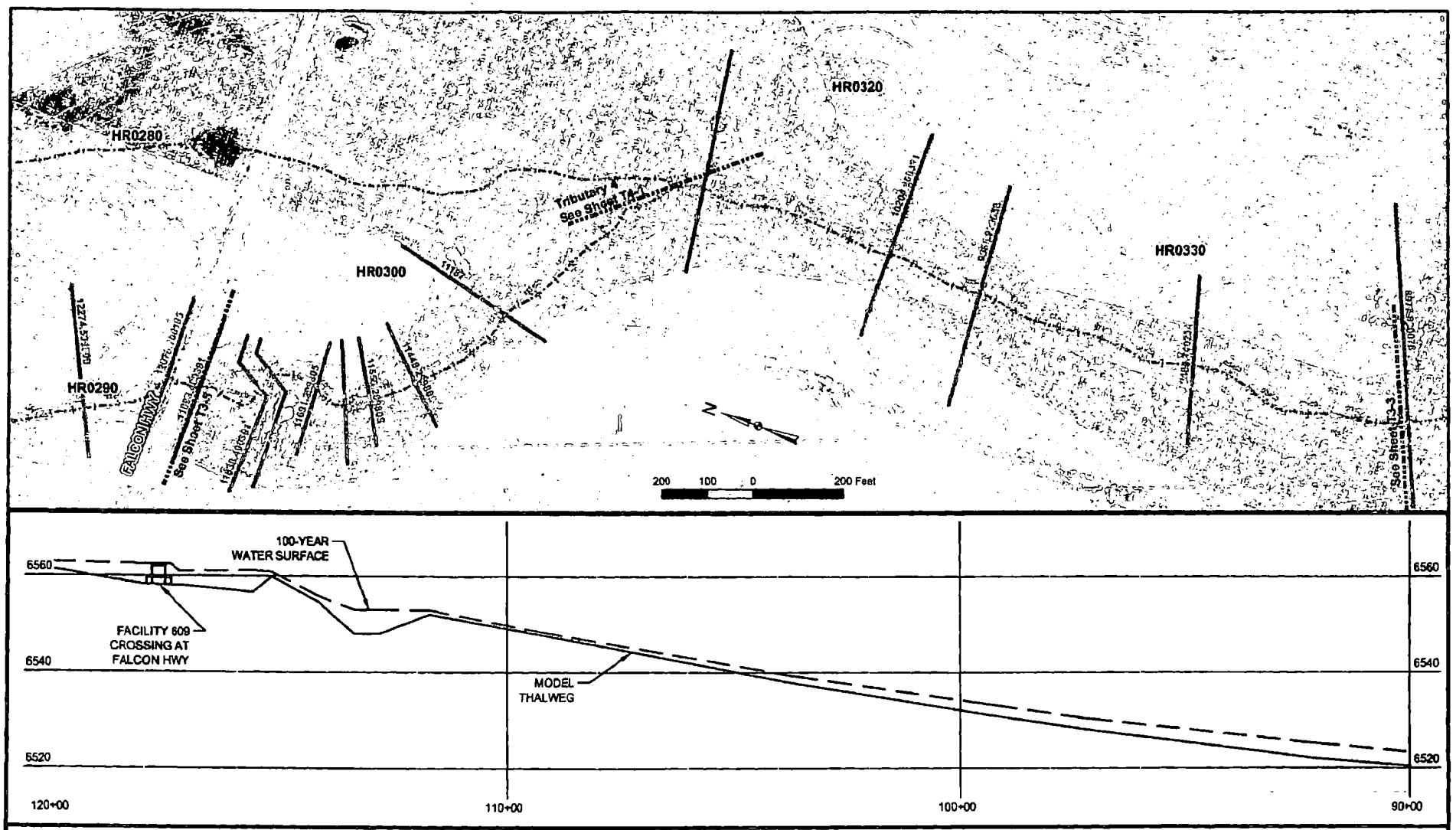
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T3-3
FIGURE 5-4

URS NO. 21711039



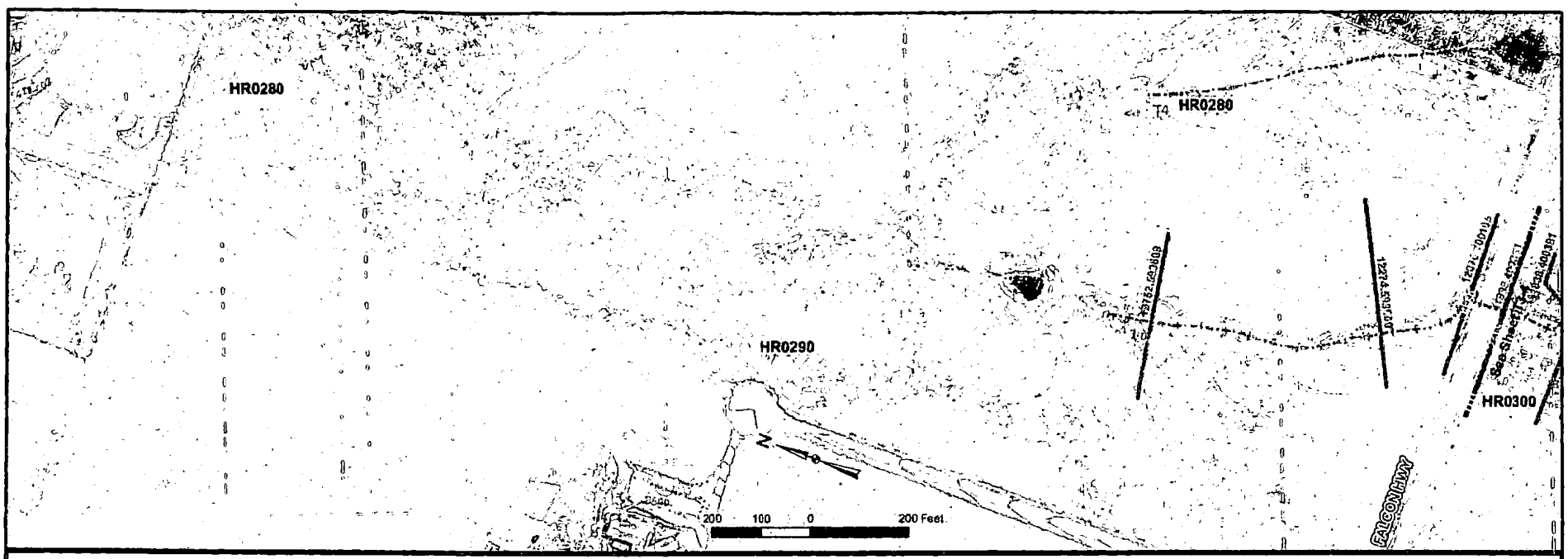
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

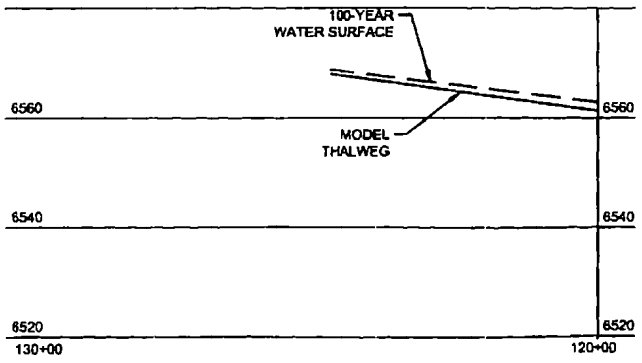
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T3-4
FIGURE 5-4

URS NO. 21711039





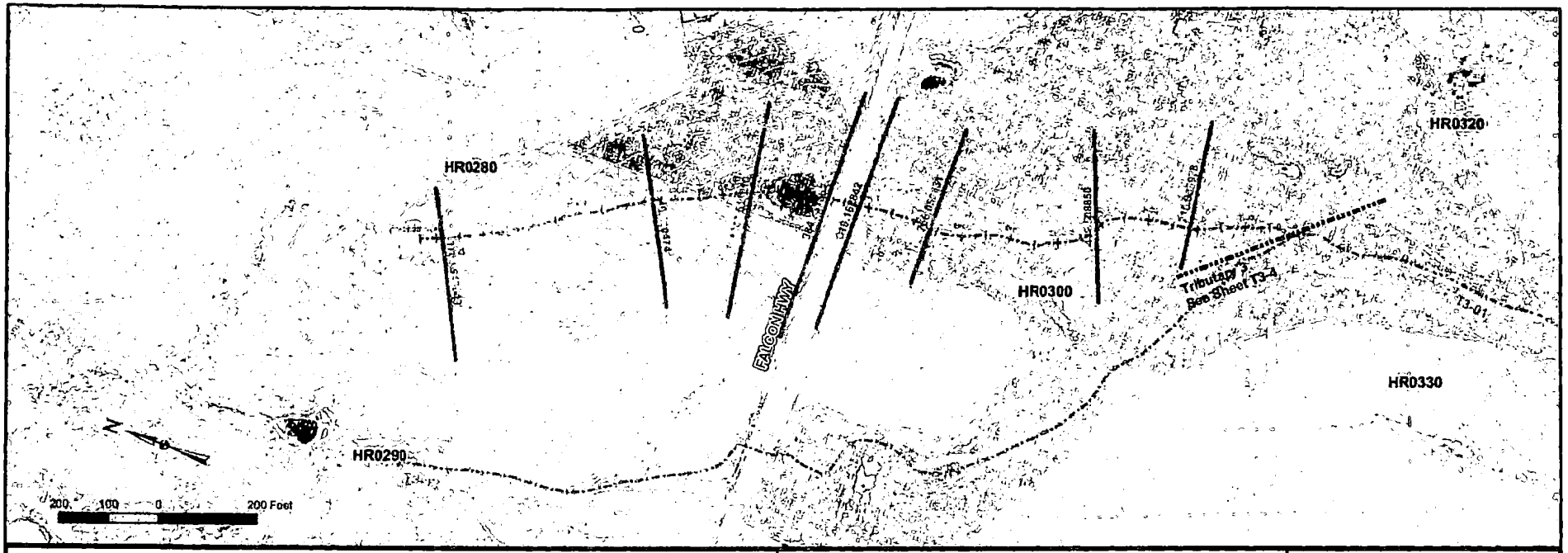
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

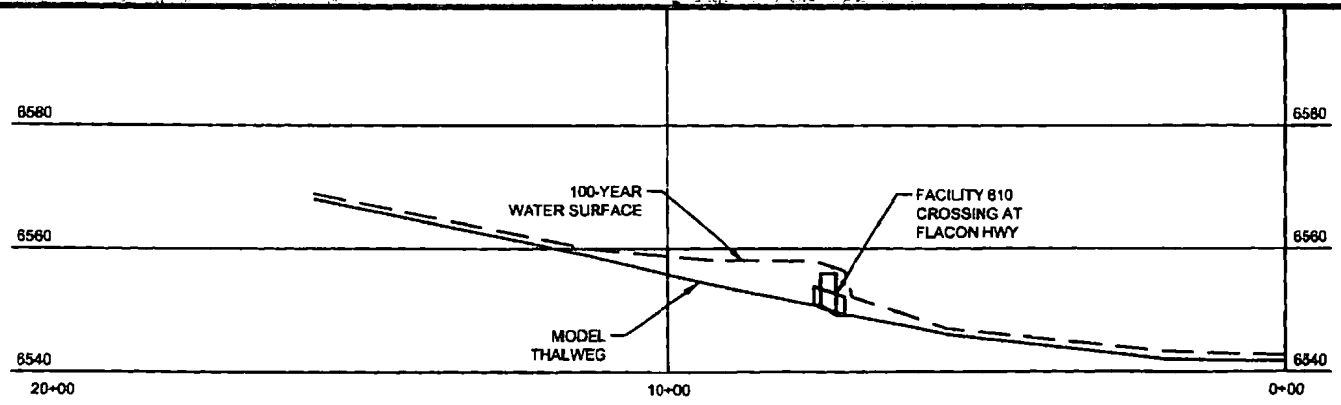
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T3-5
FIGURE 5-4

URS NO. 21711039





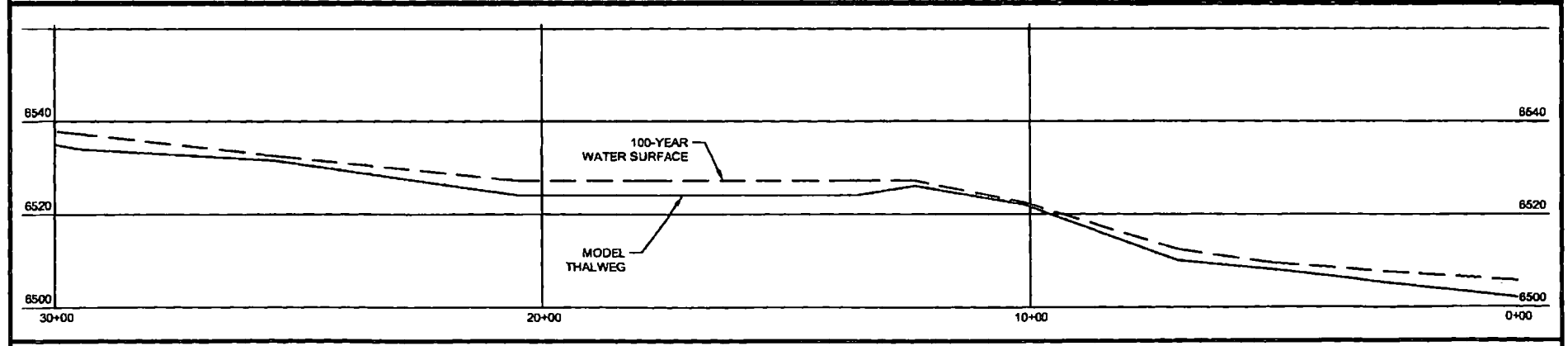
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T4-1
FIGURE 5-4

URS NO. 21711039



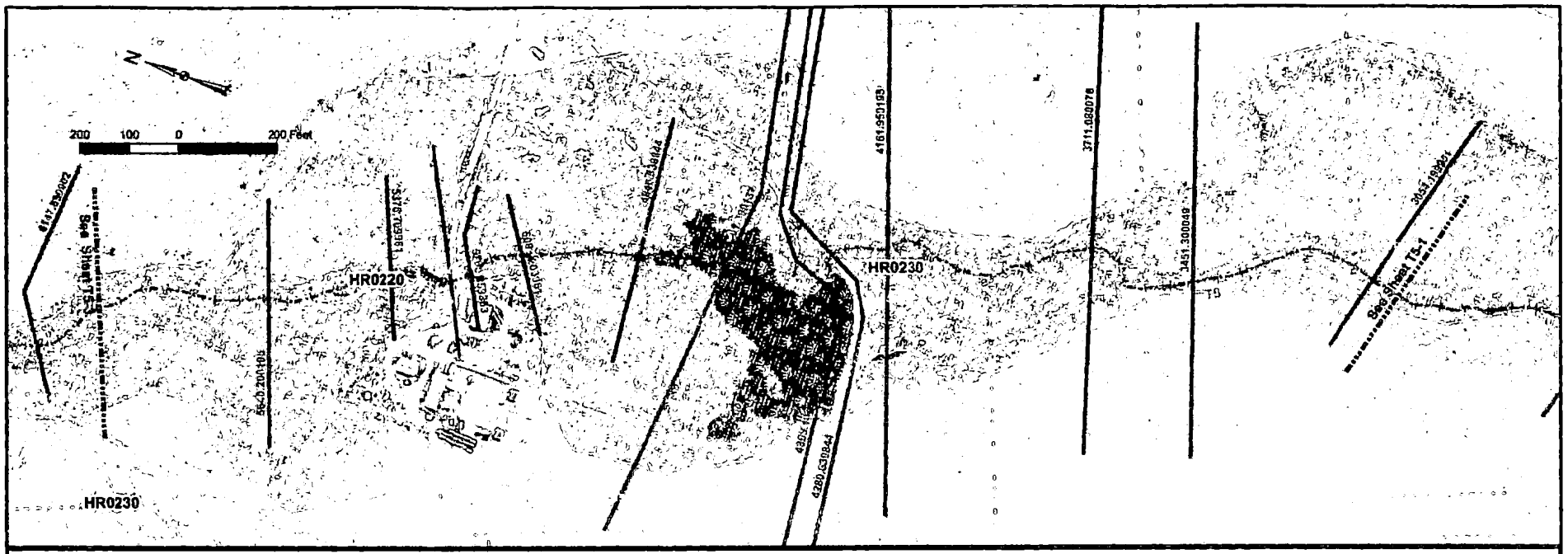
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

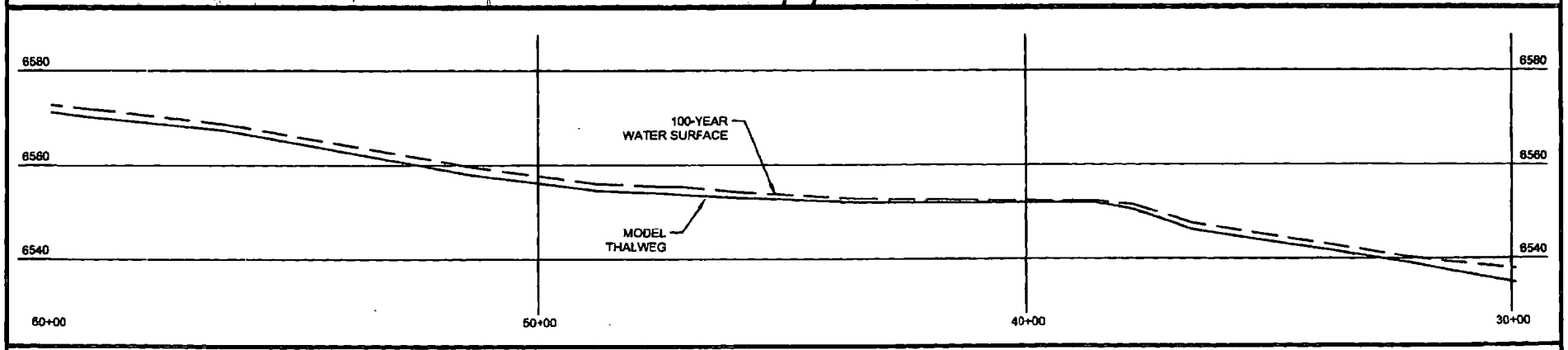
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T5-1
FIGURE 5-4

URS NO. 21711039





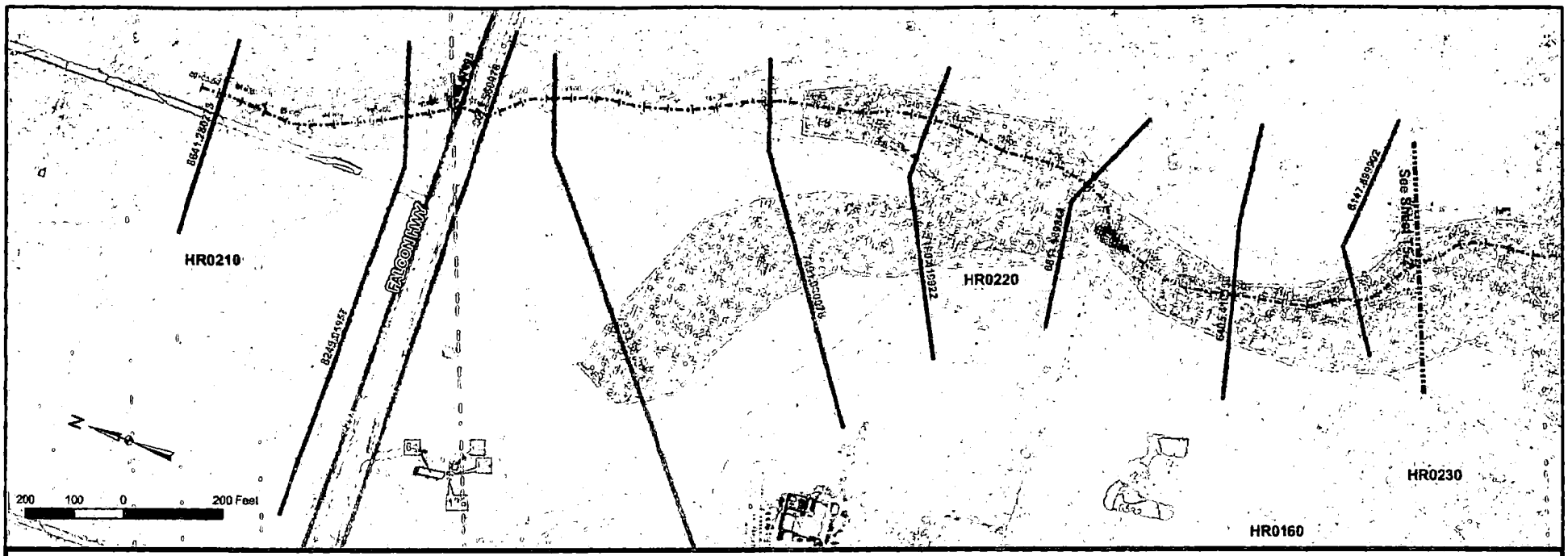
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

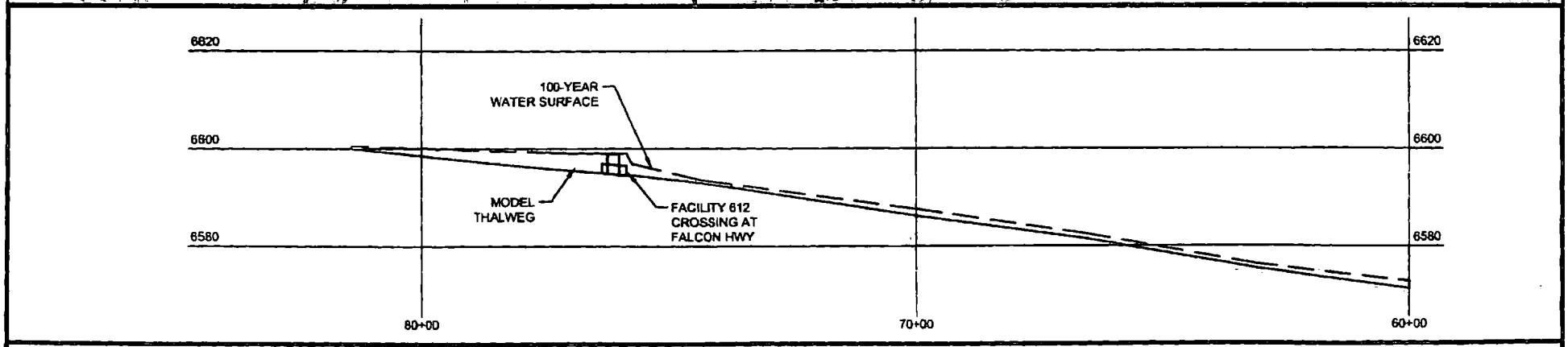
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T5-2
FIGURE 5-4

URS NO. 21711039





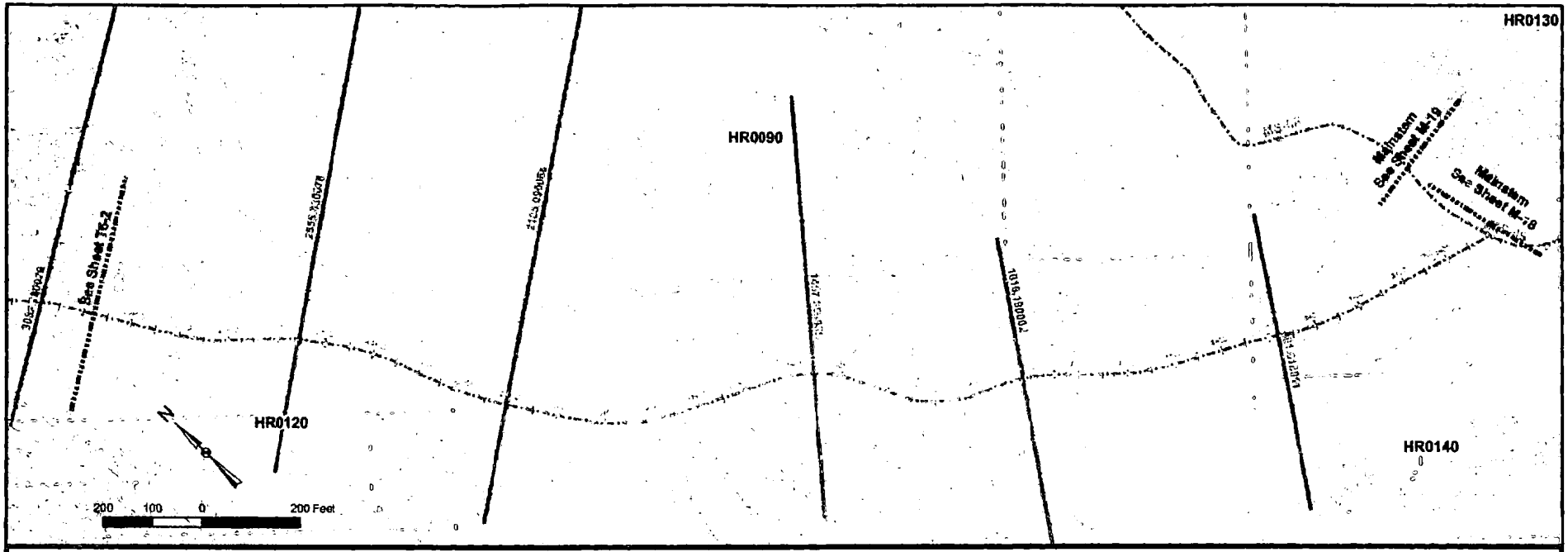
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

