

Drainage Study North Douglas I & II

*County of Sacramento,
California*

April, 2006

AMERICANOS ROAD

DOUGLAS ROAD

Prepared By

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Executive Summary

North Douglas II is a medium density residential development located in the City of Rancho Cordova within Sacramento County, California. Of the total 41.5 acres, the southern 22.9 acres will be developed while the remaining northern 18.6 acres will remain undeveloped.

This report documents the on-site drainage facilities required for ultimate development of the 22.9 acres of the North Douglas II property. The Rio Del Oro Master Drainage Study (RDO MDS) (Wood Rodgers Inc., August 2005) and Addendum (Wood Rodgers, Inc., October 2005) were used as a basis for this report.

Due to the limited capacity of the existing central and south over-chutes at the Folsom South Canal crossings, the maximum allowable discharge from this development is dictated by the "peak flow apportionment" ratio of 0.14 cfs/acre for all watersheds contributing flows to the over-chutes (Table 3, RDO MDS). Based on this ratio, the maximum allowable discharge from the 22.9-acre residential development cannot exceed 3.2 cfs (i.e. $22.9 \times 0.14 = 3.2$) for the 100-year storm event.

With this 3.2-cfs peak flow as the limiting criterion, detention basin DBNDII and its outlet mechanism were designed to provide the detention and water quality needs of the North Douglas II development regardless of any development or drainage improvement occurring off-site.



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1. Introduction

1.1 Overview

North Douglas II is a proposed medium density residential development located within the recently incorporated City of Rancho Cordova in the County of Sacramento, California. The site is bound by the North Douglas I and II property on the south and the Rio Del Oro property on the west.

The south branch of Upper Morrison Creek traverses the undeveloped northern half of the North Douglas II property from east to west. The creek will remain intact and unimproved and continues downstream through the Rio Del Oro development.

The site is located within the Sunrise Douglas Community Plan Area (SDCPA). See **Figures 1 and 2** for the vicinity map and site plan, respectively.

1.2 Purpose

This report documents the on-site drainage facilities required to mitigate impact to downstream drainage facilities (i.e. Rio Del Oro central and south over-chutes at the Folsom South Canal crossings) as a result of the proposed development. The report builds on the concepts presented in the Master Drainage Study and Addendum for the Rio Del Oro project as noted below.

1.3 Previous Studies

The existing central and south over-chutes at the Folsom South Canal crossings have been defined as the controlling element for future development of all upstream watersheds contributing flows to the over-chutes. Due to the limited flow capacity of these over-chutes, the maximum allowable discharge from all future upstream developments cannot exceed the "peak flow apportionment" ratio of 0.14 cfs/acre specified in the Rio Del Oro Master Drainage Study, Wood Rodgers, Inc., August 2005.

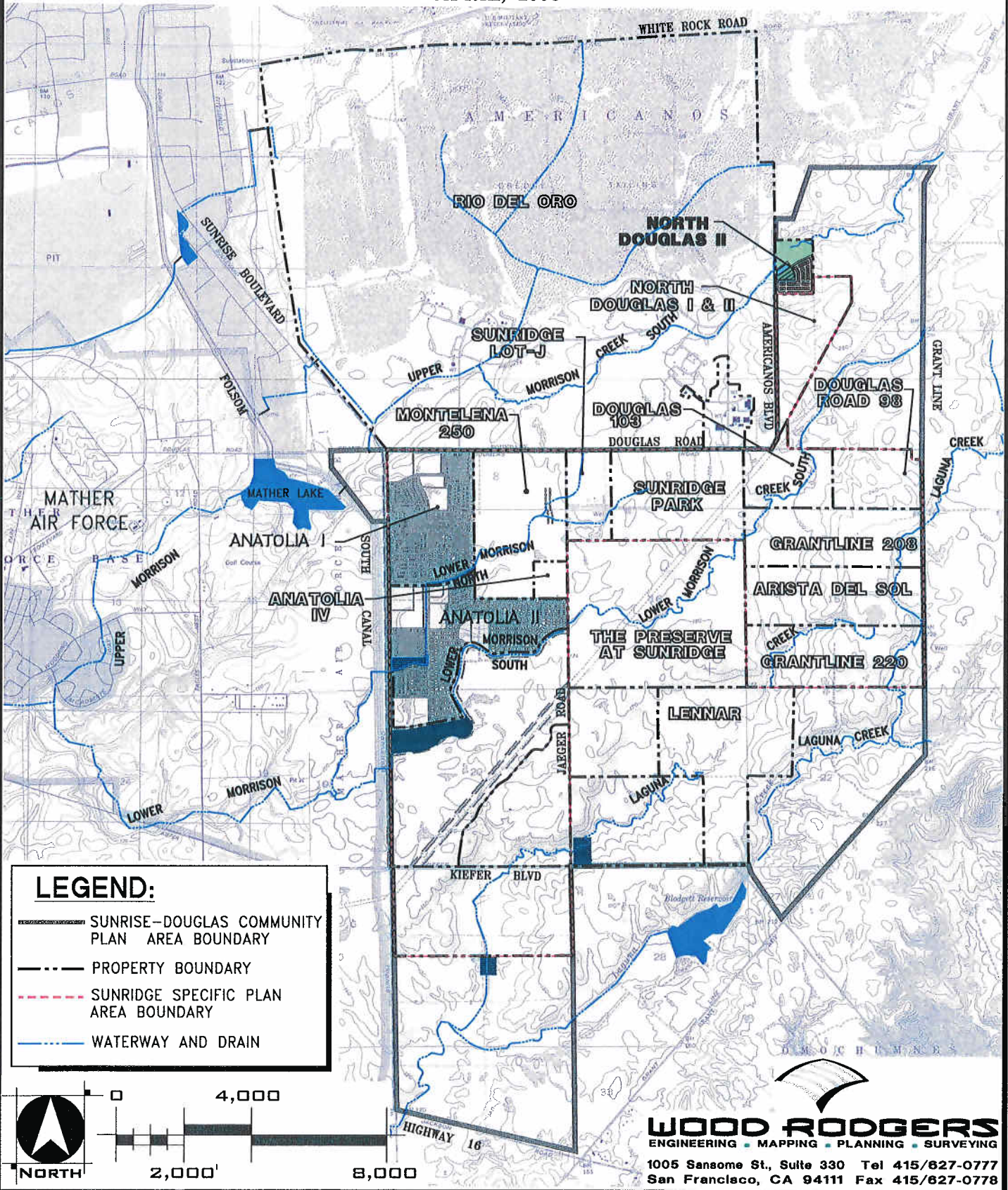
The Addendum (Wood Rodgers, Inc., October 2005) to the RDO MDS reflects the dredger tailings pile areas *removed* from the hydrologic models. Therefore, the intact and undeveloped tailings areas are assumed to *contribute no flow* to Upper Morrison Creek South. The HEC-1 models reflecting this assumption were utilized in this drainage study.

These studies for the RDO development were used as a basis for this report in conjunction with other design constraints identified by the County of Sacramento Department of Water Resources.

