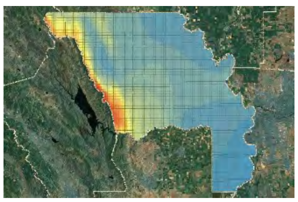

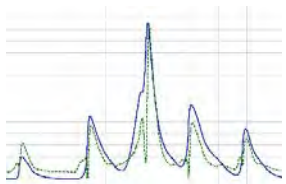

Final

Yolo County Airport Drainage Plan Update

Report prepared by

Mead & Hunt

Offices Nationwide

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September 2014

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1.0 Introduction

The Yolo County Airport (Airport) consists of approximately 498 acres, and is located west of County Road 96, south of County Road 29, east of County Road 95, and north of County Road 31 within Yolo County, California. The location of the Airport is shown on Map 1 of Appendix 1.

The Airport was constructed circa 1942 by the U.S. Army Corps of Engineers (USACE). Existing drainage facilities on the Airport property include a network of ditches and underground pipes designed to keep the Airport's runway and other primary facilities drained during storm events.

The Airport is a publicly-owned general aviation airport. The Airport was ceded to Yolo County by the United States government following the end of World War II. The existing north-south runway is approximately 6,000 feet long by 100 feet wide, and has a 35-foot-wide parallel taxiway, as well as several right angle taxiways along the parallel taxiway that service various aircraft hangars and aprons on the Airport property. There is an additional hangar south of the Airport's southern property line that has a "through the fence" access to the runway via a gravel taxiway. The northeastern corner of the Airport property is currently leased to the Yolo Sportsmen's Association as a recreation area for its members.

According to local knowledge, historically, on-site runoff created only minor flooding on the Airport property in the initial years following the construction of the Airport. However, areas developed on the east side of the Airport property since the Airport was developed now experience flooding during certain storm events due to changes in the drainage system adjacent to the Airport. Flooding in the low-lying portions of the Airport property occurs fairly regularly in the winter months, particularly after a heavy or prolonged storm, or a series of storms. This is primarily the result of alterations to adjoining and nearby drainage facilities and other natural drainage patterns that have occurred east of the Airport which have raised receiving waters and restrict the outlet at the southeastern corner of the Airport property. As a result, a regulatory (100-year) floodplain area is delineated on Airport property (FEMA, 2010).

To address this flooding issue, the "Yolo County Airport Drainage Plan" was initially prepared in October 1984 by Borcalli, Ensign, and Buckley on behalf of the County. The purpose of this study was to address development on the airport property without adversely impacting drainage and flooding along Airport Slough. This study was updated in 2005 following adoption of the Yolo County Airport Master Plan by Yolo County in 1998.

The Airport Layout Plan was updated in 2009, and proposes development as described on Exhibit A. The proposed development would add impervious area to the contributing watershed, which if not mitigated, would increase runoff volume and peak discharge into drainage facilities. As part of the planning efforts of the Yolo County Airport to accommodate existing and potential development on the Airport property, as well as to bring the Yolo County Airport Drainage Plan up to current County drainage standards, the County retained the services of Mead & Hunt, Inc. (Mead & Hunt) to update the Yolo County Airport Drainage Plan.

The purpose of this Drainage Plan Update is to identify facilities to accommodate existing and planned development on the Airport property, while mitigating adverse impacts related to storm water quality and quantity.

2.0 Design Criteria

Mead & Hunt has identified facilities needed to mitigate the adverse impacts of existing and planned airport development related to storm water quality and quantity according to the requirements of the Yolo County City/County Drainage Manual (floodSAFE Yolo, 2009). Hydrologic and hydraulic design criteria and requirements given in the Drainage Manual are summarized in Table 1.

Table 1: Yolo County Drainage Manual Hydrologic and Hydraulic Design Criteria

Criterion	Value
Storm Frequency	Varies by type and size of facility
Storm Duration	10-day for storage elements, 24-hour for conveyance elements
Depth-Duration-Frequency	Depth from County-specific formula on Page 12; MAP and Cv values from Figure 8 / interactive ArcGIS map; Frequency factor for Pearsons Type III distribution as listed on Pages 11-12 (Drainage Manual)
Storm Areal Distribution	Not used (basin area less than 10 square miles)
Storm Temporal Distribution	
Short-Duration Storms (24 hours or less)	Use the "Frequency Storm" method in HEC-HMS (symmetrical storm distribution)
Long-Duration Storms	Use the distributions provided in Tables 6, 7, and 8 (Drainage Manual, Volume 1)
Computation Time Interval	Shortest subbasin time of concentration divided by 5.5, rounded down to 1, 2, 3, 4, 5, 10, 15, 30, 60, 120, 180, or 360 minutes
Antecedent Moisture Condition (AMC)	Table 9 (Drainage Manual, Volume 1)
SCS Runoff Curve Numbers (CN)	Table 10 (Drainage Manual, Volume 1)
Curve Number Adjustment for AMC	National Engineering Handbook, Part 630, Chapter 10
Rational Method Runoff Coeff. (C)	Table in Exhibit 1 (Drainage Manual, Volume 2)
Base Flow	1 cfs/square mile of drainage area, unless site-specific base flow is known
Lag Time	Travel Time Component Lag Time Method used
Synthetic Unit Hydrographs	USBR dimensionless urban unit hydrograph used
Routing Methods	Modified Puls, Muskingham-Cunge, and Muskingham methods recommended. See Table 18 (Drainage Manual, Volume 1)
Water Quality Detention Basin (Dry)	
Water Quality Volume (WQV)	According to Exhibit 1 (Drainage Manual, Volume 2)
Unit Basin Storage Volume	Figure "Sacramento 5 ESE (7633)" in California Stormwater Quality Association's Stormwater Best Management Practice Handbook, New Development and Redevelopment.
Capture (% of Runoff)	80% required, according to Exhibit 1 (Drainage Manual, Volume 2)
Release Rate	75% WQV released in 24 hours, 100% WQV released in 48 hours
Basin Length-to-Width Ratio	3:1 minimum
Side Slopes	Minimum 4H:1V inside, 3H:1V outside
Inlet Energy Dissipation	Prevent erosion and re-suspension of sediment
Outlet Design	Trash rack per Yolo County drawing 9-15, flap gate required
Access Design	Provide gated concrete access ramp to basin bottom. Width = 15 feet min. Slope = 10% max. Turning radius = 40 feet min.
Perimeter Fence	Suggested for basins deeper than 4 feet
Dry-Weather Flow Treatment	Flow rates from landscape irrigation should be estimated according to County-specified design criteria. A vegetated submerged gravel bed should be incorporated into each dry detention basin as specified in Volume 2, pp. 37-38 (Drainage Manual).
Landscaping Plan	As specified in Volume 2, pp. 38-39 (Drainage Manual)
Topsoil	Top 12 inches of the basin, to support plant growth
Storage Facilities Hydraulic Design	
Freeboard, 100-yr 10-day	1 foot
Freeboard, 200-yr 10-day	0.5 foot
Side Slopes	4H:1V or flatter
Buffer Width	20 feet, including all-weather access road with adequate turning radius
Access Ramps Slope	10% maximum
Bottom Slope	2% minimum (to allow for complete drainage)

Criterion	Value
Open Channels Hydraulic Design	
Freeboard, 100-yr 24-hour	2 feet (3 feet if fill is required to achieve freeboard)
Freeboard, 200-yr 24-hour	1 foot
Side Slopes	3H:1V or flatter
Buffer Width	20 feet, including 15-foot-wide all-weather access road
Manning's n values	Table 5 (Drainage Manual, Volume 1)
Vegetation	Minimize maintenance requirements (use higher "n" value); native plants selected for soil and groundwater conditions by a qualified consultant
Contraction and expansion loss coefficients	For gradual transitions use 0.1 and 0.3, respectively. For bridge or culvert sections use 0.3 and 0.5, respectively.

2.1 Local Drainage Facilities

Local drainage facilities include conveyance, flood protection, water quality treatment, and recreational, environmental, and aesthetic elements, which may consist of roadside ditches, storm drainage pipe systems, and overland conveyance systems.

2.2 Regional Drainage Facilities

Regional drainage facilities include conveyance, flood protection, water quality treatment, recreational, environmental, and aesthetic elements, which may consist of channels, culverts associated with channels, bridges, detention basins, pump stations, and levees.