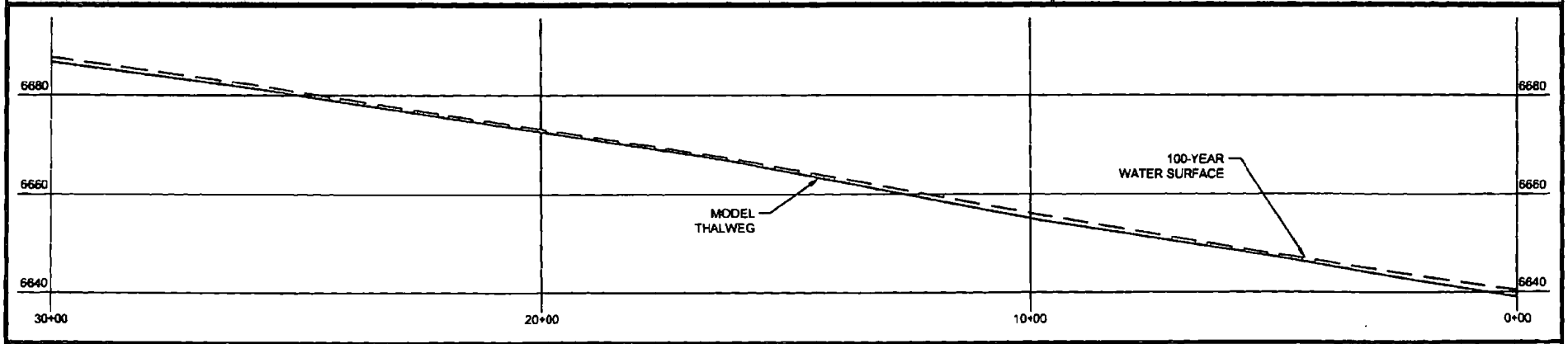
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T5-3
FIGURE 5-4

URS NO. 21711039





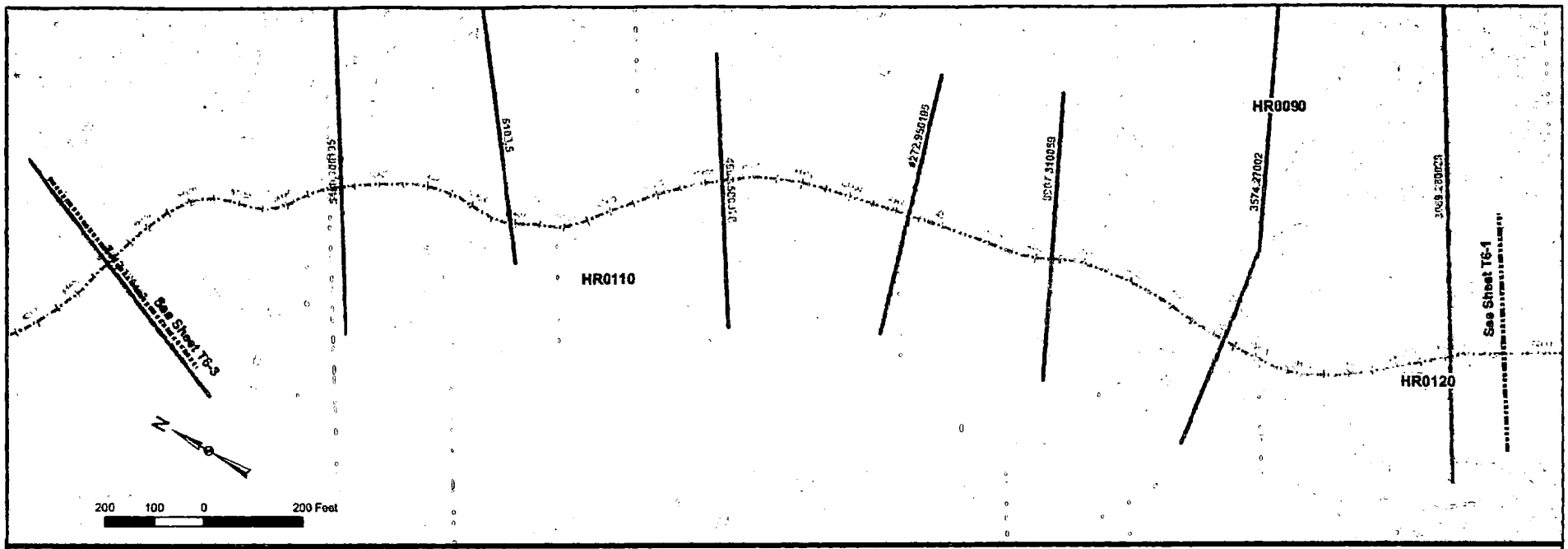
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

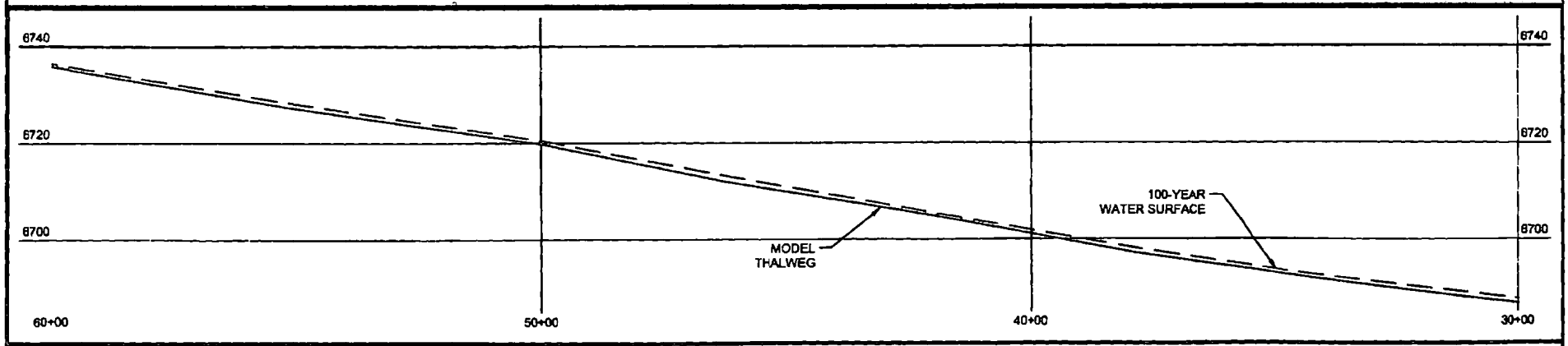
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T6-1
FIGURE 5-4

URS NO. 21711039





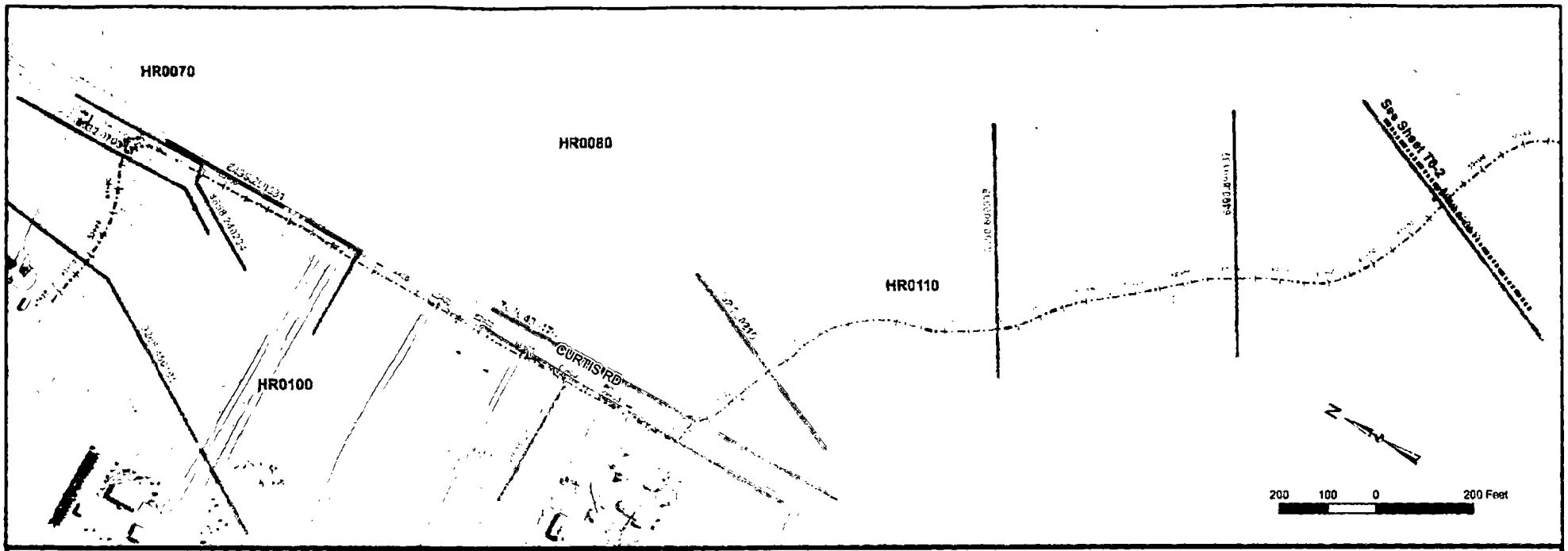
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

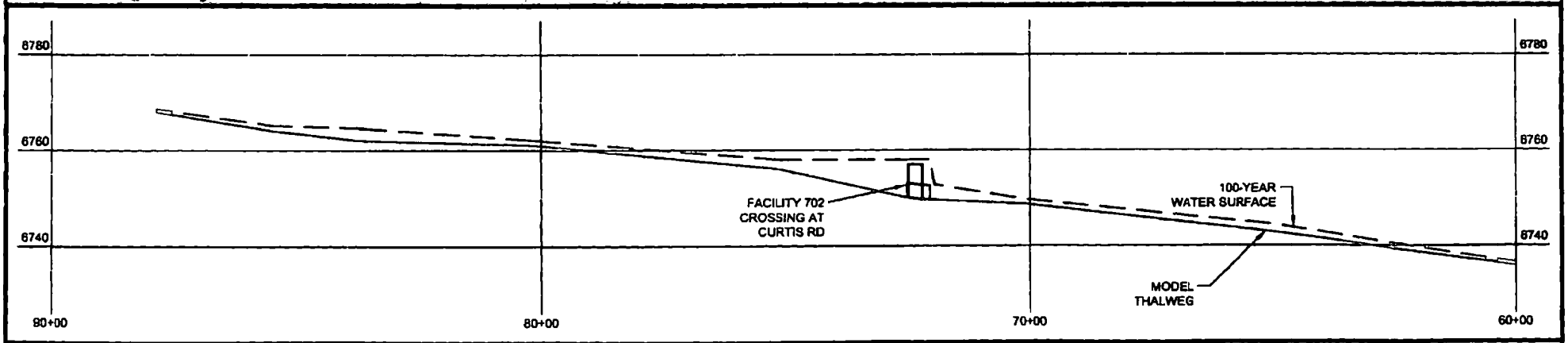
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T6-2
FIGURE 5-4

URS NO. 21711039





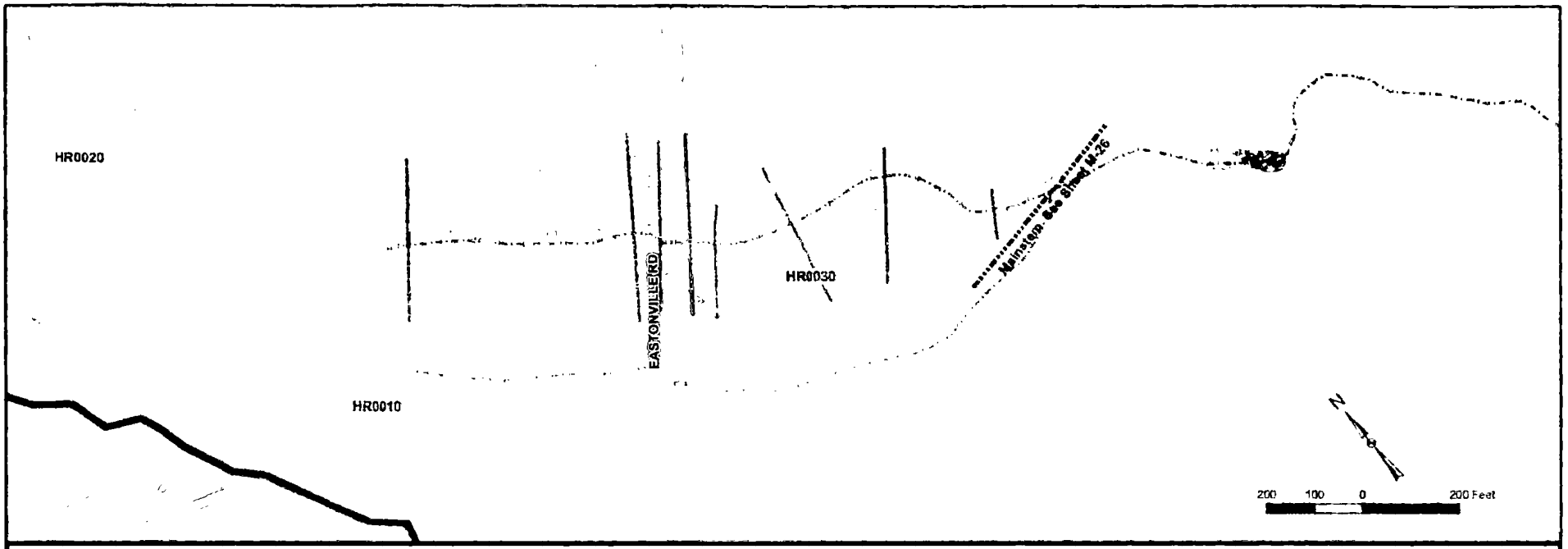
URS
9960 Federal Dr
Suite 300
Colorado Springs, CO 80921
719.531.0001

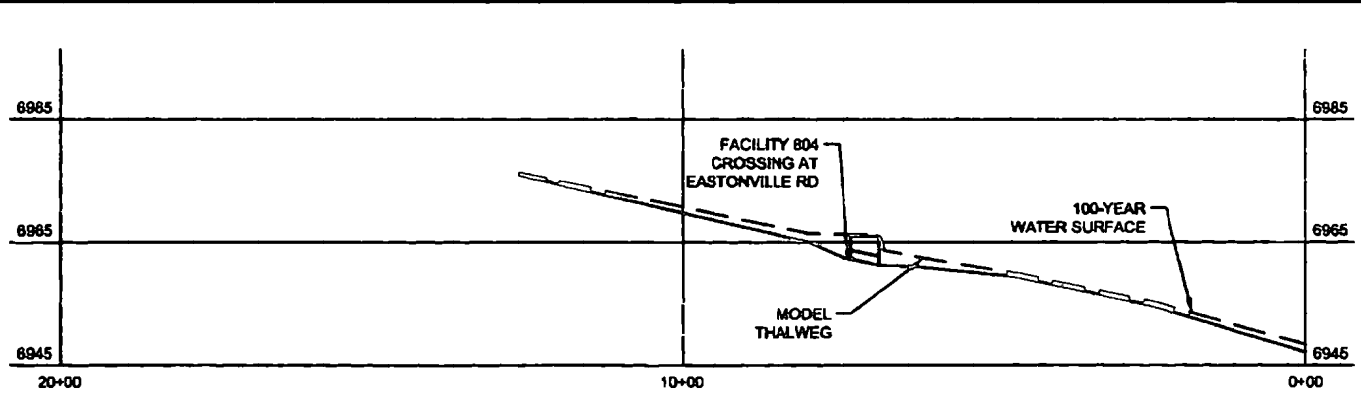
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T6-3
FIGURE 5-4

URS NO. 21711039





URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

Haegler Basin Boundary
Potential Wetlands
Subbasin Boundaries
Approximate 100-Year Floodplain
Thalweg
Cross Sections
2' Contours

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
APPROXIMATE 100-YEAR FLOOD LIMITS
SHEET T7-1
FIGURE 5-4

URS NO. 21711039

6.0 ALTERNATIVES

To manage increases in runoff to Haegler Ranch Basin from future development, alternatives for flood control have been developed conceptually so that feasibility and cost of flood control alternatives can be determined and compared. The objectives of this alternatives evaluation are to identify cost effective measures to control developed runoff from the watershed such that: 1) runoff rates leaving the basin are not greater than existing, 2) potential for damages to conveyances and structures within the watershed from the design flood is minimized, and 3) flood control measures can be implemented effectively as development occurs. Once a feasible alternative is developed, the costs of implementing the alternative will be estimated and compared with the costs of other alternatives.

6.1. Summary of Criteria

Generally, the criteria and methods used to develop detention and conveyance requirements follow the DCM. The criteria and process for estimating right-of-way and the financial costs, such as use of assessor's data for property costs or City of Colorado Springs data for estimating costs of structures, were established in discussions with El Paso County. Except as noted, the conceptual design of each alternative was bound by the criteria presented in the Manual. Culverts, for example, were generally designed to pass the design storm with a headwater over depth ratio of less than 1.5. For bridges, 1-foot of freeboard between the computed water-surface elevation and the minimum low-chord elevation is required. Each alternative was also developed to reduce impacts to private property, especially property that is highly developed. Alternative plans have been developed to address flood impacts, and consider stream stability, cost effectiveness, implementation, and aesthetics.

6.1.1. Flood Impacts

Development will cause stormwater flows in the Haegler Ranch Basin to increase, causing impacts to channels and culverts within the basin and downstream receiving streams. Damage to conveyance channels and structures could potentially occur due to an increase in the flood flows. The flood impacts within the basin along channels and crossings as well as impacts to downstream reaches need to be mitigated as development occurs.

6.1.2. Stream Stability

For the purposes of this evaluation, it is assumed that the channel forming flow is the 2-year peak flow. As noted in the hydrologic analysis, the 2-year peak flows increase dramatically from development within the watershed. With an increase in the 2-year peak flow, channel instability may occur resulting in degradation or aggradation of downstream conveyance channels. This instability could propagate upstream and downstream without proper maintenance and repairs, therefore alternatives need to address control of the 2-year flow in order to address stream stability.

6.1.3. Cost Effectiveness

Each alternative will have an associated construction cost. Construction costs are estimated for each alternative and compared to other alternatives along with an evaluation of how well each alternative addresses the other criteria. Cost effectiveness depends not only on the bottom line construction cost but also the benefits of the cost expenditure in achieving all the goals of this Drainage Basin Planning Study.

6.1.4. Implementation

To be effective, the preferred alternative must be implemented as development occurs so that the adverse impacts to the watershed are controlled. If a developer is dependant on improvements disconnected from the site to mitigate impacts, other requirements may be placed on the developer to control stormwater release rates. The overall purpose of the Drainage Basin Planning Study is to create a plan to address flood impacts on a regional basis, which can be implemented cost effectively by individual developers. Alterations to this plan can be made, but should not reduce the effectiveness.

6.1.5. Aesthetics

Since the Haegler Ranch basin is in a rural setting, aesthetics of the proposed conveyance channels and structures is important. Generally, concrete channels do not fit well with the aesthetics of the surrounding environment, and their use should be limited. Grass-lined channels are more consistent with the characteristics of the Haegler Ranch.

6.2. Design Methods

The 100-year flows for the Haegler Ranch Basin vary from 25 cfs at the upstream end to 5600 cfs at the outlet into Geick Ranch Basin. Culverts and channels have been designed using the methods discussed in the following paragraphs. Note that, prior to construction, these conceptual designs need to be engineered for the infrequent major storm event and the frequent minor storm event, per current El Paso County standards. This could include additional low flow channels, culverts and riprap to provide erosion protection through the basin.

6.2.1. Channel Design

Generally, conceptual channel geometry was developed from the DCM and HEC 15 (FHWA 2005), and consists of a trapezoidal section with a minimum bottom width of 4 feet, side slopes 2:1 or greater, and a design depth of less than 5 feet. Manning's roughness coefficients for each channel lining were estimated from typical values for each material from the DCM and HEC-15. The selected "n' values used for design are listed in Table 6-1.

Table 6-1 Constructed Channel Manning's Roughness Coefficients

Channel Linings	Manning's Roughness Coefficients
Grass	0.035
Riprap	0.047

The channel bottom width must be at least twice the flow depth per the DCM Section 10.5.3. Side slopes are 4:1(H:V) for grass-lined channels, 3:1 for riprap, and 2:1 for concrete linings. The flow depth is assumed to be at normal depth. Freeboard is calculated using Section 10.5.5 from the DCM and rounded up to the nearest even foot. Grass lined channels were selected as the preferred channel type for this study. Grass lined channels were calculated to be the most cost effective in terms of capital cost for most cases. Grass lined channels also mimic the existing channels and their side slope requirement will reduce head-cutting into tributary channels when compared to other channel linings.

detention occurred upstream, the Simplified Full-Spectrum Detention Sizing (Excess Urban Runoff Flow Control) method was used. For all other "full spectrum detention" ponds, the Hydrograph Routing Detention Sizing Procedure was applied and the Excess Urban Runoff Volume (EURV) is sized using the same equations as in the Full-Spectrum Detention Sizing.

For Sub-Regional Detention Alternative, the Hydrograph Routing Detention Sizing Procedure in Chapter 10, Storage, of the UDFCD SDCM was applied using the major 100-year storm event in the HEC-HMS model.

If another detention pond needed to be sized downstream of a proposed pond, the Hydrograph Routing Detention Sizing Procedure was applied and the corresponding outflow storage curve was used to simulate the detention pond in HEC-HMS. The new hydrology model was then run to determine the inflow hydrograph for the downstream elements. If necessary, the outflow storage curve was extrapolated in HEC-HMS, but the outflow was limited to the 100-year existing flow rate.

Using the Simplified Full-Spectrum Detention and Hydrograph Routing Detention, required volumes were determined for each detention pond. To estimate an area necessary for construction, a maximum of 5 feet was assumed for the pond depth due to the potential for high ground water levels. The corresponding area was increased by 10% to account for grading buffers and access.

6.3. Conceptual Alternatives

Basic alternative flood control concepts for major and minor flood events, and their associated impacts throughout the basin, are listed in Table 6-4. As noted in the Table, some of the impacts would propagate to receiving streams downstream of the Haegler Ranch.