NORTH DOUGLAS II

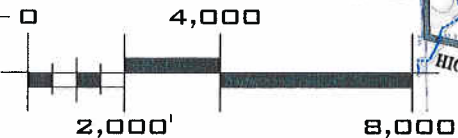
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APRIL, 2006



LEGEND:

- SUNRISE-DOUGLAS COMMUNITY PLAN AREA BOUNDARY
- PROPERTY BOUNDARY
- SUNRIDGE SPECIFIC PLAN AREA BOUNDARY
- WATERWAY AND DRAIN

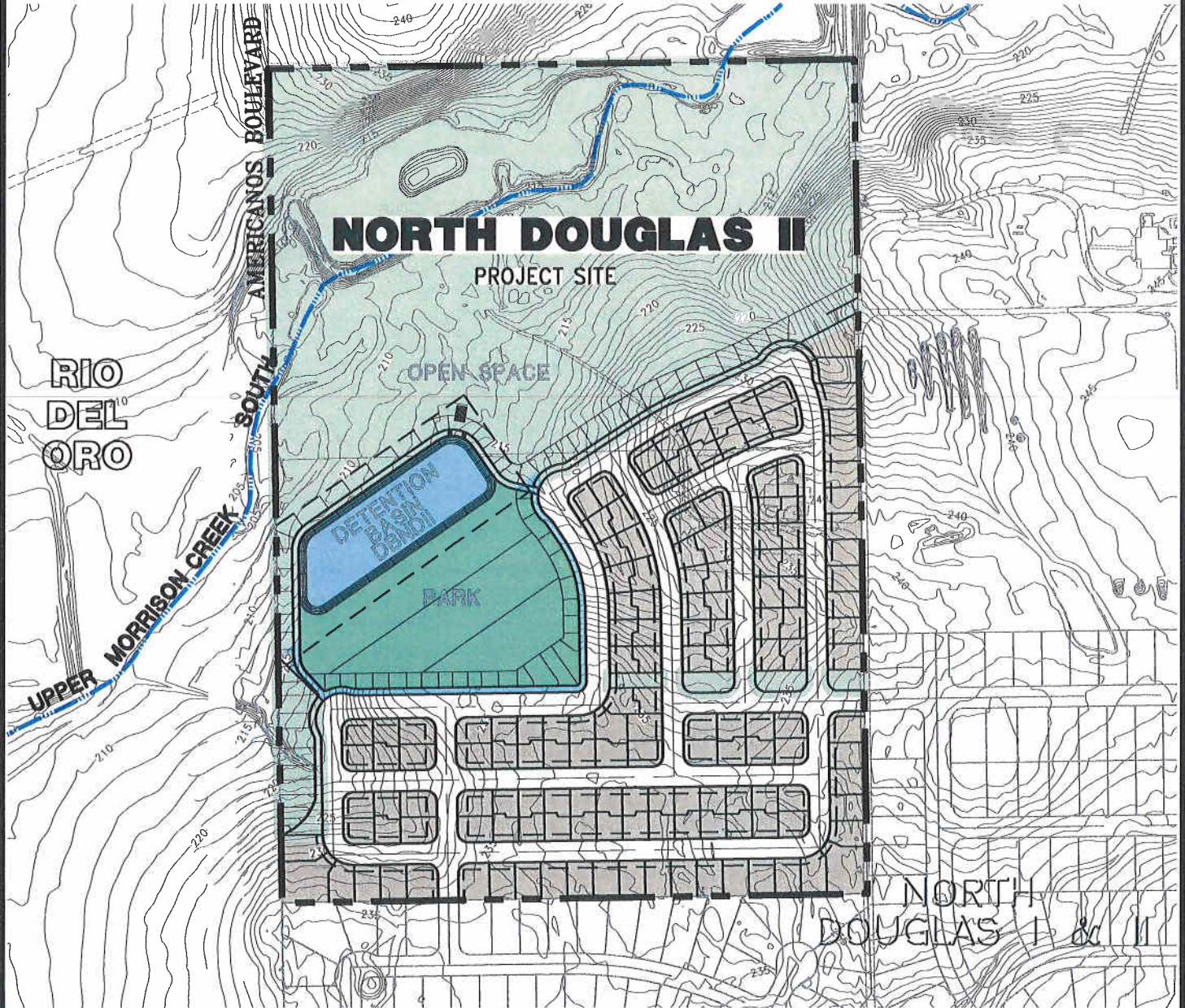


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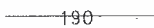
SITE PLAN NORTH DOUGLAS II

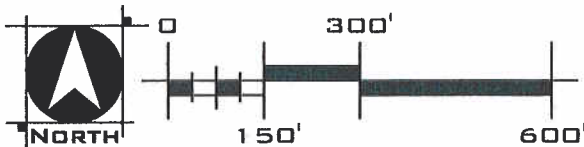
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LEGEND:

-  PROPERTY BOUNDARY
-  WATERWAY AND DRAIN
-  EXISTING GROUND CONTOUR



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1.4 Existing Conditions

The watershed (i.e. Shed US3), in its existing conditions, contains scattered areas of mining tailings piles as a result of the mining activities which concluded in the 1960s. These tailings piles remain today and have been defined with the use of a recent aerial photo (**Figure 3**). Today, the watershed is primarily open space and pasture land as noted on the aerial photo.

The subject North Douglas II property does not contain any tailings piles but consists primarily of open space. The site generally slopes to the northwest toward Upper Morrison Creek South which traversed the northern half of the property from east to west.

1.5 FEMA Information

The North Douglas II project lies within the greater Morrison Creek watershed. Parts of the Morrison Creek stream group have not received detailed study by FEMA for the purposes of drafting a Flood Insurance Study (FIS) or Flood Insurance Rate Map (FIRM). However, Morrison Creek and some of its tributaries have been studied under the Awareness Floodplain Mapping Program.

The California Department of Water Resources has undertaken efforts through this program to provide approximate floodplain delineations of undocumented watercourses throughout the state. The County of Sacramento studied the local hydrology and developed hydrologic and hydraulic models of the system, and the California Department of Water Resources prepared the awareness floodplain maps.

Floodplain mapping for awareness floodplains identifies flood hazard areas using approximate assessment procedures. These floodplains are shown simply as flood prone areas without specific depth and other flood hazard data. This effort is directed toward advising the public and interested parties of the approximate flooding risks present in these unmapped watersheds. It is not used as a regulatory tool. Area floodplains are depicted in **Figure 4**.

1.6 Soils Information

The Soil Survey of Sacramento County, California provides soil data used in this study (NRCS, April 1993). The soils within the studied watershed (i.e. Shed US3) have been classified as one of four hydrologic soil groups (i.e. A, B, C, and D). Group "A" soils have a high infiltration rate when thoroughly wet and a low runoff potential. Group "D" soils have a very low infiltration rate and a high runoff potential. **Figure 5** illustrates the hydrologic soil group classification of soils within the studied watershed.

Based on **Figure 5**, the proposed 22.9-acre development area (i.e. Shed US3B) of the North Douglas II property consists of soils classified within the types "C/D". All areas on-site and off-site consisting of soils classified within the types "C/D" are assumed to have the same hydrologic properties of soils group "D".




