CITY OF ALBUQUERQUE

December 2, 2014

Charles Easterling, P.E.
Easterling Consultants
3613 NM 528, Suite E-2
Albuquerque, NM 87114

Re: I40 South and Unser Mini DMP
Engineer's Stamp Date 11-5-14 (K09D026)

Dear Mr. Easterling,

Based upon the information provided in your submittal received 11-5-14, the above referenced report is approved for Drainage Masterplan with the following condition:

Hydrology's comment that the freeboard for Pond 6 is insufficient at 0.4 feet is still valid. Future drainage reports for basins that drain to Pond 6 will have to address this comment. Most likely it will not be an issue as development will most likely occur at a lower impervious percentage than used in the report and this report was submitted prior to the City's first flush requirement of retaining the runoff from 0.44" storm events.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Curtis Cherne, P.E.
Principal Engineer, Hydrology
Planning Dept.

C: file

PO Box 1293
Albuquerque
New Mexico 87103
www.cabq.gov

DRAINAGE AND TRANSPORTATION INFORMATION SHEET
(Rev. 12/05)

PROJECT TITLE: I-40 South and Unser Mini DMP ZONE MAP PAGE: J-9/K-9
DRB#: _____ EPC#: _____ WORK ORDER#: _____

LEGAL DESCRIPTION: Avalon Subdivision Unit 5 Tracts 2-7
CITY ADDRESS: Unser Boulevard and I40

ENGINEERING FIRM: Easterling Consultants CONTACT: Charles Easterling
ADDRESS: 3613 NM 528 NW, Suite E-2 PHONE: 505-821-6646
CITY, STATE: Albuquerque, NM ZIP CODE: 87114

OWNER: I40 South LLC C/O Kelleher McCloud LLC CONTACT: Thomas Kelleher
ADDRESS: PO Box AA PHONE: (505) 346-4646
CITY, STATE: Albuquerque, NM ZIP CODE: 87103

ARCHITECT: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

SURVEYOR: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

CONTRACTOR: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

TYPE OF SUBMITTAL:
XX DRAINAGE REPORT
_____ DRAINAGE PLAN 1st SUBMITTAL
_____ DRAINAGE PLAN RESUBMITTAL
_____ CONCEPTUAL G & D PLAN
_____ GRADING PLAN
_____ EROSION CONTROL PLAN
_____ CLOMR/LOMR
_____ TRAFFIC CIRCULATION LAYOUT
_____ ENGINEER/ARCHITECT CERT (TCL)
_____ ENGINEER/ARCHITECT CERT (DRB S.P.)
_____ ENGINEER/ARCHITECT CERT (AA)
_____ OTHER (SPECIFY)

CHECK TYPE OF APPROVAL SOUGHT:
_____ SIA/FINANCIAL GUARANTEE RELEASE
_____ PRELIMINARY PLAT APPROVAL
_____ S. DEV. PLAN FOR SUB'D APPROVAL
_____ S. DEV. FOR BLDG. PERMIT APPROVAL
_____ SECTOR PLAN APPROVAL
_____ FINAL PLAT APPROVAL _____ ENGINEER'S CERT (HYDROLOGY)
_____ FOUNDATION PERMIT APPROVAL
_____ BUILDING PERMIT APPROVAL
_____ CERTIFICATE OF OCCUPANCY (PERM)
_____ CERTIFICATE OF OCCUPANCY (TEMP)
_____ GRADING PERMIT APPROVAL
_____ PAVING PERMIT APPROVAL
_____ WORK ORDER APPROVAL
_____ OTHER (SPECIFY)

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NOV - 4 2014
LAND DEVELOPMENT SECTION

WAS A PRE-DESIGN CONFERENCE ATTENDED:
_____ YES
_____ NO
_____ COPY PROVIDED

SUBMITTED BY: Chris Naidu DATE: 11-5-14

Requests for approvals of Site Development Plans and/or Subdivision Plats shall be accompanied by a drainage submittal. The particular nature, location and scope to the proposed development define the degree of drainage detail. One or more of the following levels of submittal may be required based on the following:

1. **Conceptual Grading and Drainage Plan**: Required for approval of Site Development Plans greater than five (5) acres and Sector Plans.

2. **Drainage Plans**: Required for building permits, grading permits, paving permits and site plans less than five (5) acres.

3. **Drainage Report**: Required for subdivision containing more than ten (10) lots or constituting five (5) acres or more.

CITY OF ALBUQUERQUE

May 15th, 2014

Evette Tovar, P.E.
New Mexico Water Collaborative
1751 Bellamah NW #1101
Albuquerque, NM 87104

Re: Sawmill Pond Modification-Sawmill Village Wastewater Reuse

Dear Ms. Tovar,

Based upon the information provided in your submittal received 5-9-14 and the easement, it is acceptable to build the wastewater reuse project in the Sawmill pond.

Hydrology understands that 2000 gallons/day will be pumped to the pond for irrigation.

If for some reason water is accumulating in the pond due to irrigation; at the point the volume reaches 0.5 acre-feet, a modification to the system may be required.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Curtis Cherne, P.E.
Principal Engineer, Hydrology
Planning Dept.

PO Box 1293

Albuquerque

New Mexico 87103

www.cabq.gov

C: e-mail

6-20-16

1. Do ponds represent proposed grading by Tierra Nueva?
They appear to keep the ponds

As long as we maintain the flows from
the catch basin part 4 from the South depict
in channel in Chuck's report we are ok.

~~Retain 4 pts~~
AP into pond 4 142 cfs → 153 cfs

into pond 5 203 cfs

into pond 6 199 cfs

~~AP~~

Daytime Facility depr. 90 cfs ?
" " Chris 47 cfs

pond 4 237 acre ft in model

in the Short .011 in US .017

CITY OF ALBUQUERQUE
PLANNING DEPARTMENT

HYDROLOGY DEVELOPMENT SECTION
DEVELOPMENT REVIEW BOARD MEMO

DRB PROJECT NO: 1006008 **AGENDA ITEM NO: 7**

SUBJECT:

Plat Approval

mp Defr Sdwk Constr

ENGINEERING COMMENTS:

Hydrology has an approved grading plan, stamp date, 6-6-14, for Preliminary Plat approval.
Hydrology has comments on the infrastructure list.

Hydrology has no objection.

SIGNED:
Curtis Cherne
Hydrology Section
City Engineer Designee
AMAFCA Designee
924-3986

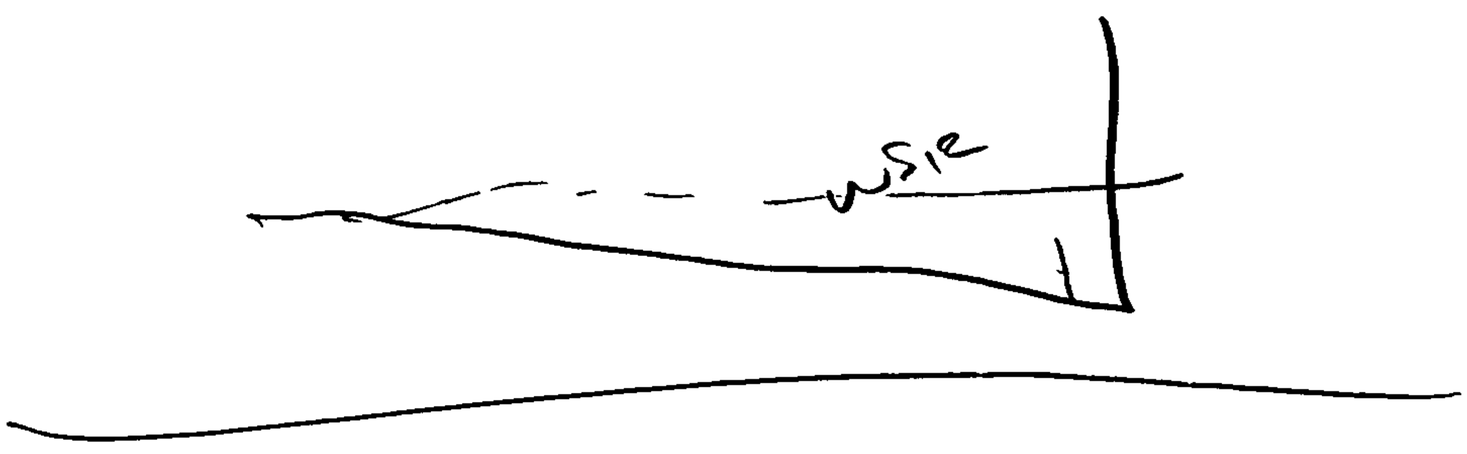
DATE: 6-18-14

1. 227-3323 Ofc 1A

Bruce Kurt

2 pm today

Draw out the distribution



frequency shown

w/ peak citrate at 25%



PAYROLL CHECK LIST

SUPERVISORS BEFORE TURNING IN PAYROLL, PLEASE CHECK IF:

- ☐ **Time sheet signed by the employee and supervisor in black ink only.** ✍✍
- ☐ **No white out or yellow out used on the time sheet or any supporting documentation.**
- ☐ **Overtime comp. sheet completed and signed.** ✍
- ☐ **If possible one P-30** *completed* **and signed with all the supporting documentation attached.** ✍
- ☐ **Check if employee has enough time accrued in bucket that he/she is requesting.**
- ☐ **Make sure the** *correct Department ID # s* **and** *Division name* **match on both P-30 & time sheet.**

✓**Time sheets Deadline:** **5:00 p.m. Wednesday on PPE.**

✓**Attach** Check list to the front of your Department Timesheets/ PPE (pay period ending date).

My signature ensures that I have reviewed and agree with the payroll as submitted. ✍

SUPERVISOR SIGNATURE: _____ **DATE:** _____

PPE: **06/13/2014** (PAY PERIOD ENDING DATE IS ALWAYS A FRIDAY)

Planning Department ID and NAME (circle/highlight one):

Strategic Support
4910000 – Administration
4913000 – AGIS
4925000 – Community Neighborhood Coord.

Code Enforcement
4919000 – Housing Code Enforcement

MR Fund
4967000 - Impact Fees
4926000 – Urban Design & Development
4937000 – ABQ Development Services
4968000 – Metropolitan Redevelopment

One Stop Shop
4955000- Bldg & Safety
4958000 - Land Dev Coordination
4961000 – Development Review Services
4962000 – FasTrax
4964000 – Construction Management
4967000 – One Stop Shop/Impact Fees

Supervisor – Curtis Cherne
Tim Sims
Rudy Rael
_____
_____
_____

[illegible]

HMS

Smith report Daytona family 90 cb

Volvo 42 at-sf hc

4/0 in small

862156 ft2

70735 ft2 small

9%

Cherne, Curtis

From: E. Chris Naidu <Chris@ecengr.com>
Sent: Wednesday, September 17, 2014 11:36 AM
To: Cherne, Curtis
Cc: Chuck Easterling
Subject: Kelleher DMP
Attachments: Curtis 9-17-14.zip

pics in share drive

Curtis we already talked on the phone about most of this but here is a written response. I will finalize my model and leave Pond 6 with the 0.72 ft. of freeboard along with the commercial assumptions for subbasin A-1D. See the pictures I took and let me know what you think about offsite drainage.

Comments 1 and 2 don't affect the structure of the report, however we will reword the report to soften the language regarding models.

Comment 3: Offsite basins draining in from north of I-40.
I went back out to the field yesterday and took a good look on the north side of I-40. You're quite right as far the dirt ROW in between the NMDOT fence line and edge of pavement**. See picture1**. This also captures the surface runoff from I-40 west-bound. However I included that area in my basins from I-40. It's hard to tell due to the scale of the basin map and I'll add annotation to the map to make it clear.

The fence basically acts as a divide between the dirt patch and the maintenance road, **see Pictures 1& 2.**
The area from the fence north towards the maintenance road basically drains towards the diversion channel due to the grade of the maintenance road. So even though the general longitudinal slope of the maintenance road is towards the east, the cross sectional slope is to the north into the channel.
See the tilt of my car in **picture3**.

Down at the inlet to the box culverts, the maintenance road is lower than the concrete pad. The dirt and vegetation act as berm. **See picture 4**.
You can see evidence of AMAFCA crews working to remove the channelized erosion cuts on the channel slope as well as rock that's been put down for slope stabilization **picture 5.**

From my field observation, I think it would be inappropriate to add anything north of the fence to our current watershed (the maintenance road in particular).

Comment 4:
Text will be changed

Comment 5: (I think we're resolved on this issue but I had already written it)
As far as freeboard, I dialed the percent impervious for subbasins A-2D and A-3D down to what is reality based on aerial photography. I am modeling subbasin A-1D as industrial (75% impervious and CN 81 based on NRCS Table 2-2a)
Freeboard in Pond 6 is up to 0.72ft. I know you guys are worried about freeboard to be one foot but you still have an excess of 2.53 ac-ft. of storage available in addition to the 0.72 feet of freeboard.

I ran the model with subbasin A-1D basically as a parking lot (98 CN and 90% impervious) and Pond 6 still retained 0.4 ft. of freeboard. So we're safe.

E. Christian Naidu, E.I
Easterling Consultants, LLC

3613 NM 528 NM, Suite E-2
Albuquerque, NM, 87114
Office: (505) 821-6646
Fax: (505) 897-2965

Precipitation

Precipitation is one of the three components of a meteorologic model, and the one required in almost all meteorologic models. The only time precipitation is not required is if a basin model contains no subbasins. Any basin model that contains at least one subbasin can only be used in a simulation with a meteorologic model that includes a precipitation method. Some of the method choices are designed to work with statistical data. Others are designed to work with gage data. Regardless of the supporting data source, the precipitation method produces a hyetograph at the correct time step for each subbasin.