2.3 FEMA Criteria

Yolo County is a participant in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP), so drainage facilities must comply with FEMA criteria in addition to complying with the local cities and/or County standards. FEMA criteria relevant to this Drainage Plan Update are consistent with County standards regarding required freeboard for conveyance and storage facilities. In addition, FEMA requires one foot of freeboard to finished floor elevations above the base flood condition (100-year storm event).

2.4 Federal Aviation Administration (FAA) Criteria

FAA drainage standards regarding precipitation depth, design storm frequency, and runoff calculation method are less conservative than the standards set forth in the Drainage Manual. One FAA standard which is more conservative is a minimum design flow velocity in storm drainage pipes of 2.5 feet per second.

3.0 Existing Conditions

3.1 Topography and Subbasin Boundaries

The Airport is located within the Airport Slough subbasin, which consists of approximately 4.9 square miles. Within the Airport Slough subbasin, the terrain generally slopes from west to east. The approximate ground elevations range from a maximum of 120 feet[1] in the western portion of the watershed, to a minimum of 72.5 feet where the Airport Slough forms a confluence with Union School Slough. The Union School Slough subbasin is located north of the Airport Slough subbasin, and the Moody/Dry Slough subbasin is located to the south. The existing Airport Slough subbasin boundary, its internal subbasin

[1] Unless otherwise noted, all elevations given are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

boundaries, and topographic mapping of Airport Slough and adjacent areas can be found on Map 4 of Appendix 1.

3.2 Land Use

The existing land use within the Airport Slough subbasin outside of the Airport primarily consists of agricultural, rural residential, and open space. Land within the Airport itself is a mix of commercial development and open space.

3.3 Soils

Based on the Yolo County soil survey performed by the U.S. Department of Agriculture, Soil Conservation Service, the soils within the Airport Slough subbasin have generally been classified as hydrologic soil type D (USDA SCS, 1972). Refer to the referenced SCS document for specific area delineations.

3.4 Groundwater Elevation

Historical data for spring and fall groundwater levels are presented in the Annual Engineer's Report – 2002 (YCFCWCD, December 2002). The groundwater table within low-lying areas of the Airport Slough subbasin is rarely less than 15 feet below existing ground level.

3.5 Existing Drainage System

On-site runoff on the Airport property generally drains from west to east under the runway and main taxiway, into three primary drainage ditches that drain east to a single north-south drainage ditch, which parallels the Pleasant Prairie Canal/Flightline Ditch. This north-south drainage ditch conveys flows southward along the eastern boundary of the Airport property parallel to the Pleasant Prairie Canal, eventually draining to Airport Slough to the south. The on-site tributary area is approximately 357.2 acres, and consists of a mix of undeveloped and developed land. The existing drainage facilities are presented on Map 5 of Appendix 1.

The Airport is also subject to runoff that drains from off-site. The tributary area for the off-site runoff component is approximately 230.8 acres of agricultural land. West of the Airport, flow drains generally from west to east. Portions of this land drain southeasterly and directly to Airport Slough. The remainder flows northeasterly, with the majority of the runoff collecting and pooling in a low-lying area on the western side of the Airport, between the airstrip and County Road 95. The water that drains to this location has two outlets: a 36-inch RCP that drains eastward under the airstrip and onto the Airport property, and a section of low lying ground which allows water to spill northward, eventually overtopping County Road 29 and draining to Union School Slough. As the invert of the pipe is considerably lower than the ground serving as an overland release to the north, flow will primarily flow east until the capacity of the pipe is exceeded.

3.6 Hydrologic and Hydraulic Modeling

Hydrologic and hydraulic computer simulation models were developed for the 2005 Drainage Plan to represent the existing conditions at the time of that study. These models have been converted to more recent versions of the software and modified as described below to be consistent with the current County drainage standards and planned development on Airport property.

3.7 Flooding

Due to the limited conveyance capacity at the downstream end of the Airport's drainage system, there is a significant 100-year floodplain located on the eastern side of the Airport. Within the Airport property, the FEMA Flood Insurance Rate Map (FIRM) number 06113C0580G shows the effective flood insurance zone designations.

4.0 Planned Development

Three phases of development have been considered for this update, as described below. The phased development plans are based on the Airport Layout Plan (County of Yolo, 2009), along with additional detail provided on the phased improvements graphic which is included as Exhibit A. For the purposes of this study, it was assumed that no low-impact development (LID) mitigation measures will be included as part of the planned development. Any LID measures added in conjunction with the development (e.g. porous pavement, green roofs) could reduce the size of the required drainage facility improvements or possibly eliminate them altogether.

1. Phase 1 consists of existing development constructed since 2005 as well as development planned for the near future. Existing development which has been constructed since the last drainage plan update includes new hangars and pavement area. Development planned for the near future includes new hangars, new pavement area, and new aircraft runup aprons. Some pavement area will be removed and replaced with grass area as part of the Phase 1 improvements, as shown on Exhibit A.

2. Phase 2 development assumes 8.8 acres of new airport development and removal of some pavement area in YAP-6 (see Map 4 of the 2005 Drainage Plan for description of subbasins).

3. Phase 3 development assumes 10 acres of new commercial/industrial development in YAP-8 and/or YAP-9.

5.0 Drainage Plan

Mead & Hunt selected drainage facility improvements to mitigate the adverse effects of existing and planned development related to water quality and quantity. Conceptually, the improvements consist of three new water quality detention basins (dry type) and the appurtenant inlet and outlet structures, vegetated submerged gravel beds, and access roads/ramps. Approximate sizes have been determined in accordance with the assumptions and methods described in the following sections. The proposed drainage facility improvements are shown on Exhibit A.

5.1 Land Use

Land use changes have been accounted for by adjusting the runoff curve numbers (CN) and initial abstraction depths for the subbasins to reflect the Phase 1, 2, and 3 conditions, in accordance with the Drainage Manual. The land use types and acreages from the 2005 Drainage Plan appeared to accurately represent the baseline scenario, with the exception of subbasins YAP-3A, YAP-3B, and YAP-6. For those three subbasins, the land use areas for the baseline scenario were re-delineated by Mead & Hunt because the land use types used in the 2005 Drainage Plan were not consistent with the actual land use at the time. Table 2 summarizes the land use changes (in acres) due to planned development and corresponding runoff curve numbers for the development areas (in parenthesis) for each hydrologic subbasin.

Table 2: Land Use Changes from Baseline Scenario

Subbasin	Phase 1 Area (CN)	Phase 2 Area (CN)	Phase 3 Area (CN)
YAP-3A	9.2 (98)		
YAP-3B	2.3 (98)		
YAP-5	0.6 (98)		
YAP-6	3.7 (98)	8.8 (95) 0.8 (87)*	
YAP-8			7.5 (95)
YAP-9			2.5 (95)

*Pavement removal and conversion to grass.

5.2 Precipitation and Design Storms

The 2005 Drainage Plan identified the 10-day storm as the critical duration for both the 100-year and 10-year events for storage facility design, and the 100-year 24-hour storm for conveyance facility design. Therefore, in accordance with the nature of this update, only these three storms have been carried forward. In addition, the Drainage Manual now requires evaluation of 200-year storms for freeboard determination on ponds and open channels, so the 200-year 10-day and 24-hour storms are also included in this Drainage Plan Update.

The design storm precipitation depths and temporal distributions were determined in accordance with the data and procedures recommended in the Drainage Manual. The following depth-duration-frequency equation (Volume 1, Page 12 of the Drainage Manual) was used to calculate the design precipitation depth for each storm frequency and duration:

$$P_{ij} = (-0.0974 + 0.1212*MAP)*(1 + K_j*C_v)*T_i^{0.4227}$$

where:
P_{ij} = design precipitation depth for return period j and storm duration i (inches)
MAP = mean annual precipitation (inches)
Cv = coefficient of variation
Kj = frequency factor for the Pearsons Type III distribution
Ti = time of the storm duration being calculated (days)

Mean annual precipitation (MAP) for the study area was determined to be 21.3 inches on an area-weighted-average basis using the interactive GIS map calculator published with the Drainage Manual. The coefficient of variation (Cv) for this area is 0.3728. Frequency factors of 1.341, 3.087, and 3.575 were used for the 10-year, 100-year, and 200-year storms, respectively, from the values included under Volume 1, Part II, Section E of the Drainage Manual.