MINING TAILINGS PILES NORTH DOUGLAS II

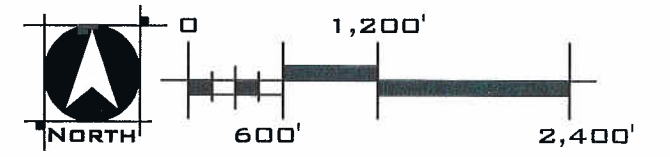
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LEGEND

-  PROPERTY BOUNDARY
-  EXISTING SHED BOUNDARY
-  MINING TAILINGS PILES

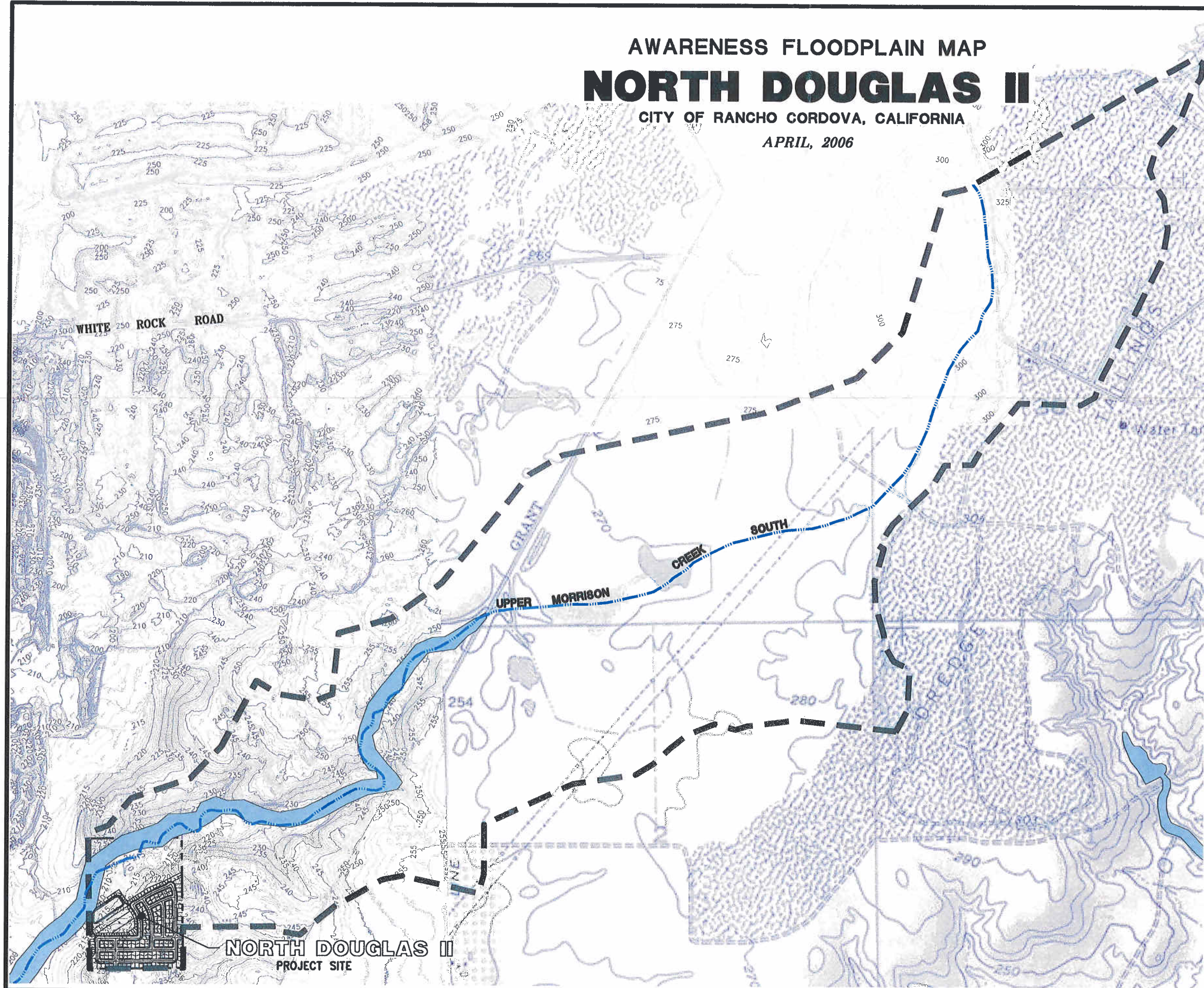



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AWARENESS FLOODPLAIN MAP

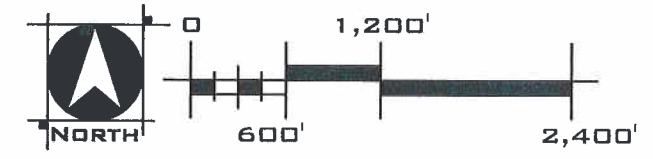
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LEGEND