Frequency Storm

The frequency storm method is designed to produce a synthetic storm from statistical precipitation data. The most common source of statistical data in the United States is the National Weather Service. Typically the data is given in the form of maps, where each map shows the expected precipitation depth for a storm of specific duration and exceedance probability. This method is designed to use data collected from the maps along with other information to compute a hyetograph for each subbasin.

This method uses the same parameter data for all subbasins in the meteorologic model. The *Watershed Explorer* will show the precipitation icon one level under the meteorologic model (Figure 172). Click on the icon to access the *Component Editor* for the frequency storm (Figure 173).

Each storm has a single exceedance probability which must be selected from the list of available choices. The choices range from 0.2 to 50 percent and generally match the precipitation maps that are commonly available. Please note that return interval is not used in the program.

The frequency storm method is designed to accept partial duration precipitation data, as this is the most common type. However, annual duration data can also be entered by selection the correct input option. Either annual or partial-duration output can be calculated. You must select the type of input and output you wish the program to compute. The difference between annual and partial-duration output is small for exceedance probabilities 4% and smaller; you must select the type when the 10%, 20% or 50% exceedance probability is selected. The default selection is partial duration input and annual duration output.

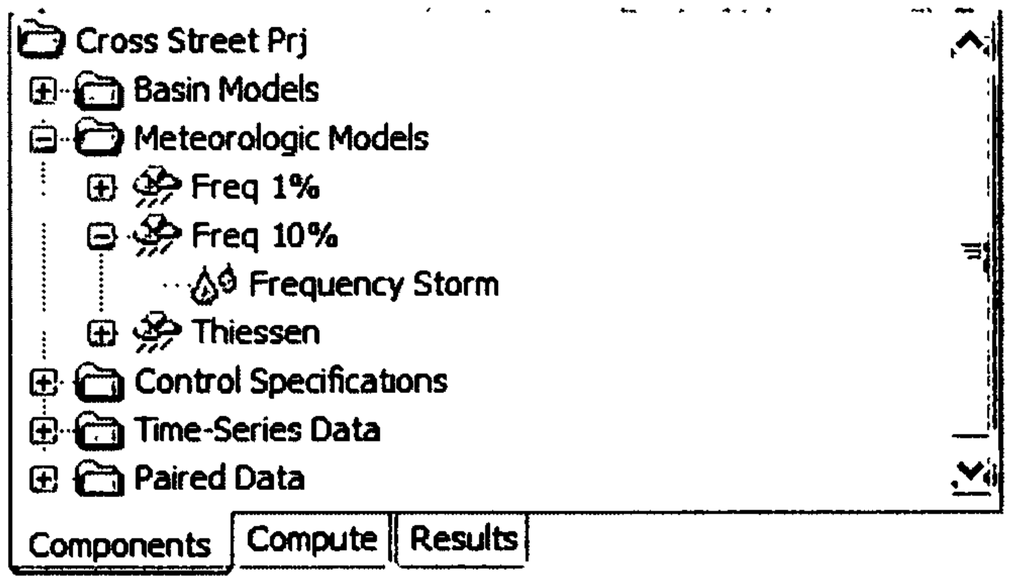


Figure 172. A meteorologic model using the frequency precipitation method with the precipitation node shown.

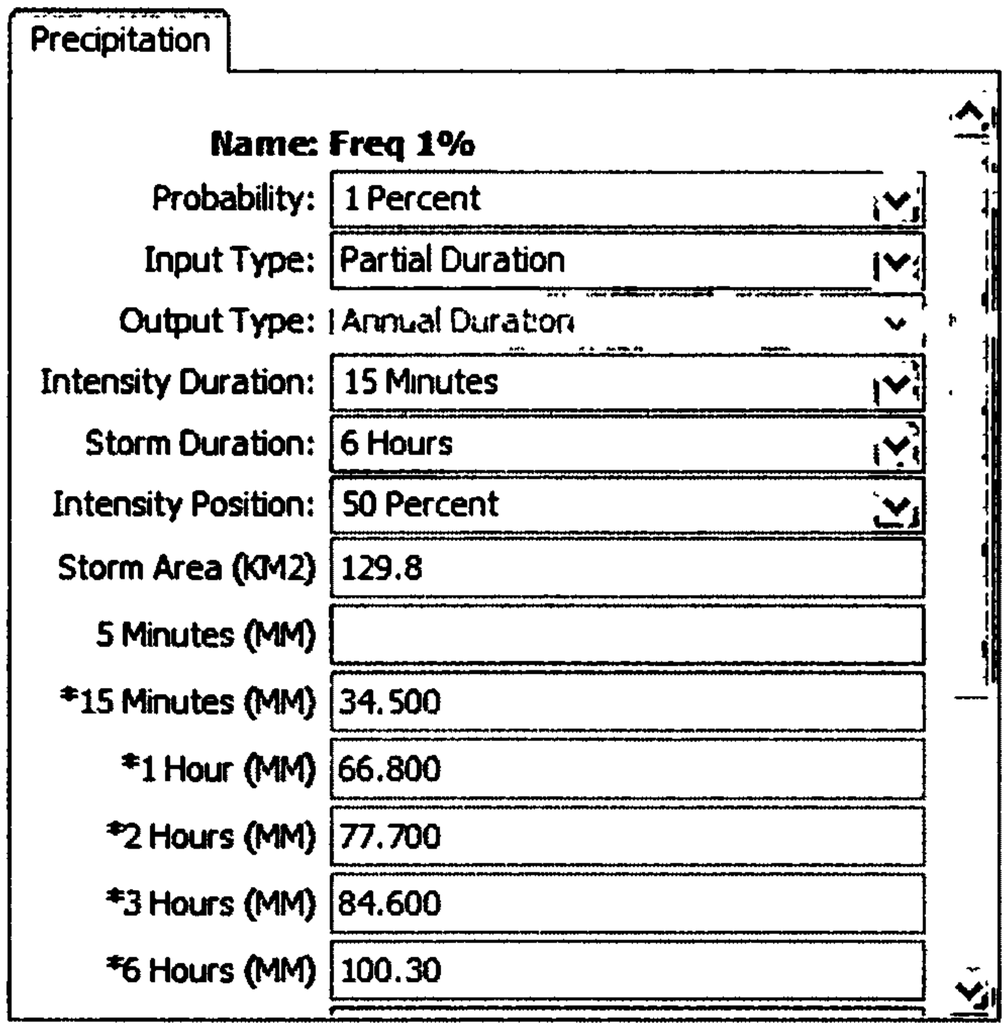


Figure 173. Precipitation editor for all subbasins when the frequency storm method is selected.

The intensity duration specifies the shortest time period of the storm. Usually the duration should be set equal to the time step of the simulation. It must be less than the total storm duration.

Storm duration determines how long the precipitation will last. It must be longer than the intensity duration. If the simulation duration is longer than the storm duration, all time periods after the storm duration will have zero precipitation.

The intensity position determines where in the storm the period of peak intensity will occur. Changing the position does not change the total depth of the storm, it only changes how the total depth is distributed in time during the storm. You may select 25%, 33%, 50%, 67%, or 75% from the list of choices. If the storm duration is selected to be 6 hours and the 25% position is selected, the peak intensity will occur 1.5 hours after the beginning of the storm. The default selection is 50%.

The storm area is used to automatically compute the depth-area reduction factor. In most cases the specified storm area should be equal to the watershed drainage area at the point of evaluation. The same hyetograph is used for all subbasins. Optionally you may leave the storm area blank. When no storm area is specified, each subbasin will have a different hyetograph computed using the subbasin area as the storm area.

Precipitation depth values must be entered for all durations from the peak intensity to the total storm length. Values for durations less than the peak intensity duration, or greater than the total storm duration cannot be entered. The values must be entered as partial-duration data. Values should be entered as the total precipitation depth expected for the specified duration.

Gage Weights

The gage weights method is designed to work with recording and non-recording precipitation gages. Recording gages typically measure precipitation as it occurs and

Project: Kelleher I-40 South Simulation Run: DEVEX2

Start of Run: 23Mar2014, 09:00 Basin Model: I-40 SOUTH
End of Run: 27Mar2014, 09:00 Meteorologic Model: 100Yr-24Hr_
Compute Time: 11Jun2014, 12:51:23 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	50.1	23Mar2014, 21:03	4.0
D-1.1_R	0.0309000	50.1	23Mar2014, 21:03	4.0
I40_1	0.0115038	15.6	23Mar2014, 21:06	1.5
D-1.1	0.0009000	1.4	23Mar2014, 21:03	0.1
AP-1.1	0.0433038	66.5	23Mar2014, 21:03	5.6
D-1.2R	0.0433038	66.3	23Mar2014, 21:03	5.6
A-2D	0.0181000	29.3	23Mar2014, 21:03	2.4
i40_2	0.0061859	10.0	23Mar2014, 21:03	0.8
I40_3	0.0032439	5.2	23Mar2014, 21:03	0.4
I40_4	0.0030882	4.9	23Mar2014, 21:03	0.4
AP1.2	0.0125180	20.1	23Mar2014, 21:03	1.6
AP-1	0.0739218	115.8	23Mar2014, 21:03	9.6
D-1_R	0.0739218	115.5	23Mar2014, 21:03	9.6
J-1	0.0739218	115.5	23Mar2014, 21:03	9.6
D-1.3_R	0.0739218	115.3	23Mar2014, 21:03	9.6
J-2	0.0739218	115.3	23Mar2014, 21:03	9.6
D-1.4_R	0.0739218	114.8	23Mar2014, 21:03	9.6
D-1.2	0.0020000	3.2	23Mar2014, 21:03	0.3
AP-2	0.0759218	118.0	23Mar2014, 21:03	9.9
A-3D	0.0307000	43.1	23Mar2014, 21:06	4.0
O-1	0.0044562	0.7	23Mar2014, 21:09	0.1
AP-3	0.1110780	160.7	23Mar2014, 21:03	13.9
POND 6	0.1110780	43.6	23Mar2014, 21:24	13.9
AP-P6	0.1110780	43.6	23Mar2014, 21:24	13.9
C-2D.2	0.0419000	68.2	23Mar2014, 21:03	5.5
Pond 5	0.0419000	40.9	23Mar2014, 21:09	5.5

total volume

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
AP-P5	0.1529780	67.4	23Mar2014, 21:18	19.4
C-2D.1	0.0193000	31.3	23Mar2014, 21:03	2.5
AP5.1	0.0193000	31.3	23Mar2014, 21:03	2.5
C-1D	0.0103000	16.6	23Mar2014, 21:03	1.3
AP-4	0.0103000	16.6	23Mar2014, 21:03	1.3
LV1_R	0.0103000	16.6	23Mar2014, 21:03	1.3
LV-1	0.0011266	1.8	23Mar2014, 21:03	0.1
AP-5	0.0114266	18.4	23Mar2014, 21:03	1.5
LV-1_R2	0.0114266	18.3	23Mar2014, 21:03	1.5
AP-6	0.0307266	49.6	23Mar2014, 21:03	4.0
LV_2R	0.0307266	48.7	23Mar2014, 21:03	4.0
LV-2	0.0019141	3.1	23Mar2014, 21:03	0.2
AP-7	0.0326407	51.8	23Mar2014, 21:03	4.2
AP-8	0.1856187	96.8	23Mar2014, 21:09	23.7
POND 4	0.1856187	73.1	23Mar2014, 21:27	23.7

Easterling Consultants LLC

November 4th, 2014

Curtis Cherne, PE

City of Albuquerque

RE: I40 South and Unser Mini DMP

Engineers Stamp Date 7-14-14 (K09D026)

Dear Mr. Cherne, we are responding to your comments from September 11th, 2014. Your comments are listed in red and our responses are in black.

Dear Mr. Easterling,

Based upon the information provided in your submittal received 6-12-14, the above referenced report cannot be approved for Drainage Masterplan until the following comments are addressed:

1. The report claims that the recent migration in computer software to 64 bit Windows 7 operating systems made it impossible to model the hydrology using the traditional AHYMO '97 model. This must be a self-imposed limitation as a drainage report for FedEx was submitted and approved using AHYMO '97 and numerous other firms submit drainage reports using AHYMO '97 every day.

2. AHYMO is still the approved model in the DPM and is on the approved hydrologic models list for the NFIP. HEC-HMS 3.0 and higher is not listed as an approved model by the NFIP without local calibration, however it seems they accept LOMR's using the program.

Based on our telephone conversation, I have amended the report to soften the language. As I mentioned we are in the process of getting two LOMR's approved by FEMA using HEC-HMS as the primary hydrologic software in the Sanchez Farm area in the valley. So there is no cause for concern as far as FEMA approvals for LOMR's using HEC-HMS.

The basin north of 1-40, as mentioned in previous letters, was not included in this analysis. This basin includes the area; north of 140, west of 98th street, south of the diversion channel with the eastern extent across 140 from the northwest corner of Bruckner's Truck stop.

Based on my field investigations and pictures that I submitted to you, we have now agreed that the limits of the watershed shown in this drainage master plan are correct.