Storm temporal distributions for long-duration storms (durations greater than 24-hours) followed the generalized temporal distributions presented in Tables 6, 7, and 8 of the Drainage Manual. For the 24-hour storms, a symmetrical storm distribution was assumed, using the “Frequency Storm” method in HEC-HMS.

Because the total contributing watershed of the study area is less than 10 square miles, neither storm centering nor area reduction factors were used.

Table 3 summarizes the calculated precipitation design values, design storms used, and the total and partial duration precipitation depths for each storm.

Table 3: Design Precipitation Data

Parameter	Value
Mean Annual Precipitation (MAP)	21.3 inches (average for study area from interactive GIS map)
Coefficient of Variation (Cv)	0.3728 (Figure 8, Drainage Manual, Volume 1)
Frequency Factor (Kj)	
10-year	1.341
100-year	3.087
200-year	3.575
Design Storms	**Total Precipitation Depths**
10-year 10-day	9.86 inches
100-year 24-hour	5.34 inches
100-year 10-day	14.14 inches
200-year 24-hour	5.79 inches
200-year 10-day	15.34 inches
Frequency and Partial Duration	**Partial Duration Depths (for Frequency Storm method in HEC-HMS)**
100-year 5-minute	0.49 inches
100-year 15-minute	0.78 inches
100-year 1-hour	1.39 inches
100-year 2-hour	1.87 inches
100-year 3-hour	2.22 inches
100-year 6-hour	2.97 inches
100-year 12-hour	3.99 inches
100-year 24-hour	5.34 inches
200-year 5-minute	0.53 inches
200-year 15-minute	0.84 inches
200-year 1-hour	1.51 inches
200-year 2-hour	2.03 inches
200-year 3-hour	2.41 inches
200-year 6-hour	3.23 inches
200-year 12-hour	4.32 inches
200-year 24-hour	5.79 inches

5.3 Hydrologic and Hydraulic Modeling

Mead & Hunt performed hydrologic and hydraulic modeling of the Airport drainage facilities using the computer software programs HEC-HMS Version 3.5 and HEC-RAS Version 4.1, respectively. The HEC-HMS model was used to estimate the timing and quantity of runoff based on factors such as land use, precipitation depth and timing, drainage facilities geometry, and surface roughness. Output hydrographs from the HEC-HMS model were used as inputs to the HEC-RAS model. The HEC-RAS model was used to simulate the hydraulic routing characteristics of the proposed dry detention basins and the main north-south airport drainage ditch.

Mead & Hunt created the HEC-HMS model by converting an existing HEC-1 model developed for the 2005 Drainage Plan Update and updating it to reflect changes in land use and precipitation depths. Mead & Hunt modified the existing HEC-RAS model from the 2005 Drainage Plan Update to include the proposed dry detention basins and the calculated inflow hydrographs.

The domain of the HEC-HMS model included the entire area contributing runoff to the north-south drainage ditch on the eastern edge of the Airport. The domain of the HEC-RAS model included the main north-south airport drainage ditch from its northern end to just upstream of the confluence with Airport Slough. The HEC-RAS model also included the proposed dry detention basins.

5.3.1 Scenarios Modeled

Four scenarios were modeled for this Drainage Plan Update, as follows:

- 2005 Existing – This is the baseline scenario, and is based on the same land use assumptions as the 2005 Plan existing conditions model.
- Phase 1 – This scenario includes land use changes that have occurred since 2005, as well as various developments planned for the near future.
- Phase 2 – This scenario assumes a future 8.8 acre airport development site between the existing north-south taxiway and Aviation Avenue.
- Phase 3 – This scenario assumes a future 10.0 acre commercial/industrial development site east of Aviation Avenue.

In order to create an unbiased comparison between the baseline scenario and the future development scenarios, Mead & Hunt used the same HEC-HMS model subbasin boundaries for all the scenarios, defined according to the "Ultimate Conditions" boundaries shown on Map 7 of Appendix 1. Using the same subbasin configuration ensures that the timing of individual runoff hydrograph peaks is similar for all scenarios, so that the differences in total peak outflow are attributable only to the proposed development and not to a modeling artifice.

5.3.2 Water Quality Volume

Mead & Hunt sized the proposed dry water quality detention basins to capture and treat stormwater runoff equal to 80% of the volume of annual runoff, determined in accordance with the methodology set forth in the California BMP Handbook, using local rainfall data. The proposed basin outlet structures include a low-flow orifice sized to drain the water quality volume (WQV) in 48 hours, in accordance with the requirements outlined in Exhibit 1 of the Drainage Manual.

Because the required WQV is based on the entire drainage area contributing to the dry detention basin, the resulting WQV is greater than would be necessary if treating only the developed area. If future development is constructed so that runoff from the developed area is treated separately from the undisturbed area runoff, the dry detention basins may be reduced in size. However, additional conveyance elements such as pipes and open channels would need to be constructed to separate the runoff from developed and undisturbed areas.

5.3.3 Flood Attenuation

Exhibit B shows the 100-year 10-day discharge hydrograph at the downstream end of the HEC-RAS model for the 2005 Existing (baseline) and Phase 3 scenarios, as well as water surface profiles for all storm events. The dry detention basins effectively mitigate the increase in peak discharge resulting from development, and the peak flow at the downstream end of the model is actually reduced by about 1% for the 100-year and 200-year storms.

5.3.4 Dry Detention Basin Outlet Design

The outlet structures for the proposed dry detention basins include a low-flow orifice outlet and an overflow spillway. The crest elevation of the overflow spillways was set at 86.0 feet, which is the top of the WQV, and the spillways were sized in order to achieve a maximum design water surface elevation of 87.4 feet during the 100-year storm and 87.9 feet during the 200-year storm. The finished elevation of Aviation Avenue is shown as 90.9 feet on the preliminary design plans in the 2005 Drainage Plan Update.

Assuming the pad elevations for existing and future development are at or above the elevation of Aviation Avenue, and accounting for additional headloss through the culverts and local drainage channels, the design water surface elevations represent at least one (1) foot of freeboard during the 100-year storm and one-half (0.5) foot of freeboard during the 200-year storm.

The low-flow orifice outlets were sized to release 75% of the WQV within 24 hours, and the entire WQV within 48 hours. WQV drawdown timing was calculated assuming a fixed tailwater elevation of 82.0 feet at the downstream model boundary, which resulted in a Froude number at the downstream boundary that was consistent with the Froude number in the rest of the drainage ditch. This tailwater assumption appears reasonable for the purpose of sizing the orifice outlets to release the WQV in 48 hours following water quality storm events.

5.4 Local Conveyance Facilities Design

Local conveyance facilities, such as culverts and local overland drainage ditches, were not re-designed as part of this update task for two reasons. First, the peak flow rates for 24-hour storms in the Phase 3 condition are only slightly (about 1%) higher than the flow rates in the 2005 Existing (baseline) condition. Second, the previous calculations appear to have been performed in accordance with the methods prescribed in the current Drainage Manual. Local conveyance facilities designed as part of the 2005 Drainage Plan Update are reproduced on Exhibit A.

5.5 Additional Design Considerations

In addition to the basic sizing of the dry detention basins, outlet pipes, and spillways listed herein, the Drainage Manual outlines several design criteria which will have to be taken into consideration during final design and construction of drainage facilities. Some of these additional considerations include:

- Treatment for dry-weather flows (e.g. vegetated submerged gravel bed)
- Trash racks
- Flap gates to reduce backwater effects
- Minimum bottom slope inside basins
- Final design of embankments, spillways, and outlet pipes
- Landscaping plan
- All-weather access roads/ramps
- Security gates
- Security fencing (may not be necessary for this facility)
- Sediment forebay (may not be necessary for this facility)
- Other specific design considerations as listed in Table 1 above

5.6 Assessment of Floodplain Impacts

In order to preserve the maximum amount of space for future development adjacent to the Airport facilities, the proposed locations of two of the new dry detention basins are inside the regulatory floodplain (see Exhibit A). While the basin embankments may only extend a few feet above the existing ground elevation, they still represent an obstruction to flow during the regulatory event (i.e. 100-year flood). The 2005 Drainage Plan Update included a proposed bench at Elevation 85.5 east of Aviation Avenue. This bench is also recommended as part of this update because it will act to mitigate the lost floodplain storage, but likely will not fully mitigate the lost conveyance capacity. It is likely that local widening of the main channel near the detention basins or other strategies to increase conveyance will be necessary to demonstrate no net increase in the regulatory floodplain elevations resulting from construction of the drainage improvements.