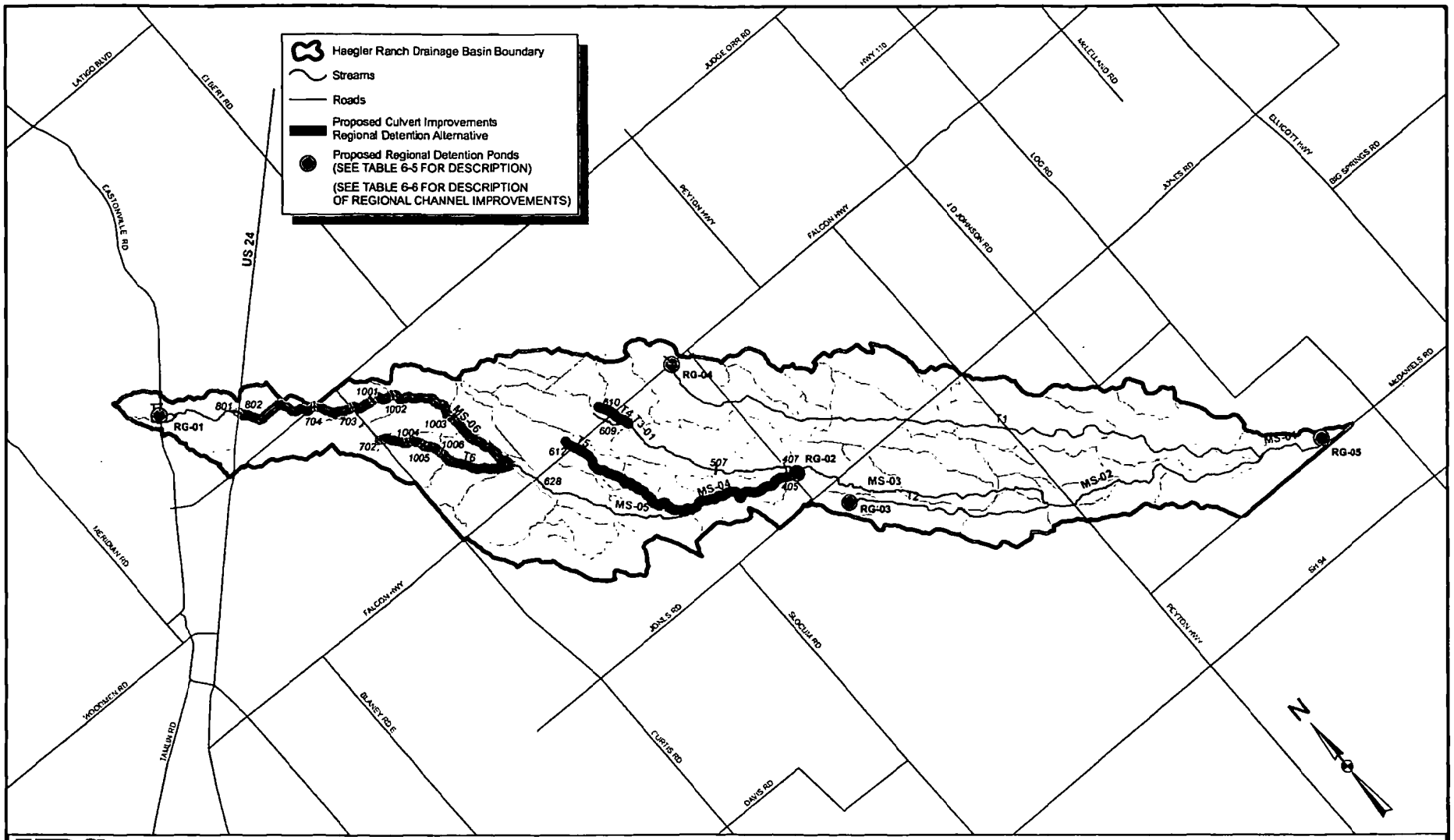
The first alternative, Channel Improvements with No detention, consists of releasing all developed flows without any detention. This alternative would require that channels and culverts downstream of the developing areas would need to be sized to convey future developed peak flows. Because development in the Haegler Ranch is occurring in the upper watershed and not the lower watershed, and because these downstream improvements would need to be in place before development occurs in order to mitigate potential flooding and stream stability problems, this alternative does not satisfy the implementation criterion and therefore is considered to be infeasible. Detention is required in the Haegler Ranch Basin in order to control stormwater flows from development.

Table 6-4 Basic Flood Control Concepts

Alternative	100-Year			2 Year		
	Channel / Culvert Improvements (Within Basin)	Downstream Flood Impact (Outside Basin)	Detention	Degradation / Sedimentation Issues (Within Basin)	Downstream Stability Issues (Outside Basin)	Detention
Channel Improvements with No Detention (Not Feasible)	Yes	Yes	No	Yes	Yes	No
Channel Improvements with Regional Detention	Yes	No	Yes	Yes	Yes	No
Channel Improvements w/ Subregional Detention	Minimal	No	Yes	No	No	Yes

6.3.1. Regional Detention

This first detention alternative places regional detention ponds strategically within the basin to release 100-year peak flows at existing conditions rates. Regional detention ponds are sized using the procedure described above for traditional detention, and are located within the basin as shown on Figure 6-1. The proposed locations were selected to be near proposed developments to intercept runoff before it entered the main stream. Regional detention ponds are sized to address local and regional development. Two developments that were isolated from the regional detention pond were evaluated independently to reduce improvements along the channels. A summary of the proposed Regional detention ponds is listed in Table 6-5.



URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
REGIONAL DETENTION
ALTERNATIVES
FIGURE 6-1

URS NO. 21711039

Table 6-5 Regional Detention Pond Summary

Pond	Volume (AF)	Peak Inflow (cfs)		Peak Outflow (cfs)	
		2-yr	100-yr	2-yr	100-yr
RG-01	9.02	100	320	11	63
RG-02	170	600	4800	150	2200
RG-03	0.04	3	70	2	9
RG-04	1.07	19	140	1	55
RG-05	0.03	12	120	11	3

For the 100-year peak flow, flood impacts downstream from the regional detention pond will not increase.

6.3.1.1. Channels

Channels upstream of the regional detention ponds need to be sized for the future undetained 100-year peak flow rates from development, while culverts and channels downstream of regional ponds are sized for the existing 100-year peak flow rates. Proposed channel improvements along the corresponding reaches are summarized in Table 6-6.

Table 6-6 Channel Designs for Regional Detention Alternative

Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Material
Main Stem (MS-04)	1700	3400	3500	7140	Riprap
Main Stem (MS-05)	1500	3000	3000	11100	Grass
Main Stem (MS-06)	590	890	900	7330	Grass
Main Stem (MS-06)	660	930	1000	3170	Grass
Main Stem (MS-06)	720	1500	1500	4450	Grass
Main Stem (MS-06)	750	1600	2000	3330	Grass
Tributary 3 (T3-01)	720	1500	1500	10710	Grass
Tributary 4 (T4)	200	570	600	1840	Grass
Tributary 5 (T5)	150	240	300	930	Grass
Tributary 5 (T5)	270	410	500	7770	Grass
Tributary 6 (T6)	200	440	500	4270	Grass
Tributary 6 (T6)	240	570	600	3940	Grass

6.3.1.2. Culverts

As with the channels, culverts upstream of a regional detention pond need to be sized for the future undetained 100-year peak flow rates, while culverts and channels downstream are sized for the existing 100-year peak flow rates. Proposed culvert improvements along the corresponding reaches are summarized in Table 6-7 for the Regional Detention Alternative.

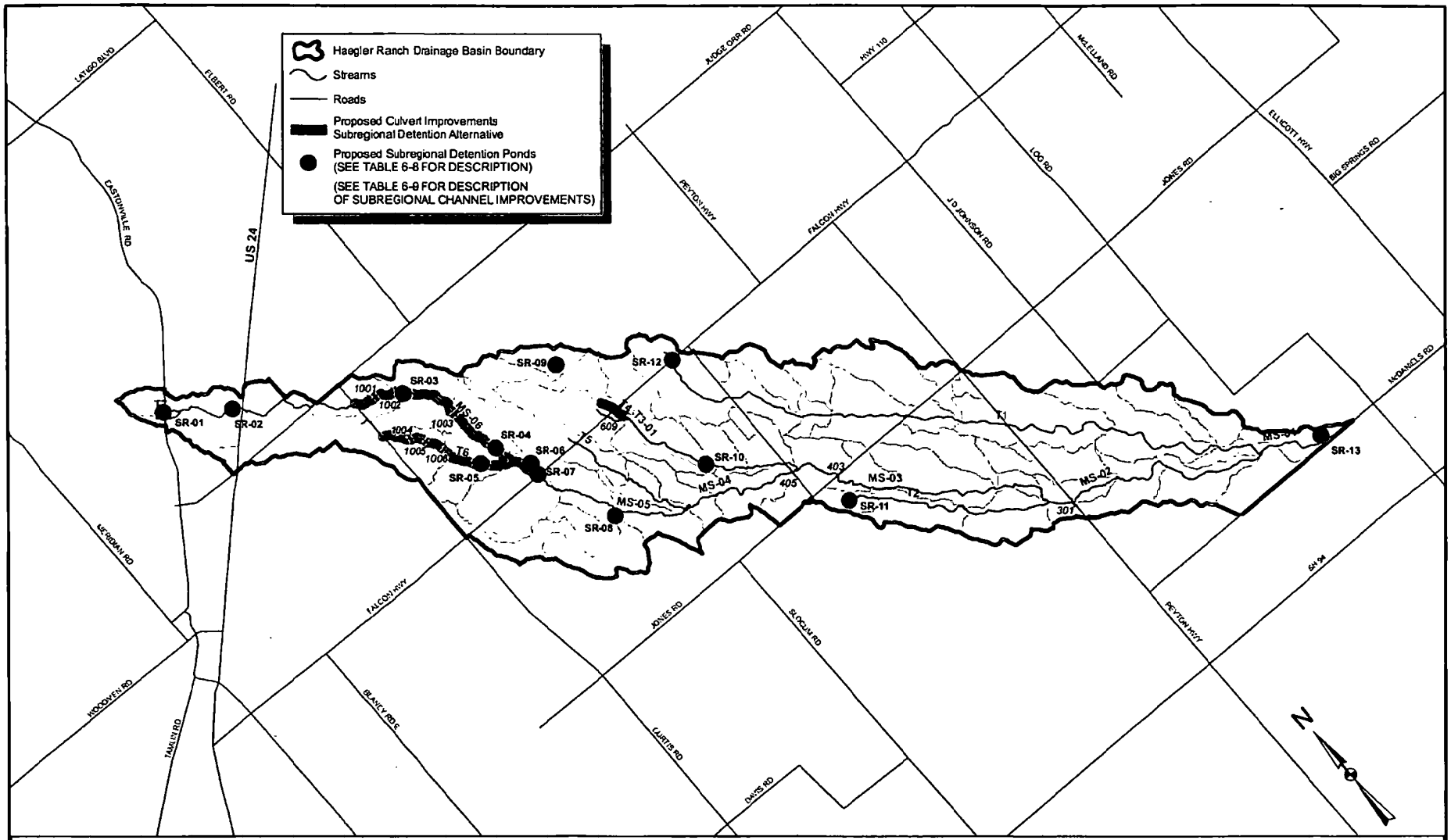
Table 6-7 Culvert Designs for Regional Detention

Facility Number	Road Crossing	Channel	Existing Size	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow
405	Murr Road	Main Stem (MS-04)	66" RCP	3,400	Overtops	6-10'X6' RCBs
507	Peerless Farms Road	Tributary 3 (T3-01)	60" CMP	1200	Overtops	2-10'X6' RCBs
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	460	Overtops	2-66" RCPs
610	Falcon Highway	Tributary 4 (T4)	24" CMP	570	Overtops	2-72" RCPs
612	Falcon Highway	Tributary 5 (T5)	24" CMP	240	Overtops	72" RCP
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	2,200	Overtops	4-10'X6' RCBs
702	Curtis Road	Tributary 6 (T6)	36" CMP	140	Overtops	60" RCP
703	Curtis Road	Main Stem (MS-06)	24" CMP	890	Overtops	2-8'X6' RCBs
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	830	Overtops	2-8'X6' RCBs
1001	Future Pastura Street	Main Stem (MS-06)	N/A	930	Future Road	2-8'X6' RCBs
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	N/A	930	Future Road	2-8'X6' RCBs
1003	Future Arroyo Hondo Blvd. S.	Main Stem (MS-06)	N/A	1500	Future Road	3-8'X6' RCBs
1004	Future Pastura Street	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs
1005	Future El Vado Road	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs
1006	Future Socorro Trail	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs

Note: Changes recommended to other culverts under existing conditions still apply

6.3.2. Subregional Detention

For this alternative, subregional detention ponds are located and sized to address development as it will occur. Locations of proposed subregional detention ponds are shown in Figure 6-2 and are summarized in Table 6-8. A connectivity diagram for the sub-regional HEC-HMS model is shown in Figure 6-3.

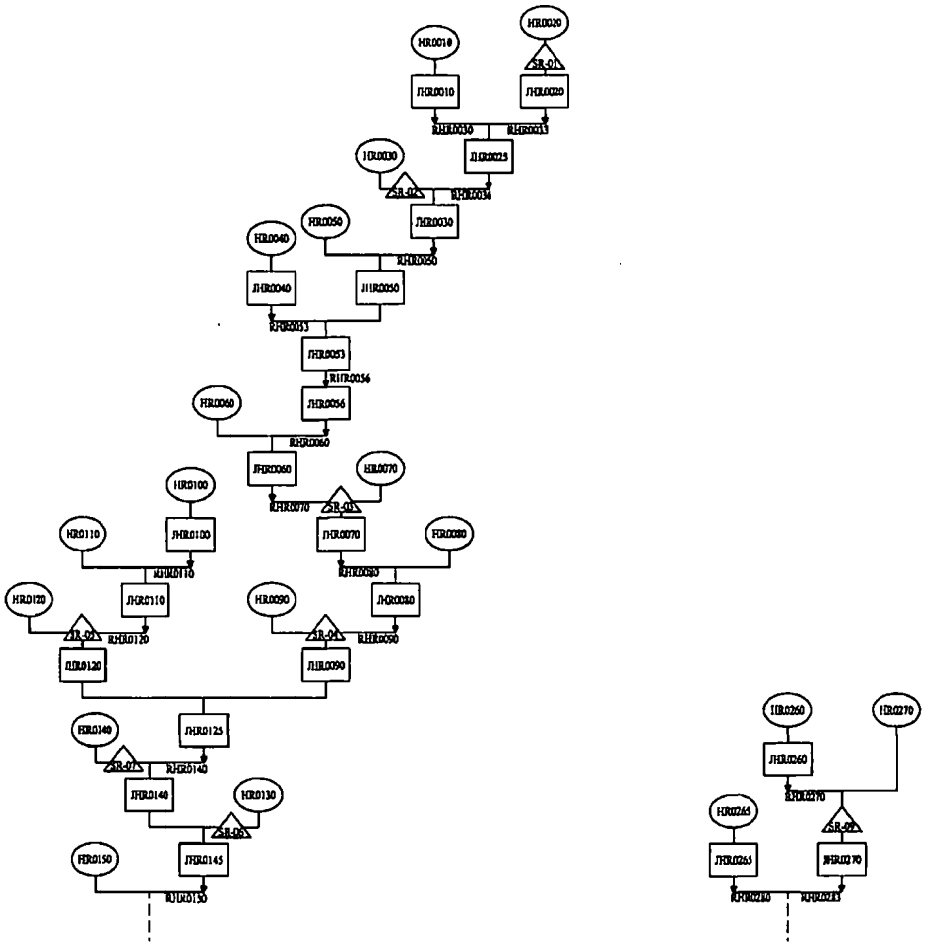


URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVES
FIGURE 6-2

URS NO. 21711039

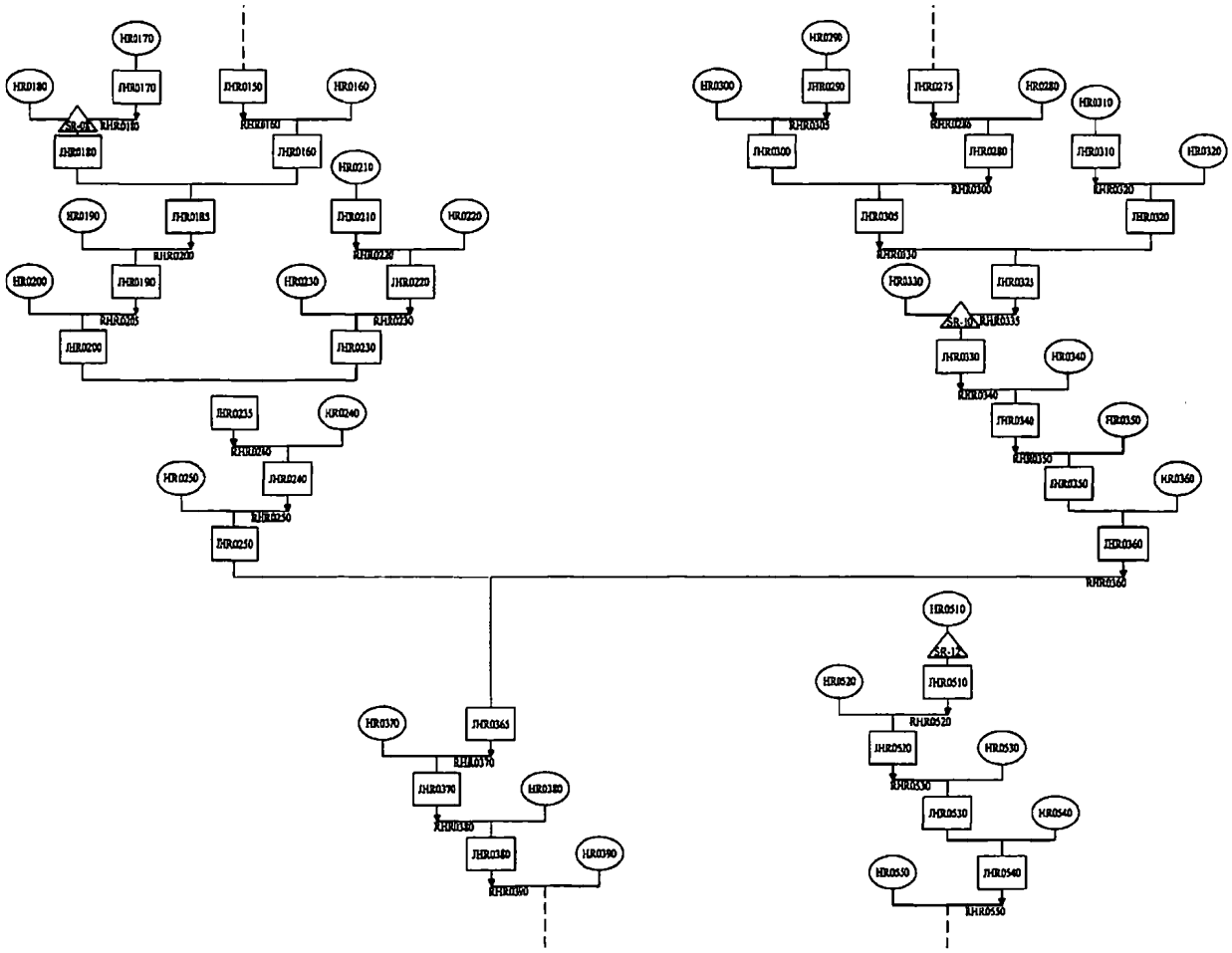


URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719 531.0001

URS NO. 21711039

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVE
SHEET 1
FIGURE 6-3



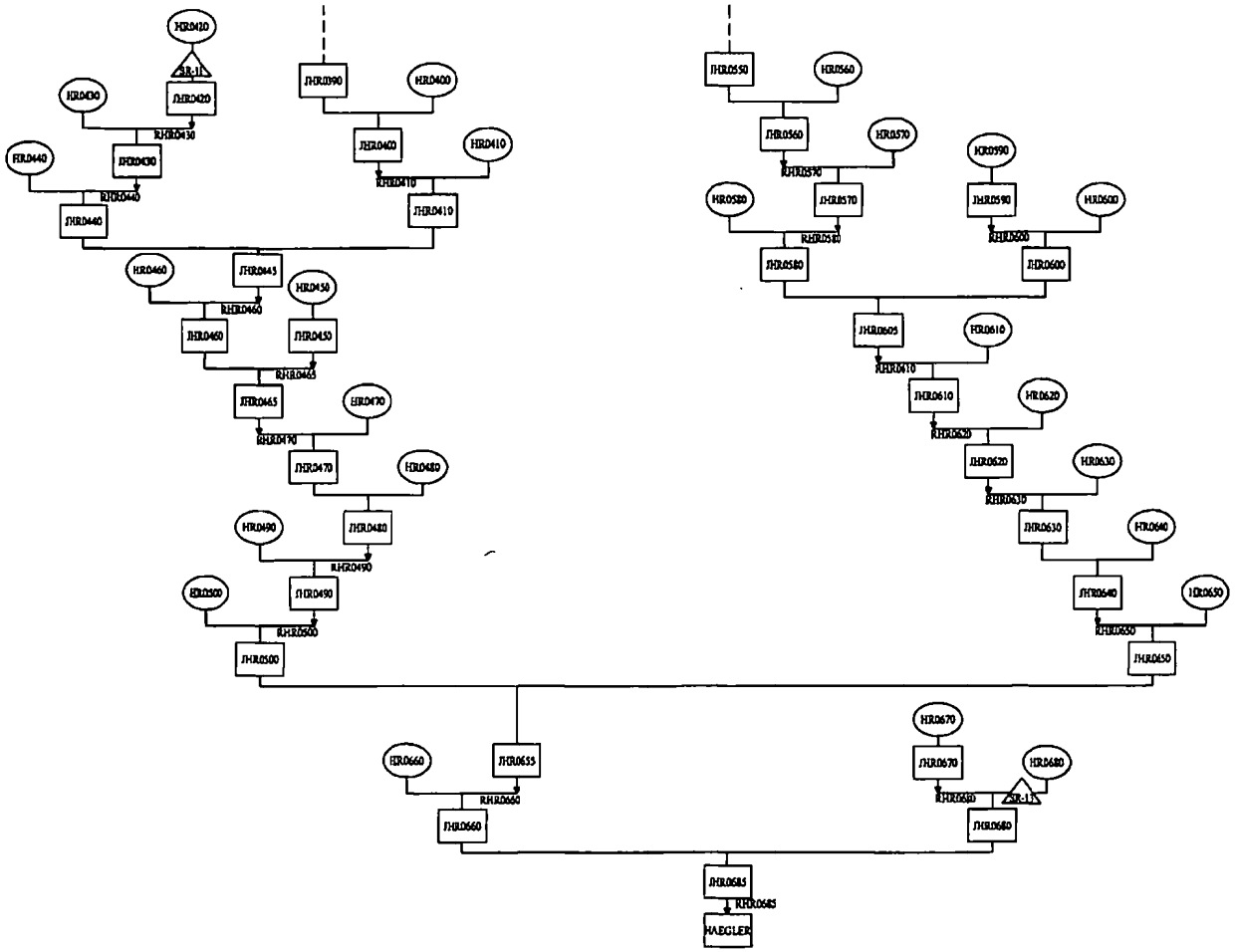
URS

9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION ALTERNATIVE
SHEET 2
FIGURE 6-3

URS NO. 21711039



URS

9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

HAEGLER RANCH DRAINAGE BASIN

SUBREGIONAL DETENTION ALTERNATIVE

SHEET 3

FIGURE 6-3

DATE: 05/08

URS NO. 21711039

6.4. Cost Estimates

The regional and subregional detention alternatives have been evaluated by assembling necessary design requirements using the above criteria and estimating the capital cost of the improvements. Proposed improvements are separated into existing or future, depending on whether facilities are designed for the existing or future peak flow rates. Unit rates for all cost estimating are based on an average of the bid tabulations published by CDOT for 2006. These unit rates are presented in Table 6-11. Land acquisition costs were included only for the detention facilities in the alternatives analysis, because channel improvements would essentially be in floodplain areas not otherwise developable. Cost estimates are included in Appendix C.

Table 6-11 Unit Rates

Item Number	Description	Units	URS Estimated Unit Price
203-00010	Unclassified Excavation (Complete In Place)	CY	$7.00
203-00060	Embankment Material (Complete In Place)	CY	$9.00
207-00205	Topsoil	CY	$8.00
212-00006	Seeding (Native)	ACRE	$580.00
420-00100	Geotextile (Erosion Control) (Class A)	SY	$3.00
506-00206	Riprap (6 Inch)	CY	$80.00
506-00212	Riprap (12 Inch)	CY	$76.00
506-00218	Riprap (18 Inch)	CY	$64.00
507-00100	Concrete Slope and Ditch Paving (Reinforced)	CY	$300.00
601-03030	Concrete Class D (Box Culvert)	CY	$435.00
602-00000	Reinforcing Steel	LB	$1.10
603-01185	18 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$48.00
603-01245	24 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$56.00
603-01305	30 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$68.00
603-01365	36 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$80.00
603-01425	42 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$100.00
603-01485	48 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$110.00
603-01545	54 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$145.00
603-01605	60 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$185.00
603-01665	66 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$210.00
603-01725	72 Inch Reinforced Concrete Pipe (Complete In Place)	LF	$230.00
603-05018	18 Inch Reinforced Concrete End Section	EACH	$735.00
603-05024	24 Inch Reinforced Concrete End Section	EACH	$850.00
603-05030	30 Inch Reinforced Concrete End Section	EACH	$1,100.00
603-05036	36 Inch Reinforced Concrete End Section	EACH	$1,275.00
603-05042	42 Inch Reinforced Concrete End Section	EACH	$1,550.00
603-05048	48 Inch Reinforced Concrete End Section	EACH	$1,990.00
603-05054	54 Inch Reinforced Concrete End Section	EACH	$2,150.00
603-05060	60 Inch Reinforced Concrete End Section	EACH	$2,275.00
603-05066	66 Inch Reinforced Concrete End Section	EACH	$2,300.00
603-05072	72 Inch Reinforced Concrete End Section	EACH	$2,400.00
603-70606	6x6 Foot Concrete Box Culvert (Precast)	LF	$475.00
603-70806	8x6 Foot Concrete Box Culvert (Precast)	LF	$535.00
603-71006	10x6 Foot Concrete Box Culvert (Precast)	LF	$570.00
N/A	Land Acquisition	ACRE	$55,000

Note: Land acquisition costs were provided by El Paso County

Cost estimates have been prepared for public roadway crossing facilities designed for existing peak flow rates and are shown in Table 6-12.