- PROPERTY BOUNDARY
- EXISTING SHED BOUNDARY
- EXISTING GROUND CONTOUR
- WATERWAY AND DRAIN
- EXISTING FLOODPLAIN

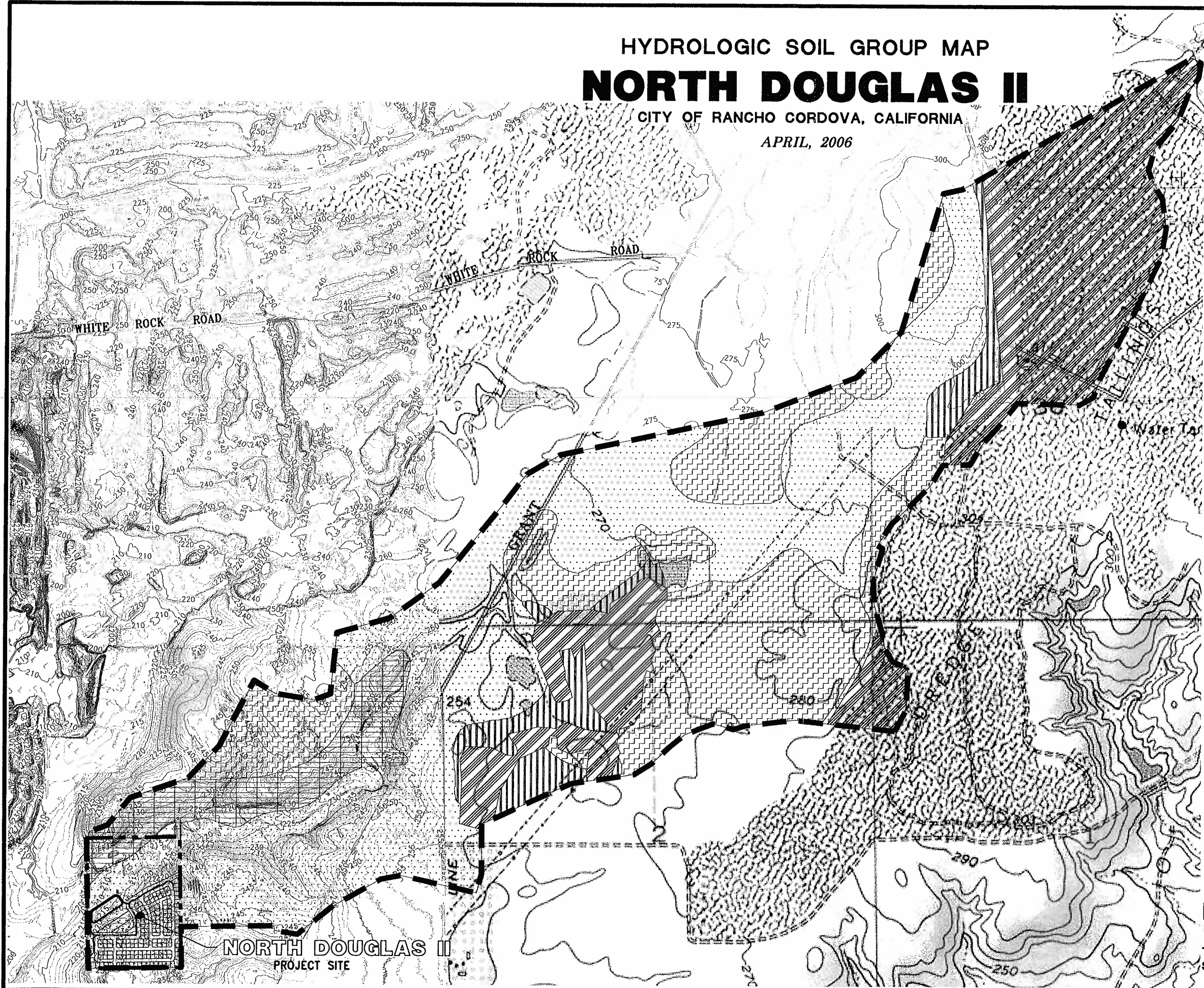



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HYDROLOGIC SOIL GROUP MAP NORTH DOUGLAS II

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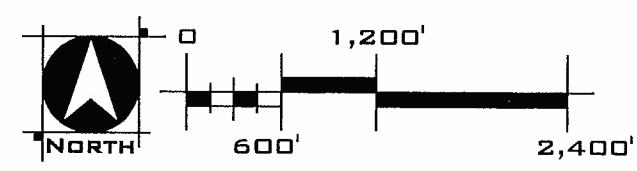
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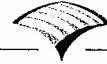
LEGEND

- PROPERTY BOUNDARY
- EXISTING SHED BOUNDARY
- EXISTING GROUND CONTOUR
- HYDROLOGIC SOIL GROUP A
- HYDROLOGIC SOIL GROUP B
- HYDROLOGIC SOIL GROUP C
- HYDROLOGIC SOIL GROUP D
- HYDROLOGIC SOIL GROUP C/D

NOTE: HYDROLOGIC SOIL GROUP C/D IS ASSUMED TO HAVE THE SAME HYDROLOGIC PROPERTIES OF SOIL GROUP D.




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1.7 Criteria

1.7a Proposed On-Site Detention Basin

The proposed on-site detention basin and its discharge mechanism have been design to meter the discharge from the development of the 22.9-acres area of the North Douglas II property such that the maximum discharge does not exceed the maximum allowed as determined by the “peak flow apportionment” ratio.

The 10- and 100-year flood hydrographs were developed using SACPRE and HEC-1 as documented in the City and County of Sacramento Hydrology Standards. These hydrographs were developed for:

Existing Conditions – All areas within watershed US3 undeveloped.

Ultimate Conditions – 22.9 acres (Shed US3B) of North Douglas II developed; all other areas (Shed US3A) undeveloped.

1.7b Proposed On-Site Drainage Pipe System

The on-site drainage pipe system was designed consistent with the County of Sacramento requirements. Trunks were sized using the Nolte design flows in the pipes and the 10-year peak water surface at the trunk outfalls into the basin.

The design was conducted for ultimate conditions and was checked to ensure that all criteria (i.e. freeboard, minimum and maximum flow velocities, pipe covers, etc.) were met.

1.7c Overland Drainage System

The roadway within the public right-of-way have been designed to convey the overland flow for the 100-year storm event as determined by the difference of the 100-year flow obtained from the Sacramento method and the 10-year flow estimated by the Nolte method.

2. Proposed Drainage Facilities

According to the RDO MDS, this development, which contributes flow to the existing central and south over-chutes at the Folsom South Canal crossings, will require an on-site drainage facility to mitigate the discharge from this development such that the maximum discharge does not exceed the maximum allowable discharge as determined by the “peak flow apportionment” ratio.

2.1 Existing Regional Drainage Conditions

Analysis of the existing regional drainage conditions was conducted to provide a basis for comparison with the ultimate regional drainage conditions. Existing conditions assume all mining tailings areas within watershed US3 *contribute no flow* to Upper Morrison Creek South and all other areas within the shed are undeveloped open space.



The existing conditions peak flow was developed using HEC-1 models. Table 1 summarizes the result of the HEC-1 analysis.

Table 1. Existing Regional Drainage Conditions Peak Flow

Sub-basin I.D.	Outfall Location	Area (ac)	10-yr 24-hr (cfs)	100-yr 24-hr (cfs)	100-yr 10-day (cfs)
US3	East of Rio Del Oro	768.9	217	361	265

The result of the analysis is also presented in the Existing Regional Drainage Conditions map (Figure 6).