4. On the top of page 4 add the 140 basins as contributors to Pond 6.

Change incorporated in the report

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LAND DEVELOPMENT SECTION

5. The freeboard for Pond 6 is shown as 0.4 feet. Proposed runoff should be reduced to increase the freeboard to 1.0 feet.

Based on our conversation, we agreed that imposing discharge restrictions on subbasin A-1D would be unfair as the other subbasins that have already developed have already taken more than their fair share of discharge capacity into Pond 6.

Secondly, the model simulates subbasin A-1D at a curve number of 90 with 90% imperviousness. The basin will unlikely develop as such, which makes the runoff results very conservative. From a hydrological stand point, Subbasin A-1D can't become impervious enough to generate enough runoff in order to overwhelm Pond 6 therefore, no modeling changes were made.

RECEIVED
JUN 12 2014
LAND DEVELOPMENT SECTION

Easterling Consultants *LLC*

3613 NM 528 NW, Suite E-2
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Office (505) 821-6646
Fax (505) 897-2965

June, 2014

Mr. Curtis Cherne PE
RE: I40 South and Unser Mini DMP

Easterling Consultants is responding to your letter and comments dated May 29, 2014. The comments are addressed in the order they were made. Your comments are in red with the responses in black.

1. This is the first drainage submittal to the City of Albuquerque using the HECHMS model. As you are aware, incorporating HEC-HMS into the DPM is scheduled to be discussed with the DPM Technical Committee in the next few months. It appears you do not wish to wait for the usual collaboration. Therefore, submit a parallel analysis using AHYMO (preferably version 97) as the model for comparison using the DEVEX land treatments.

We understand your request for a parallel AHYMO model. Unfortunately, with our computers running the 64 bit version of Windows 7, we're unable to run AHYMO without having to install some version of a virtual Windows XP. As you are aware, with Windows XP unsupported against viruses and other internet hazards, we would be jeopardizing the security of the company network.

We have matched the AHYMO model produced by Smith as closely as possible with HEC-HMS. Please see the report text for a detailed description and Conclusion/Discussion section on the final results.

2. Show the new alignment of 94th/Daytona per the Avalon Unit 5 plat. This will most likely change DEVEX basins A-ID and C-2D.l by removing the piece east of 94th out of basin A-I D and putting this area into basin C-2D.l

We have updated Plate 2 to show the potential future alignment of 94th/ Daytona Road. We did not change the basin boundaries as the location of the potential crest vertical curve is unknown. Therefore it is more conservative to assume that subbasins A-1D and C-2D.1 drain into the study area in their entirety.

3. On the existing and DEVEX plates, it would be beneficial to replace the HECHMS input parameters table with a table that provides curve number, soil group, volumes and flows per basin.

The changes required as far as the tables presented have been made. You will find the subbasin parameter computational table in the Hydrology Appendix A.5. Please see updated Plates 1and 2.

4. There should be an eastern boundary for basin C-2D.2. Why would platting change the existing basin boundaries?

Plates 1 and 2 show the eastern boundary for subbasin C-2D.2. The subbasin will be re-platted once the FEDEX site goes up. This subbasin was subdivided due to the proposed FEDEX grading plan that when implemented will create a physical boundary within the original basin C-2D as the final ground elevation of FEDEX will be several feet higher than existing ground.

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5. Include the offsite basins and entry location shown in Brucker's drainage report by Tierra West as well as the offsite basin on the north side of 1-40 that drains to the pipe near the existing box culvert that caused the flooding problem at Bruckner's. This offsite basin extends west to 98th street.

Subbasins have been included. Please see updated plates 1 and 2. NOTE

6. On the bottom of p.3 the report states that "Pond 6 .... outfall through and connects to Pond 5 .. " The Unser Diversion Channel Design report states that "A 36" storm drain will connect Pond 6 to downstream Pond 4 ... "

The verbiage has been changed to be more concise. See updated report text page 4.

7. The eastern boundary for basin C-2D.2 in the developed condition should be near the east side of the ponds.

Basin boundary has been moved to include the ponds and areal adjustments made in the model. Please refer to Plates 1 and 2.

8. Provide documentation of how the program uses the information when information is included in the Curve Number and the impervious boxes.

The curve number is a representation of the various soil groups and land uses in a subbasin and therefore it's typically weighted. The curve number does not include any impervious area. See discussion on HEC-HMS parameters on pages 5 &6 and Appendix A.2 for relevant portions of HEC-HMS User Manual.

9. Provide a time-stage/wse elevation curve for each pond so it is evident how long it takes for the ponds to drain.

The outflow curves for the ponds can be viewed directly in the model but printed copies are included all ponds reacquire greater than or equal to 95% storage capacity after 24 hours. See Appendix B.3 for outflow stage storage curves.

NO SHALL NOT be high

10. The 24-hour storm was used in this analysis, but the model was ~set to run for 7 days. Therefore, the 7-day storm should be used. Hydrology would model back-to-back six hour storms as that is more representative conditions in Albuquerque. HEC-HMS has an "Initial Storage" component that could be used in this analysis.

The SCS type II storm generates a hydrograph for only a 24 hour period; however the simulation run, which is different from the storm duration, is set to run for at least 96 hours in order to see if the ponds drain sufficiently to meet state engineer's criteria.

From reviewing the outflow curves all ponds have drained or contain greater than 95 percent of storage capacity after 24 hours therefore this no need for modeling back to back 6 hour storms or running a 7 day storm.

NO. See HY 2

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11. For street and pipe flows, the 6-hour storm should be used as the peak is higher than the 24-hour storm.

A 6 hour storm was modeled but the peak was lower than the 100 year storm (45 cfs vs 52 cfs) therefore the 100 Yr peak flow was used for storm drain calculations.

12. How does the SCS Type II storm differ from the AHYMO storm? Provide both hyetographs on the same page for review.

Please refer to the report text page 6 for comparison.

13. TR 55 specifies using a curve number of 98 for streets. Why did you us a curve number of 82?

Composite curve number for roads has been modified to 87. Refer to composite curve number tables in Appendix A.2.

14. "DEVEX" is an unusual designation and may not be received as meaning developed conditions. Please replace all instances of "DEVEX" with "Developed Conditions" .

Your point is well noted. We will use the above terminology for future reports, however due to the pressing nature of this DMP and the high volume of models, tables, figures and appendices affected we did not make the change to prevent inconsistency in the overall content.

Engineer Certification

I, Charles Easterling, do hereby certify that this report and the analyses which were done in its production were prepared by me or under my direction and that I am a duly registered Professional Engineer under the laws of the State of New Mexico.

Charles M. Easterling, P.E. #6411

7-

Date



Engineer Certification

I, Charles Easterling, do hereby certify that this report and the analyses which were done in its production were prepared by me or under my direction and that I am a duly registered Professional Engineer under the laws of the State of New Mexico.

Charles M. Easterling, P.E. #6411

6-12-14
Date



Engineer Certification

I, Charles Easterling, do hereby certify that this report and the analyses which were done in its production were prepared by me or under my direction and that I am a duly registered Professional Engineer under the laws of the State of New Mexico.

Charles M. Easterling, P.E. #6411

11-5-14

Date



I-40 South and Unser
Mini Drainage Master Plan

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November 2014
Revision #4

RECEIVED
NOV - 4 2014
LAND DEVELOPMENT SECTION

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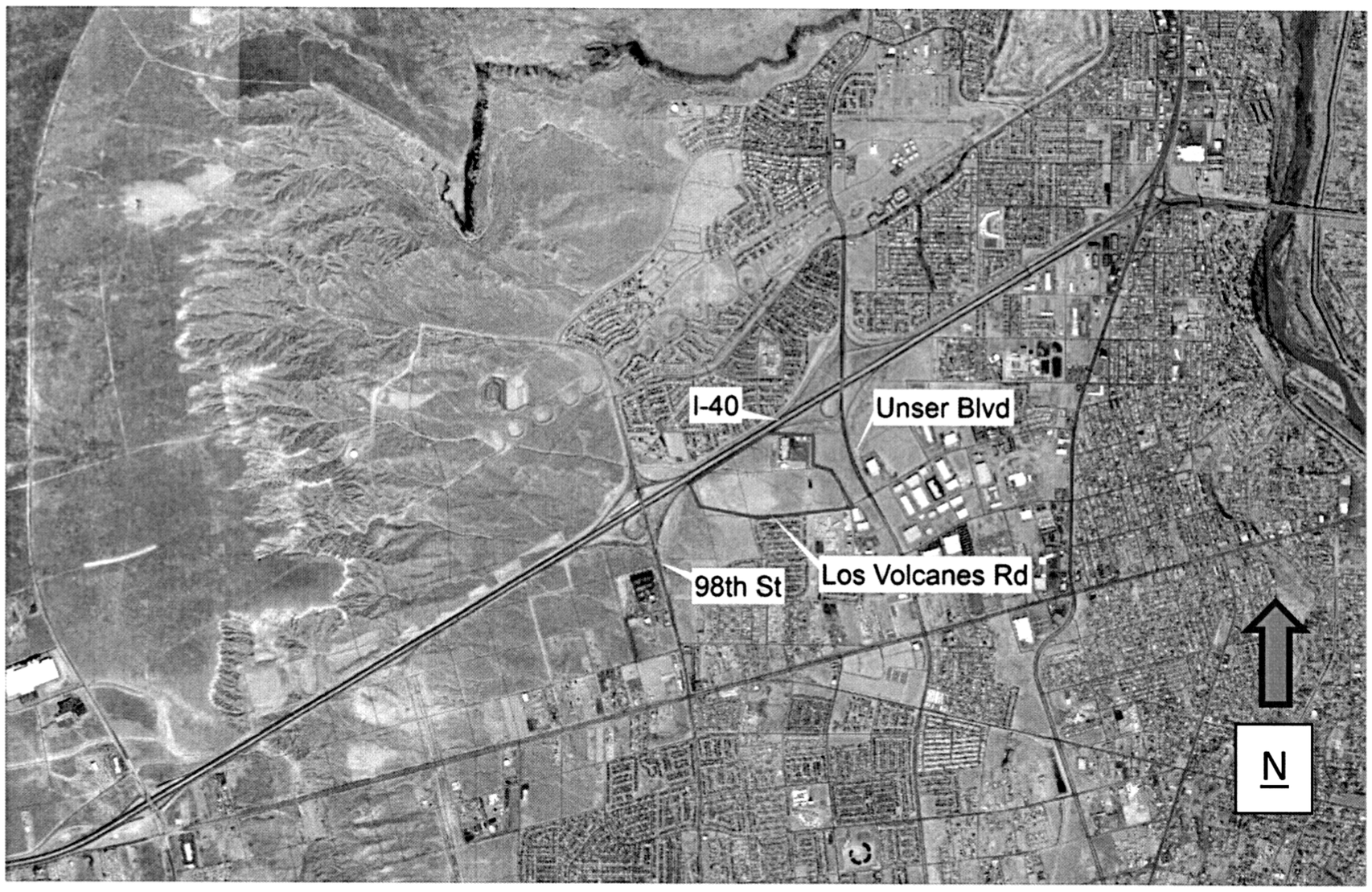
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A. Introduction

Easterling Consultants was commissioned by I-40 South LLC to perform a Mini-Drainage Management Plan for an area bounded by I-40 on the north, on the west by the large sand hill located west of 98th Street, on the east by the Unser Diversion Channel, and on the south by Los Volcanes Road. The watershed area is approximately 119 acres or 0.186 square miles and is largely undeveloped land consistent with the semi-arid environment of suburban Albuquerque's west side. **Figure 1** shows the vicinity map. This watershed drains into a series of 6 ponds known as the Unser Diversion Channel (UDC).

Figure 1- Vicinity Map



B. Background

Historically, this watershed received flows from the north side of I-40 from a tributary of the Mirehaven Arroyo (Trib C). However, after the construction of the I-40 Interceptor on the north side of I-40, the offsite flows from the north are now diverted east via an AMAFCA channel that runs parallel to I-40.

The Unser Diversion Drainage Analysis Report in 1993 by Easterling and Associates (EA) was the foundation for the design of the UDC.

The original EA study modeled fully developed conditions using AHYMO in order to design the UDC system of interconnected ponds. A second drainage master plan was completed in 2001 by Smith Engineering Company (SEC) in support of the City's Westside Transit Center design.

The major premise for developed conditions in both these reports and subsequent construction of facilities was that the West I-40 interceptor would be in place diverting the off-site flows from the north and that Pond 5, which is a temporary sedimentation basin, would no longer be part of the system. Pond 5 of the UDC was constructed as a temporary sediment pond with a reversion clause in the easement that dedicated it. The easement and pond anticipated the removal of flows from north of I-40 and elimination of the pond, easement and resulting flood plain upon completion of the channel north of I-40. Both studies used AHYMO as the primary hydrologic modeling software with developed subbasin zoning conditions assumed to be R-LT (high density residential). Digital copies of these reports are included in **Appendix C**.

However with the construction of the Westside Transit Center and Bruckner's Truck Sales facility on the north side of Daytona Rd and rezoning of the RLT lands to commercial, the watershed is most likely going to develop as commercial/light industrial area. Currently, FedEx is proposing to buy and develop Tracts 4 and 5 as their FedEx Ground service facility.