Table 6-12 Existing Conditions Roadway Crossing Deficiencies and Costs to Correct

Facility Number	Road Crossing	Channel	Necessary Facility	Cost
301	Peyton Highway	Main Stem (MS-02)	7-6'X6' RCBs	$314,535
401	Jones Road	Tributary 1 (T1)	6'X6' RCB	$53,111
403	Jones Road	Main Stem (MS-03)	6-6'X6' RCBs	$270,947
405	Murr Road	Main Stem (MS-04)	5-6'X6' RCBs	$180,371
407	Murr Road	Tributary 3 (T3-01)	2-6'X6' RCBs	$77,801
507	Peerless Farms Road	Tributary 3 (T3-01)	2-6'X6' RCBs	$115,801
509	Murr Road	Tributary 1 (T1)	66" RCP	$19,300
601	Whiting Way	Tributary 1 (T1)	66" RCP	$23,500
604	Max Road	Tributary 1 (T1)	66" RCP	$19,300
609	Falcon Highway	Tributary 3 (T3-02)	66" RCP	$25,600
610	Falcon Highway	Tributary 4 (T4)	66" RCP	$23,500
612	Falcon Highway	Tributary 5 (T5)	60" RCP	$21,200
628	Falcon Highway	Main Stem (MS-05)	3-6'X6' RCBs	$154,741
702	Curtis Road	Tributary 6 (T6)	54" RCP	$23,150
703	Curtis Road	Main Stem (MS-06)	2-6'X6' RCBs	$125,301
704	Judge Orr Road	Main Stem (MS-06)	2-72" RCPs	$83,200
801	Pedestrian Bridge	Main Stem (MS-06)	Existing Bridge	$0
802	US24	Main Stem (MS-06)	Existing Culvert	$0
803	Eastonville Road	Main Stem (MS-07)	30" RCP	$9,680
804	Eastonville Road	Tributary 7 (T7)	48" RCP	$14,980
N/A	Peyton Highway	Tributary 1 (T1)	2-72" RCPs	$51,000
N/A	Falcon Highway	Tributary 1 (T1)	36" RCP	$9,750
Sub-Total				$1,616,769
30% Construction Contingency				$485,031
15% Engineering Contingency				$242,515
Total				$2,344,315

(See Table C3 in Appendix C for details)

Table 6-16 Sub-Regional Detention Roadway Crossing Cost Estimate Summary

Facility Number	Road Crossing	Channel	Proposed 100-yr Flow (cfs)	Necessary Facility for Proposed 100-year Flow	Estimated Cost
301	Peyton Highway	Main Stem (MS-02)	3,370	9-6'X6' RCBs	$402,000
403	Jones Road	Main Stem (MS-03)	2,970	8-6'X6' RCBs	$358,000
405	Murr Road	Main Stem (MS-04)	2,870	8-6'X6' RCBs	$283,000
609	Falcon Highway	Tributary 3 (T3-02)	460	2-6'X6' RCBs	$106,000
N/A	Falcon Highway	Tributary 1 (T1)	110	2 - 36" RCP	$20,000
1001	Future Pastura Street	Main Stem (MS-06)	610	2-6'X6' RCBs	$107,000
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	610	2-6'X6' RCBs	$87,000
1003	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	530	2-6'X6' RCBs	$87,000
1004	Future Pastura Street	Tributary 6 (T6)	440	2-66" RCPs	$43,000
1005	Future El Vado Road	Tributary 6 (T6)	440	2-66" RCPs	$43,000
1006	Future Socorro Trail	Tributary 6 (T6)	440	2-66" RCPs	$43,000
Sub-Total					$1,582,000
30% Construction Contingency					$475,000
15% Engineering Contingency					$237,000
Total					$2,294,000

(See Tables C5 in Appendix C for details)

6.4.2. Detention Pond Costs

The cost of detention ponds, both regional and subregional, is based on the cubic yards of excavation, an estimated outlet structure, and the cost of the land required for the facility. These costs are presented in Table 6-17 and Table 6-18.

Table 6-17 Regional Detention Pond Cost Summary

Facility	Storage (AF)	Total Cost Including Construction and Engineering Contingencies
RG-01 9.02	9.02	$542,000
RG-02 64.52	64.52	$4,053,000
RG-03 0.04	0.04	$146,000
RG-04 1.07	1.07	$160,000
RG-05 0.03	0.03	$146,000
Total		$5,048,000

(See Tables C1 in Appendix C for details)

Table 6-18 Sub-Regional Detention Pond Cost Summary

Facility	Storage (AF)	Total Cost Including Construction and Engineering Contingencies
SR-01	10	$899,000
SR-02	5	$640,000
SR-03	16	$868,000
SR-04	25	$1,453,000
SR-05	24	$1,557,000
SR-06	9	$547,000
SR-07	5	$524,000
SR-08	5	$326,000
SR-09	20	$861,000
SR-10	23	$1,069,000
SR-11	2	$182,000
SR-12	9	$477,000
SR-13	3	$376,000
Total		$9,780,000

(See Table C1 in Appendix C for details)

6.4.3. Other Costs

Design Engineering costs are also included as 15% of the construction costs. Construction contingencies (30%) include such items as utility relocations, mobilization, temporary erosion control, and construction engineering.

6.4.4. Conceptual Alternative Costs

The total estimated capital costs for each alternative are based on the sum of the cost of the proposed facilities, plus costs for engineering and construction contingencies. These costs are listed in Table 6-19.

Table 6-19 Conceptual Alternative Costs

	Regional Alternative	Subregional Alternative
Detention Ponds	$5,048,000	$9,780,000
Channel Improvements	$10,737,000	$2,110,000
Drop Structures	$9,988,000	$3,442,000
Roadway Crossing Culverts	$2,307,000	$2,294,000
Total	$28,080,000	$17,627,000

7.1.5. Detention

The recommended plan calls for the construction of nine sub-regional detention basins within the Haegler Ranch Basin. One of these has already been designed as part of the Meridian Ranch Development. The purpose of the Haegler Ranch Basin detention basins is to limit peak discharges throughout the drainage to the existing condition levels. The detention basins in the upper portions of the Haegler Ranch Basin will reduce the peak flows so that the majority of the existing channel sections and bridges along SH 24 will have adequate flow capacity in the future development condition. The detention basins have been designed to accommodate the 100-year future condition volume without overtopping the overflow spillway. Detention ponds are shown in drawings in Appendix D.

7.1.6. Water Quality

Improvement of stormwater quality has become an important issue in drainage basin planning. Some pollutants occur naturally and are associated with sediments from the watershed. Other pollutants such as lawn chemicals, oil and grease, pet feces, lawn clippings and other items are the result of human development. Many of these pollutants can be reduced by implementing erosion control measures at construction sites, educational programs to inform the public as to the proper use of lawn chemicals, oil recycling and street sweeping programs.

Various methods of water quality enhancement have been identified for use in this Conceptual Design. 100-year and 10-year flow channels are lined to reduce erosion, drop/check structures are used to control channel grade, and water quality pools within the detention basins are proposed. The water quality pools for the subregional detention basins have been sized to store runoff generated by the two-year storm to a maximum of 5 Ac-ft. A maximum size for the regional Water Quality Capture Volume (WQCV) is supported by studies by the Urban Drainage and Flood Control District ("Sizing a Capture Volume for Stormwater Quality Enhancement", by Urbonas, Guo, and Tucker, published in the Flood Hazard News. December 1989), which show a diminishing level of return for larger, scarcer storm events. The water quality pool within each detention basin is sized to detain the WQCV over a 40-hour time period. The water quality measures for each sub-regional detention basin includes an inlet forebay, a water quality storage area, a water quality outlet control structure and the introduction of water tolerant vegetation in the basin bottom.

7.1.7. Trails

Major drainageway floodplains may be designated for use as open space and trail corridors. Maintenance access to the drainageway and to existing utilities within the drainageway corridor can offer a multiple use aspect to a trail project. The siting of a trail along a drainageway should be carried out while taking into account hydraulic considerations, utilities in the area, access to dedicated parks and roadway crossings.

7.2. Implementation and Permitting

Many of the channel sections shown on the plans may have to be modified to fit specific site conditions. This will be particularly true in the segments where selective channel treatments are proposed. Drop and check locations are approximate and may be moved to reduce disturbances to existing vegetation, roads, trails, and utilities. Existing right-of-ways will play a key role in the location of future drainageways. Tributary channel sizes, sections and alignments will have to be verified at the time the surrounding land is proposed for development.

It is expected that additional design of the detention ponds will occur as the areas around each one is planned. The Detention Facilities within Woodmen Hills have already been constructed. The acquisition of property for the remaining detention basins can proceed at any time, preferably no later than during the development planning stages of properties that lie adjacent to or surround any of the proposed sites. The timing of construction of the sub-regional detention facilities will mainly be driven by the rate of upstream development, and funding.

Improvements within Haegler Ranch Basin within and adjacent to park areas should be completed with the following general goals in mind: (1) provide a more stable drainage way, (2) maintain and enhance the visual setting of the drainage, and (3) provide multiple uses within the drainageway corridors. Construction of drops or checks could be combined with trail crossings of the creek. Low flow linings could be constructed in order to make the creek more visually pleasing and to protect active park facilities from damages due to frequent flooding or stream bank erosion. Localized creek improvements will be necessary as trails transition at roadway crossings, or at side tributary crossings. Implementation should also be completed in coordination with the Colorado Department of Wildlife comments, provided in Appendix F.

In areas where the existing drainage facilities are inadequate, capital improvement projects will be necessary. This will be particularly true at road crossings and within the East Tributary where extensive channelization is required. Several bridges are presently inadequate or nonexistent. These structures may have to be funded through capital improvement or bridge replacement funds.

7.2.1. Right-of-Way

With the exception of the Meridian Ranch development, the main channel and sub-tributaries which pass through developed portions of the basin (primarily south of SH 24) are not in dedicated drainage tracts, easements, or rights-of-way. This means that the County must have the approval and cooperation of property owners to maintain or improve the channels in these areas. Acquiring drainage easements along the drainageways is needed to provide access to the drainageways for construction and maintenance of improvements.

7.2.2. Roadway Bridge and Culvert Replacements

Bridge and culvert replacements shown on the Conceptual Design drawings have been sized in accordance with the DCM. Bridges are defined as those structures conveying at least 1500 cubic feet per second, having a flow area of at least 200 square feet, or having a span of 20-feet or greater. Road crossings conveying flows less than 1500 cubic feet per second, smaller than 200 square feet in flow area, or less than 20-feet in span have been included in the drainage basin fee calculation. Structures defined as bridges have been included in the County Bridge fee calculations. Note that many structures have been classified as bridges due to their total span, and not because of the volume they convey.

7.3. Revegetation

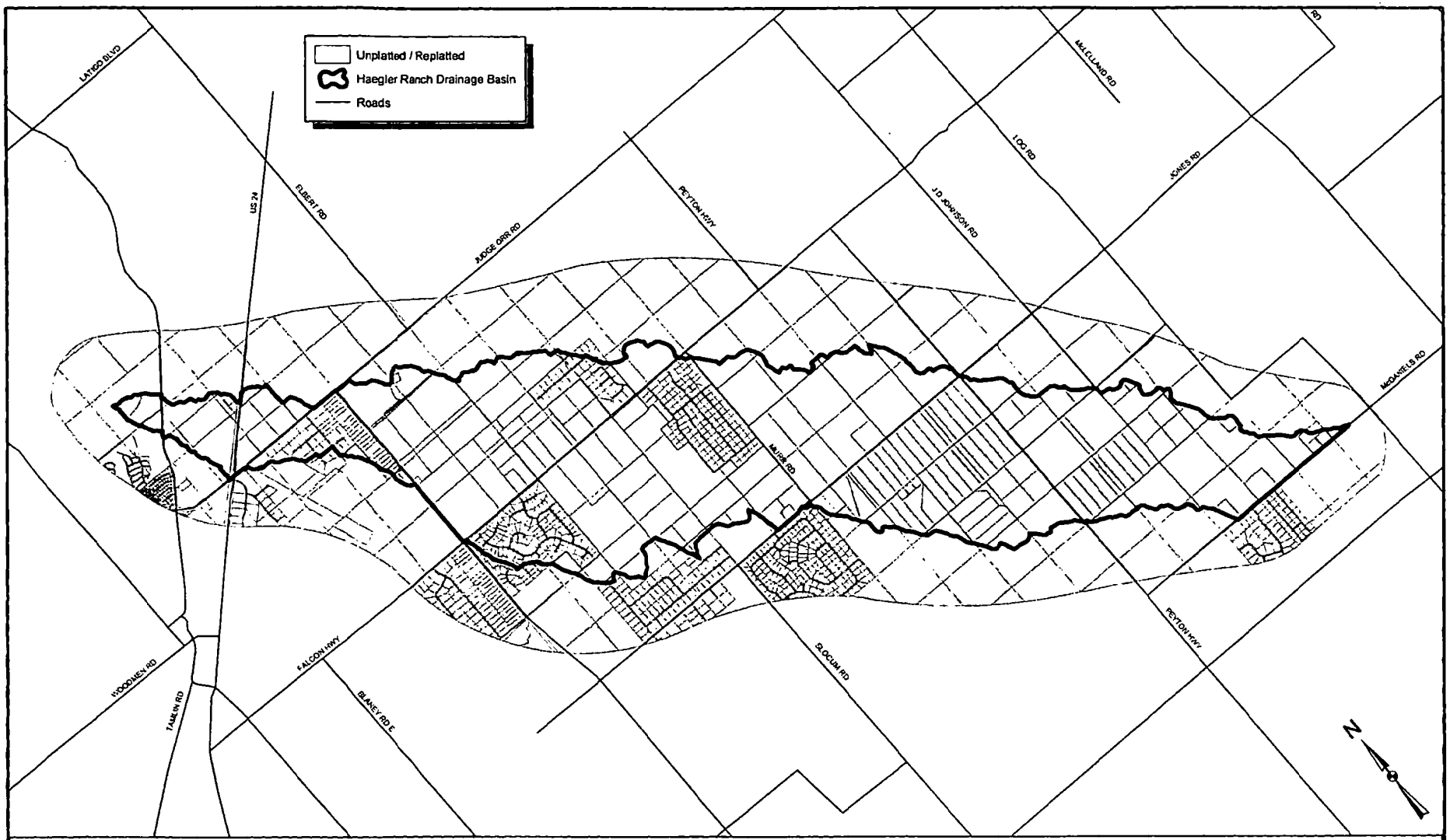
Soils in the Haegler Ranch Basin vary widely and, because of this, drainageways are subject to varying degrees of hazard resulting from erosion and sediment transport. During the collection of field and drainage inventory data, numerous areas were noted which were being impacted by either erosion (of one form or another), or sediment deposition. The soils of the basin are generally highly erodible, and this is particularly the case where the channel has a sand bottom and the watersheds have poor to fair vegetative cover. The disturbance of the native vegetation and failure to properly revegetate areas

Table 7-2 Drainage Basin Fee Calculations

Channel Improvements					
Channel	Basins	Channel Construction Cost	Drop Structure Construction Cost	Contingency Cost	Total Cost
Main Stem (MS-05)	HR0200	$224,000	$363,600	$264,420	$852,020
Main Stem (MS-06)	HR0070	$162,000	$295,400	$205,830	$633,230
Main Stem (MS-06)	HR0080	$331,000	$374,500	$317,475	$1,022,975
Main Stem (MS-06)	HR0090	$188,000	$368,000	$250,200	$806,200
Tributary 3 (T3-01)	HR0330	$259,000	$422,000	$306,450	$987,450
Tributary 3 (T3-02)	HR0300	$18,000	$37,000	$24,750	$79,750
Tributary 4 (T4)	HR0300	$40,000	$74,000	$51,300	$165,300
Tributary 6 (T6)	HR0110	$179,000	$333,000	$230,400	$742,400
Tributary 6 (T6)	HR0120	$55,000	$106,500	$72,675	$234,175
Subtotal Channel Costs					$5,553,500
Culvert Improvements					
Culvert	Road Crossing	Channel	Culvert Construction Cost	Contingency Cost	Total Cost
609	Falcon Highway	Tributary 3 (T3-02)	$106,301	$47,836	$154,137
N/A	Falcon Highway	Tributary 1 (T1)	$19,500	$8,775	$28,275
1001	Future Pastura Street	Main Stem (MS-06)	$106,301	$47,836	$154,137
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	$87,301	$39,286	$126,587
1003	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	$87,301	$39,286	$126,587
1004	Future Pasture Street	Tributary 6 (T6)	$51,000	$22,950	$73,950
1005	Future El Vado Road	Tributary 6 (T6)	$19,500	$8,775	$28,275
1006	Future Socorro Trail	Tributary 6 (T6)	$42,800	$19,260	$62,060
Subtotal Culvert Costs					$754,007
Detention Improvements					
Facility	Storage (AF)	Construction Cost		Contingency Cost	Total Cost
SR-01	10	$296,701		$133,516	$430,217
SR-02	5	$207,949		$93,577	$301,525
SR-03	16	$186,252		$83,814	$270,066
SR-04	25	$390,182		$175,582	$565,764
SR-05	24	$455,235		$204,856	$660,091
SR-06	9	$140,670		$63,301	$203,971
SR-07	5	$162,046		$72,921	$234,967
SR-08	5	$87,489		$39,370	$126,860
SR-09	20	$188,250		$84,713	$272,963
SR-10	23	$331,635		$149,236	$480,871
SR-11	2	$56,880		$25,596	$82,476
SR-12	9	$108,987		$49,044	$158,031
SR-13	3	$107,812		$48,515	$156,327
Subtotal Detention Costs					$3,944,129
Total Cost					**$10,251,636**
Total Unplatted Impervious Acres					**1,343**
Fee Per Impervious Acre					**$7,633**

Table 7-3 Bridge Fee Calculation

301	Peyton Highway	Main Stem (MS-02)	401,710	$180,770	$582,480
403	Jones Road	Main Stem (MS-03)	358,123	$161,155	$519,278
405	Murr Road	Main Stem (MS-04)	282,941	$127,323	$410,264
Subtotal Bridge Costs					$1,512,022
Total Cost					**$1,512,022**
Total Unplatted Impervious Acres					**1,343**
Bridge Fee Per Impervious Acre					**$1,126**



URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

DATE: 02/09

HAEGLER RANCH DRAINAGE BASIN
AREAS CALCULATED
AS UNPLATTED ACREAGE
FIGURE 7-1

URS NO. 21711039

8.0 REFERENCES

Aero-Metric, Inc. 2004. *Haegler Ranch Drainage.* Photogrammetric and Geographic Information Systems (GIS) data copied to compact disc October 1, 2004.

City of Colorado Springs, HDR Infrastructure, Inc., and El Paso County. 1994. *City of Colorado Springs and El Paso County Drainage Criteria Manual, Volume 1.*

Colorado Springs Utilities (CSU). 2005. *Haegler Ranch Drainage Basin ArcInfo Landuse and Landuse 2030 Coverages.* File Transfer Protocol (FTP) performed February 2005. El Paso County Information Technologies Department.

Colorado Water Conservation Board. 2004. *Guidelines for Determining 100-year Flood Flows for Approximate Floodplains in Colorado, Version 6.0.* Prepared in cooperation with the Colorado Flood Hydrology Advisory Committee.

El Paso County Department of Transportation, Pikes Peak Regional Development Center, and LSA Associates, Inc. 2004. *The El Paso County Major Transportation Corridors Plan, September 21, 2004.*

Federal Emergency Management Agency. 1997. Flood Insurance Rate Map, Panels 08041CO-0575F, -600F, and 825F.

Federal Emergency Management Agency. 2000. *Letter of Map Revision, Panel 08041CO-0825F.* Case No. 00-08-054P.

Federal Emergency Management Agency. 2004. *Letter of Map Revision, Panel 08041CO-0575F.* Case No. 04-08-0012P.

Federal Emergency Management Agency. 2005. *Letter of Map Revision, Panel 08041CO-0575F.* Case No. 04-08-0519P.

Federal Emergency Management Agency. 2005. *Letter of Map Revision, Panel 08041CO-0575F.* Case No. 04-08-0587P.

Federal Emergency Management Agency. 1999. *Flood Insurance Study: El Paso County Colorado and Incorporated Areas, Volumes 1-4, Rev. ed.* GPO Publications No. 1999-454-605/00106). Washington, DC: U.S. Government Printing Office.

Federal Higway Administration. 2005. *Hydraulic Engineering Circular No. 15 Design of Roadside Channels with Flexible Linings, Third Ed.* FHWA Publication No. FHWA-NHI-05-114. US Department of Transportation.

Miller, J.F., R.H. Fredrick, and R.J. Tracey. 1973. *NOAA Atlas 2: Precipitation-Frequency Atlas of the Western United States, Volume III-Colorado.* Prepared in cooperation with the U.S. Department of

Commerce, National Oceanic and Atmospheric Administration, National Weather Service. GPO Publication No. 1974-0-507-854.

Soil Conservation Service. 1981. *Soil Survey of El Paso County Area, Colorado.* Prepared in cooperation with the Colorado Agricultural Experiment Station. Washington, D.C. GPO Publication No. 1981-259-823/107.

Soil Conservation Service. 1984. Procedures for Determining Peak Flows in Colorado: Incorporates and Supplements Technical Release No. 55 Urban Hydrology for Small Watersheds.

URS Corporation. 2003. Preliminary Drainage Report for Meridian Ranch Phase II. July.

URS Corporation. 2004. Conditional Letter of Map Revision for a Tributary of Black Squirrel Creek, Meridian Ranch Subdivision, near Falcon, El Paso County, Colorado. October, pending FEMA Case Number 05-08-0050R.

U.S. Army Corps of Engineers. 1998. Design of Roadside Channels with Flexible Lining, HEC 15.

U.S. Army Corps of Engineers. 2003. Flood Plain Management Services Program: Black Squirrel Creek, El Paso and Pueblo Counties, Colorado, Hydrologic Analysis. Prepared for the Colorado Water Conservation Board.

U.S. Geological Society and U.S. Department of the Interior. 2000. *Analysis of the Magnitude and Frequency of Floods in Colorado.* Water-Resources Investigations Report 99-4190. Prepared in cooperation with the Colorado Department of Transportation and the Bureau of Land Management.