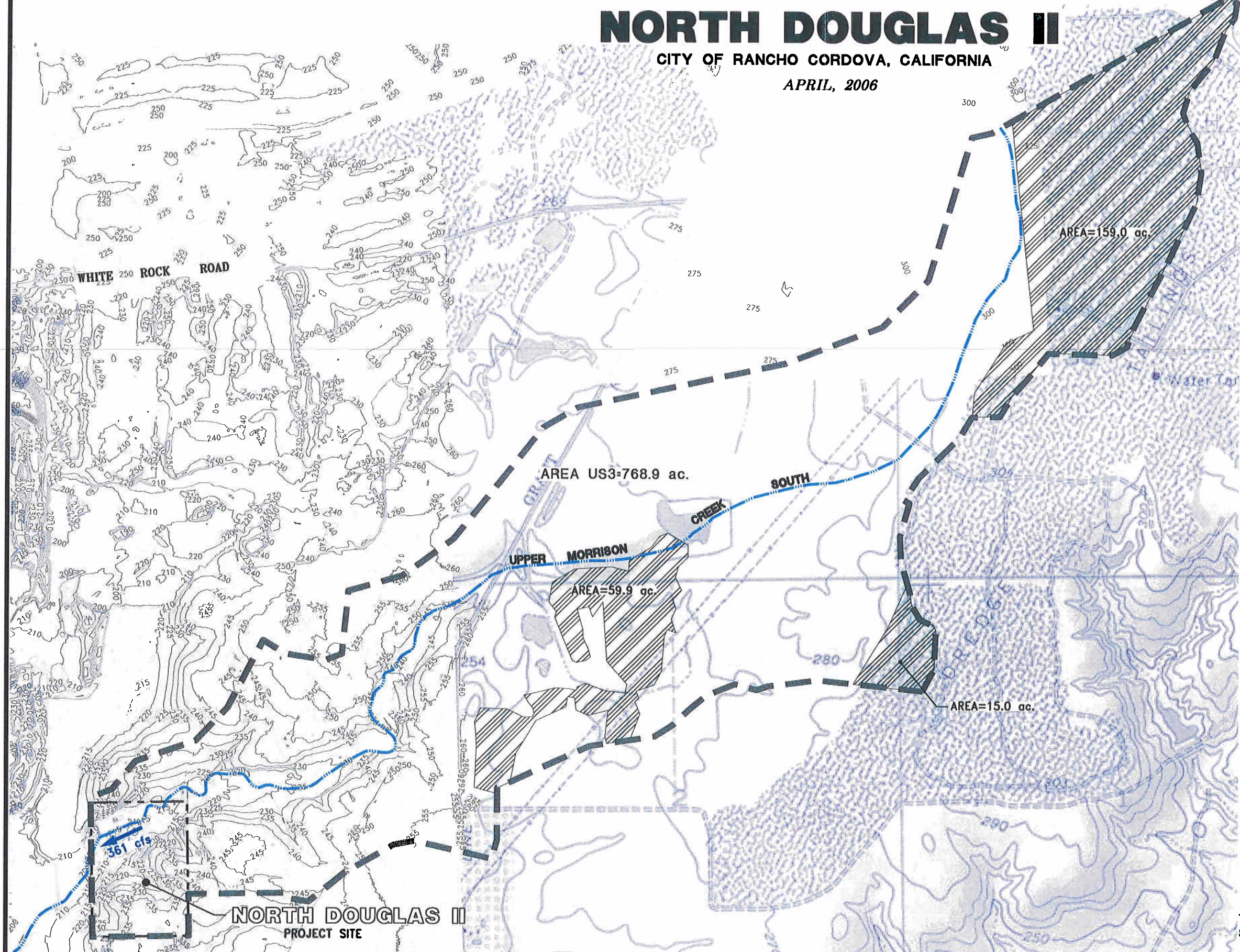
HEC-1 input and output data, SacPRE data, and land use summaries are included on the CD in Appendix C.

EXISTING REGIONAL DRAINAGE CONDITIONS (100-YR, 24-HR)

NORTH DOUGLAS II

CITY OF RANCHO CORDOVA, CALIFORNIA

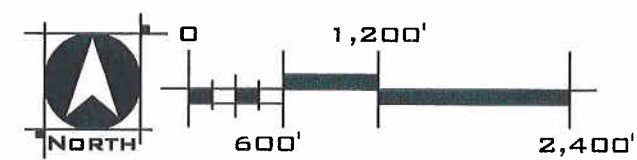
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LEGEND

- PROPERTY BOUNDARY
- EXISTING SHED BOUNDARY
- EXISTING GROUND CONTOUR
- WATERWAY AND DRAIN
- MINING TAILINGS PILE
- FLOW (cfs)
361 cfs

- NOTE:**
1. MINING TAILINGS PILES ARE ASSUMED TO CONTRIBUTE NO FLOW TO UPPER MORRISON CREEK SOUTH.
 2. ALL OTHER AREAS OF WATERSHED US3 ARE ASSUMED UNDEVELOPED OPEN SPACE.



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2.2 Ultimate Regional Drainage Conditions

In this report, “Ultimate” conditions refers to the full development of the 22.9 acres of the North Douglas II property and all other areas within the watershed are considered undeveloped or in their existing conditions. This is consistent with the original RDO MDS.

As mentioned earlier in this report, due to the limited capacity of the existing over-chutes at the Folsom South Canal crossings, this development is required to construct an on-site detention basin to control its discharge such that the maximum allowable discharge as determined by the “peak flow apportionment” ratio (i.e. $Q_{max} = 22.9ac \times 0.14cfs/ac = 3.2 cfs$) is not exceeded for the 100-year storm event. Detention basin DBNDII, located northwest of the proposed residential development, is solely designed to provide the stormwater detention and water quality treatment needs of this development.

The ultimate regional drainage conditions peak flows and detention basin maximum stage, storage and discharge were developed using HEC-1 and the results are summarized on Tables 2 and 3, respectively.

Table 2. Ultimate Regional Drainage Conditions Peak Flows

Sub-basin I.D.	Outfall Location	Area (ac)	10-yr 24-hr (cfs)	100-yr 24-hr (cfs)	100-yr 10-day (cfs)
US3A	East of Rio Del Oro	746.0	210	349	257
US3B	East of Rio Del Oro	22.9	35	60	17
Confluence of US3A & DBNDII (CP1)			212	352	260

** Peak flows resulting from combined hydrographs are shown in BOLD.*

Table 3. Ultimate Conditions Maximum Stage-Storage-Discharge

Basin	Location		10-yr 24-hr	100-yr 24-hr	100-yr 10-day
DBNDII	Northwest Corner of Residential Development	Max Stage(ft)	218.1	218.7	218.9
		Storage (af)	3.74	5.43	5.9
		Flow (cfs)	2.1	2.8	3.0

Illustrations representing the results of the analyses are presented in the Ultimate Regional Drainage Conditions map (Figure 7) and Ultimate Detention Basin DBNDII Details (Figure 7A).

HEC-1 input and output data, SacPRE data, and land use summaries have been included in Appendix C.