C. Purpose

In light of the proposed FedEx Ground site and zone changes affecting the watershed, **the primary purpose of this Mini Drainage Master Plan is to analyze and determine an equitable distribution of the downstream capacity of the UDC Ponds 6 and 4 and the final disposition of Pond 5 under fully developed conditions with the assumption that there is no off site flow from north of I-40 and that the watershed develops as a commercial/light industrial area as opposed to R-LT.**

Natural Resources Conservation Service (NRCS) Runoff Curve Number method as described in TR-55 was applied to the hydrologic analysis in conjunction with the Army Corp of Engineers HEC-HMS V.3.5 hydrologic software.

D. Hydrology

Existing Conditions

Subbasins within the watershed were delineated using Bernalillo County LIDAR topography from 2012. **Plate 1** shows the existing conditions subbasins. The Majority of the subbasin boundaries were adopted from The Drainage Master Plan for West Side Transit Facility by Smith Engineering.

These boundaries were field verified and the following changes were made:

- Roadway basins were added for Daytona and Los Volcanes Road because both have a significant right-of-way that is currently unpaved. Under developed conditions, these subbasins were modeled as fully paved.
- Subbasins A-3D and A-4D were merged as one subbasin A-3D due the construction of the West Side Transit Center and its onsite storm drains.
- Subbasin C-2D was broken into two subbasins called C-2D.1 and C-2D.2 due to the impending replatting of tracts 5 and 6 associated with the proposed FedEx facility.
- The previous studies included four offsite basins from I-40 contribute runoff to the watershed through a series of median drop inlets and culvert pipes. The offsite I-40 subbasins were included in this DMP and are shown on Plates 1 and 2 along with where the median drop inlets are located.

The 100-yr-24-Hr rainfall depth was obtained from NOAA Atlas 14 Data Server using the latitude and longitude coordinates from the approximate centroid of the watershed.

This depth was 2.52 inches compared to the 2.66 inches used in the study done by Smith in 2003 from NOAA Atlas 2. A copy of the rainfall data is included in **Appendix A.1.**

The NRCS TR-55 method uses the curve numbers to estimate runoff. The curve numbers are directly related to the physical characteristics of the watershed such as the Hydrologic Soil Groups (HSG), type of cover, level of urbanization, and the percent of the watershed that would be considered impervious. Based on the soil groups present and level of cover, a composite curve number for each subbasin was calculated. The curve numbers are derived from Tables 2-2a and 2-2d in the NRCS Urban Hydrology for Small Watersheds manual. Relevant tables and charts used for this study are included in **Appendix A.2.**

The NRCS Web Soil Survey online resource was used to obtain soils data for the various subbasins. Based on field observation, the undeveloped parts of the watershed have primarily well drained sandy soils. This was confirmed by the NRCS soils report. Copies of the soils reports are included in **Appendix A.3.**

Time of concentration, (T_c) values were calculated based on the methods outlined in both TR 55 and Chapter 22 of the City of Albuquerque Development Process Manual (DPM). T_c flow paths for each subbasin are delineated on **Plate 1**. The parameters used to compute T_c and the composite curve numbers for each subbasin are summarized in Table 1 that is included in **Appendix A.4**.

The elevation-storage-discharge data for Ponds 4, 5, and 6 were taken directly from the Master Drainage Plan for the West Side Transit Facility by Smith Engineering Company. These ponds were also inspected to verify that they had not been significantly regraded since the topo was developed. The tabulated data is presented on **Plate 1** and also in **Appendix A.5.**

Since Pond 5 was primarily designed as a sedimentation pond, it was not modeled in the existing conditions model. Pond 6 is the upstream-most pond that receives flows from I-40, Bruckners and West Side Transit Center and all the other subbasins designated with an 'A' via the Daytona storm drain system.

The storm drain diameter varies from a 36 inch RCP at the upstream end of Daytona and to a 60 inch RCP at its terminus in Pond 6.

Appendix C includes the as-built drawings for existing infrastructure in the watershed. Pond 6 has a standard trash rack type outlet structure that outfalls through and connects to Pond 4 via a 36 inch RCP storm drain. This storm drain transitions to a 48 inch pipe south of Pond 5.

Pond 5 has a sediment control outlet structure that outfalls via a 42 inch pipe which then connects to the 48 inch storm drain from Pond 6 and that outfalls into Pond 4.

Routing reaches were defined for the storm drains in Daytona Road. As-built data was used to define slopes, Manning's "n" values, and storm drain diameter.

Street surface routing was used for routing reaches in Los Volcanes Road. All record drawings referenced in this study are included digitally in **Appendix C**.

HEC-HMS version 3.5 was used to model the hydrology for the watershed using the SCS Unit Hydrograph method. The Atlas 14 Frequency Storm at 25% Intensity Position was used for rainfall distribution.

Fully Developed Conditions (DEVEX)

Four models were created for fully developed (DEVEX) conditions.

1. The first model used all the developed conditions flow direction, land treatment assumptions and rainfall data used by Smith Engineering Company. This was called the I-40 South_DEVEX_SMITH basin model. This model was used to perform a sensitivity analysis in order to understand how the different methods would affect runoff volume and peak discharge throughout the watershed compared to what had been computed in the Smith Engineering DMP using AHYMO_94.
2. The second model, called DEVEX 1, uses parameters computed based on the most appropriate data available. This model utilized land treatments for subbasins that are fully developed as commercial/light industrial areas, assuming a very conservative 90 percent imperviousness. This model still matches the Smith developed conditions where Pond 5 is not part of the system and Basin C-2D.2 drains into Pond 4. The primary objective of this model was to generate a like to like comparison of how the system functions using TR-55 hydrology method relative to the Smith AHYMO model, in particular the capacity of Pond 4 and Pond 6.

3. The third model, called DEVEX 2 incorporates the developed conditions as they will be per the proposed FedEx Ground site plan. This model simulates Pond 5 as part of the system with subbasin C-2D.2 draining directly to it. Pond 5 is simulated with existing outfall structure elevation-storage-discharge curves as outlined in Smith DMP. The remainder of the 'C' basins designated is assumed to drain into Pond 4 along with the fully developed Los Volcanes Road basins. Developed conditions drainage basins are shown on **Plate 2** along with modified subbasin curve numbers and T_c values.
4. The final model DEVEX, Option 1, basically is identical to DEVEX 2 with the exception that the discharge rating curve for Pond 5 is modified to restrict the outflow from the pond. Under this scenario, both the 100-yr-24-Hr and the 100-yr-24-Hr storms were simulated. The 6 hour storm was simulated to compare peak flows and determine storm drain size that would be required to convey developed conditions flows from subbasin C-1D, C-2D.1 and the fully paved Los Volcanes Road.

Tables are included in **Appendix A.4.** Full size versions of **Plates 1 and 2** and are included digitally on the DVD in **Appendix D**.

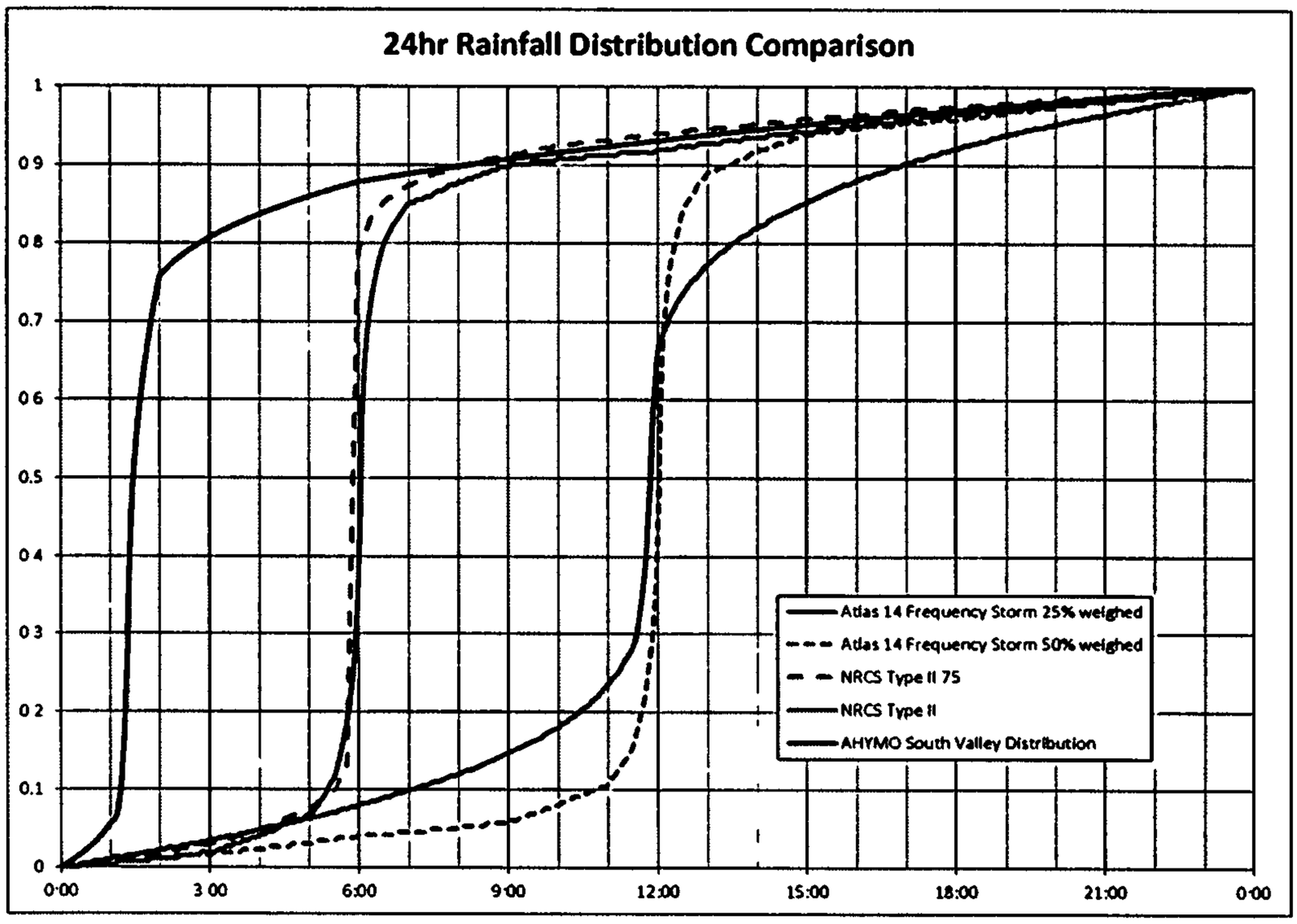
Basic HEC-HMS Functions and Definitions

HEC-HMS V3.5 was used for this DPM. Some basic parameters that have to be specified are as follows:

- Subbasin area - Area of each subbasin in square miles
- SCS Curve number (CN) - TR-55 hydrology method uses a composite/weighted curve number to define the hydrological soil conditions and cover for the watershed thereby determining initial losses and runoff. Table 2-2a and 2-2D are setup to be able to compute composite/weighted CN's for urban and semi-arid rangelands. Based on the tables it is clear that the CN is a function of the cover type and the hydrological soil group in a subbasin. The cover can be determined based on the various descriptions outlined in the tables for urban or semi-arid rangelands. The hydrological soil groups were derived from the NRCS Websoil Survey website. Detailed soils reports are presented in the back up Appendix A.3. The CN **does not** include the portion of the subbasin that is impervious.
- Percent Imperviousness - This is the percentage of the subbasin that is considered impervious such as asphalt, rooftops and so forth. When using the TR-55 method in HEC-HMS, the program allows the impervious part of the subbasin to be specified directly. When this option is chosen, no rainfall losses are allocated to the portion of the subbasin specified as impervious. In other words, HEC-HMS treats all precipitation on impervious areas to direct runoff. As a result, runoff rates and volumes for urbanized conditions modeled herein are very conservative. In contrast, the DPM and AHYMO allocate 0.1 inches of initial abstraction to impervious areas.

- HEC-HMS uses the SCS Unit Hydrograph method to generate runoff. The parameter that has to be specified is the lag time. The City of Albuquerque outlines detailed methods to compute time of concentration and lag time (which follow NRCS TR 55 guidelines).
- Based on the frequency storm being analyzed, HEC-HMS requires that the rainfall depths be specified. These depths are derived from the NOAA 14 website by specifying the coordinates of the centroid of the watershed.
- The hyetograph is generated by using the Atlas 14 Frequency Storm at 25% intensity position. **Figure 2** compares the rainfall mass curve of the various distributions including the distribution embedded in AHYMO.
- Routings – HEC-HMS uses the Muskingum-Cunge routing methods. The reaches can be conformed to match open channels, storm drains or user defined 8 point sections.
- Pond Routing – Pond routings are done by specifying elevation-storage-discharge rating curves.
- Model simulation time – Model was simulated for 96 hours in order to observe how the ponds drained. The simulation time is different from the storm duration which only lasts for 24 hours.

Figure 2



E. Results

It is clear that the Unser Diversion Channel System has sufficient capacity to accept the runoff from the existing undeveloped drainage area for all reasonable development scenarios. Very conservative assumptions were used in this effort in order to establish the maximum allowable. DEVEX option 1 had to be simulated because the existing discharge rating curve for Pond 5 was not restricting the peak inflow in the DEVEX 2 model. The peak inflow was 98.2 cfs and the peak outflow was 78.4 cfs meaning the pond only stored 1.59 ac-ft. of water. As a result the rating curve was modified to simulate a 12 inch orifice in order to achieve storage higher efficiency in Pond 5.