The impact of the proposed dry detention basins on the regulatory floodplain elevations will need to be investigated separately as part of a Conditional Letter of Map Revision (CLOMR) process prior to construction of Phase 1 mitigation facilities.

5.7 Drainage Facilities Phasing

Conceptual dry detention basin and outlet sizes have been selected in order to mitigate existing and future development on the Airport, as shown in Table 4.

Table 4: Conceptual Dry Detention Basin Sizes

Construction Phase	Name	WQV (acre-feet)	Total Volume (acre-feet)	Orifice Area (feet^2)	Spillway Length (feet)	Bottom Elevation (feet)	Top of Berm (feet)	Approx. Footprint Area*
1	Basin 1	3.43	7.13	0.31	26	84.3	88.4	180' x 800'
1 / 2	Basin 2	3.13	6.31	0.30	19	84.0	88.4	210' x 570'
3	Basin 3	1.55	2.94	0.13	14	83.5	88.4	160' x 360'

*Approximate footprint areas shown are based on specific assumptions such as a relatively flat bottom as in the 2005 Plan, the basin bottom and top of berm elevations shown, the outlet sizes, and 10:1 basin side slopes. Berm width and exterior side slopes will be determined during final design, and are not included in the approximate footprint area.

Basin 1 needs to be constructed to bring the Airport into compliance for the existing development constructed since 2005 near the general aviation hangars area. Basin 1 will also mitigate for Phase 1 development near the general aviation hangars area that is planned for the near future.

Basin 2 needs to be constructed concurrent with Phase 1 development (south runup apron and Davis Flight Support area). Basin 2 will also mitigate for the future Phase 2 Airport development (8.8 acres).

Basin 3 needs to be constructed concurrent with the future Phase 3 commercial development (10 acres).

6.0 Regional Solution Alternative

The required mitigation for existing and future Airport development could potentially be accomplished in tandem with a more comprehensive, regional drainage solution. This solution would be a cooperative effort by several stakeholders, including the Airport, Yolo County, Yolo County Flood Control and Water Conservation District, local residents, and environmental interests.

Figure 1 shows the existing regional drainage features near the airport. Currently, a large portion of the area to the west of the airport drains to the north end of the airport, then flows south along the north-south airport drainage ditch, east and then north along the Airport Slough, and finally crosses County Road 29 before flowing into Union School Slough. This long, circuitous route contains many culverts and flow restrictions which exacerbate flooding in the residential area east of the airport. Additionally, another large portion of the area to the west of the airport drains into Airport Slough south of the airport before flowing through the same residential area.

A regional drainage solution could involve creating a supplementary bypass channel to take flow from both ends of the existing north-south airport drainage ditch (including the upstream portion of Airport Slough) and route it along County Road 29 to rejoin Airport Slough downstream of the residential area. This would result in a steeper grade along the new drainage channel compared to the existing Airport Slough route and would add valuable conveyance and storage capacity, reducing peak flood elevations in the region. Essentially, a portion of the flow would be re-routed from Airport Slough to the new drainage ditch, relieving pressure on the existing system. The new ditch would likely have fewer culverts than the existing Airport Slough reach. A new dry detention basin could also be constructed south of County Road 29, just north of the Yolo Sportsmen's Association facility for water quality and peak flow reduction purposes.

The airport and its neighbors could benefit from this type of regional solution because the new drainage system would route airport and other runoff around the residential area, clearly segregating any perceived consequences of airport development from those affected properties. Another benefit is that constructing a single dry detention basin on the north side of the airport could be more cost-effective than constructing three separate basins adjacent to the existing north-south ditch. The airport has much to offer toward a regional drainage solution because it possesses a continuous length of undeveloped land which can be used to bypass the Airport Slough around the residential area. It should be noted, however, that no cost-benefit analysis of this regional solution has been performed as part of this study. Such a solution might be more expensive overall because of the need to cross the existing canal, and the need to acquire right-of-way for almost a mile along County Road 29. A feasibility study could be conducted to identify specific merits and challenges associated with this solution.

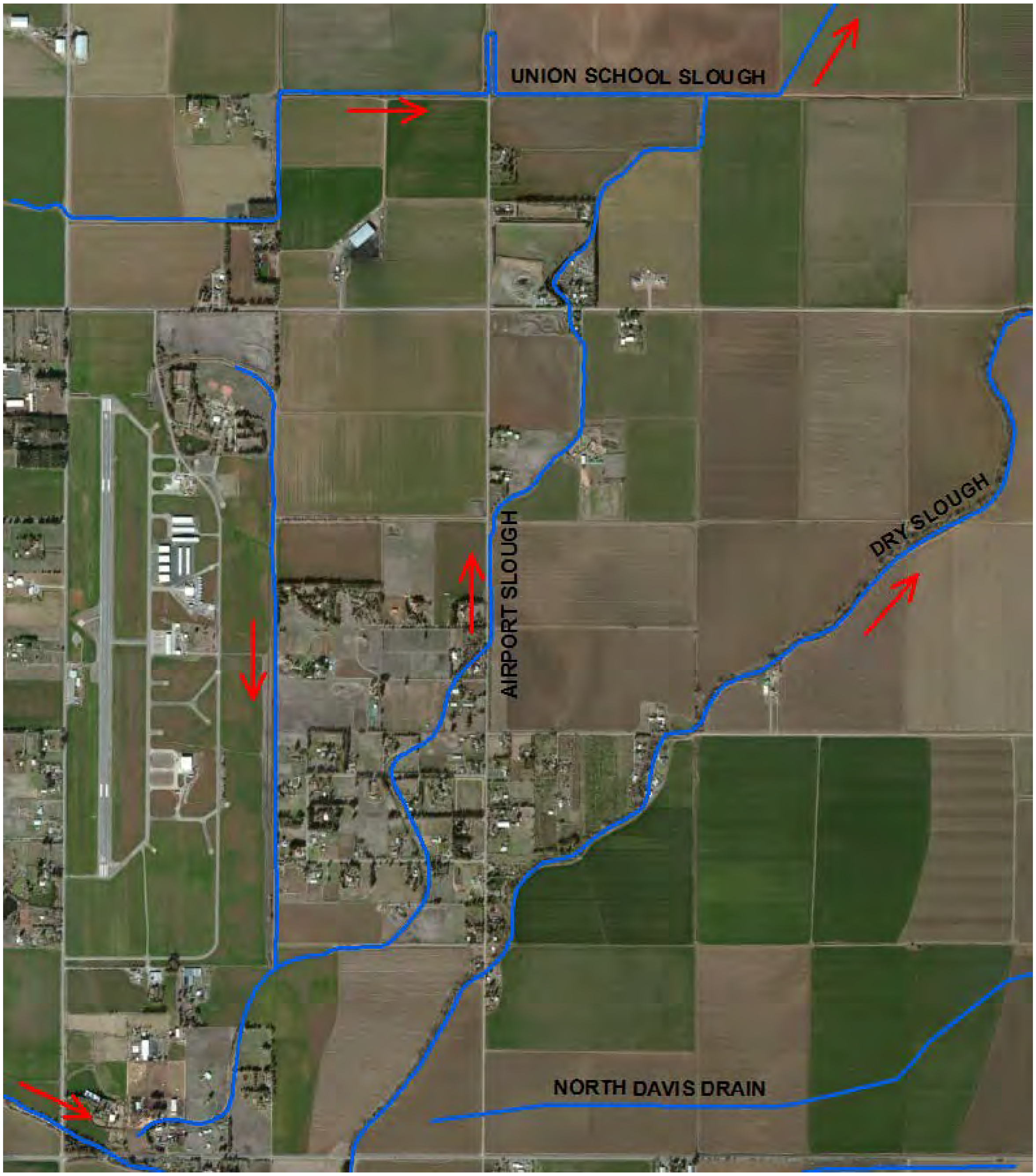

Figure 1: Existing Regional Drainage Schematic

7.0 Summary of Recommendations

1. Investigate the possibility of separating runoff from undeveloped and newly developed areas for the purpose of reducing the required water quality volume and overall dry detention basin size, as discussed in Section 5.3.2 “Water Quality Volume.” This could be the first step of the final design process.