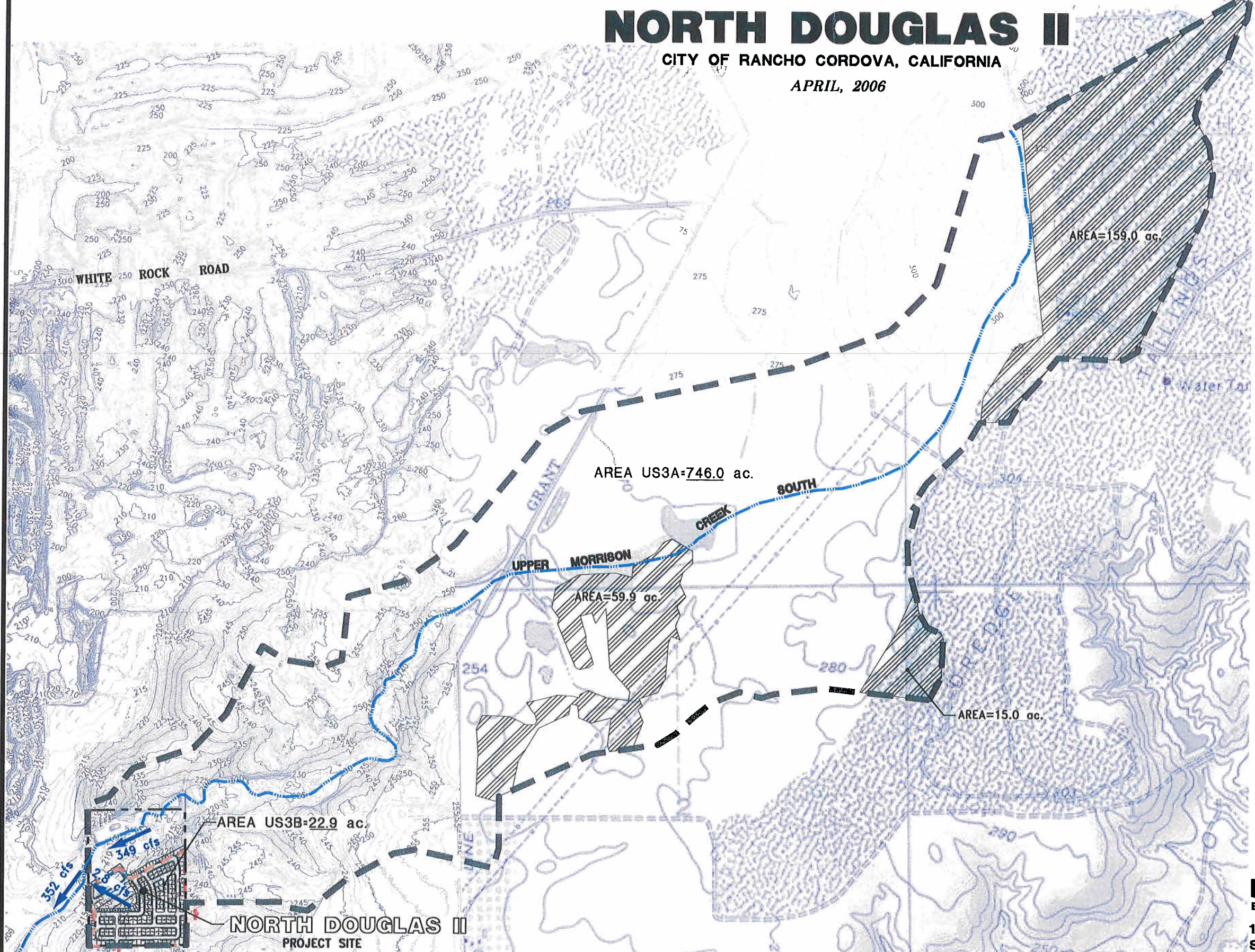
FIGURE 7

ULTIMATE REGIONAL DRAINAGE CONDITIONS (100-YR, 24-HR)

NORTH DOUGLAS II

CITY OF RANCHO CORDOVA, CALIFORNIA

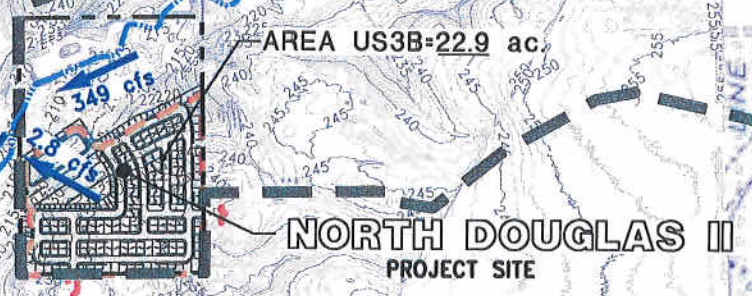
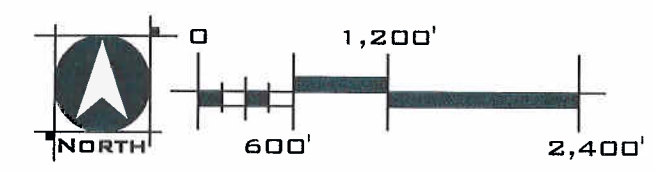
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LEGEND

- PROPERTY BOUNDARY
- PROPOSED ONSITE SHED BOUNDARY
- EXISTING SHED BOUNDARY
- EXISTING GROUND CONTOUR
- WATERWAY DRAIN
- MINING TAILINGS PILE
- FLOW (cfs)

- NOTE:**
1. MINING TAILINGS PILES ARE ASSUMED TO CONTRIBUTE NO FLOW TO UPPER MORRISON CREEK SOUTH.
 2. ALL OTHER AREAS OF WATERSHED US3A ARE ASSUMED UNDEVELOPED OPEN SPACE.