The pond routing results for Existing and DEVEX_Option 1 are summarized below. A detailed pond routing summary for all options is included in **Appendix B.3**.

The effects of modifying the discharge rating curve for Pond 5 are quite clear in Table 1. The peak inflow is 98.2 cfs and the peak discharge is 10.5 cfs. Consequently the storage in Pond 5 increases from 1.59 ac-ft. to 3.14 ac-ft. Consequently the storage in Pond 4 goes down from 5.69 ac-ft. to 4.93 ac-ft.

This leaves an excess of 3.58 ac-ft. of capacity in Pond 4.

Table 1

Summary of Pond Routings

Pond	Model Description	Design Volume	100 Yr-24 Hr Peak Storage Volume	100 Yr-24 Hr Inflow Volume	100 Yr-24 Hr Outflow Volume	100 Yr-24 Hr Inflow	100 Yr-24 Hr Outflow	Elevation of Emergency Spillway	100 Yr-24 Hr Peak Water Surface Elevation	Freeboard from Emergency Spillway	Available Storage	Comments
		ac-ft	ac-ft	ac-ft	cfs	cfs	cfs	ft	ft	ft	ac-ft	
		a						a		b		
Pond 4	*Smith DEVEX Conditions Results from Report*	*8.51*	*4.50*	--	--	--	--	*5155.1*	*5152.9*	*2.2*	*4 01*	*All values reported on this table are taken directly from The Master Drainage Plan for the West Side Transit Facility by Smith Engineering Company, 2001.*
Pond 6	*"*	*9 01*	*6.20*	--	--	--	--	*5177.9*	*5176 7*	*1.2*	*2.81*	
Pond 4	DEVEX Option 1	8 51	4.93	23.5	23 5	147.1	96 4	5155.1	5153.33	1.8	3 58	Watershed modeled as fully developed commercial/business site at 90% impervious, using latest NOAA 14 100-Yr-24Hr rainfall depth of 2.52 in Basin C-2D 2 drains to Pond 5 with modified outfall restricting discharge using a 12" outlet pipe as principal spillway
Pond 5	DEVEX Option 1	4.73	3.14	5.43	5 43	98.2	10 5	5168.8	5167.66	1.1	1 59	
Pond 6	DEVEX Option 1	9.01	6.90	13.8	13.8	231.4	83.1	5177.9	5177.5	0 4	2.11	

a- All values reported on this table are taken directly from The Master Drainage Plan for the West Side Transit Facility
100 Yr 24 Hr rainfall depth based on lates NOAA Atlas 14 data
b - Freeboard = Elevation of Emergency Spillway - Peak Water Surface Elevation

Still to Small → 1.0 ft
cc 12-2-14

The peak flow at AP-7 was 72 cfs in the 100-yr-24 hr. storm. This flow was used to size the proposed storm drain in Los Volcanes Road as it was higher than the 100-yr-6 hr. storm. It was determined that a 36 inch storm drain would be sufficient to convey fully developed flows in Los Volcanes Road. See **Appendix B.4** for detailed calculations.

F. Conclusions/Discussion

The general conclusion of this DMP is that the UDC ponds will have sufficient capacity to handle the developed conditions 100-yr-24-Hr runoff volume. In other words, subbasins C-1.D and C-2D.1 should be able to free discharge into Pond 4 without compromising the downstream capacity of the UDC. By making Pond 5 into a permanent pond and modifying its outfall structure to restrict the outflow, the entire system is able to operate well within the bounds of COA guidelines for the design and function of ponds.

The reductions in Pond 5 outflow provide flexibility to the future development of the subbasins C-1 and C-2D.1 as the Smith Master plan as well as this DMP indicates that these subbasins assume to drain to Pond 4.

A recently completed 1 ft. interval topographic survey indicates that the side slopes of Pond 5 are much steeper than the 1V:3H slopes shown on the as-builts. This means that there is more storage available at Pond 5 than what is being modeled. This also provides a lot of flexibility to the final design of Pond 5 in terms of incorporating water quality features (if required or desired) while restricting the discharge in order to maximize the available storage in the pond and minimize the cost of any required modifications to the outlet structure.

Manning's Equation was used to determine the appropriate storm drain pipe size to the developed conditions from C-1, C-2D.1 and fully paved Los Volcanes Rd. A 36 inch RCP will safely convey the 72 cfs. See detailed calculations in Appendix B.4.

Using HEC-HMS with TR 55 CN hydrology rather than the traditional AHYMO'97 raises the question as to its effect on the modeling results compared to what was previously generated using AHYMO. Referring to **Table 1** , it is clear that the net results are almost identical in terms of the resulting impact on downstream facilities as determined by volumes stored and freeboard retained in Ponds 4 and 6 when compared to the developed conditions Smith Westside Transit Facility model and that any differences found are not significant. **Note that the modeling performed for this study assumed 100% of the runoff from the future impervious areas south of Daytona (assumed at 90% impervious) is an extremely conservative assumption,** particularly given that the proposed FedEx development plans are in the 75% range.

A further consideration is that the Smith DMP simulated only Ponds 4 and 6 with a higher rainfall depth under fully developed conditions.

The most significant impact of this DMP is the demonstration that Ponds 4, 5, and 6 have significant additional capacity when modeled with the lower NOAA 14 rainfall depth. For a volume-bound system like the UDC, using a lower design/evaluation rainfall depth has the effect of increasing downstream capacity for the benefit of the upstream properties, whose owners contributed to the construction of the UDC for that very purpose. The choice of a hydrologic modeling system (HEC-HMS with TR 55 vs AHYMO'97) had a less significant impact.

G. References

City of Albuquerque DMP Manual, Chapter 22

NOAA Atlas 14, Volume 1, Version 5

USDA Urban Hydrology for Small Watersheds TR-55, June 1986

US Army Corps of Engineers Hydrologic Modeling System HEC-HMS, August 2010

Design Analysis Report for the Albuquerque Metropolitan Arroyo Flood Control Authority-Unser Diversion-Prepared by Easterling & Associates, September 1993

Master Drainage Plan for the West Side Transit Facility City of Albuquerque, New Mexico-Prepared by Smith Engineering Company, February 2011

Appendix "A"

Appendix A.1

NOAA Atlas 14 Rainfall Data

NOAA Atlas 14, Volume 1, Version 5
Location name: Albuquerque, New Mexico, US*
Latitude: 35.0867°, Longitude: -106.7375°
Elevation: 5214 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.167** (0.143-0.195)	**0.217** (0.185-0.252)	**0.291** (0.248-0.340)	**0.349** (0.297-0.406)	**0.429** (0.363-0.498)	**0.492** (0.414-0.571)	**0.558** (0.466-0.647)	**0.628** (0.521-0.727)	**0.723** (0.594-0.838)	**0.798** (0.651-0.925)
10-min	**0.254** (0.218-0.297)	**0.330** (0.282-0.384)	**0.443** (0.377-0.517)	**0.532** (0.452-0.618)	**0.653** (0.552-0.758)	**0.748** (0.630-0.868)	**0.848** (0.709-0.984)	**0.955** (0.793-1.11)	**1.10** (0.903-1.28)	**1.21** (0.991-1.41)
15-min	**0.315** (0.271-0.367)	**0.408** (0.349-0.476)	**0.549** (0.467-0.640)	**0.659** (0.560-0.766)	**0.810** (0.684-0.940)	**0.927** (0.781-1.08)	**1.05** (0.879-1.22)	**1.18** (0.983-1.37)	**1.36** (1.12-1.58)	**1.50** (1.23-1.75)
30-min	**0.424** (0.364-0.495)	**0.550** (0.470-0.641)	**0.739** (0.629-0.862)	**0.888** (0.755-1.03)	**1.09** (0.921-1.27)	**1.25** (1.05-1.45)	**1.42** (1.18-1.64)	**1.59** (1.32-1.85)	**1.84** (1.51-2.13)	**2.03** (1.65-2.35)
60-min	**0.525** (0.451-0.612)	**0.680** (0.582-0.793)	**0.914** (0.779-1.07)	**1.10** (0.934-1.28)	**1.35** (1.14-1.57)	**1.54** (1.30-1.79)	**1.75** (1.47-2.03)	**1.97** (1.64-2.29)	**2.27** (1.87-2.63)	**2.51** (2.05-2.91)
2-hr	**0.599** (0.512-0.708)	**0.765** (0.654-0.907)	**1.01** (0.865-1.20)	**1.22** (1.03-1.43)	**1.50** (1.26-1.75)	**1.72** (1.44-2.01)	**1.96** (1.63-2.29)	**2.22** (1.83-2.59)	**2.58** (2.10-3.00)	**2.86** (2.31-3.34)
3-hr	**0.647** (0.560-0.762)	**0.823** (0.710-0.970)	**1.08** (0.933-1.27)	**1.29** (1.10-1.51)	**1.57** (1.34-1.83)	**1.80** (1.53-2.10)	**2.05** (1.72-2.38)	**2.31** (1.93-2.69)	**2.67** (2.20-3.11)	**2.97** (2.42-3.47)
6-hr	**0.747** (0.651-0.870)	**0.943** (0.824-1.10)	**1.22** (1.06-1.42)	**1.44** (1.25-1.67)	**1.73** (1.50-2.00)	**1.96** (1.69-2.27)	**2.21** (1.89-2.56)	**2.47** (2.09-2.85)	**2.83** (2.37-3.27)	**3.12** (2.59-3.61)
12-hr	**0.838** (0.736-0.956)	**1.06** (0.930-1.21)	**1.34** (1.18-1.53)	**1.57** (1.37-1.78)	**1.87** (1.63-2.12)	**2.10** (1.82-2.38)	**2.35** (2.02-2.66)	**2.60** (2.22-2.94)	**2.94** (2.49-3.34)	**3.22** (2.70-3.66)
24-hr	**0.939** (0.831-1.07)	**1.18** (1.04-1.33)	**1.47** (1.30-1.67)	**1.71** (1.51-1.93)	**2.02** (1.78-2.29)	**2.27** (1.99-2.56)	**2.52** (2.21-2.84)	**2.78** (2.42-3.13)	**3.12** (2.70-3.51)	**3.39** (2.92-3.82)
2-day	**0.996** (0.887-1.12)	**1.25** (1.11-1.40)	**1.56** (1.39-1.75)	**1.80** (1.60-2.02)	**2.13** (1.89-2.38)	**2.38** (2.10-2.66)	**2.64** (2.33-2.94)	**2.90** (2.54-3.24)	**3.25** (2.83-3.63)	**3.52** (3.05-3.94)
3-day	**1.12** (1.01-1.24)	**1.39** (1.26-1.54)	**1.72** (1.56-1.90)	**1.98** (1.79-2.19)	**2.33** (2.10-2.57)	**2.60** (2.33-2.86)	**2.86** (2.56-3.15)	**3.13** (2.79-3.45)	**3.49** (3.10-3.85)	**3.77** (3.33-4.16)
4-day	**1.24** (1.14-1.36)	**1.54** (1.41-1.68)	**1.89** (1.72-2.06)	**2.16** (1.97-2.36)	**2.53** (2.30-2.76)	**2.81** (2.55-3.06)	**3.09** (2.80-3.36)	**3.37** (3.04-3.67)	**3.73** (3.36-4.07)	**4.01** (3.60-4.38)
7-day	**1.42** (1.30-1.55)	**1.76** (1.61-1.92)	**2.14** (1.97-2.33)	**2.44** (2.24-2.65)	**2.83** (2.59-3.08)	**3.12** (2.85-3.38)	**3.40** (3.11-3.69)	**3.68** (3.35-3.99)	**4.04** (3.67-4.38)	**4.30** (3.90-4.67)
10-day	**1.57** (1.45-1.71)	**1.95** (1.79-2.12)	**2.38** (2.19-2.59)	**2.73** (2.50-2.95)	**3.17** (2.91-3.43)	**3.51** (3.21-3.79)	**3.85** (3.51-4.16)	**4.18** (3.81-4.51)	**4.60** (4.18-4.98)	**4.92** (4.45-5.33)
20-day	**1.97** (1.81-2.15)	**2.45** (2.25-2.67)	**2.97** (2.73-3.23)	**3.36** (3.09-3.65)	**3.86** (3.54-4.19)	**4.22** (3.87-4.58)	**4.57** (4.18-4.95)	**4.90** (4.48-5.30)	**5.31** (4.84-5.74)	**5.59** (5.10-6.06)
30-day	**2.37** (2.17-2.56)	**2.93** (2.69-3.17)	**3.52** (3.24-3.81)	**3.96** (3.64-4.28)	**4.51** (4.14-4.86)	**4.90** (4.49-5.27)	**5.26** (4.83-5.67)	**5.61** (5.13-6.03)	**6.02** (5.50-6.48)	**6.30** (5.75-6.79)
45-day	**2.88** (2.66-3.12)	**3.57** (3.29-3.86)	**4.25** (3.92-4.58)	**4.73** (4.37-5.10)	**5.31** (4.91-5.73)	**5.71** (5.28-6.15)	**6.07** (5.61-6.53)	**6.39** (5.90-6.87)	**6.73** (6.23-7.24)	**6.94** (6.44-7.46)
60-day	**3.33** (3.07-3.60)	**4.11** (3.80-4.45)	**4.90** (4.53-5.29)	**5.46** (5.05-5.89)	**6.14** (5.67-6.61)	**6.59** (6.10-7.11)	**7.01** (6.48-7.56)	**7.38** (6.83-7.96)	**7.80** (7.22-8.41)	**8.06** (7.47-8.68)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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Appendix A.2