2. Conduct a topographic survey to verify the geometry of critical hydraulic features, such as ditch flowlines, culvert sizes and invert elevations, and ground elevations in the vicinity of the proposed basins. This could be done as part of the final design of the mitigation facilities.

3. Plan for a CLOMR process to evaluate and mitigate the floodplain impacts of the proposed mitigation facilities prior to construction.

4. Consider reserving an additional 50-foot-wide strip of land adjacent to the existing north-south ditch for additional future conveyance capacity, possibly to be used as part of a regional flood protection solution.

5. Construct Basin 1 to bring the Airport into compliance for the existing development constructed since 2005.

6. Construct Basin 2 concurrent with the Phase 1 development on the southern portion of the Airport (south runup apron and Davis Flight Support area).

7. Construct Basin 3 concurrent with the Phase 3 commercial development.

8. Engage potential stakeholders in discussions surrounding the formation of a regional drainage solution that could satisfy the airport’s drainage needs, solve long-term drainage problems, and improve community relations. A feasibility study could be conducted to investigate the costs and benefits of such a solution.

8.0 References

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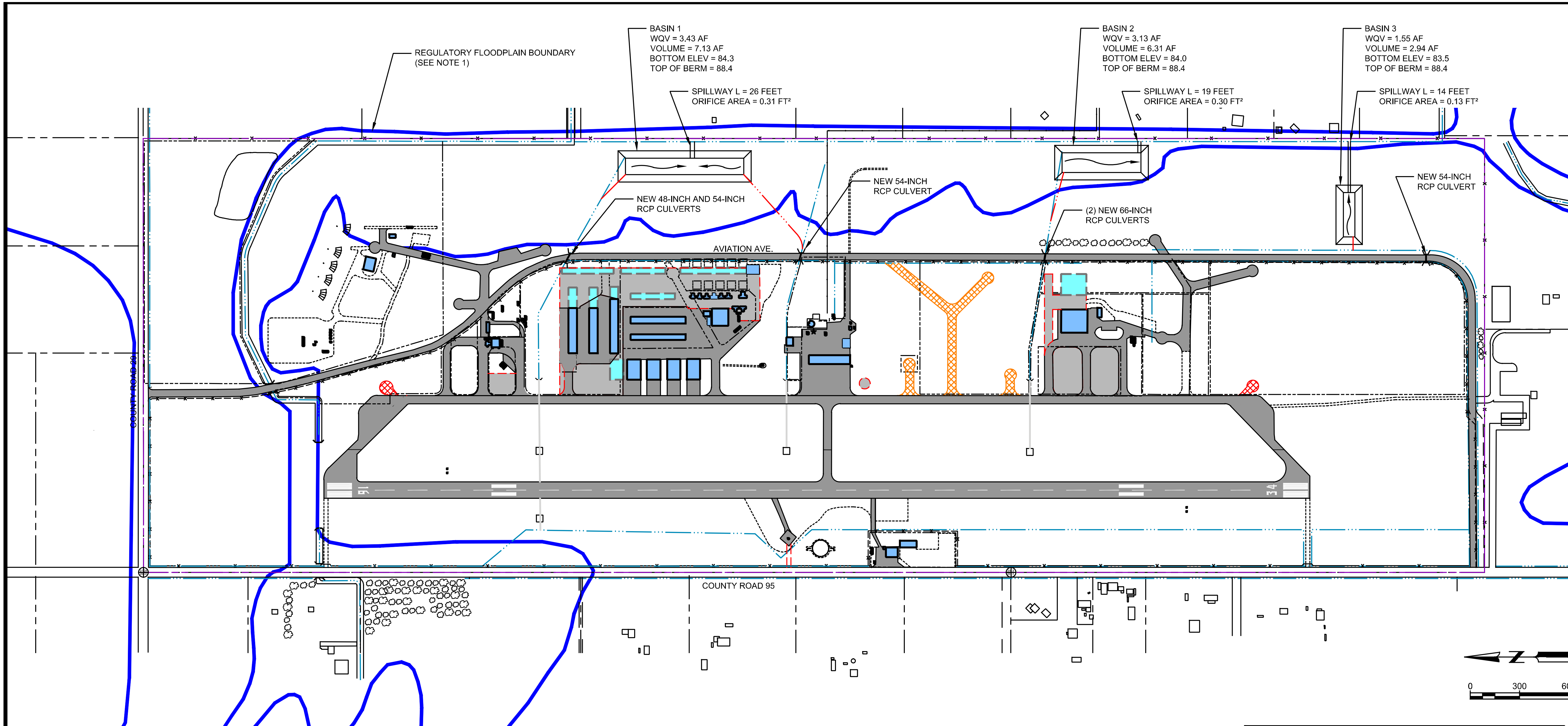
Appendix 1

Yolo County Airport Drainage Plan Update (December 2005)

Mead&Hunt

Exhibit A

Proposed Drainage Facility Improvements



NOTES:

1. REGULATORY FLOODPLAIN BOUNDARY SHOWN IS APPROXIMATE. REFER TO FEMA FIRM NUMBER 06113C0580G FOR EFFECTIVE FLOOD INSURANCE ZONE DESIGNATIONS.
2. PRELIMINARY DETENTION BASIN LOCATIONS, DIMENSIONS, AND OUTLET SIZES HAVE BEEN SELECTED TO MITIGATE RUNOFF FROM FUTURE PHASED DEVELOPMENT. ALTERNATE MITIGATION CONFIGURATIONS SUCH AS IN-CHANNEL STORAGE OR DIFFERENT BASIN LOCATIONS WILL RESULT IN DIFFERENT EQUIVALENT FACILITY SIZES. BASINS CAN BE RELOCATED, SPLIT, COMBINED, OR RESIZED AT THE TIME OF FINAL DESIGN TO ACCOMMODATE SPECIFIC DEVELOPMENT GOALS.
3. IT IS ADVISABLE TO MAINTAIN A MINIMUM 50-FOOT OFFSET FROM THE EDGE OF THE NEW DETENTION BASINS TO THE EDGE OF THE EXISTING NORTH-SOUTH DRAINAGE DITCH TO ALLOW FOR A POTENTIAL FUTURE INCREASE IN CHANNEL WIDTH.
4. THE DRAINAGE INFRASTRUCTURE IS BASED ON PHASE 1 DEVELOPMENT AS SHOWN, AS WELL AS A PHASE 2 AIRPORT DEVELOPMENT (8.8 ACRES) DRAINING TO BASIN 2 AND A PHASE 3 COMMERCIAL/INDUSTRIAL DEVELOPMENT (10.0 ACRES) DRAINING TO BASIN 3, THE LOCATIONS OF WHICH HAVE YET TO BE DETERMINED.

DRAWING LEGEND

	EXISTING	FUTURE
BASELINE STUDY - AIRFIELD PAVEMENT		N/A
BASELINE STUDY - BUILDING		N/A
PHASE 1 - AIRFIELD PAVEMENT	N/A	
PHASE 1 - BUILDING	N/A	
DIRT OR GRAVEL ROAD		N/A
REMOVAL - BASELINE	N/A	
REMOVAL - PHASE 2	N/A	
AIRPORT PROPERTY		N/A
OTHER PROPERTY LINES		N/A
INTERNAL BOUNDARY (lease, R.O.W., etc.)		N/A
WATERWAY / CHANNEL / CULVERT		
UNDERGROUND STORM DRAIN / CATCH BASIN		N/A
REGULATORY FLOODPLAIN BOUNDARY		N/A
FENCE		
FLOW DIRECTION	N/A	
CUT/FILL AREA	N/A	