9.0 APPENDICES

Appendix A HYDROLOGY

Reference Attached CD

Appendix B HYDRAULICS

Reference Attached CD

Table C1

Regional Ponds

Note: Total Costs in Bold have used a minimum expected cost instead of QTY * COST/UNIT

Pond RG-01

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	14,552	$15	$218,284
Seeding	Acre	2	$580	**$2,500**
Topsoil	CY	970	$8	$7,761
Land Costs	Acre	2	$55,000	$124,025
Outlet Culvert	EACH	1	$14,150	$14,150
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$374,000
			30% Construction Contingency	$112,200
			15% Engineering Contingency	$56,100
			Total	$542,300

Pond RG-02

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	104,092	$15	$1,561,384
Seeding	Acre	13	$580	$7,484
Topsoil	CY	6,939	$8	$55,516
Land Costs	Acre	14	$55,000	$760,692
Outlet Culvert	EACH	1	$382,950	$382,950
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$2,795,306
			30% Construction Contingency	$838,592
			15% Engineering Contingency	$419,296
			Total	$4,053,194

Pond RG-03

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	65	$7	**$5,000**
Seeding	Acre	1	$580	**$2,500**
Topsoil	CY	538	$8	**$5,000**
Land Costs	Acre	1	$55,000	$68,750
Outlet Culvert	EACH	1	$12,500	$12,500
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$101,030
			30% Construction Contingency	$30,309
			15% Engineering Contingency	$15,155
			Total	$146,494

Pond RG-04

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	1,726	$7	$12,084
Seeding	Acre	1	$580	**$2,500**
Topsoil	CY	538	$8	**$5,000**
Land Costs	Acre	1	$55,000	$68,750
Outlet Culvert	EACH	1	$14,400	$14,400
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$110,014
			30% Construction Contingency	$33,004
			15% Engineering Contingency	$16,502
			Total	$159,520

Pond RG-05

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	48	$7	**$5,000**
Seeding	Acre	1	$580	**$2,500**
Topsoil	CY	538	$8	**$5,000**
Land Costs	Acre	1	$55,000	$68,750
Outlet Culvert	EACH	1	$12,475	$12,475
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$101,005
			30% Construction Contingency	$30,302
			15% Engineering Contingency	$15,151
			Total	$146,457
			Subtotal Regional Ponds	**$5,047,965**

Sub-Regional Ponds

Note: Total Costs in Bold have used a minimum expected cost instead of QTY * COST/UNIT

Pond SR-01

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	26,800	$9	$241,200
Seeding	Acre	5	$580	$2,726
Topsoil	CY	2,528	$8	$20,220
Land Costs	Acre	6	$55,000	$323,125
Outlet Culvert	EACH	1	$25,275	$25,275
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$619,826
			30% Construction Contingency	$185,948
			15% Engineering Contingency	$92,974
			Total	$898,748

Pond SR-02

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	18,339	$9	$165,051
Seeding	Acre	3	$580	**$2,500**
Topsoil	CY	1,828	$8	$14,628
Land Costs	Acre	4	$55,000	$233,750
Outlet Culvert	EACH	1	$18,490	$18,490
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$441,699
			30% Construction Contingency	$132,510
			15% Engineering Contingency	$66,255
			Total	$640,463

Pond SR-03

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	14,141	$9	$127,269
Seeding	Acre	6	$580	$3,480
Topsoil	CY	3,227	$8	$25,813
Land Costs	Acre	8	$55,000	$412,500
Outlet Culvert	EACH	1	$22,410	$22,410
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$598,752
			30% Construction Contingency	$179,626
			15% Engineering Contingency	$89,813
			Total	$868,191

Pond SR-04

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	29,750	$9	$267,750
Seeding	Acre	9	$580	$5,162
Topsoil	CY	4,786	$8	$38,290
Land Costs	Acre	11	$55,000	$611,875
Outlet Culvert	EACH	3	$23,900	$71,700
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$1,002,057
			30% Construction Contingency	$300,617
			15% Engineering Contingency	$150,309
			Total	$1,452,982

Table C2
Outlet Pipe Cost Estimates

Detention	Pipe Size (in)	Number of Barrels	Pipe Length (ft)	Slope (ft/ft)	Pipe Cost	End Section Cost	Total Cost
SR-01	36	1	300	0.02	$24,000	$1,275	$25,275
SR-02	48	1	150	0.03	$16,500	$1,990	$18,490
SR-03	72	1	87	0.02	$20,010	$2,400	$22,410
SR-04	54	3	150	0.02	$65,250	$6,450	$71,700
SR-05	54	1	150	0.02	$21,750	$2,150	$23,900
SR-06	24	1	150	0.02	$8,400	$850	$9,250
SR-07	42	1	135	0.02	$13,500	$1,550	$15,050
SR-08	48	1	100	0.02	$11,000	$1,990	$12,990
SR-09	36	1	175	0.01	$14,000	$1,275	$15,275
SR-10	60	2	300	0.01	$111,000	$4,550	$115,550
SR-11	30	1	100	0.03	$6,800	$1,100	$7,900
SR-12	30	1	200	0.01	$13,600	$1,100	$14,700
SR-13	48	1	300	0.01	$33,000	$1,990	$34,990
RG-01	36	1	150	0.01	$12,000	$2,150	$14,150
RG-02	6x6	6	300	0.01	$333,000	$49,950	$382,950
RG-03	30	1	150	0.01	$10,200	$2,300	$12,500
RG-04	36	1	150	0.01	$12,000	$2,400	$14,400
RG-05	30	1	150	0.01	$12,000	$475	$12,475

Table C4

Regional Detention Alternative Culvert Cost Calculation

Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency	Necessary Facility for Existing 100-year Flow	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow	Number of Culverts	Assumed Length (LF)[1]	Unit Cost	End Section Unit Cost	Headwall Concrete (LF/HW)	Headwall Steel (LB/HW)	Wingwall[2] Concrete (CY)	Wingwall[2] Steel (tons)	Concrete Unit Cost $/CY	Steel Unit Cost $/ton	Total Cost
405	Murr Road	Main Stem (MS-04)	66" RCP	2,200	Overtops	5-6'X6' RCBs	3,400	Overtops	6-10x6 Box	6	70	$570		0.581	151	24.42	1144	$435	$1.10	$256,307
507	Peerless Farms Road	Tributary 3 (T3-01)	60" CMP	600	Overtops	2-6'X6' RCBs	1200	Overtops	2-10x6 Box	2	110	$570		0.581	151	24.42	1144	$435	$1.10	$138,956
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	180	Overtops	66" RCP	460	Overtops	2-66" RCPs	2	100	$210	$2,300							$51,200
610	Falcon Highway	Tributary 4 (T4)	24" CMP	200	Overtops	66" RCP	570	Overtops	2-72" RCPs	2	90	$230	$2,400							$51,000
612	Falcon Highway	Tributary 5 (T5)	24" CMP	150	Overtops	60" RCP	240	Overtops	72" RCP	1	90	$230	$2,400							$25,500
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	1,100	Overtops	3-6'X6' RCBs	2,400	Overtops	4-10x6 Box	4	100	$570		0.581	151	24.42	1144	$435	$1.10	$243,232
702	Curtis Road	Tributary 6 (T6)	36" CMP	120	Overtops	54" RCP	140	Overtops	60" RCP	1	130	$185	$2,275							$28,600
703	Curtis Road	Main Stem (MS-06)	24" CMP	590	Overtops	2-6'X6' RCBs	890	Overtops	2-8x6 Box	2	120	$535		0.581	151	24.42	1144	$435	$1.10	$141,956
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	540	Overtops	2-72" RCPs	830	Overtops	2-8x6 Box	2	160	$535		0.581	151	24.42	1144	$435	$1.10	$184,756
N/A	New Santa Fe Springs 1	Main Stem (MS-06)	N/A	660	N/A	No Culvert	930	New Road	2-8x6 Box	2	80	$535		0.581	151	24.42	1144	$435	$1.10	$99,156
N/A	New Santa Fe Springs 3	Main Stem (MS-06)	N/A	660	N/A	No Culvert	930	New Road	2-8x6 Box	2	80	$535		0.581	151	24.42	1144	$435	$1.10	$99,156
N/A	New Santa Fe Springs 3	Main Stem (MS-06)	N/A	720	N/A	No Culvert	1500	New Road	3-8x6 Box	3	80	$535		0.581	151	24.42	1144	$435	$1.10	$142,794
N/A	New Santa Fe Springs 1	Tributary 6 (T6)	N/A	200	N/A	No Culvert	440	New Road	2-66" RCPs	2	80	$210	$2,300							$42,800
N/A	New Santa Fe Springs 2	Tributary 6 (T6)	N/A	200	N/A	No Culvert	440	New Road	2-66" RCPs	2	80	$210	$2,300							$42,800
N/A	New Santa Fe Springs 3	Tributary 6 (T6)	N/A	200	N/A	No Culvert	440	New Road	2-66" RCPs	2	80	$210	$2,300							$42,800

[1] Length is based on Future Land Use Road widths

[2] Wingwalls assumed 15' long for calculations. Calculations based on CDOT cross sections.

Sub-Total	$1,591,015
30% Construction Contingency	$477,305
15% Engineering Contingency	$238,652
Total	$2,306,972

Table C6
General Channel Design

URS

Job: Haegler DBPS
Description: Channelization

Project No: 21711039 Sheet:
Computed by: KAP Date: 6/18/08
Checked by: Date:

Assumptions:
4' bottom width minimum.
Bottom width is at least twice the flow depth — El Paso County DCM Section 10.5.3
Allowable Shear Stress
t_d = 1.00 psf — Grass
2.00 psf — 6" Riprap
4.00 psf — 12" Riprap
6.00 psf — 18" Riprap
8.00 psf — 24" Riprap
Limit slope to 0.30% minimum
Limit Velocity of flow to 20 fps for concrete channels.
Limit Constructed Depth to 5 ft. or less.

	Unit Cost	
Common Excavation	$7.00	/CY
Structure Excavation	$18.00	/CY
Topsoil	$8.00	/CY
Seeding	$580.00	/Acre
6" Riprap	$80.00	/CY
12" Riprap	$76.00	/CY
18" Riprap	$64.00	/CY
24" Riprap	$75.00	/CY
Grouted Riprap	$90.00	/CY
Slope Paving	$300.00	/CY
Concrete Class B	$500.00	/CY *This includes steel reinforcing cost
Geotextile	$3.00	/yd²

Channel Dimensions

Q (cfs)	n	Slope	Side Slopes	Bottom Width (ft)	Normal Depth (ft)	Froude Number	Constructed Depth (ft)	Velocity (fps)	Flow Area (sf)	Wetted Perimeter (ft)	R (ft)		t_d (psf)
GRASS													
300	0.035	0.90%	4	6	2.93	0.77	5	5.79	51.92	30.16	1.721	Sub	0.97
500	0.035	0.70%	4	8	3.68	0.70	5	5.97	83.61	38.35	2.180	Sub	0.95
600	0.035	0.60%	4	15	3.55	0.66	5	5.80	103.66	44.27	2.341	Sub	0.88
800	0.035	0.60%	4	20	3.72	0.67	5	6.16	129.75	50.68	2.560	Sub	0.96
900	0.035	0.60%	4	25	3.64	0.68	5	6.25	144.00	55.02	2.617	Sub	0.98
1000	0.035	0.60%	4	30	3.57	0.68	5	6.31	158.08	59.44	2.660	Sub	1.00
1500	0.035	0.50%	4	50	3.71	0.63	5	6.22	240.56	80.59	2.985	Sub	0.93
2000	0.035	0.40%	4	80	3.66	0.57	5	5.76	346.38	110.18	3.144	Sub	0.78
3000	0.035	0.45%	4	120	3.59	0.61	5	6.22	482.35	149.60	3.224	Sub	0.91
3500	0.035	0.45%	4	140	3.61	0.61	5	6.29	557.53	169.77	3.284	Sub	0.92

Channel Costs

Q (cfs)	Excavation Area (ft²/lin. ft)	Excavation (cy/lin. ft)	Excavation Cost ($/lin. ft)	Surface Area (ft/lin. ft)	4" Topsoil (cy/ lin. ft)	4" Topsoil Cost ($/lin. ft)	Seeding (acre)	Seeding Cost ($/lin. ft)	TOTAL COST ($/LF)
GRASS									
300	130	4.8	$33.70	47.23	0.58	$4.66	0.00108	$0.63	$39.00
500	140	5.2	$36.30	49.23	0.61	$4.86	0.0011	$0.66	$41.81
600	175	6.5	$45.37	56.23	0.69	$5.55	0.0013	$0.75	$51.67
800	200	7.4	$51.85	61.23	0.76	$6.05	0.0014	$0.82	$58.71
900	225	8.3	$58.33	66.23	0.82	$6.54	0.0015	$0.88	$65.76
1000	250	9.3	$64.81	71.23	0.88	$7.04	0.0016	$0.95	$72.80
1500	350	13.0	$90.74	91.23	1.13	$9.01	0.0021	$1.21	$100.97
2000	500	18.5	$129.63	121.23	1.50	$11.97	0.0028	$1.61	$143.22
3000	700	25.9	$181.48	161.23	1.99	$15.92	0.0037	$2.15	$199.55
3500	800	29.6	$207.41	181.23	2.24	$17.90	0.0042	$2.41	$227.72

Channel Dimensions — Drop Structures & Costs

Q (cfs)	n	Slope	Constructed Depth (ft)	Length Perp. To Channel (ft/lin. ft)	Drop Depth (ft)	Height of Concrete Cutoff Wall (1' thick) (ft)	Volume of Concrete (cy)	Concrete Cost ($/Str)	Structure Excavation (cy)	Structure Excavation Cost ($/Str)	Approach Armoring Length (ft)	Approach Armoring Bed Thickness (ft)	Approach Armoring Volume of Riprap (cy)	Approach Armoring Cost - 12" Riprap ($/Str)	Approach Armoring Geotextile (yd²)	Approach Armoring Geotextile Cost ($/Str)	Exit Armoring Length (ft)	Exit Armoring Bed Thickness (ft)	Exit Armoring Volume of Riprap (cy)	Exit Armoring Cost - 24" Riprap ($/Str)	Exit Armoring Geotextile (yd²)	Exit Armoring Geotextile Cost ($/Str)	TOTAL COST ($/STR)
GRASS																							
300	0.035	0.90%	5	47.23	4	12	21.0	$10,496	13.99	$251.90	20	3	104.96	$7,976 80	104.96	$314.87	40	3	209.92	$15,743.69	209.92	$629.75	$35,500
500	0.035	0.70%	5	49.23	4	12	21.9	$10,940	14.59	$262.57	20	3	109.40	$8,314.58	109.40	$328.21	40	3	218.80	$16,410.35	218.80	$656.41	$37,000
600	0.035	0.60%	5	56.23	4	12	25.0	$12,496	16.66	$299.90	20	3	124.96	$9,496 80	124.96	$374.87	40	3	249.92	$18,743.69	249.92	$749.75	$42,200
800	0.035	0.60%	5	61.23	4	12	27.2	$13,607	18.14	$326.57	20	3	136 07	$10,341.25	136.07	$408.21	40	3	272.14	$20,410.35	272.14	$816.41	$46,000
900	0.035	0.60%	5	66.23	4	12	29.4	$14,718	19.62	$353.23	20	3	147.18	$11,185.69	147.18	$441.54	40	3	294.36	$22,077.02	294.36	$883 08	$49,700
1000	0.035	0.60%	5	71.23	4	12	31.7	$15,829	21.11	$379.90	20	3	158.29	$12,030.13	158.29	$474.87	40	3	316.58	$23,743.69	316.58	$949.75	$53,500
1500	0.035	0.50%	5	91.23	4	12	40.5	$20,274	27.03	$486.57	20	3	202.74	$15,407.91	202.74	$608.21	40	3	405.47	$30,410.35	405.47	$1,216.41	$68,500
2000	0.035	0.40%	5	121.23	4	12	53.9	$26,940	35.92	$646.57	20	3	269.40	$20,474.58	269.40	$808.21	40	3	538.80	$40,410.35	538.80	$1,616.41	$90,900
3000	0.035	0.45%	5	161.23	4	12	71.7	$35,829	47.77	$859.90	20	3	358.29	$27,230.13	358.29	$1,074.87	40	3	716.58	$53,743.69	716.58	$2,149.75	$120,900
3500	0.035	0.45%	5	181.23	4	12	80.5	$40,274	53.70	$966.57	20	3	402.74	$30,607.91	402.74	$1,208.21	40	3	805.47	$60,410.35	805.47	$2,416.41	$135,900

Table C8
Sub-Regional Detention Alternative Channel Design

Subregional Channel Improvements								
Channel	Basins	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Lining Material	Unit Cost	Total Cost
Main Stem (MS-05)	HR0200	1,460	1,680	2,000	1,560	Grass	$143.22	$224,000
Main Stem (MS-06)	HR0070	660	530	600	3,120	Grass	$51.67	$162,000
Main Stem (MS-06)	HR0080	720	970	1,000	4,535	Grass	$72.80	$331,000
Main Stem (MS-06)	HR0090	750	740	800	3,190	Grass	$58.71	$188,000
Tributary 3 (T3-01)	HR0330	600	600	600	5,000	Grass	$51.67	$259,000
Tributary 3 (T3-02)	HR0300	220	500	500	420	Grass	$41.81	$18,000
Tributary 4 (T4)	HR0300	220	500	500	940	Grass	$41.81	$40,000
Tributary 6 (T6)	HR0110	200	440	500	4,280	Grass	$41.81	$179,000
Tributary 6 (T6)	HR0120	240	250	300	1,400	Grass	$39.00	$55,000

Sub-Total	**$1,456,000**
30% Construction Contingency	**$436,800**
15% Engineering Contingency	**$218,400**
Total	**$2,111,200**

Subregional Drop Structures											
Channel	Basins	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Existing Slope (%)	Proposed Slope	Elevation Change	No. of Drops	Unit Cost	Total Cost
Main Stem (MS-05)	HR0200	1,460	1,680	2,000	1,560	1.40%	0.40%	15.6	4	$90,900	$363,600
Main Stem (MS-06)	HR0070	660	530	600	3,120	1.40%	0.60%	25.3	7	$42,200	$295,400
Main Stem (MS-06)	HR0080	720	970	1,000	4,535	1.03%	0.60%	24.6	7	$53,500	$374,500
Main Stem (MS-06)	HR0090	750	740	800	3,190	1.40%	0.60%	31.8	8	$46,000	$368,000
Tributary 3 (T3-01)	HR0330	600	600	600	4,725	1.30%	0.60%	37.9	10	$42,200	$422,000
Tributary 3 (T3-02)	HR0300	220	500	500	420	1.30%	0.70%	2.5	1	$37,000	$37,000
Tributary 4 (T4)	HR0300	220	500	500	940	1.33%	0.70%	5.0	2	$37,000	$74,000
Tributary 6 (T6)	HR0110	200	440	500	4,280	1.32%	0.70%	33.6	9	$37,000	$333,000
Tributary 6 (T6)	HR0120	240	250	300	1,400	1.40%	0.90%	10.7	3	$35,500	$106,500

Sub-Total	**$2,374,000**
30% Construction Contingency	**$712,200**
15% Engineering Contingency	**$356,100**
Total	**$3,442,300**

Pond SR-05

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	42,235	$9	$380,115
Seeding	Acre	9	$580	$5,220
Topsoil	CY	4,840	$8	$38,720
Outlet Culvert	EACH	1	$23,900	$23,900
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$455,235
			30% Construction Contingency	$136,571
			15% Engineering Contingency	$68,285
			Total	$660,091

Pond SR-06

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	11,460	$9	$103,140
Seeding	Acre	4	$580	$2,500
Topsoil	CY	2,312	$8	$18,500
Outlet Culvert	EACH	1	$9,250	$9,250
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$140,670
			30% Construction Contingency	$42,201
			15% Engineering Contingency	$21,100
			Total	$203,971

Pond SR-07

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	13,860	$9	$124,740
Seeding	Acre	3	$580	$1,500
Topsoil	CY	1,560	$8	$12,478
Outlet Culvert	EACH	1	$15,050	$15,050
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$162,048
			30% Construction Contingency	$48,614
			15% Engineering Contingency	$24,307
			Total	$234,967

Pond SR-08

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	6,235	$9	$56,115
Seeding	Acre	2	$580	$2,500
Topsoil	CY	1,076	$8	$8,604
Outlet Culvert	EACH	1	$12,990	$12,990
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$87,489
			30% Construction Contingency	$26,247
			15% Engineering Contingency	$13,123
			Total	$126,860

Pond SR-09

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	15,210	$9	$136,890
Seeding	Acre	6	$580	$3,422
Topsoil	CY	3,173	$8	$25,383
Outlet Culvert	EACH	1	$15,275	$15,275
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$188,250
			30% Construction Contingency	$56,475
			15% Engineering Contingency	$28,238
			Total	$272,963

Pond SR-10

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	20,000	$9	$180,000
Seeding	Acre	6	$580	$3,422
Topsoil	CY	3,173	$8	$25,383
Outlet Culvert	EACH	1	$115,550	$115,550
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$331,635
			30% Construction Contingency	$99,491
			15% Engineering Contingency	$49,745
			Total	$480,871

Pond SR-11

Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	3,800	$9	$34,200
Seeding	Acre	1	$580	$2,500
Topsoil	CY	538	$8	$5,000
Outlet Culvert	EACH	1	$7,900	$7,900
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$56,880
			30% Construction Contingency	$17,064
			15% Engineering Contingency	$8,532
			Total	$82,476

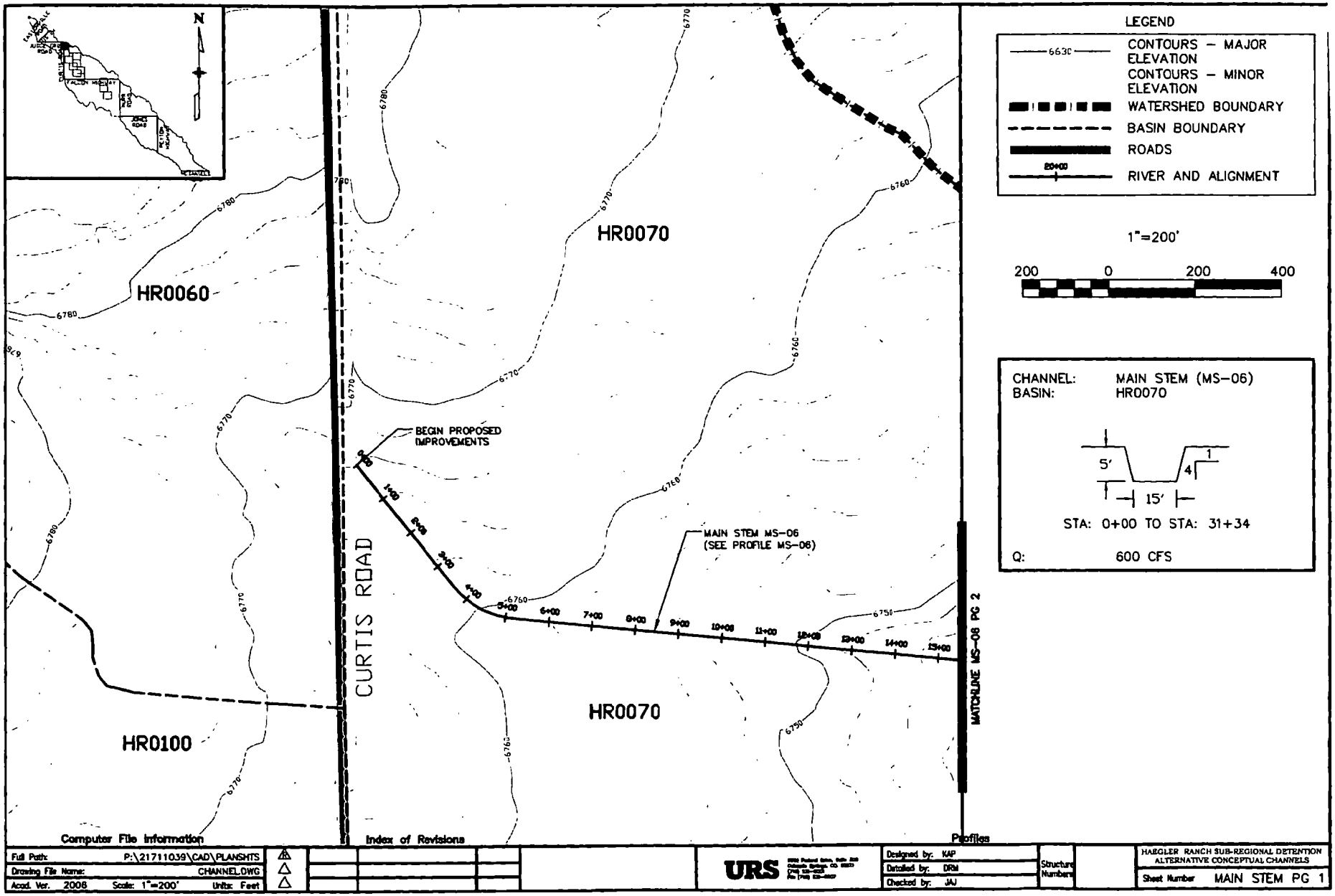
Pond SR-12

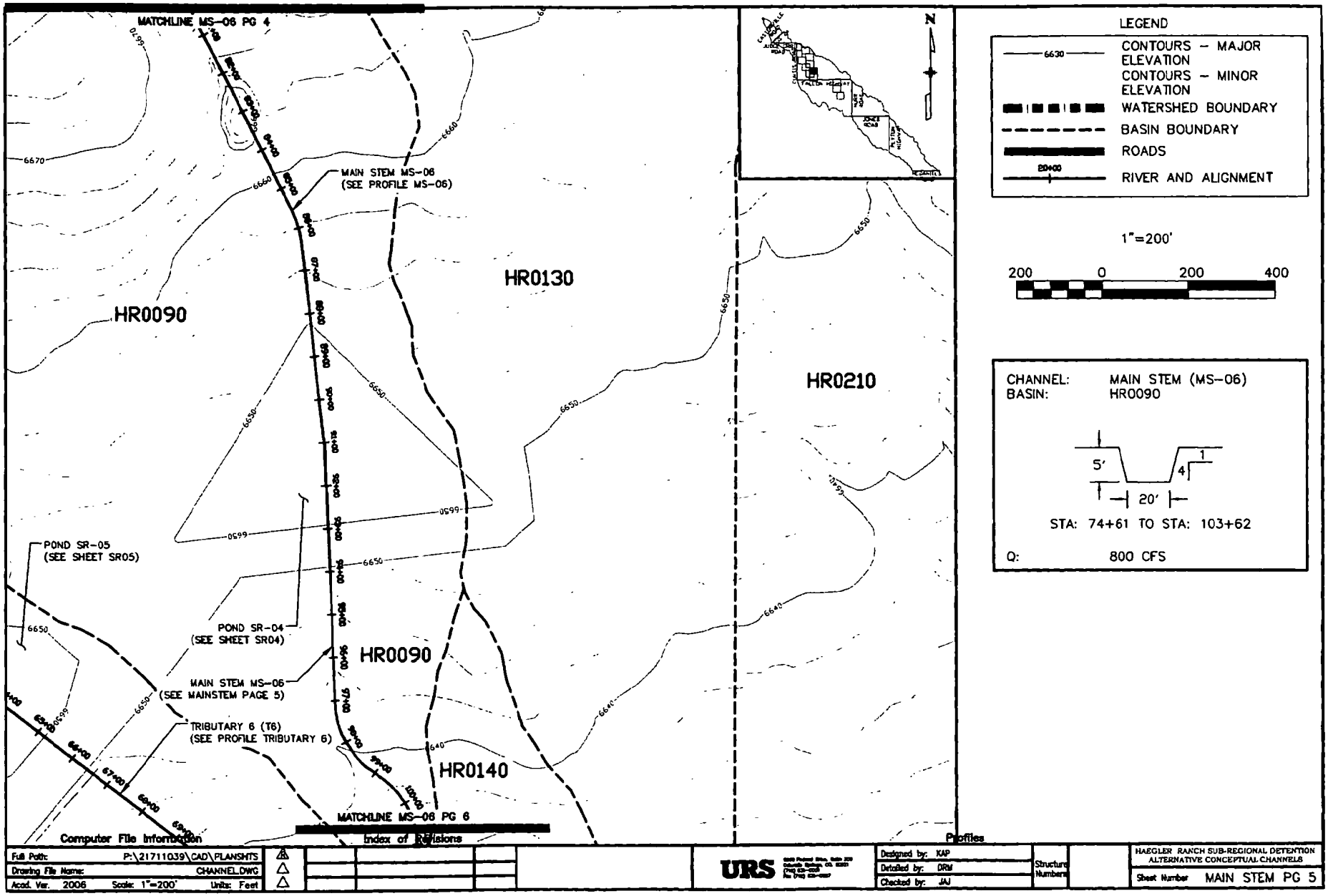
Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	7,860	$9	$70,740
Seeding	Acre	3	$580	$2,500
Topsoil	CY	1,721	$8	$13,767
Outlet Culvert	EACH	1	$14,700	$14,700
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$108,987
			30% Construction Contingency	$32,696
			15% Engineering Contingency	$16,348
			Total	$158,031