- **NRCS Curve Number Tables**
- **Curve Number Calculations**
- **HEC-HMS User Manual Excerpt On Curve Numbers & Percent Imperviousness**

	COMPOSITE CURVE NUMBER CALCULATIONS FOR EXISTING CONDITIONS										
Subbasin ID	Cover Descritpion	Cover Type	Curve numbers for Hydrological Soil Groups				Hydrological Soil Group Percent of Basin				Weighted Subbasin Curve
	[a]	[a]	[a]				[b]				[c]
			A	B	C	D	A	B	C	D	
A-1D	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.58	0 42	0	0	69
A-2D	Commercial and Business	Poor	89	92	94	95	0.53	0.47	0	0	90
A-3D	Commercial and Business	Poor	89	92	94	95	0 28	0.72	0	0	91
C-1D	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	1	0	0	0	63
C-2D 1	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.86	0 14	0	0	65
C-2D.2	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.58	0.42	0	0	69
D-1.1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.37	0.63	0	0	87
D-1.2	Impervious areas: Streets and roads· open ditches including right of way	Poor	83	89	92	93	0.37	0.63	0	0	87
LV-1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.32	0 68	0	0	87
LV-2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0 32	0.68	0	0	87
O-1	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.72	0.27	0	0	66
I40_1	Impervious areas. Streets and roads. open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_2	Impervious areas: Streets and roads· open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_3	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_4	Impervious areas· Streets and roads. open ditches including right of way	Poor	83	89	92	93	1	0	0	0	83

[a] NRCS Urban Hydrology for Small Watersheds Table 2-2a and 2-2d
[b] Obtained from NRCS Websoil Survey (http.//websoilsurvey sc egov usda.gov/App/WebSoilSurvey.aspx)
[c] Weighted Curve Number = (CN A*Percent A)+ (CN B * Percent B) + (CN C* Percent C) + (CN D * Percent D)

	COMPOSITE CURVE NUMBER CALCULATIONS FOR DEVEX Option 1 (FINAL DEVELOPED) CONDITIONS										
Subbasin ID	Cover Descritpion	Cover Type	Curve numbers for Hydrological Soil Groups				Hydrological Soil Group Percent of Basin				Weighted Subbasin Curve Number
	[a]	[a]	[a]				[b]				[c]
			A	B	C	D	A	B	C	D	
A-1D	Commercial and Business	Poor	89	92	94	95	0.58	0.42	0	0	90
A-2D	Commercial and Business	Poor	89	92	94	95	0.53	0.47	0	0	90
A-3D	Commercial and Business	Poor	89	92	94	95	1	0	0	0	89
C-1D	Commercial and Business	Poor	89	92	94	95	0.86	0.14	0	0	89
C-2D.1	Commercial and Business	Poor	89	92	94	95	0.58	0.42	0	0	90
C-2D.2	Commercial and Business	Poor	89	92	94	95	0.37	0.63	0	0	91
D-1.1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.37	0.63	0	0	87
D-1.2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.37	0.63	0	0	87
LV-1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.32	0.68	0	0	87
LV-2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.32	0.68	0	0	87
O-1	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.72	0.27	0	0	66
I40_1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_3	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_4	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	1	0	0	0	83

[a] NRCS Urban Hydrology for Small Watersheds Table 2-2a and 2-2d
[b] Obtained from NRCS Websoil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)
[c] Weighted Curve Number = (CN A*Percent A)+ (CN B * Percent B) + (CN C* Percent C) + (CN D * Percent D)

	COMPOSITE CURVE NUMBER CALCULATIONS FOR DEVEX_SMITH CONDITIONS										
Subbasin ID	Cover Descritpion	Cover Type	Curve numbers for Hydrological Soil Groups				Hydrological Soil Group Percent of Basin				Weighted Subbasin Curve Number
	[a]	[a]	[a]				[b]				[c]
			A	B	C	D	A	B	C	D	
A-1D	Commercial and Business	Poor	89	92	94	95	0.31	0	0	0.69	93
A-2D	Commercial and Business	Poor	89	92	94	95	0.1	0	0	0.9	94
A-3D	Commercial and Business	Poor	89	92	94	95	0.1	0	0	0.9	94
C-1D	1/8 acre or less (town homes)	Poor	77	85	90	92	0.43	0	0	0.57	86
C-2D.1	1/8 acre or less (town homes)	Poor	77	85	90	92	0.43	0	0	0.57	86
C-2D.2	1/8 acre or less (town homes)	Poor	77	85	90	92	0.43	0	0	0.57	86
D-1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.1	0	0	0.9	92
D-1.2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.1	0	0	0.9	92
LV-1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.1	0	0	0.9	92
LV-2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0.1	0	0	0.9	92
O-1	Desert shrub-major plants include saltbrush,greasewood,creosote bush,blackbrush,bursage,palo verde,mesquite and cactus	Poor	63	77	85	88	0.72	0.27	0	0	66
I40_1	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_2	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_3	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	0	1	0	0	89
I40_4	Impervious areas: Streets and roads: open ditches including right of way	Poor	83	89	92	93	1	0	0	0	83

[a] NRCS Urban Hydrology for Small Watersheds Table 2-2a and 2-2d
[b] Obtained from NRCS Websoil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)
[c] Weighted Curve Number = (CN A*Percent A)+ (CN B * Percent B) + (CN C* Percent C) + (CN D * Percent D)

USDA

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

Conservation
Engineering
Division

Technical
Release 55

June 1986

Urban Hydrology for Small Watersheds

TR-55

Table 2-2a Runoff curve numbers for urban areas 1/

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area 2/	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) 3/:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) 4/		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) 5/		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

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 in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands 1/

Cover description			Curve numbers for hydrologic soil group			
Cover type		Hydrologic condition 2/	A 3/	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.		Poor		80	87	93
		Fair		71	81	89
		Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.		Poor		66	74	79
		Fair		48	57	63
		Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.		Poor		75	85	89
		Fair		58	73	80
		Good		41	61	71
Sagebrush with grass understory.		Poor		67	80	85
		Fair		51	63	70
		Good		35	47	55
ert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.		Poor	63	77	85	88
		Fair	55	72	81	86
		Good	49	68	79	84

1 Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

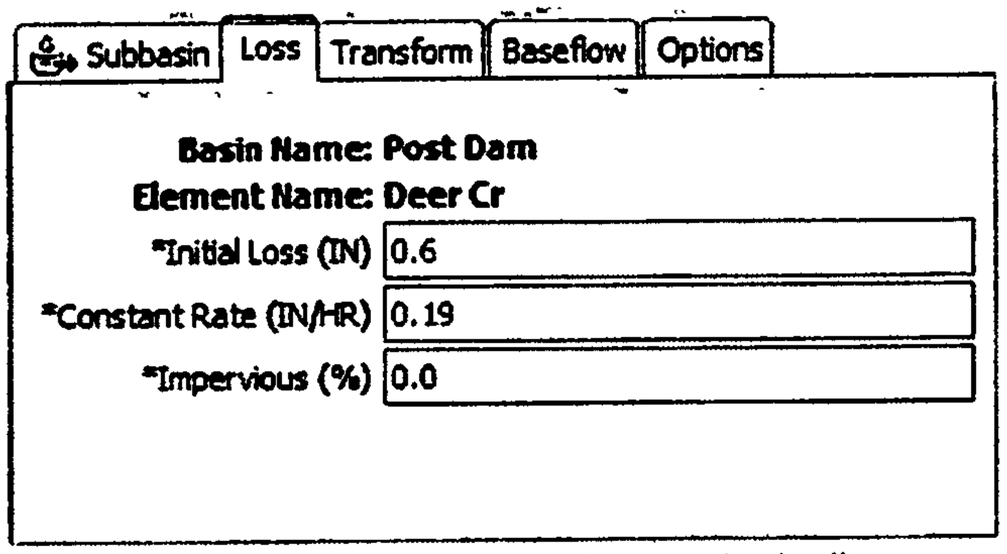


Figure 106. Initial and constant loss method editor.

SCS Curve Number Loss

The Soil Conservation Service (Now the Natural Resources Conservation Service) curve number method implements the curve number methodology for incremental losses. Originally, the methodology was intended to calculate total infiltration during a storm. The program computes incremental precipitation during a storm by recalculating the infiltration volume at the end of each time interval. Infiltration during each time interval is the difference in volume at the end of two adjacent time intervals. The *Component Editor* is shown in Figure 107.

You may optionally enter an initial abstraction. The initial abstraction defines the amount of precipitation that must fall before surface excess results. However, it is not the same as an initial interception or initial loss since changing the initial abstraction changes the infiltration response later in the storm. If this value is left blank, it will be automatically calculated as 0.2 times the potential retention, which is calculated from the curve number.

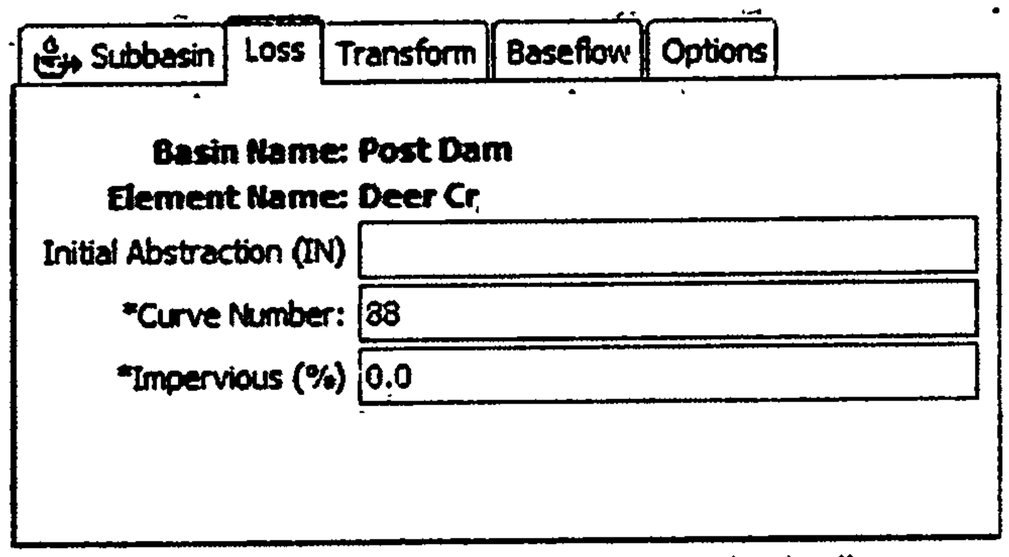


Figure 107. SCS curve number loss method editor.

You must enter a curve number. This should be a composite curve number that represents all of the different soil group and land use combinations in the subbasin. The composite curve number should not include any impervious area that will be specified separately as the percentage of impervious area.

The percentage of the subbasin which is directly connected impervious area can be specified. Any percentage specified should not be included in computing the composite curve number. No loss calculations are carried out on the impervious area; all precipitation on that portion of the subbasin becomes excess precipitation and subject to direct runoff.

Smith Parlange Loss

The Smith Parlange loss method approximates Richard's equation for infiltration into soil by assuming the wetting front can be represented with an exponential scaling of the saturated conductivity. This linearization approach allows the infiltration computations to proceed very quickly while maintaining a reasonable approximation of the wetting front. The *Component Editor* is shown in Figure 108.

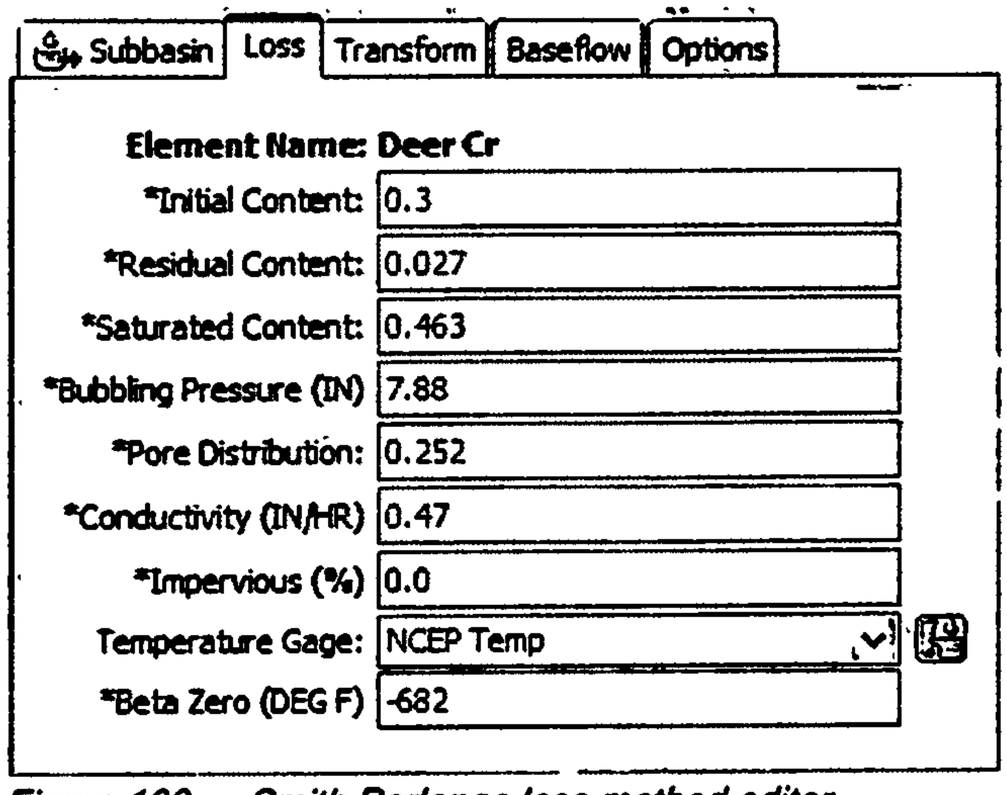


Figure 108. Smith Parlange loss method editor.