6/2/2014 4:31:06 PM
X:\25020001\130224.01\TECH\CAD\25020-00-130224.01-PHASING.DWG

Mead & Hunt

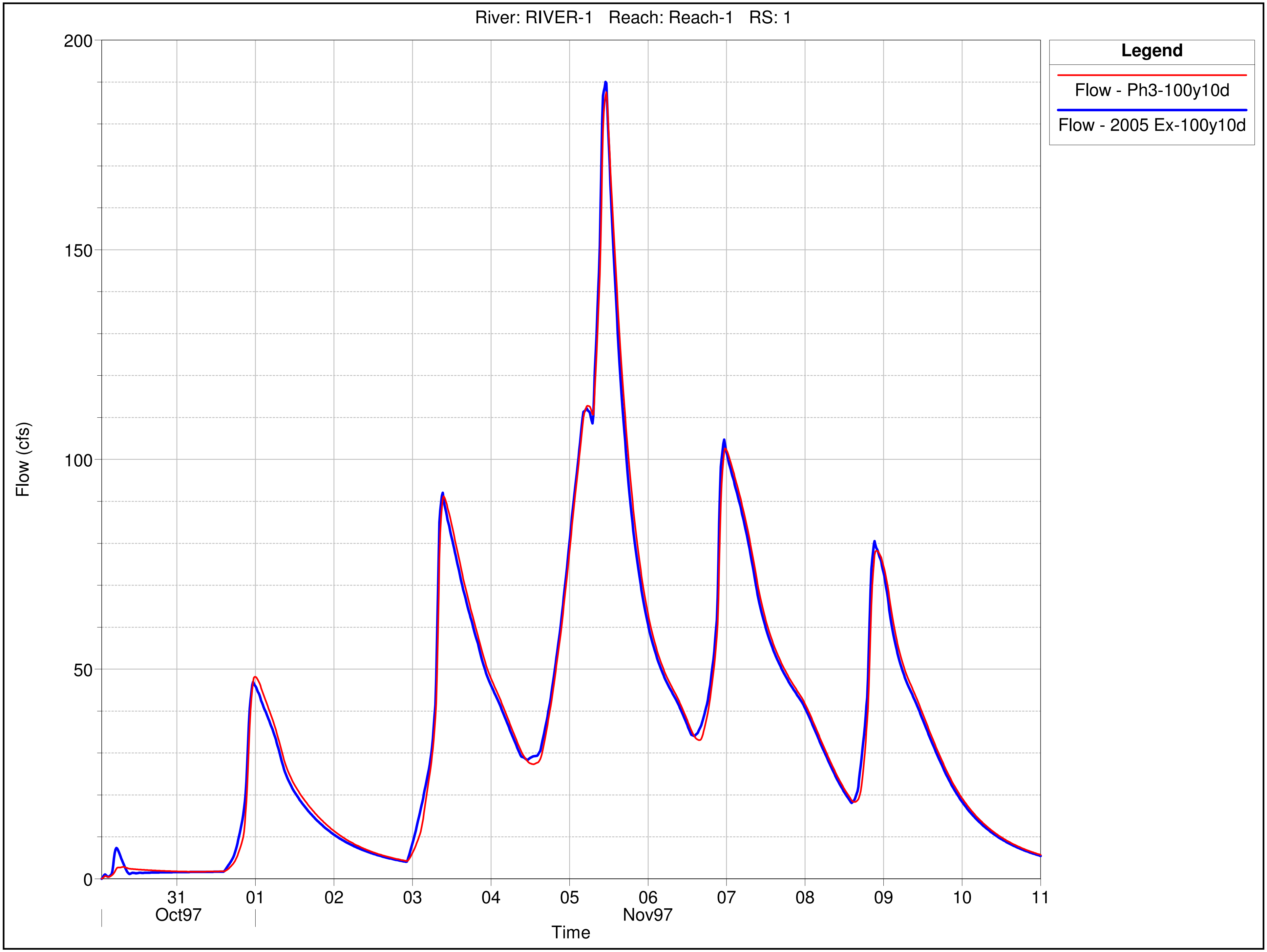
DRAINAGE STUDY UPDATE - PROPOSED DRAINAGE FACILITY IMPROVEMENTS

YOLO COUNTY AIRPORT

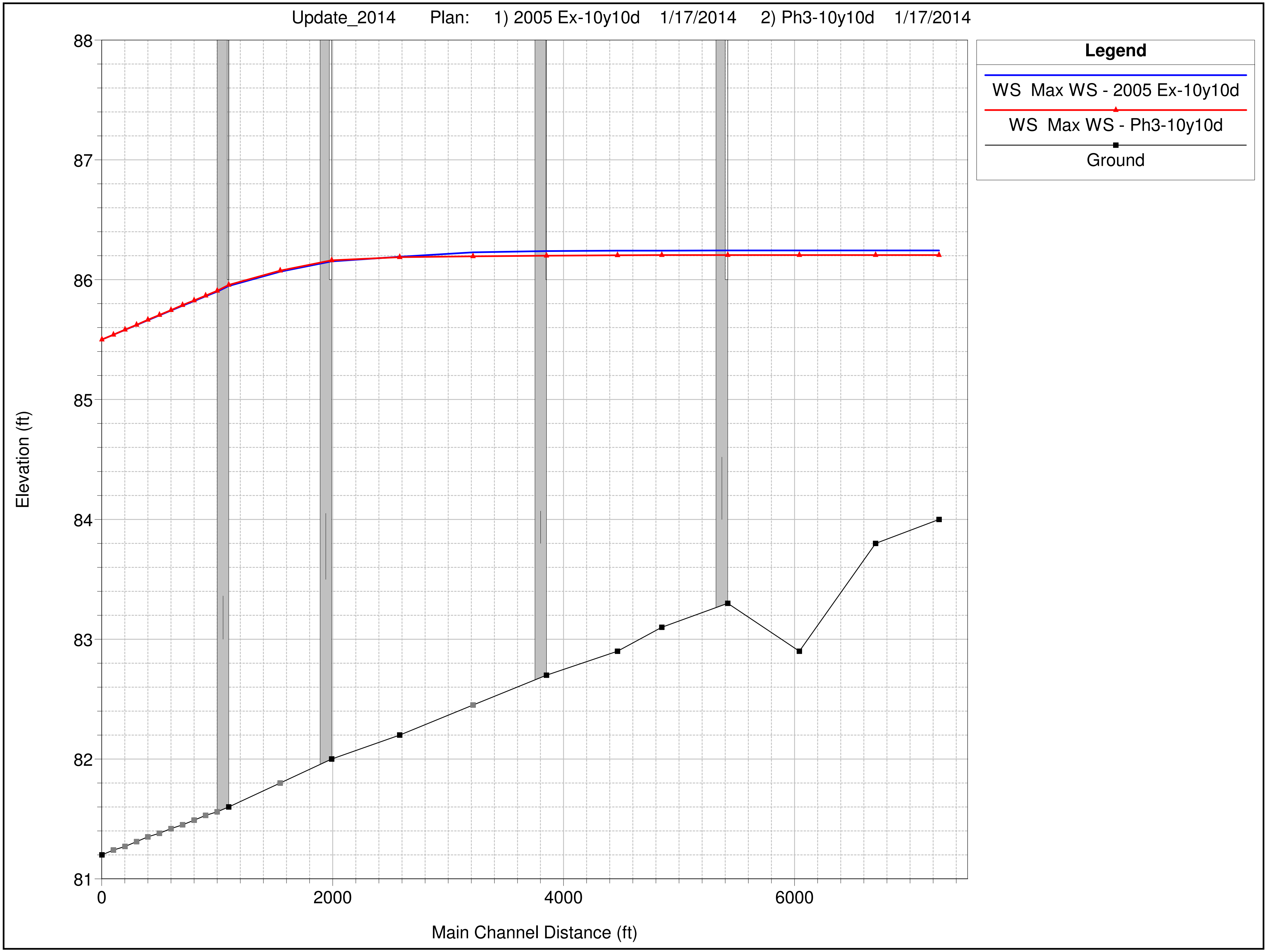
2502000-130224.01