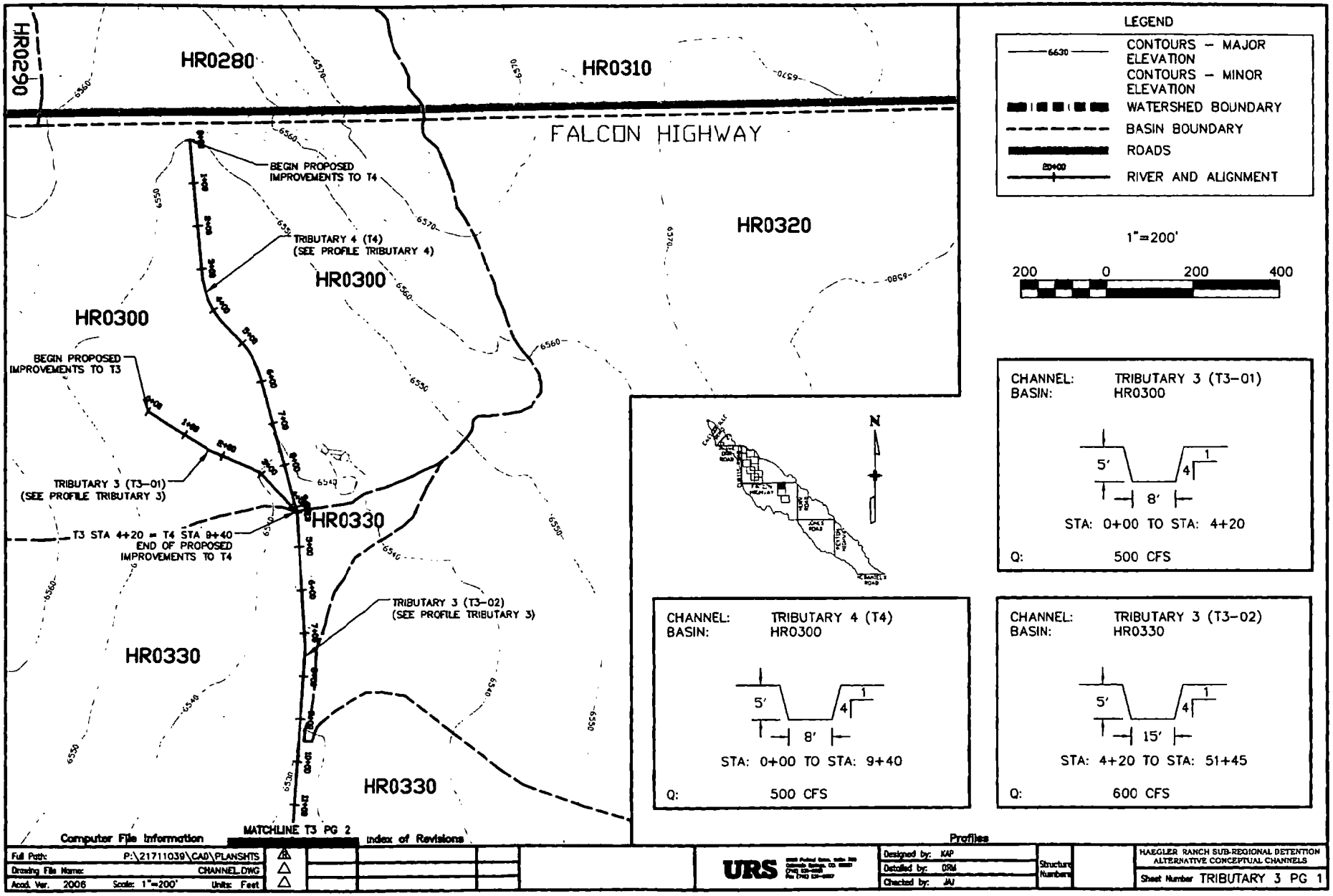
Pond SR-13

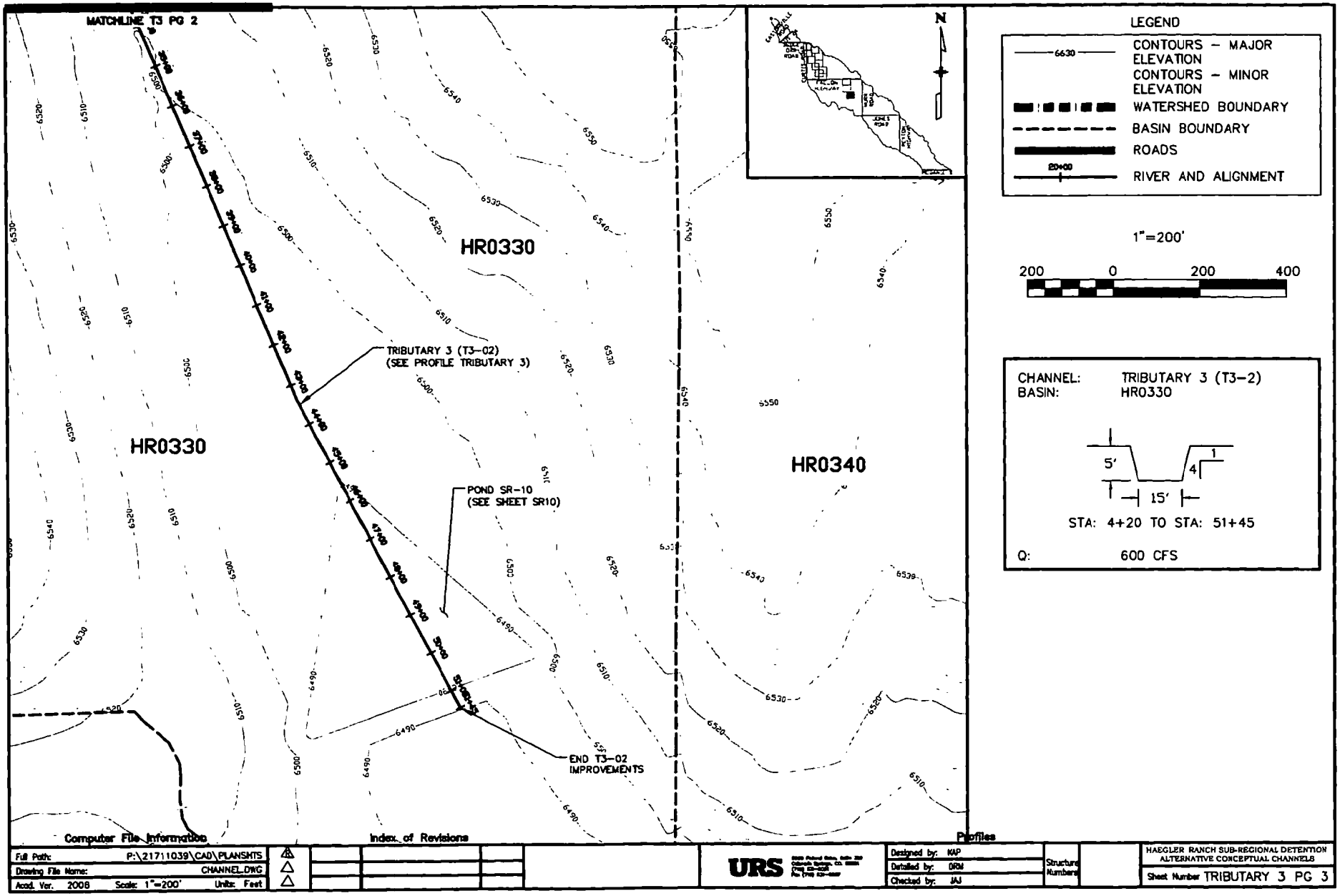
Item	UNIT	QTY	COST/UNIT	TOTAL COST
Detention Reservoir Excavation	CY	5,953	$9	$53,577
Seeding	Acre	2	$580	$2,500
Topsoil	CY	1,183	$8	$9,465
Outlet Culvert	EACH	1	$34,990	$34,990
Outlet Structure	EACH	1	$7,280	$7,280
			Subtotal	$107,812
			30% Construction Contingency	$32,344
			15% Engineering Contingency	$16,172
			Total	$156,327
			Subtotal SubRegional Ponds	$3,944,129

Appendix D PREFERRED ALTERNATIVE


LEGEND
6630
CONTOURS – MAJOR ELEVATION
CONTOURS – MINOR ELEVATION
WATERSHED BOUNDARY
BASIN BOUNDARY
ROADS
RIVER AND ALIGNMENT
1"=200'
200 0 200 400
CHANNEL: MAIN STEM (MS–06)
BASIN: HR0070
5'
1
4
15'
STA: 0+00 TO STA: 31+34
Q: 600 CFS
HR0060
HR0070
HR0100
HR0070
CURTIS ROAD
BEGIN PROPOSED IMPROVEMENTS
MAIN STEM MS–06 (SEE PROFILE MS–06)
MATCHLINE MS–06 PG 2
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: CHANNEL.DWG
Acad. Ver. 2008 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: KAP
Detailed by: DRM
Checked by: JAJ
Structure Numbers
HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS
Sheet Number MAIN STEM PG 1


MATCHLINE MS-06 PG 4
MAIN STEM MS-06
(SEE PROFILE MS-06)
HR0090
HR0130
HR0210
HR0090
HR0140
POND SR-05
(SEE SHEET SR05)
POND SR-04
(SEE SHEET SR04)
MAIN STEM MS-06
(SEE MAINSTEM PAGE 5)
TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)
MATCHLINE MS-06 PG 6
Index of Revisions
Profiles
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: CHANNEL.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet
URS
Designed by: KAP
Detailed by: DRM
Checked by: JAJ
Structure Numbers
HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS
Sheet Number MAIN STEM PG 5
LEGEND
6630 CONTOURS - MAJOR ELEVATION
CONTOURS - MINOR ELEVATION
WATERSHED BOUNDARY
BASIN BOUNDARY
ROADS
RIVER AND ALIGNMENT
1"=200'
200 0 200 400
CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090
5'
4
1
20'
STA: 74+61 TO STA: 103+62
Q: 800 CFS


HR0290
HR0280
HR0310
FALCON HIGHWAY
HR0320
HR0300
HR0300
HR0330
HR0330
HR0330
BEGIN PROPOSED IMPROVEMENTS TO T4
TRIBUTARY 4 (T4) (SEE PROFILE TRIBUTARY 4)
BEGIN PROPOSED IMPROVEMENTS TO T3
TRIBUTARY 3 (T3-01) (SEE PROFILE TRIBUTARY 3)
T3 STA 4+20 = T4 STA 9+40 END OF PROPOSED IMPROVEMENTS TO T4
TRIBUTARY 3 (T3-02) (SEE PROFILE TRIBUTARY 3)
MATCHLINE T3 PG 2
LEGEND
CONTOURS - MAJOR ELEVATION
CONTOURS - MINOR ELEVATION
WATERSHED BOUNDARY
BASIN BOUNDARY
ROADS
RIVER AND ALIGNMENT
1"=200'
200 0 200 400
N
CHANNEL: TRIBUTARY 3 (T3-01)
BASIN: HR0300
5' 4 1 8'
STA: 0+00 TO STA: 4+20
Q: 500 CFS
CHANNEL: TRIBUTARY 4 (T4)
BASIN: HR0300
5' 4 1 8'
STA: 0+00 TO STA: 9+40
Q: 500 CFS
CHANNEL: TRIBUTARY 3 (T3-02)
BASIN: HR0330
5' 4 1 15'
STA: 4+20 TO STA: 51+45
Q: 600 CFS
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: CHANNEL.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: KAP
Detailed by: DRM
Checked by: JAJ
Structure Numbers
HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS
Sheet Number TRIBUTARY 3 PG 1



Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: CHANNEL.DWG
Acad. Ver. 2008 Scale: 1"=200' Units: Feet

Index of Revisions

Profiles

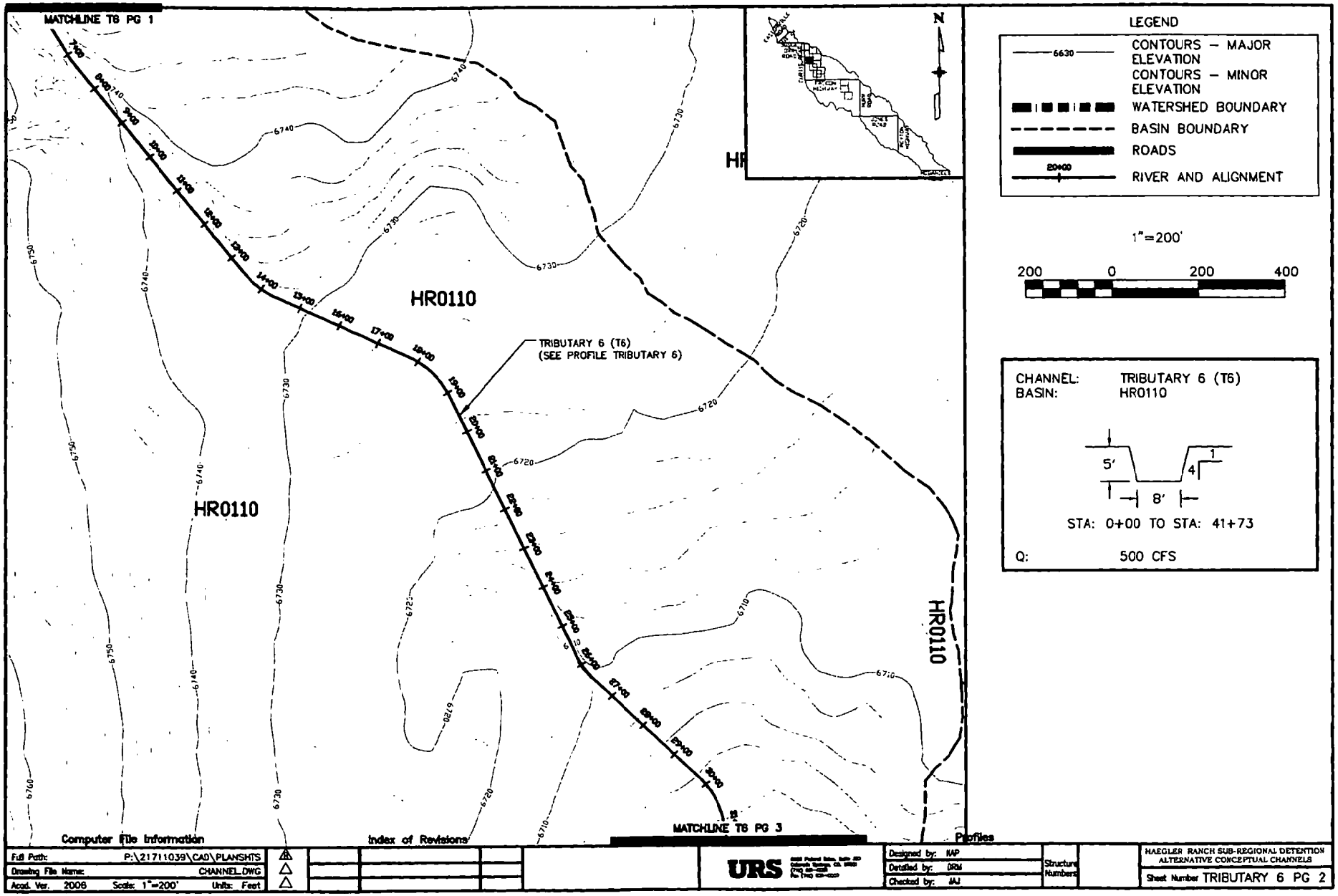
URS

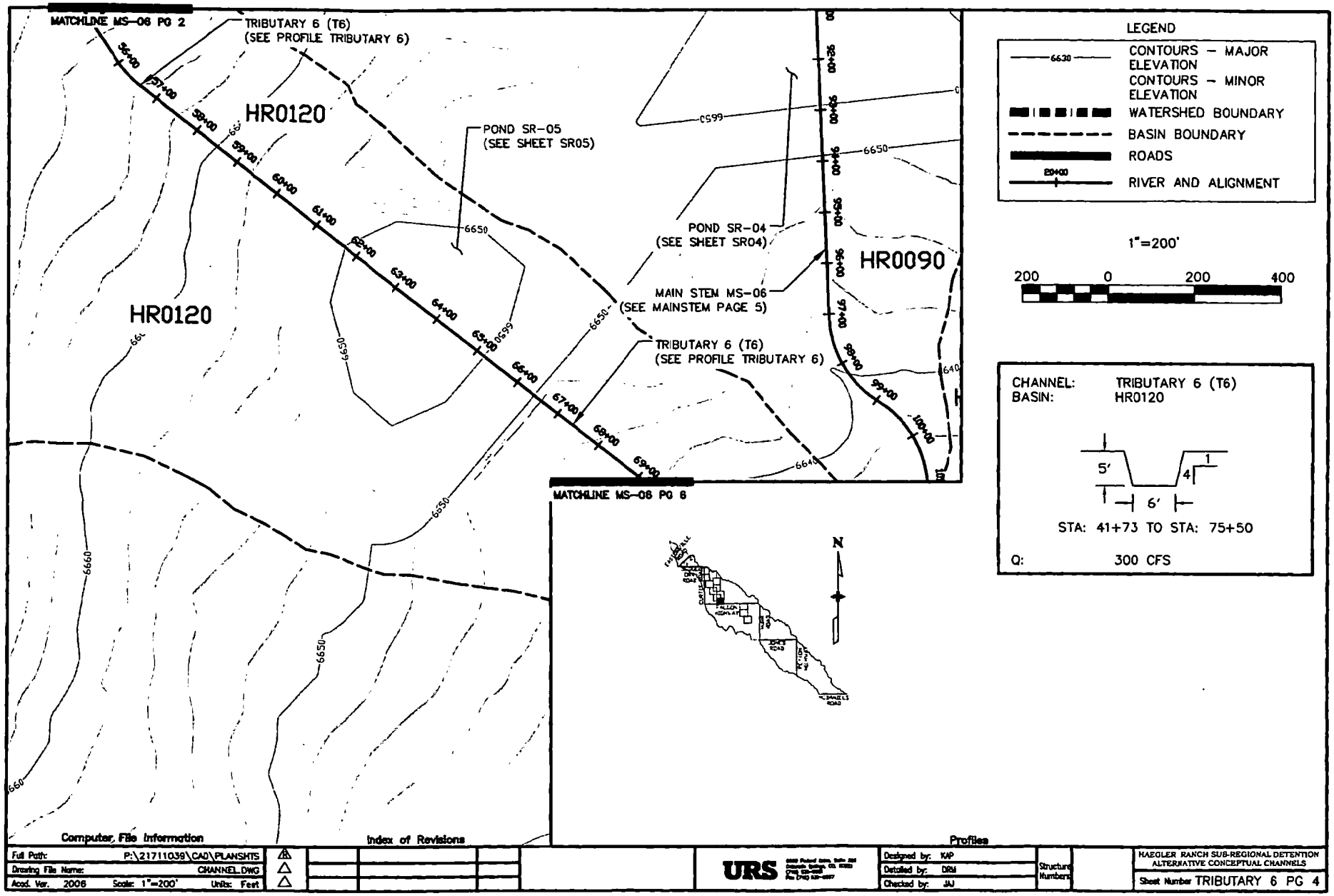
Designed by: MAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 3 PG 3


MATCHLINE T6 PG 1
HR0110
HR0110
HR0110
TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)
MATCHLINE T6 PG 3
N
LEGEND
CONTOURS – MAJOR ELEVATION
CONTOURS – MINOR ELEVATION
WATERSHED BOUNDARY
BASIN BOUNDARY
ROADS
RIVER AND ALIGNMENT
1"=200'
200 0 200 400
CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110
5'
4
1
8'
STA: 0+00 TO STA: 41+73
Q: 500 CFS
Computer File Information
Full Path: P:\21711039\CAD\PLANSMTS
Drawing File Name: CHANNEL.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: MAP
Detailed by: DRM
Checked by: MAJ
Structure Numbers
HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS
Sheet Number TRIBUTARY 6 PG 2



Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	CHANNEL.DWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

Index of Revisions

1		
2		
3		

URS

Profiles

Designed by:	KAP
Detailed by:	DRM
Checked by:	JAJ

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 4

MS-06 HR0080

SLOPE = 0.60%

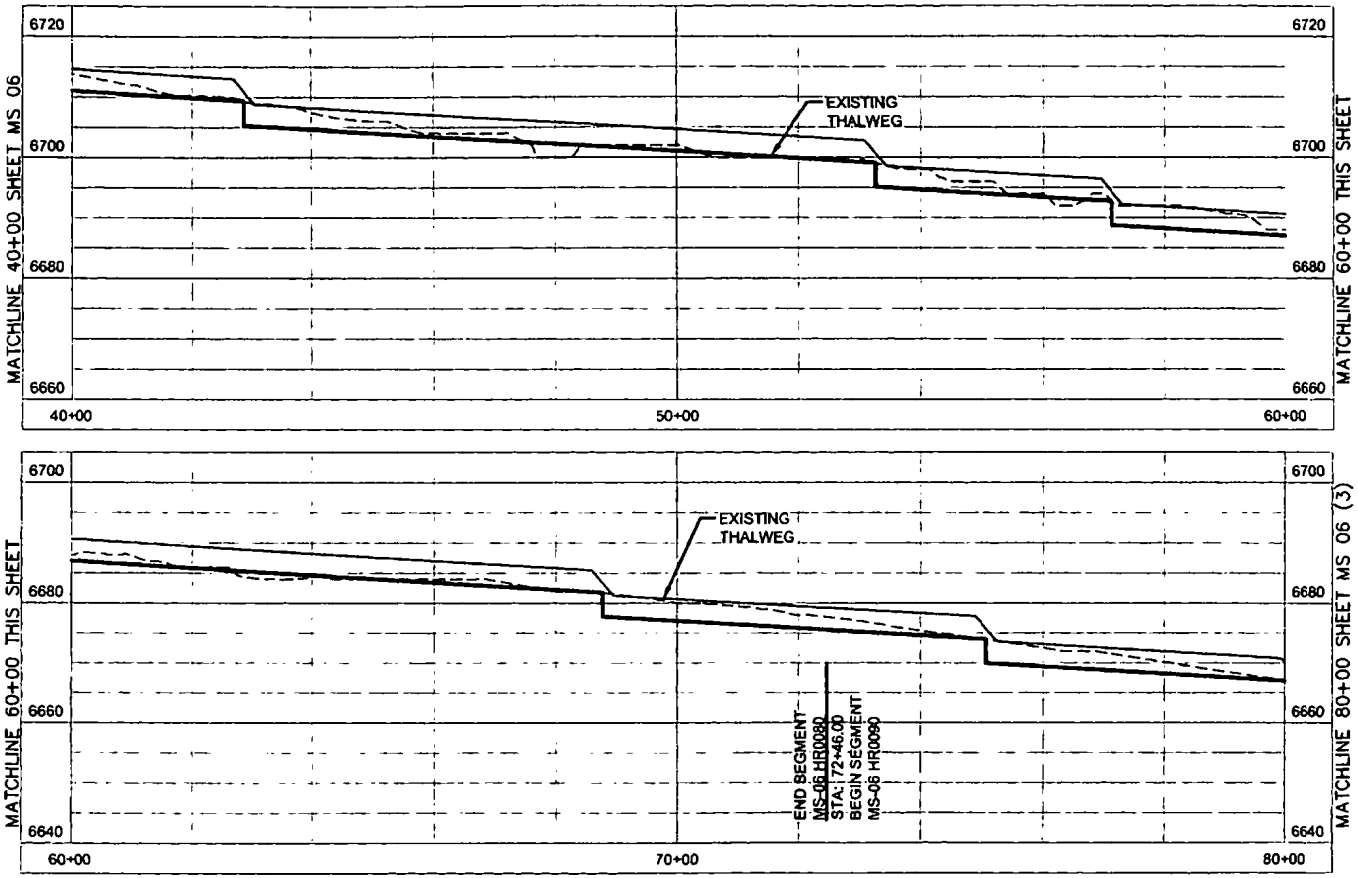
(7) 4' DROPS

MS-06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)



LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

Acad. Ver. 2008 Scale: 1"=20' Units: Feet

Index of Revisions

1		
2		
3		

URS

Profiles

Designed by: KAP

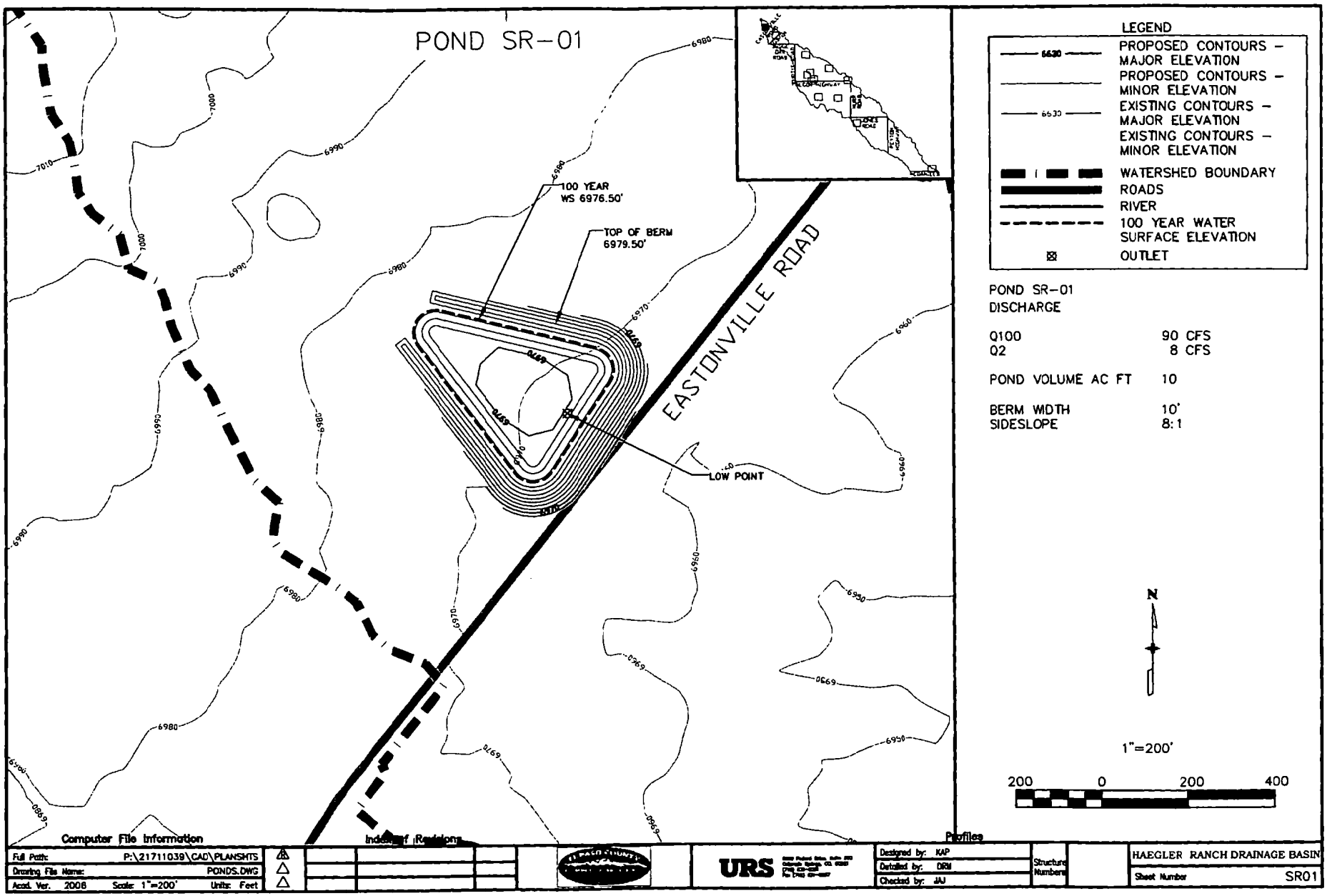
Detailed by: DRM

Checked by:

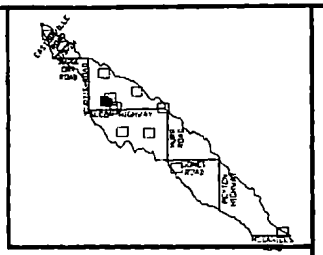
Structure Numbers:

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MSO6 (2)


POND SR-01
100 YEAR
WS 6976.50'
TOP OF BERM
6979.50'
LOW POINT
EASTONVILLE ROAD
LEGEND
PROPOSED CONTOURS - MAJOR ELEVATION
PROPOSED CONTOURS - MINOR ELEVATION
EXISTING CONTOURS - MAJOR ELEVATION
EXISTING CONTOURS - MINOR ELEVATION
WATERSHED BOUNDARY
ROADS
RIVER
100 YEAR WATER SURFACE ELEVATION
OUTLET
POND SR-01
DISCHARGE
Q100 90 CFS
Q2 8 CFS
POND VOLUME AC FT 10
BERM WIDTH 10'
SIDESLOPE 8:1
N
1"=200'
200 0 200 400
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: PONDS.DWG
Acad. Ver. 2008 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: KAP
Detailed by: DRM
Checked by: JAJ
Structure Numbers
HAEGLER RANCH DRAINAGE BASIN
Sheet Number SR01

POND SR-05



LEGEND

- PROPOSED CONTOURS – MAJOR ELEVATION
- PROPOSED CONTOURS – MINOR ELEVATION
- EXISTING CONTOURS – MAJOR ELEVATION
- EXISTING CONTOURS – MINOR ELEVATION
- WATERSHED BOUNDARY
- ROADS
- RIVER
- 100 YEAR WATER SURFACE ELEVATION
- OUTLET

POND SR-05

DISCHARGE

Q100	250 CFS
Q2	9 CFS
POND VOLUME AC FT	24
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: PONDS.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet

Index of Revisions

Profiles

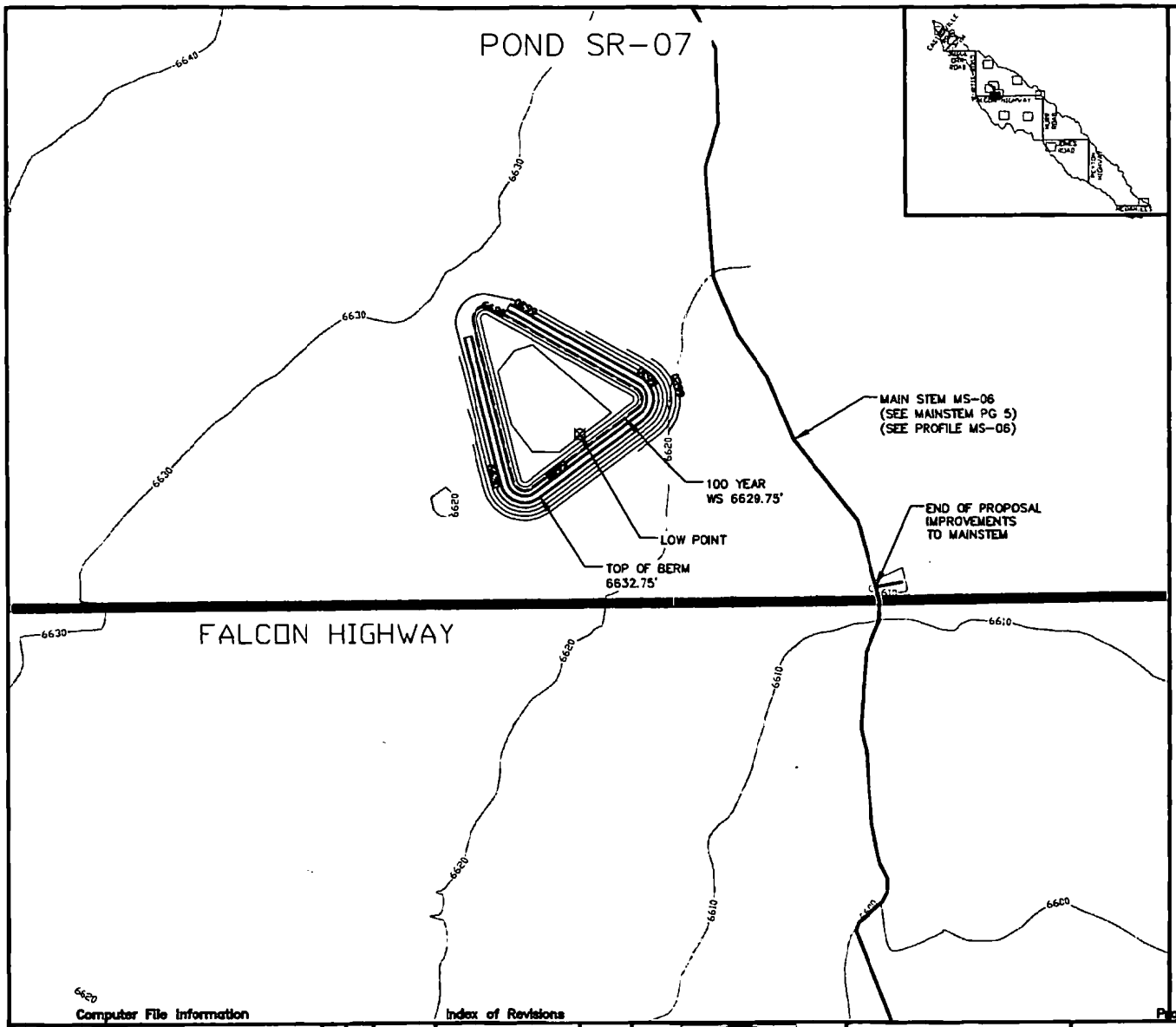
URS

Designed by: KAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR05



LEGEND

- PROPOSED CONTOURS – MAJOR ELEVATION
- PROPOSED CONTOURS – MINOR ELEVATION
- EXISTING CONTOURS – MAJOR ELEVATION
- EXISTING CONTOURS – MINOR ELEVATION
- WATERSHED BOUNDARY
- ROADS
- RIVER
- 100 YEAR WATER SURFACE ELEVATION
- OUTLET

POND SR-07
DISCHARGE

Q100	88 CFS
Q2	1 CFS
POND VOLUME AC FT	5
BERM WIDTH	10'
SIDESLOPES	4:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

Index of Revisions

1		
2		
3		

URS

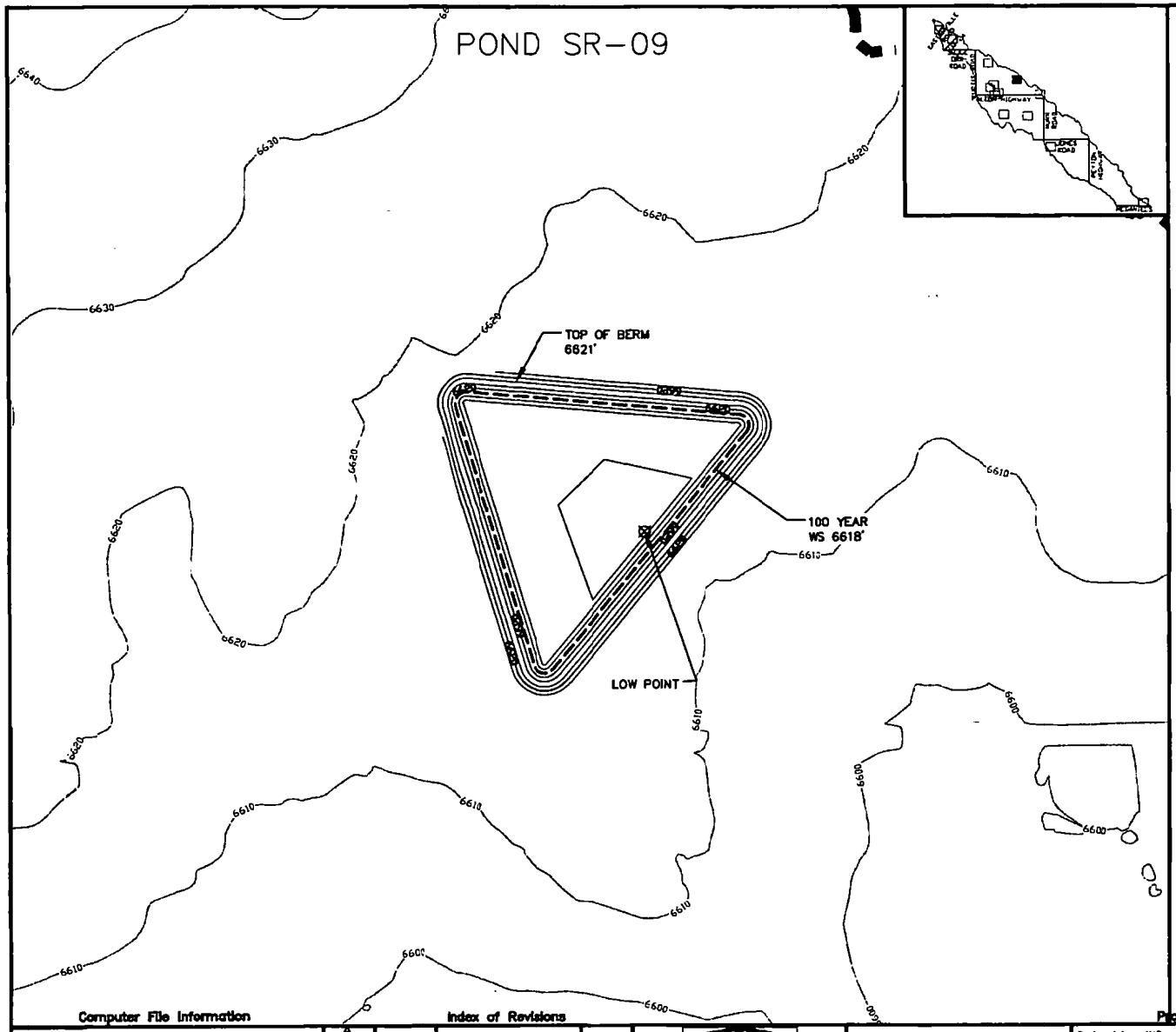
Designed by:	KAP
Detailed by:	DRM
Checked by:	JAJ

Structure Numbers

Profiles

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR07



LEGEND

- PROPOSED CONTOURS – MAJOR ELEVATION (6630)
- PROPOSED CONTOURS – MINOR ELEVATION
- EXISTING CONTOURS – MAJOR ELEVATION (6630)
- EXISTING CONTOURS – MINOR ELEVATION
- WATERSHED BOUNDARY
- ROADS
- RIVER
- 100 YEAR WATER SURFACE ELEVATION
- OUTLET

POND SR-09

DISCHARGE

Q100	66 CFS
Q2	3 CFS
POND VOLUME AC FT	20
BERM WIDTH	10'
SIDESLOPES	4:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
Acad. Ver. 2008	Scale: 1"=200' Units: Feet

Index of Revisions

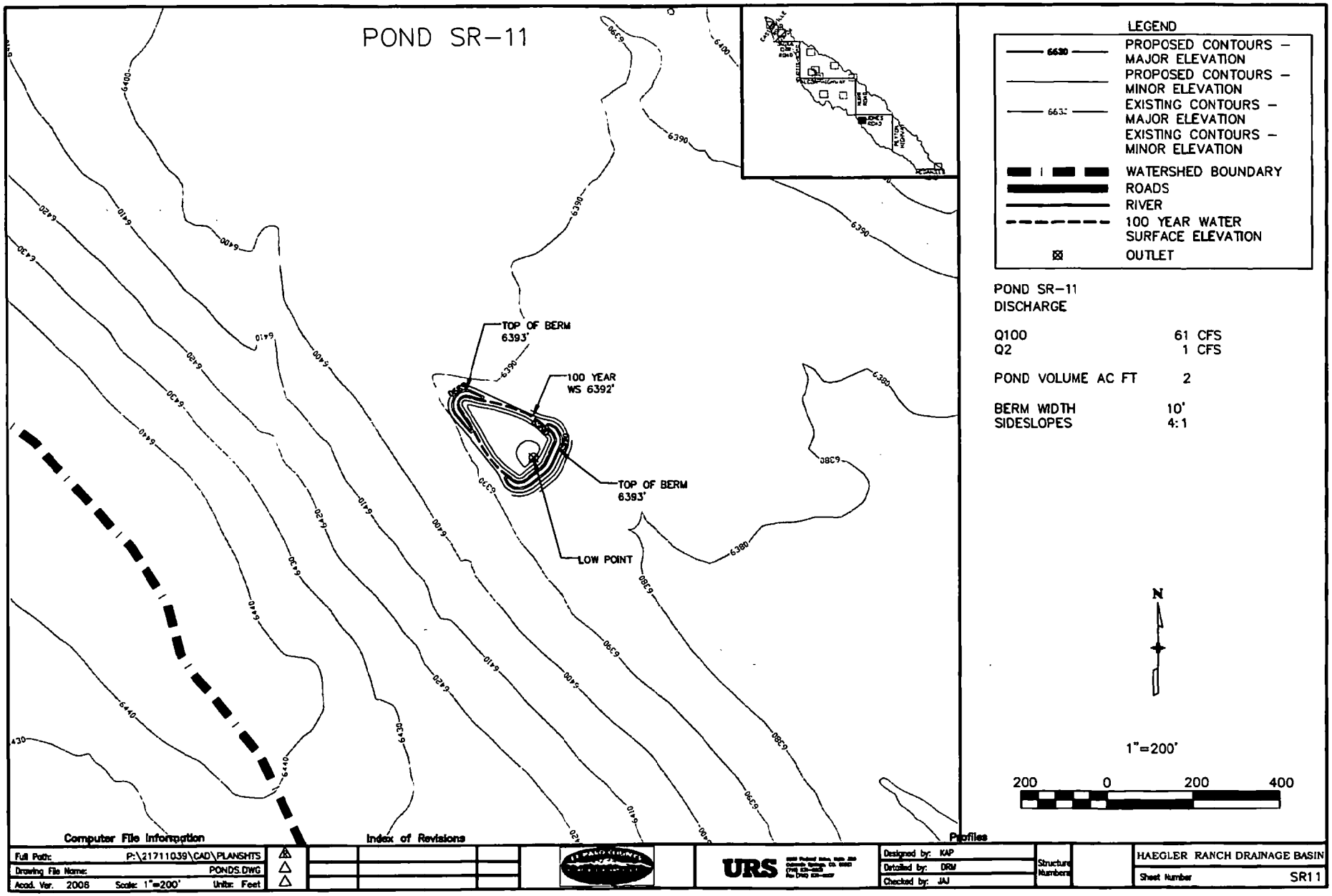
Profiles

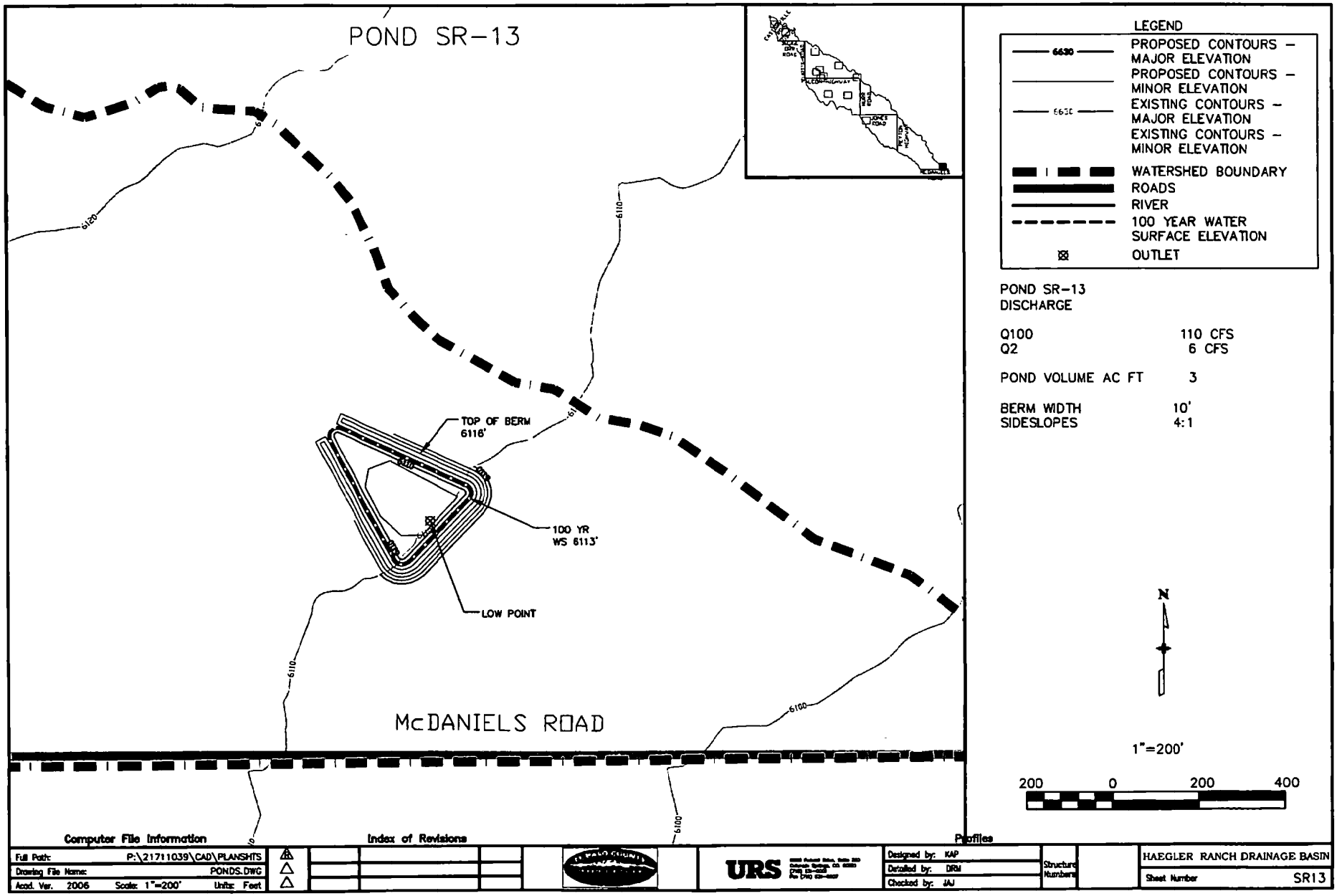
Designed by: KAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR09


POND SR-11
TOP OF BERM
6393'
100 YEAR
WS 6392'
TOP OF BERM
6393'
LOW POINT
LEGEND
PROPOSED CONTOURS - MAJOR ELEVATION
PROPOSED CONTOURS - MINOR ELEVATION
EXISTING CONTOURS - MAJOR ELEVATION
EXISTING CONTOURS - MINOR ELEVATION
WATERSHED BOUNDARY
ROADS
RIVER
100 YEAR WATER SURFACE ELEVATION
OUTLET
POND SR-11
DISCHARGE
Q100 61 CFS
Q2 1 CFS
POND VOLUME AC FT 2
BERM WIDTH 10'
SIDESLOPES 4:1
N
1"=200'
200 0 200 400
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: PONDS.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: KAP
Detailed by: DRM
Checked by: JAJ
Structure Numbers
HAEGLER RANCH DRAINAGE BASIN
Sheet Number SR11