The initial water content gives the initial saturation of the soil at the beginning of a simulation. It should be specified in terms of volume ratio.

The residual water content specifies the amount of water remaining in the soil after all drainage has ceased. It should be specified in terms of volume ratio. It may be determined in the laboratory or estimated from the soil texture.

The saturated water content specifies the maximum water holding capacity in terms of volume ratio. It is often assumed to be the total porosity of the soil.

The bubbling pressure, also known as the wetting front suction, must be specified. It is generally assumed to be a function of the soil texture.

The pore size distribution determines how the total pore space is distributed in different size classes. It is typically assumed to be a function of soil texture.

The hydraulic conductivity must also be specified, typically as the effective saturated conductivity. It can be estimated from field tests or approximated by knowing the soil texture.

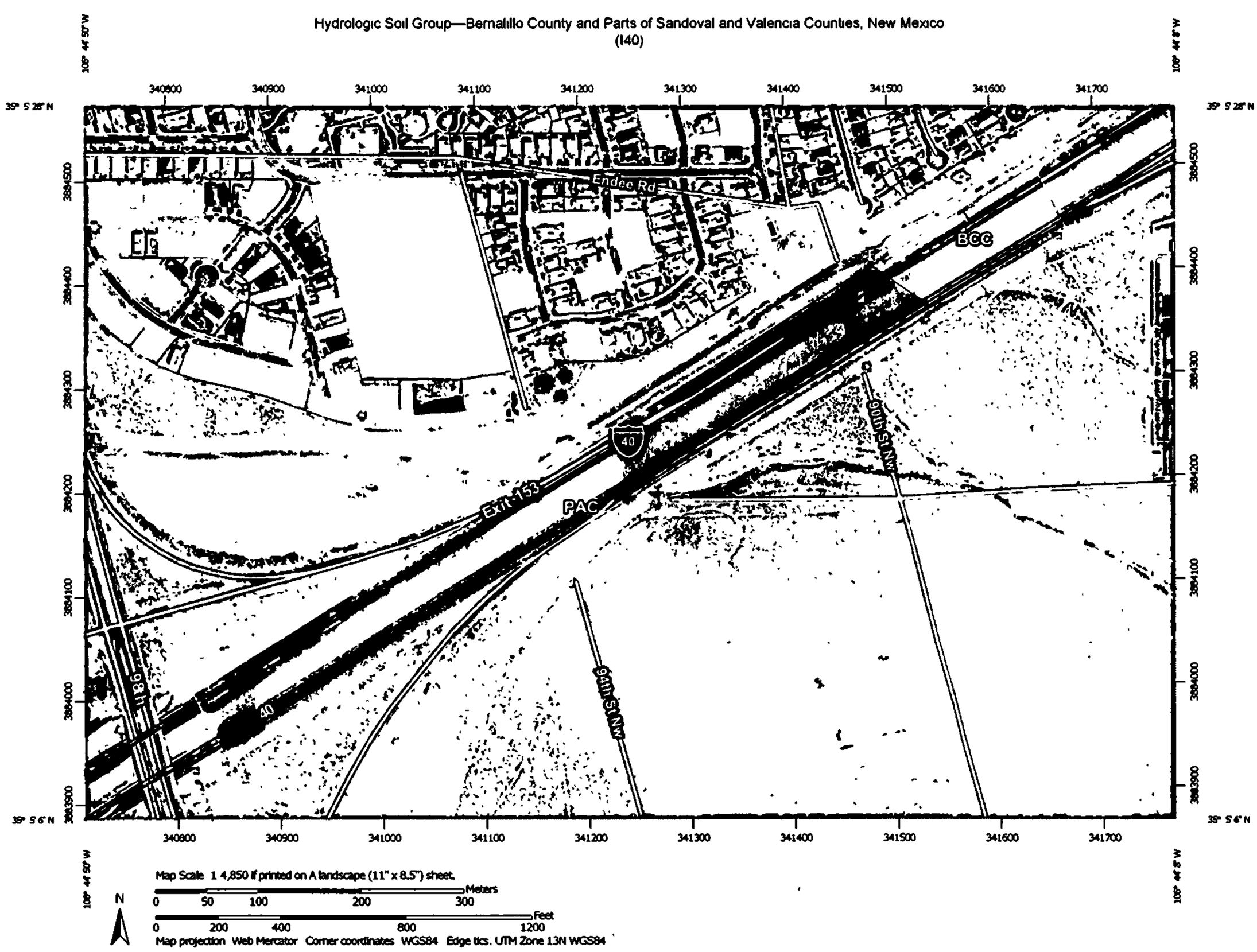
The percentage of the subbasin which is directly connected impervious area can be specified. No loss calculations are carried out on the impervious area; all precipitation on that portion of the subbasin becomes excess precipitation and subject to direct runoff.

Optionally, a temperature gage may be selected for adjusting the water density, water viscosity, and matric potential based on temperature. If no temperature gage is selected then a temperature of 25C (75F) is assumed to prevail. The gage must be defined in the time-series manager before it can be selected in the component editor.

Appendix A.3

NRCS Web Soil Survey Reports

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(I40)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1 24,000.

Warning Soil Map may not be valid at this scale

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale

Please rely on the bar scale on each map sheet for map measurements

Source of Map Natural Resources Conservation Service
Web Soil Survey URL http //websoilsurvey nrcs usda gov
Coordinate System Web Mercator (EPSG 3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1 50,000 or larger

Date(s) aerial images were photographed Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps As a result, some minor shifting of map unit boundaries may be evident

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	2.8	18.0%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	12.7	82.0%
Totals for Area of Interest			**15.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

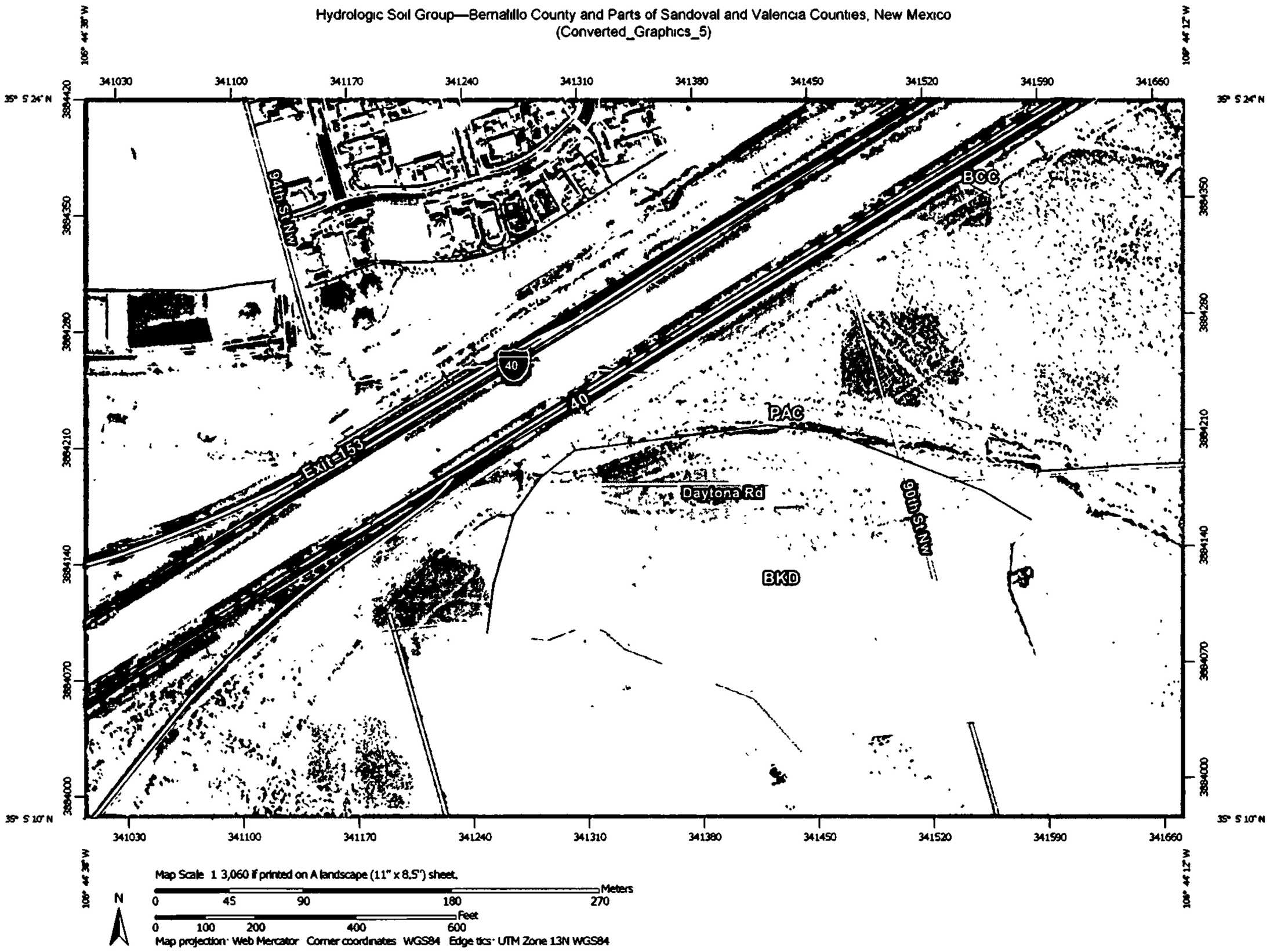
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(Converted_Graphics_5)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1 24,000

Warning Soil Map may not be valid at this scale

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements

Source of Map Natural Resources Conservation Service
Web Soil Survey URL http //websoilsurvey nrcs.usda gov
Coordinate System Web Mercator (EPSG 3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below

Soil Survey Area Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1 50,000 or larger

Date(s) aerial images were photographed Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps As a result, some minor shifting of map unit boundaries may be evident

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	0.1	0.3%
BKD	Bluepoint-Kokan association, hilly	A	11.4	57.7%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	8.3	42.0%
Totals for Area of Interest			**19.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

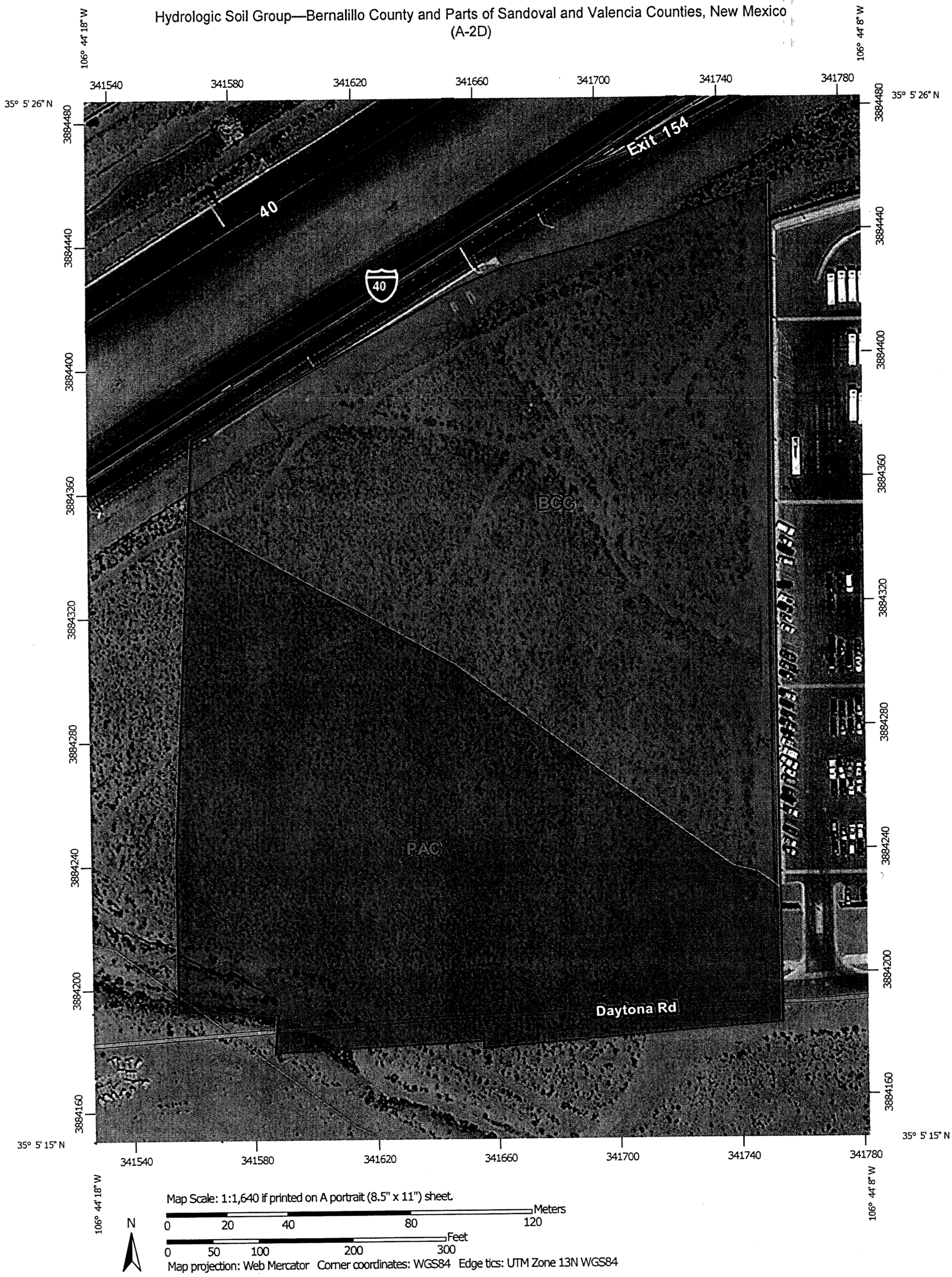
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(A-2D)