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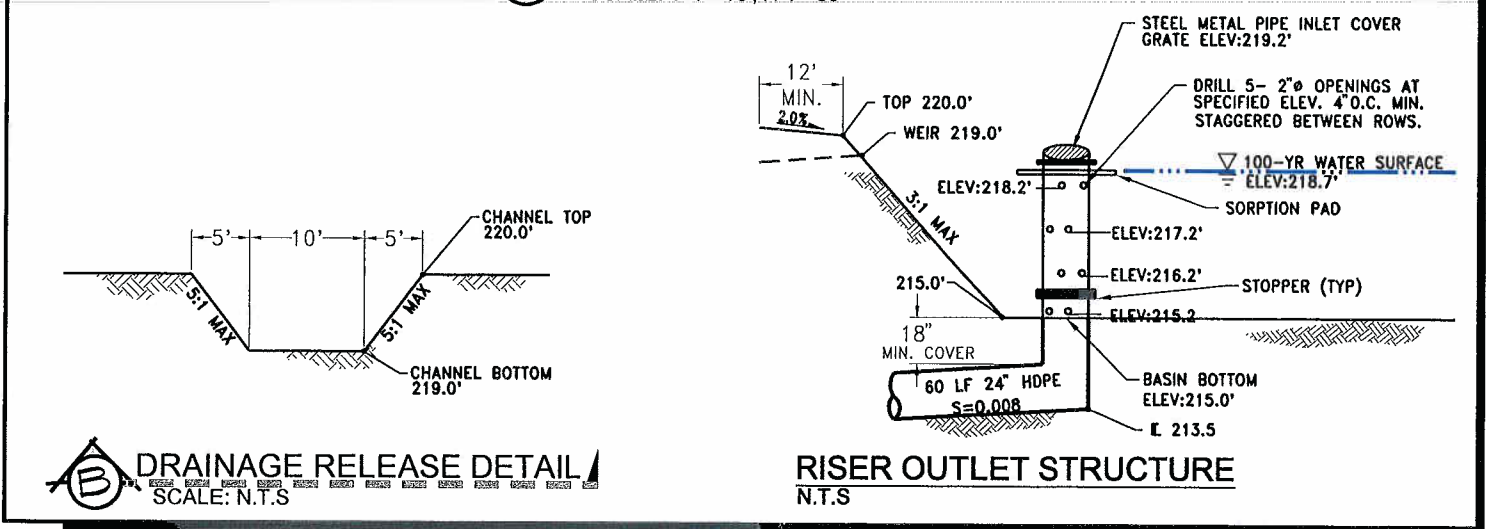
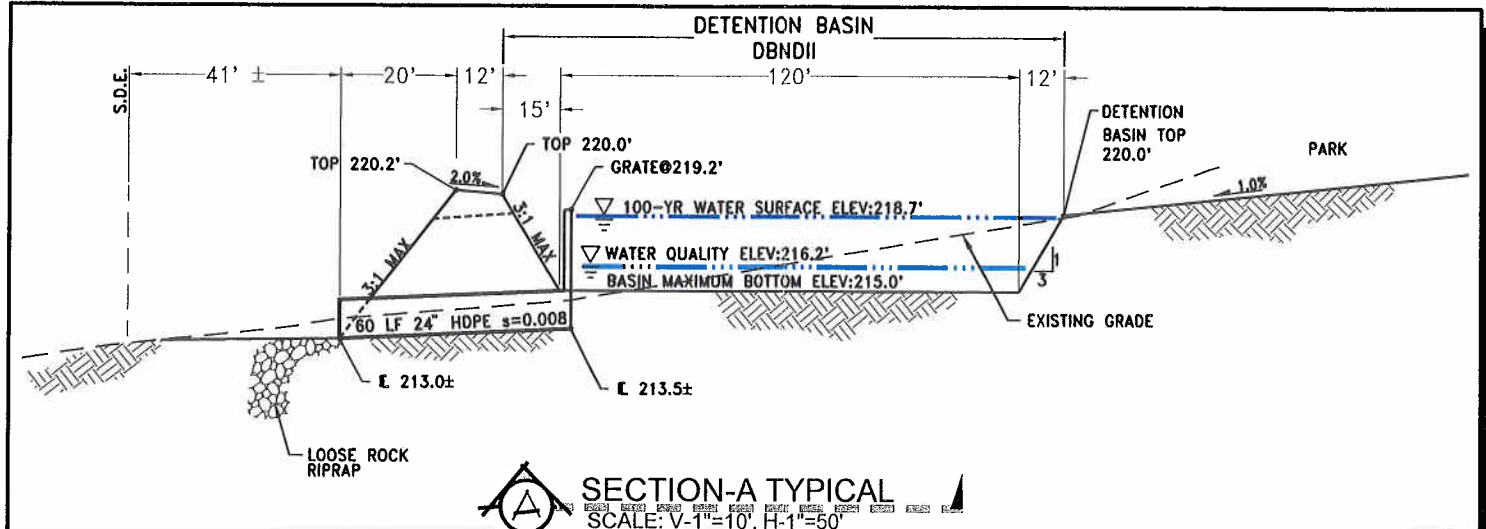
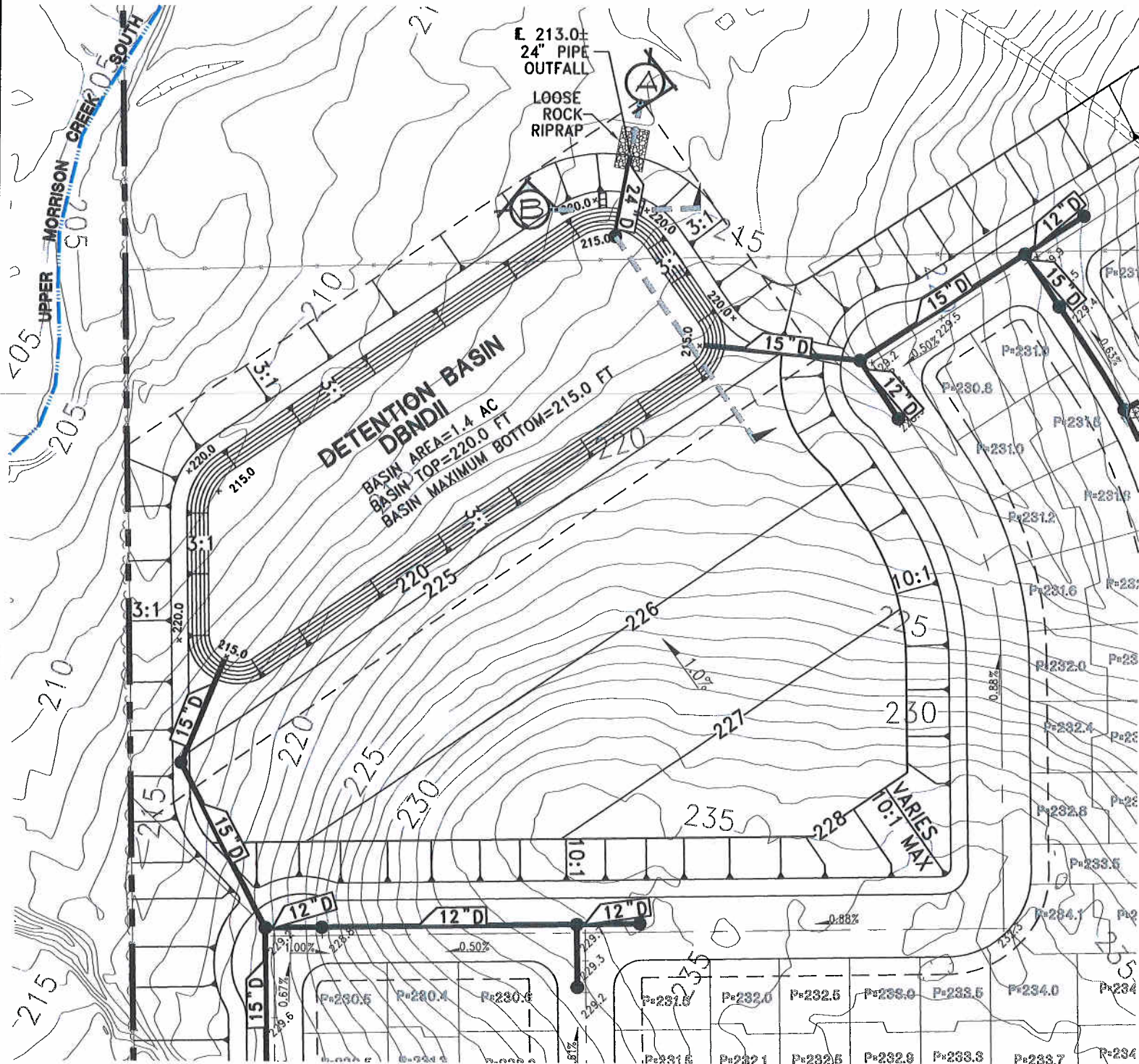
ULTIMATE DETENTION BASIN DBNDII DETAILS

FIGURE 7A

NORTH DOUGLAS II

CITY OF RANCHO CORDOVA, CALIFORNIA

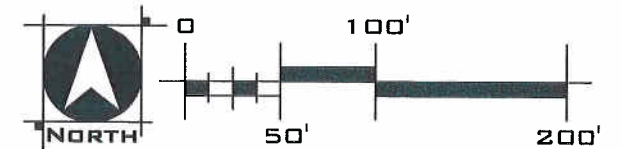
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STAGE-STORAGE DATA

ELEV. (ft)	STORAGE (ac-ft)
215.0	0.00
215.2	0.22
215.3	0.33
216.0	1.11
216.2	1.34
216.3	1.46
217.0	2.28
217.2	2.53
217.3	2.66
218.0	3.53
218.2	4.04
218.3	4.30
219.0	6.09
219.2	6.93
219.3	7.34
220.0	10.27

- LEGEND:**
- PROPERTY BOUNDARY
 - 225- PROPOSED DETENTION BASIN CONTOUR
 - PROPOSED DRAIN PIPE W/ MANHOLE
 - 12\"/>



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3. Water Quality

The ultimate detention basin DBNDII consists of a water quality portion in the bottom and a stormwater detention region above. The water quality region was sized using the Sato Design Curve for Sizing of Water Quality Dry-Extended Detention Basins in the Sacramento County Hydrology Standards. Detention basin DBNDII provides a 1.3 acre-feet, equivalent to 1.25 times the required Sato volume, dry extended basin for stormwater treatment of the North Douglas II development.