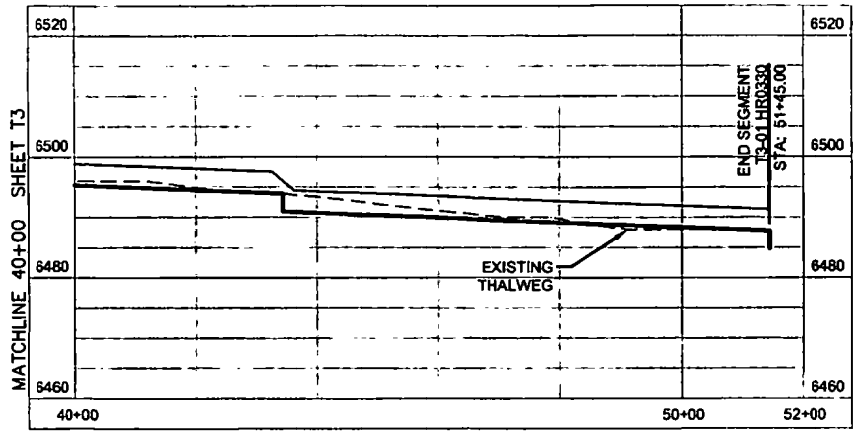

POND SR-13
TOP OF BERM
6116'
100 YR
WS 6113'
LOW POINT
McDANIELS ROAD
6120
6110
6100
LEGEND
6630
PROPOSED CONTOURS - MAJOR ELEVATION
PROPOSED CONTOURS - MINOR ELEVATION
6630
EXISTING CONTOURS - MAJOR ELEVATION
EXISTING CONTOURS - MINOR ELEVATION
WATERSHED BOUNDARY
ROADS
RIVER
100 YEAR WATER SURFACE ELEVATION
OUTLET
POND SR-13
DISCHARGE
Q100 110 CFS
Q2 6 CFS
POND VOLUME AC FT 3
BERM WIDTH 10'
SIDESLOPES 4:1
N
1"=200'
200 0 200 400
Computer File Information
Full Path: P:\21711039\CAD\PLANSHTS
Drawing File Name: PONDS.DWG
Acad. Ver. 2006 Scale: 1"=200' Units: Feet
Index of Revisions
Profiles
URS
Designed by: KAP
Detailed by: DRM
Checked by: AAJ
Structure Numbers
HAEGLER RANCH DRAINAGE BASIN
Sheet Number SR13

T3-01 HR0330

SLOPE = 0.40%

(8) 4' DROPS

PROFILE TRIBUTARY 3 (T3)



LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information	Index of Revisions	Profiles
Full Path: P:\21711039\CAD\PLANSHTS		Designed by: KAP
Drawing File Name: T PROFILE SHEETS 3_PROPOSED.DWG		Detailed by: DRM
Acad. Ver. 2006 Scale: 1"=20' Units: Feet		Checked by:

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

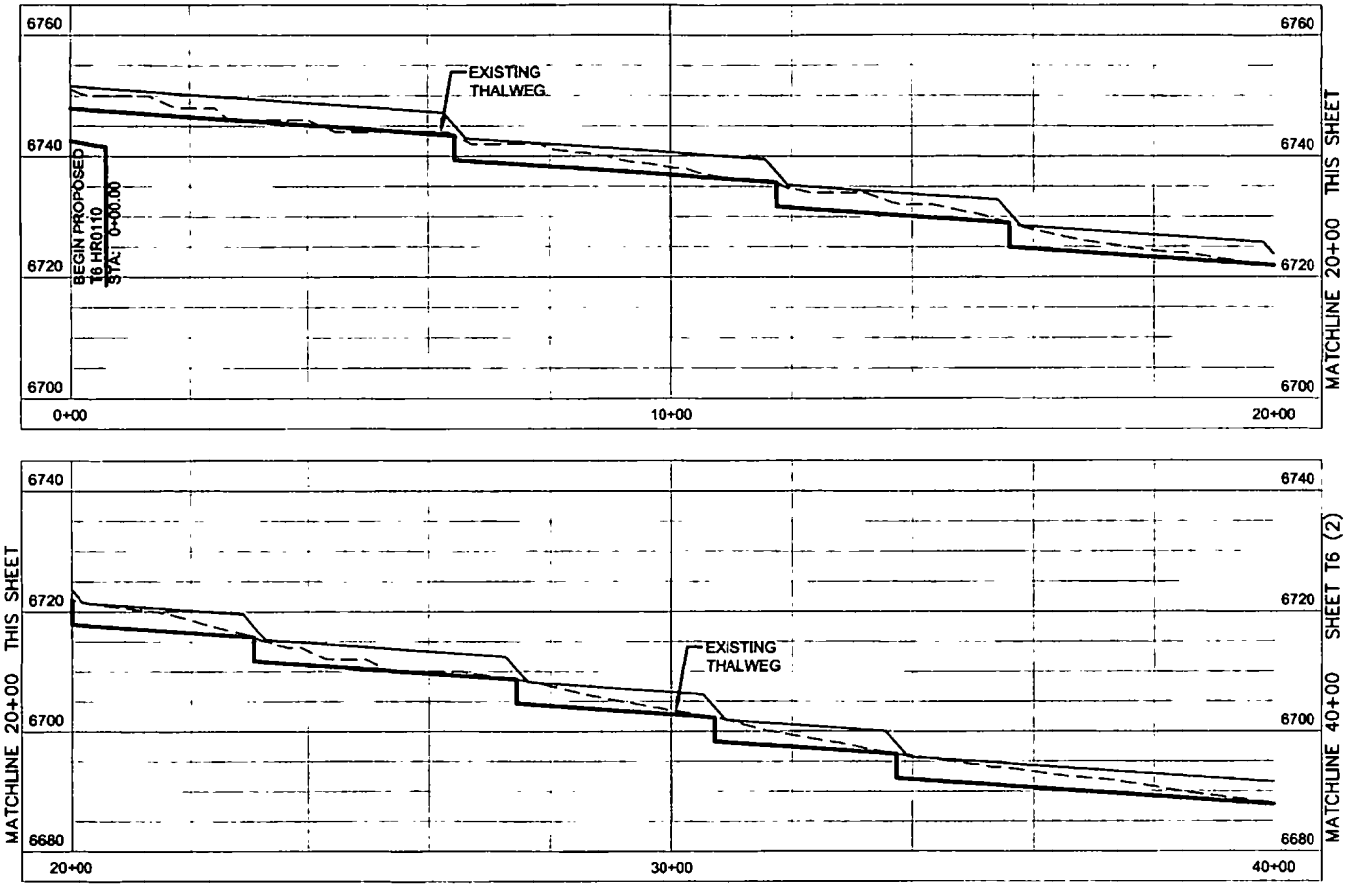
Sheet Number T3 (2)

T6 HR0110

SLOPE = 0.70%

(9) 4' DROPS

PROFILE TRIBUTARY 6 (T6)



LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: T PROFILE SHEETS 6_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

Index of Revisions

1		
2		
3		

Profiles

Designed by: KAP

Detailed by: DRM

Checked by:

Structure Numbers:

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number T6

Appendix E CONTACTS

The following is a mailing list of those involved in the preparation and review of the Haegler Ranch DBPS

U. S. Army Corps of Engineers
Van Truan
200 South Santa Fe Ave. #301
Pueblo, CO 81003
719-543-6915

John Valentine
Soils Conservation District
1826 E. Platte Avenue
Suite 114
Colorado Springs, CO 80909
719-473-7104

Colorado Department of Transportation
16 E. Arvada Street
Colorado Springs, CO 80906
719-634-2323

Colorado Division of Wildlife
2126 N. Weber Street
Colorado Springs, CO 80907
719-227-5283

Colorado Division of Wildlife
Shaun Deeney
4255 Sinton Road
Colorado Springs, CO 80307
719-227-5200

Regional Floodplain Administrator
101 W. Costilla
Colorado Springs, CO 80903
719-327-2906

Andre Brackin
El Paso Department of Transportation
3460 N. Marksheffel Road
Colorado Springs, CO 80922
719-520-6845

Falcon Homeowners' Association
7685 Mustang Rd
Colorado Springs, CO 80908
719-495-4213

Appendix F HAEGLER DOW COMMENTS

STATE OF COLORADO

Bill Ritter, Jr., Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
AN EQUAL OPPORTUNITY EMPLOYER

Thomas E. Remington, Director
Southeast Region
4255 Sinton Road
Colorado Springs, Colorado 80907
Telephone: (719)227-5200

For Wildlife. For People

December 11th, 2008

Joel Jones
URS Corporation
8181 East Tufts Avenue
Denver, CO 80237

Re: Haegler Ranch Drainage Basin Planning Study Job Number: 21711039

Dear Mr. Jones:

The Division of Wildlife (DOW) has reviewed the preliminary plans for Haegler Ranch Drainage Basin generally located near Judge Orr Road and Eastonville Road to Peyton Highway and McDaniels Road in El Paso County. DOW staff offers the following comments for your consideration.

The local vegetative community is considered rangeland and is comprised of short grass prairie species and deciduous trees with wetland areas. This habitat type will sustain numerous wildlife species including deer, pronghorn, elk, coyote, red fox, swift fox, raptors, ground nesting birds, migratory waterfowl and numerous small mammals.

Haegler Ranch and Gieck Ranch Basin are important corridors and habitat for fish and wildlife. The environmental analysis portion of your basin planning study states that on-site wetlands are not a significant habitat resource within the basin. While we agree those wetlands may not be in their original state, these riparian areas still remain important for local and migratory wildlife use. At this time, it is unclear how the water detention ponds, channel design and culverts will be established in relation to the Haegler Ranch Drainage basin and future development. The DOW is concerned about the quantity and quality of runoff from the development into the Black Squirrel Creek, which is a tributary to Chico Creek prior to it flowing into the Arkansas River. The native fish community within the basin primarily consists of small bodied fishes. We would be interested in sampling for native fish on the project site within the Basin prior to work being done. We would also like to meet with the developer to discuss water flows within the Basin and evaluate potential impacts to native fishes and amphibian species. Native fish, including the Arkansas Darter (a state threatened species), are known to exist in Black Squirrel Creek and Chico Creek downstream of the proposed development. Increased flows upstream could impact Arkansas Darter populations downstream.

-continued-

The DOW suggests keeping the channel width and stream sinuosity similar to the width and natural sinuosity of the existing stream. If changes to the channel are necessary to accommodate for any flow increase, DOW recommends maximizing the use of natural stream sinuosity, wetland improvements and soft engineering techniques. DOW recommends off channel detention or retention of water as much as possible to reduce water flows thus minimizing the need for channel and culvert improvements. Wildlife will likely be attracted to ponds. Ponds should not be fenced and have shallow slopes to promote aquatic and wetland vegetation growth. A gradual slope will also allow wildlife access to water regardless of water levels in the pond, and will decrease chances of entrapment.

The DOW is concerned about possible channel stabilization along the sides of the creek. DOW suggests maintaining the natural floodplain to promote riparian vegetation growth, channel stability, and natural stream sinuosity. If materials are used to make flat, steep, tall banks then pronghorn, deer and other animals can get trapped in the creek while retrieving water. We recommend leaving the stream in its natural state when possible. This not only benefits wildlife but makes the construction more aesthetically pleasing and less invasive.

The DOW recommends utilizing natural vegetation to control the grade. Should rip-rap be utilized we recommend non-grouted rip-rap. Vegetation and tree roots are more stable in non-grouted rip-rap. Small body fish have a difficult time moving up through large drop structures. We recommend using several drop structures with minimal drop height over fewer drop structures with a maximum drop height. We also recommend incorporating a low flow channel that would allow small bodied fishes to move through each drop structure.

The DOW is concerned about possible sedimentation in the stream during project construction and post construction. The sediment in the stream could have detrimental impacts on avian, fish and terrestrial species. We recommend placing sediment traps in areas of high sediment accumulation. This trap should be designed to allow fish species to move upstream and downstream without allowing the sediment to seep and compile downstream. The DOW recommends monitoring the sediment level in the stream for 3-5 years after the project is completed to ensure appropriate function of the sediment traps.

In reference to the roadway culverts, the DOW recommends bridges over drainages capable of seasonal flow that are likely to support native fishes and amphibians. This allows for native fish and amphibian passage, helps to maintain stream integrity, and promotes healthy wildlife permeability at road ways. Bridges will reduce wildlife mortality from vehicles by providing alternative roadway crossings. In places where culverts are used, we recommend a three sided concrete box culvert (CBC) with a natural bottom.

The DOW recommends using on-site clean fill material but if off-site fill material will be used, the DOW recommends using a clean fill material that would be conducive to growing native vegetation. Non-native vegetation can outcompete native vegetation and become problematic. Coyote Willow is a native willow that is great at bank stabilization and in reducing erosion. A seed mixture of native grasses is also recommended to provide a good support system in the soil. The DOW also recommends adoption of a noxious weed management plan and active control of noxious weeds in disturbed areas until reclaimed vegetation has become appropriately established.

-continued-

Thank you for the opportunity to comment on this preliminary plan approval. In an effort to assist with planning with wildlife in mind, we hope that we can meet with you and the project proponent prior to any earthmoving. If you have any questions or require additional information please contact District Wildlife Manager Jeromy Huntington at 719-227-5283 or via e-mail Jeromy.Huntington@state.co.us.

Sincerely,

Shaun Deeney
Area Wildlife Manager

xc: File
SE Regional Office
Jeromy Huntington

Appendix G FALCON SMALL AREA MASTER PLAN MEMO

URS

Memorandum

To: Mike Cartmell
El Paso County

From: John Griffith
Date: April 21, 2009

Subject: Haegler Ranch DBPS Land Use Considerations

This memo addresses the consideration given to the new Falcon/Peyton Small Area Master Plan (SAP) recommendations and compatibility with respect to the land use assumptions used in the Haegler Ranch Drainage Basin Planning Study (DBPS).

The new Falcon/Peyton Small Area Master Plan (Attachment 1) was approved on August 5, 2008. To address the question raised by the El Paso County Planning Commission on February 3, 2009, we overlaid the Haegler Ranch Drainage Basin boundary on the Falcon/Peyton Small Area Master Plan (Attachment 2). Proposed land use types are identified in the legend. The SAP encompasses most of the area in the upper portion of the basin, which is proposed for development within the 2030 planning horizon.

As of July 2005, when work on the Haegler Ranch DBPS hydrologic analysis began, approximately 14 percent of the Haegler Ranch drainage basin was developed. Much of the existing development consists of 2- to 5-acre lots and larger agricultural parcels south of US Hwy 24. Higher density residential developments such as Meridian Ranch, Santa Fe Springs, and Four Way Ranch were underway in the northwestern portions of the Haegler Ranch Basin.

The land use data for the Haegler DBPS was completed sometime during 2006. Future, fully developed conditions hydrology for the DBPS was modeled using proposed 2030 land uses obtained from El Paso County, which were based on Land Use Coverages from Colorado Springs Utilities (CSU 2005). The future land uses used in the Haegler DBPS are shown in Figure 3-3 in the report (Attachment 3). We modified this figure such that the color codes for land use types are similar to the color codes used for the SAP to make visual comparison easier (Attachment 4).

Meridian Ranch is in the north and Santa Fe Springs is in the central portion of the watershed. The area of Meridian Ranch within Haegler Ranch has high-density land uses of commercial and business, residential lots of 0.25 acres, and new paved roads with curb and gutter. Santa Fe Springs has a larger area in Haegler Ranch and a wider range of land uses including high density development such as commercial and business, residential lots of 0.125 acres, residential lots of 0.25 acres, schools, and new paved roads with curb and gutter as well as low density development such as residential large lots with 2% imperviousness, parks, and open space. The Sketch Plan for Sante Fe Springs (Attachment 5) shows these various types of proposed land use.

In addition to the more general land use plans received from El Paso County, URS used approved land uses in the Sketch plans of Meridian Ranch and Sante Fe Springs in the development of the DBPS hydrologic study.

The land use types used in the Haegler Ranch DBPS include more discreet categories, such as: open space, 3 categories of residential less than 2.5 acres per site, and 3 categories of residential larger than 5 acres per dwelling. The areas identified in the SAP are broader, and do not include open space. This can be seen by comparing the area being developed by Santa Fe Springs with the Haegler Ranch DBPS future land use map (Attachment 4) and the SAP (Attachment 2)

There are some differences in proposed future land uses between the 2005 plan and the current SAP, however, the DBPS is not meant to be used as a zoning document. This information is used in the DBPS for the hydrologic analysis to predict runoff rates and volumes for the purposes of stormwater facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the basin's drainageways. It is used to assess drainage/bridge fees and to provide a guideline for drainage structures as development occurs. These land use figures are not intended to reflect the future zoning or land use policies of the County, but to document assumptions used in the engineering analysis.

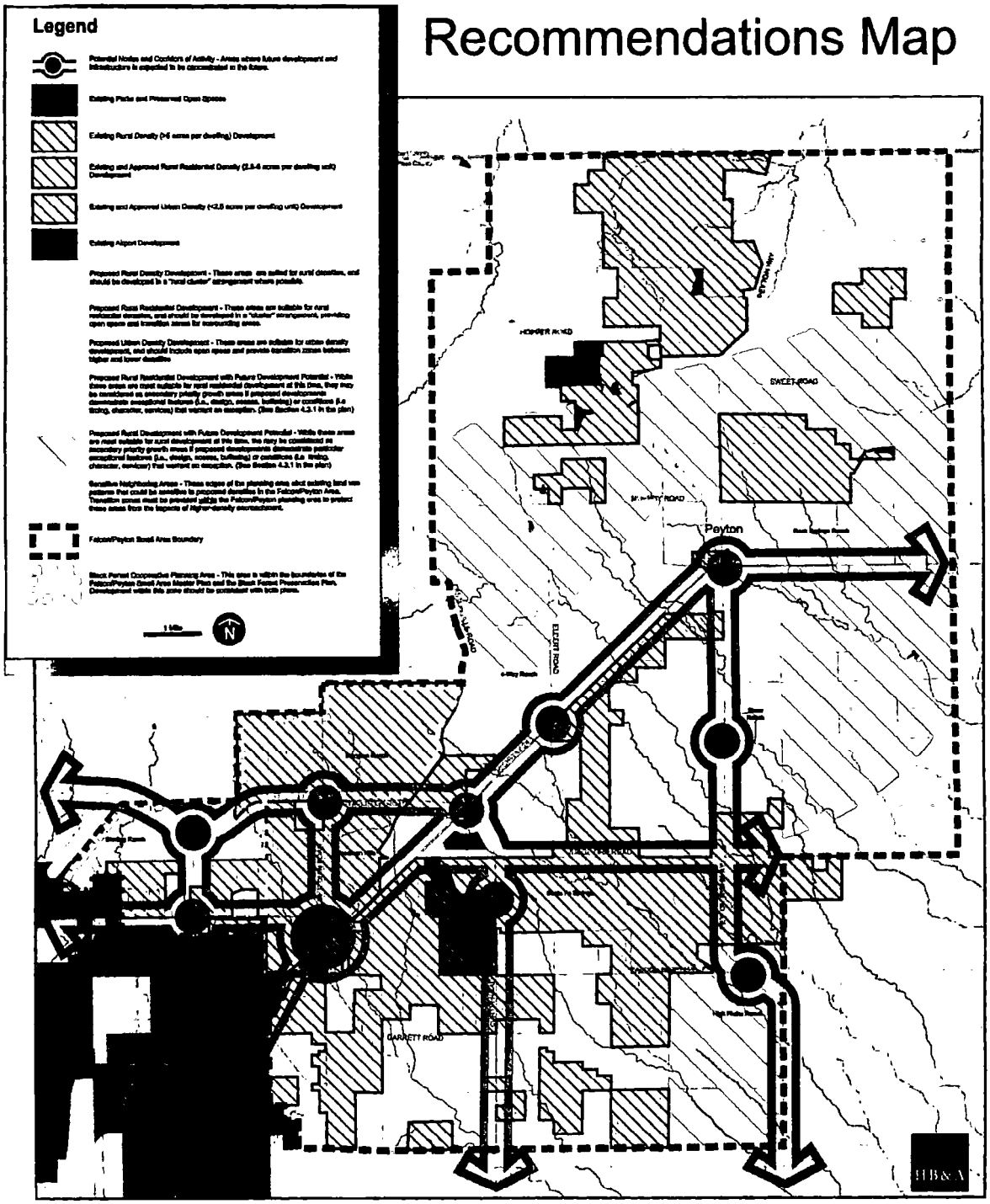
In order to answer the question of whether or not the preferred alternative and conceptual design recommendations still make sense with the newer land use plan, we have overlaid the proposed subregional detention pond locations on the future land use map, using the SAP data (Attachment 2). Several types of channel improvements are also recommended within the basin by this plan. In most cases, two alternatives have been called out on the preliminary design sheets. The cost estimate was prepared for the selected sub-regional detention alternative. The plan provides optional channel treatments to be considered during final engineering depending upon the specific land uses, while still providing similar protection. In a few cases channelization is recommended to define and contain the flow where it is currently overland flow in poorly defined, broad, dry-grass swales.

The Falcon/Peyton SAP land use data is two years fresher and a more credible data source from a planning perspective, but the SAP does not identify the location of the drainage channels in the Haegler Ranch Basin. Our conclusion is that there do not appear to be any significant inconsistencies with the location of proposed improvements and the proposed future land uses. The actual size and location of the proposed facilities will be based on actual development plans, which will have a variety of land uses not shown specifically on the SAP including open space.

The land use plan shown in the DBPS is the basis for the engineering analysis and should remain in the report. We can mention the SAP in the document and include it in the

EL PASO COUNTY
FALCON/PEYTON SMALL AREA MASTER PLAN

Recommendations Map



ATTACHMENT 1

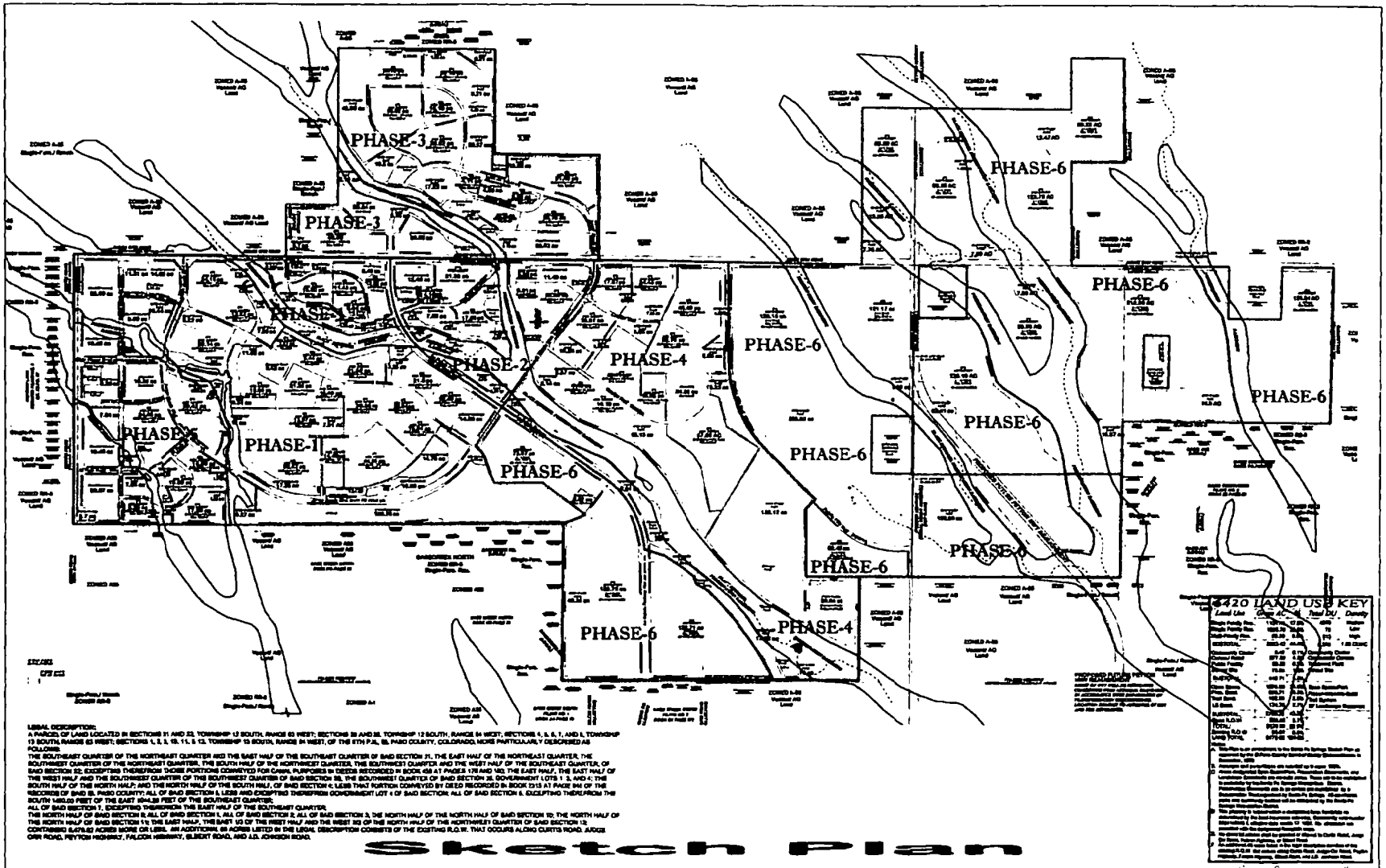
URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

HAEGLER RANCH DRAINAGE BASIN
FUTURE LAND USE

DATE: 04/07/09

ATTACHMENT 4

URS NO. 21711039



ATTACHMENT 5