FEBRUARY 20, 2014

Exhibit B

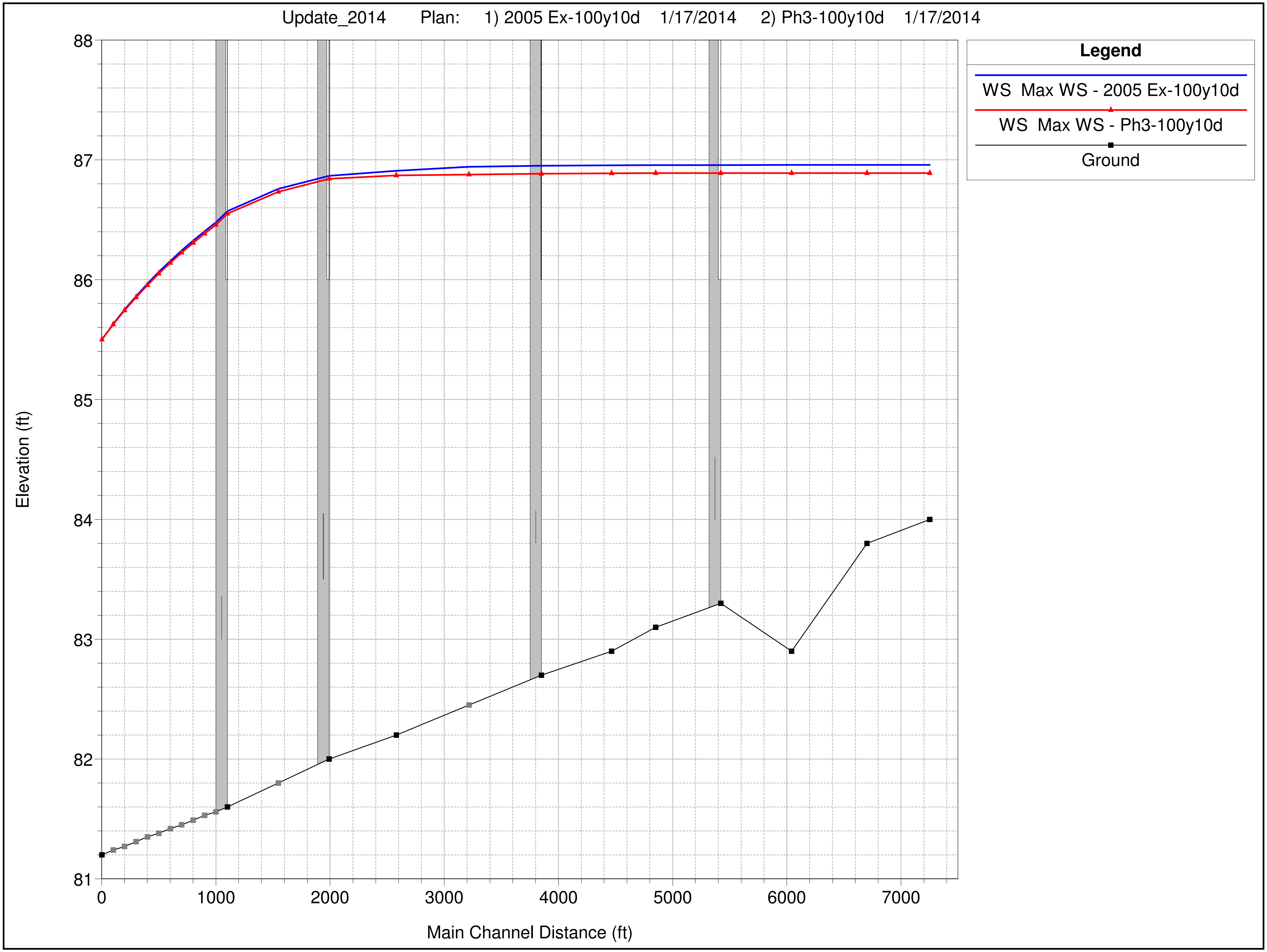
HEC-RAS Output



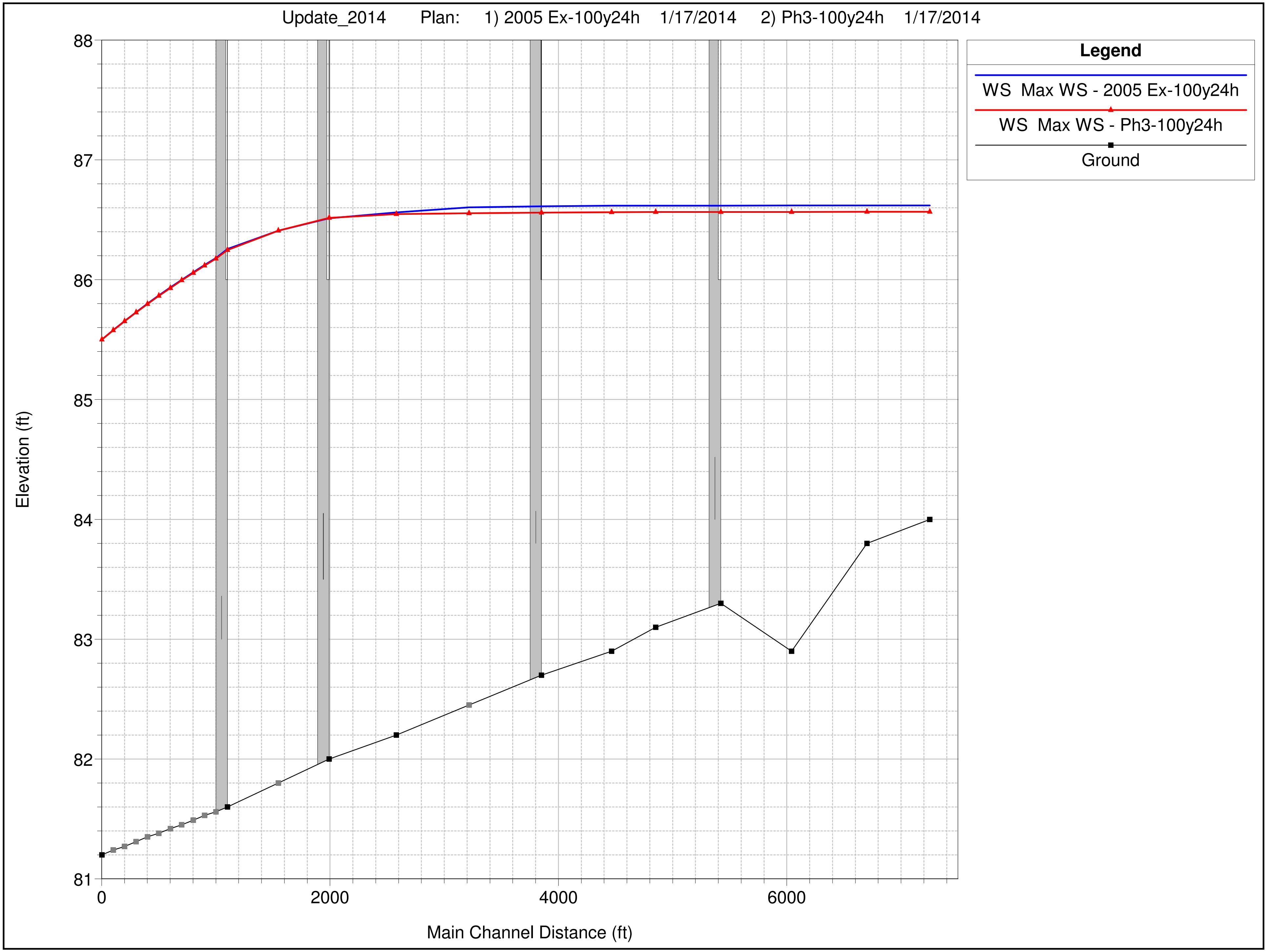
River: RIVER-1 Reach: Reach-1 RS: 1
Legend
Flow - Ph3-100y10d
Flow - 2005 Ex-100y10d
Flow (cfs)
200
150
100
50
0
31
Oct97
01
02
03
04
05
06
Nov97
07
08
09
10
11
Time