The ultimate detention basin is depicted on **Figure 7A**.

4. Proposed On-Site Drainage Systems

The on-site storm drainage trunk system was designed consistent with the County of Sacramento requirements. Trunks were sized using the Nolte Design Flows in the pipes and 10-year peak water surface at the trunk outfalls into the basin. The 10-year water surface in the detention basin was determined from the HEC-1 model. The on-site storm drainage design is enclosed in **Appendix A**.

The 100-year storm overland flows as determined by the difference of the 100-year flow obtained from the Sacramento method and the Nolte design flow can be accommodated by the street channel without impact to the residential development. An analysis of the overland flows is enclosed in **Appendix B**.

5. Conclusion

Development of the southern 22.9 acres of the North Douglas II property requires the construction of detention basin DBNDII and its outlet mechanism to meter the discharge from the development such that the maximum discharge does not exceed the maximum allowable discharge as determined by the "peak flow apportionment" ratio established in the RDO MDS. As noted on the comparison of the 100-year 24-hour storm peak flows on **Table 4**, the maximum discharge from this development does not exceed the maximum allowable discharge.

Also as noted on **Table 4** and on the comparison of the 100-year 24-hour storm hydrographs on **Figure 8**, the ultimate conditions peak flow does not exceed the existing conditions peak flow for the studied watershed. Furthermore, the existing and ultimate conditions peak flows occur at the same time during the storm event. These results indicate impact to downstream drainage facilities resulting from this development is fully mitigated by the proposed on-site drainage facilities.

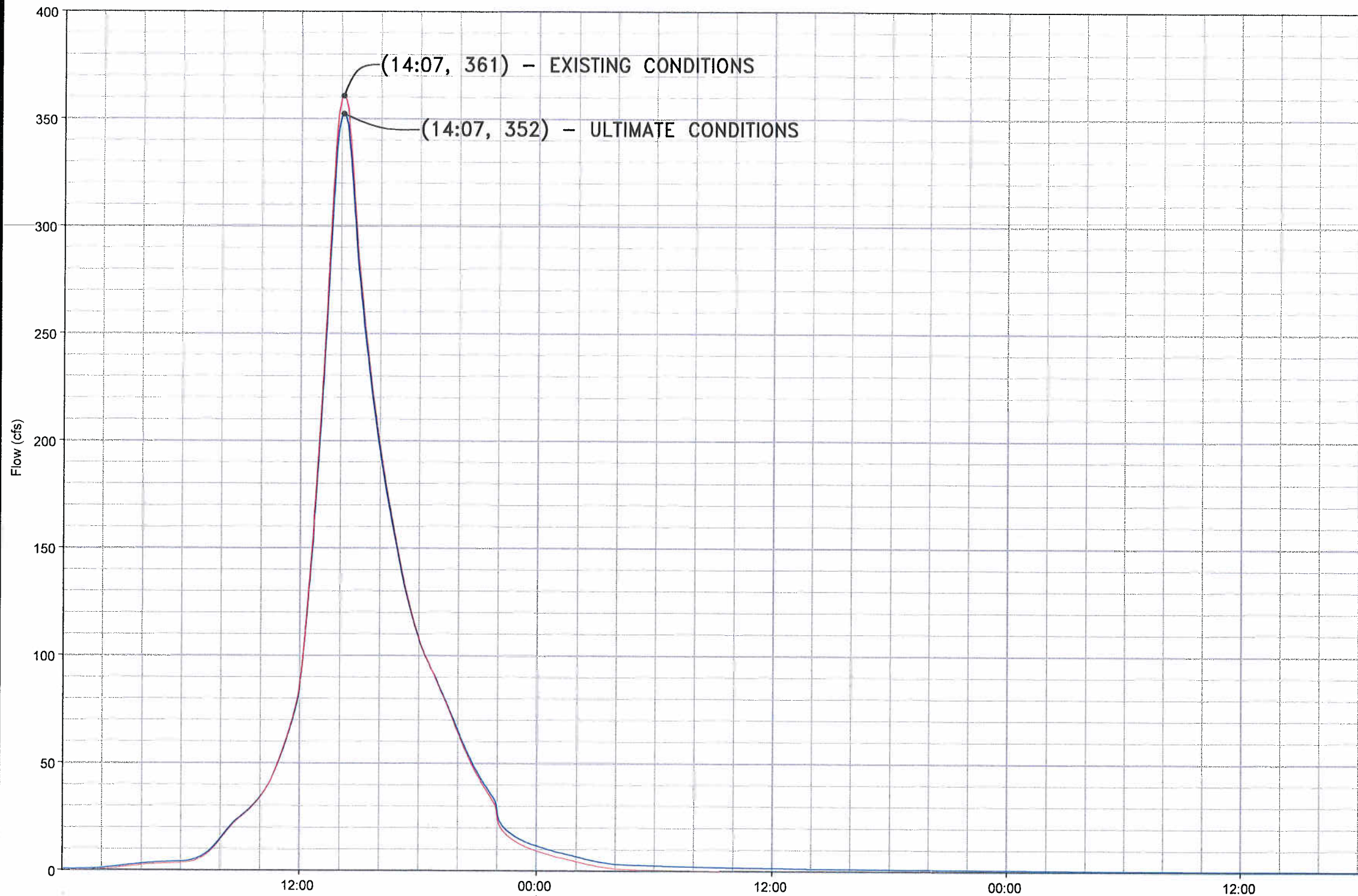
100-YEAR 24-HOUR STORM HYDROGRAPHS COMPARISON AT CONFLUENCE
OF DETENTION BASIN DBNDII AND UPPER MORRISON CREEK SOUTH

FIGURE 8

NORTH DOUGLAS II

CITY OF RANCHO CORDOVA, CALIFORNIA

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LEGEND:

EXISTING CONDITION

DESCRIPTION
SHED US3

ULTIMATE CONDITION

DESCRIPTION
CONFLUENCE OF DETENTION BASIN
DBNDII AND SHED US3A



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Table 4. 100-Year 24-Hour Storm Peak Flows Comparison

Basin I.D.	Description	Drainage Conditions	100-Yr, 24-Hr Peak Flow (cfs)
US3	Shed US3	Existing	361
Confluence of US3A & DBNDII	Confluence of Shed US3A & Detention Basin DBNDII	Ultimate	352
DBNDII	Maximum Discharge of Detention Basin DBNDII	Ultimate	2.8 *

* Maximum allowable discharge as determined by the "peak flow apportionment" ratio is 3.2 cfs.

It should also be noted that the "peak flow apportionment" ratio was established based on watersheds upstream of the RDO project site in their existing conditions. Hence, mitigation of flow from the undeveloped portion of the North Douglas II property is unnecessary.



6. References

Wood Rodgers, Inc., "Master Drainage Study for Rio Del Oro," August 5, 2005.

Wood Rodgers, Inc., "Addendum to Rio Del Oro Master Drainage Study, August 2005," October 25, 2005.