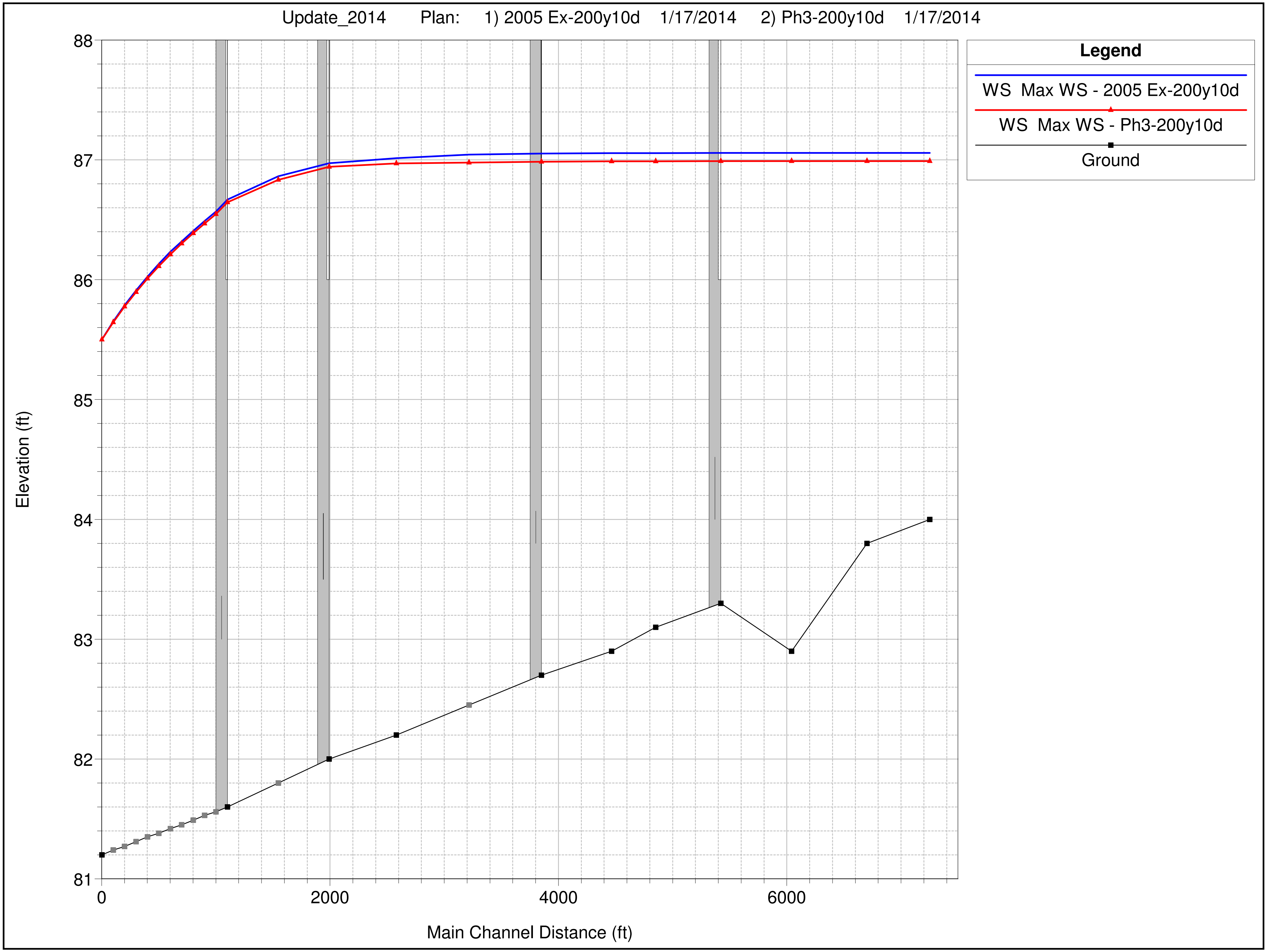
Update_2014 Plan: 1) 2005 Ex-10y10d 1/17/2014 2) Ph3-10y10d 1/17/2014
Legend
WS Max WS - 2005 Ex-10y10d
WS Max WS - Ph3-10y10d
Ground
Elevation (ft)
88
87
86
85
84
83
82
81
0
2000
4000
6000
Main Channel Distance (ft)



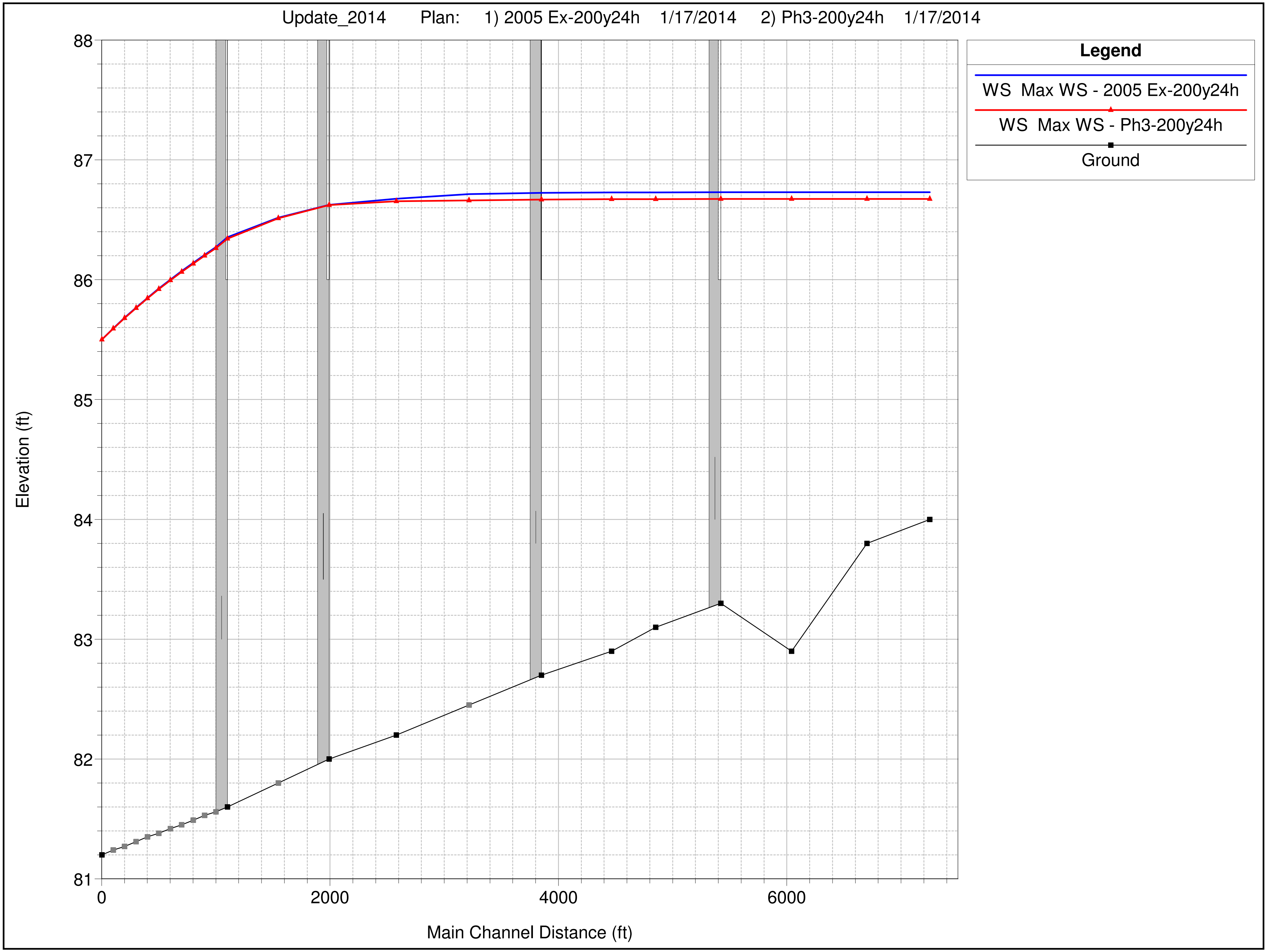
Update_2014 Plan: 1) 2005 Ex-100y10d 1/17/2014 2) Ph3-100y10d 1/17/2014
Legend
WS Max WS - 2005 Ex-100y10d
WS Max WS - Ph3-100y10d
Ground
Elevation (ft)
88
87
86
85
84
83
82
81
0
1000
2000
3000
4000
5000
6000
7000
Main Channel Distance (ft)



Update_2014 Plan: 1) 2005 Ex-100y24h 1/17/2014 2) Ph3-100y24h 1/17/2014
Legend
WS Max WS - 2005 Ex-100y24h
WS Max WS - Ph3-100y24h
Ground
Elevation (ft)
88
87
86
85
84
83
82
81
0
2000
4000
6000
Main Channel Distance (ft)



Update_2014 Plan: 1) 2005 Ex-200y10d 1/17/2014 2) Ph3-200y10d 1/17/2014
Legend
WS Max WS - 2005 Ex-200y10d
WS Max WS - Ph3-200y10d
Ground
Elevation (ft)
88
87
86
85
84
83
82
81
0
2000
4000
6000
Main Channel Distance (ft)



Update_2014 Plan: 1) 2005 Ex-200y24h 1/17/2014 2) Ph3-200y24h 1/17/2014
Legend
WS Max WS - 2005 Ex-200y24h
WS Max WS - Ph3-200y24h
Ground
Elevation (ft)
Main Channel Distance (ft)
88
87
86
85
84
83
82
81
0
2000
4000
6000