Map Scale: 1:1,640 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	6.2	53.2%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	5.4	46.8%
Totals for Area of Interest			11.6	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

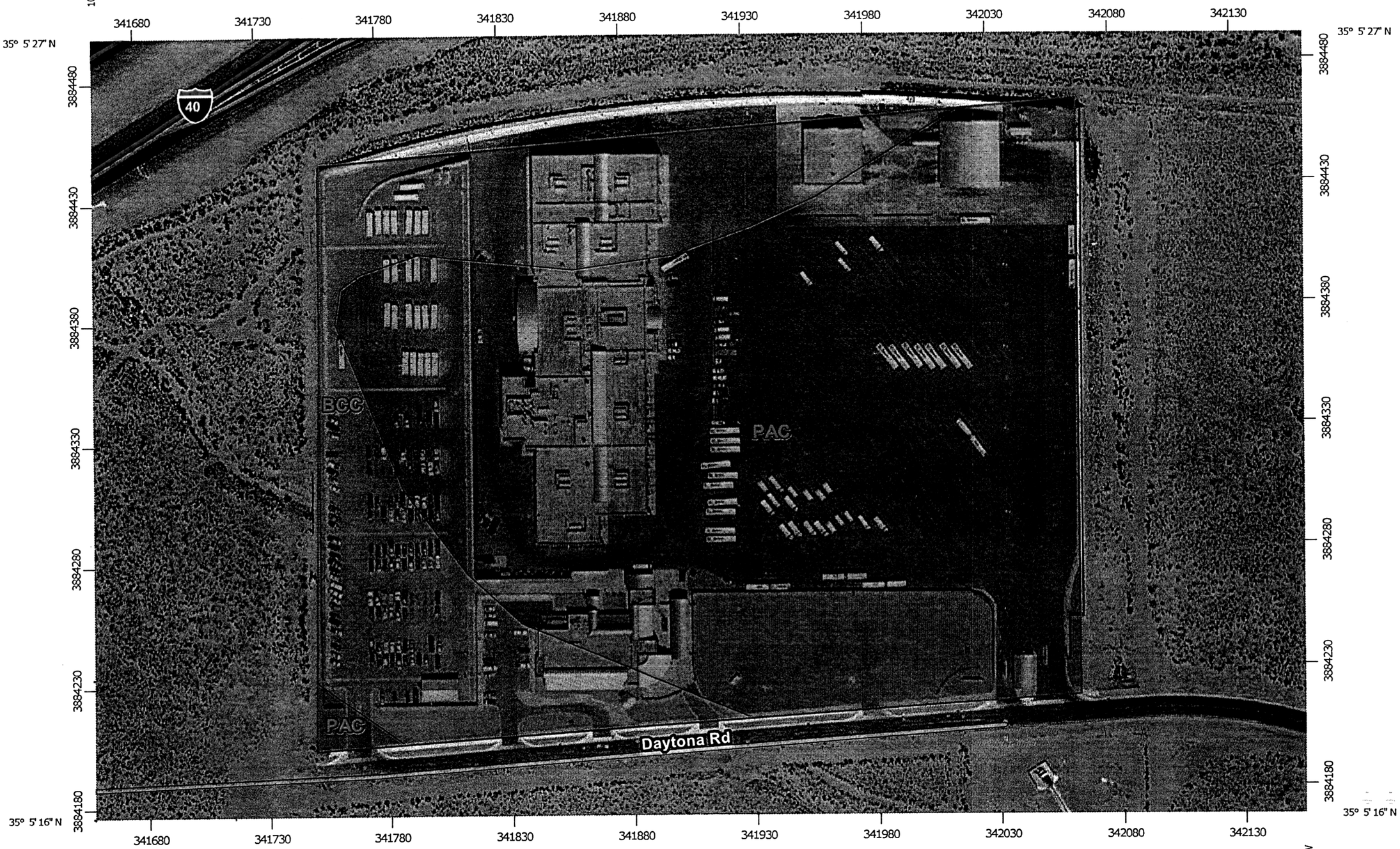
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(A-3D)



Map Scale: 1:2,270 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	5.2	27.5%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	13.7	72.5%
Totals for Area of Interest			18.9	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

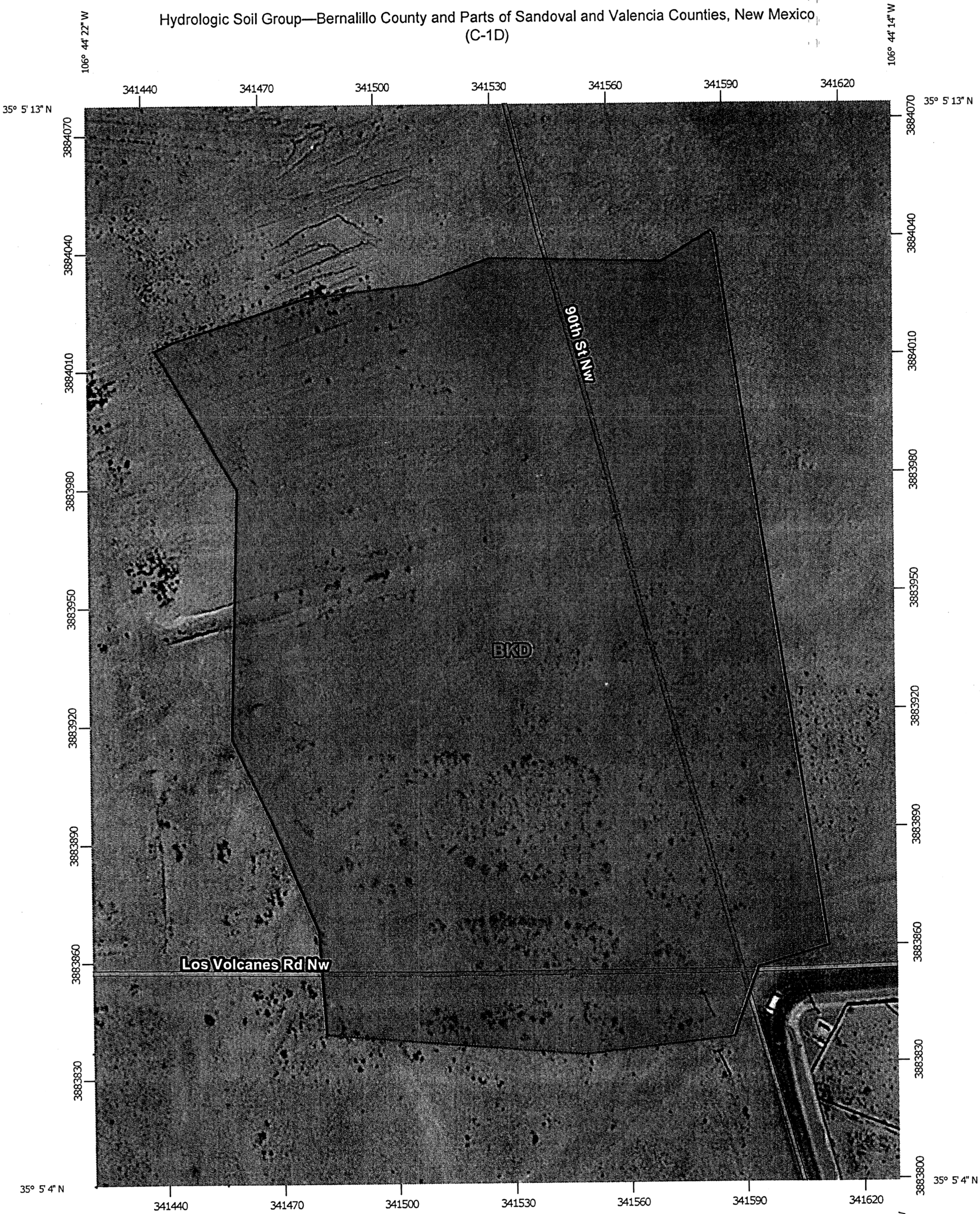
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(C-1D)



Map Scale: 1:1,340 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BKD	Bluepoint-Kokan association, hilly	A	6.6	100.0%
Totals for Area of Interest			**6.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

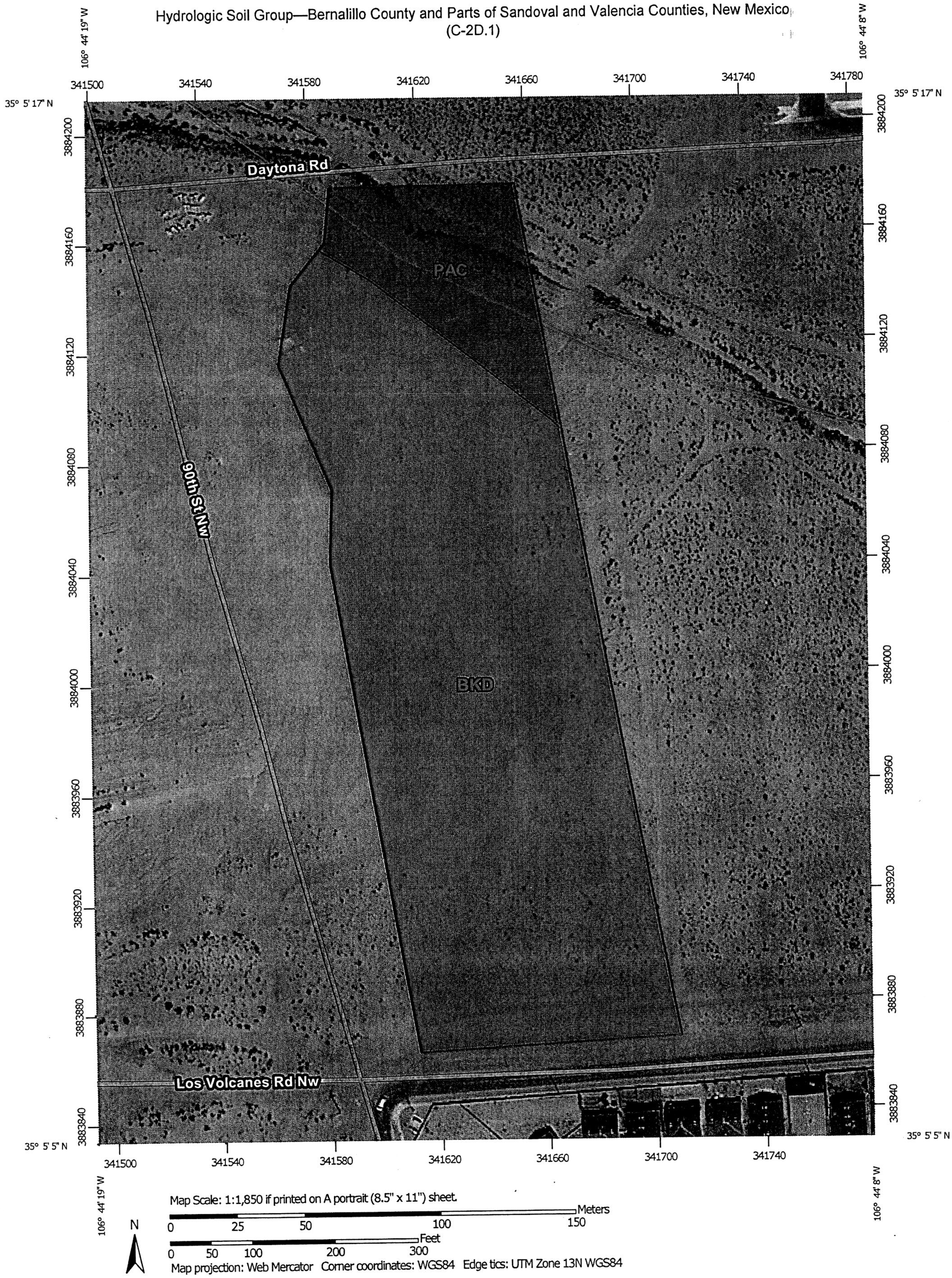
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(C-2D.1)



Map Scale: 1:1,850 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BKD	Bluepoint-Kokan association, hilly	A	6.2	86.2%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	1.0	13.8%
Totals for Area of Interest			7.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(C-2D.1)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

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Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	4.8	18.3%
BKD	Bluepoint-Kokan association, hilly	A	3.1	11.5%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	18.6	70.2%
Totals for Area of Interest			**26.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

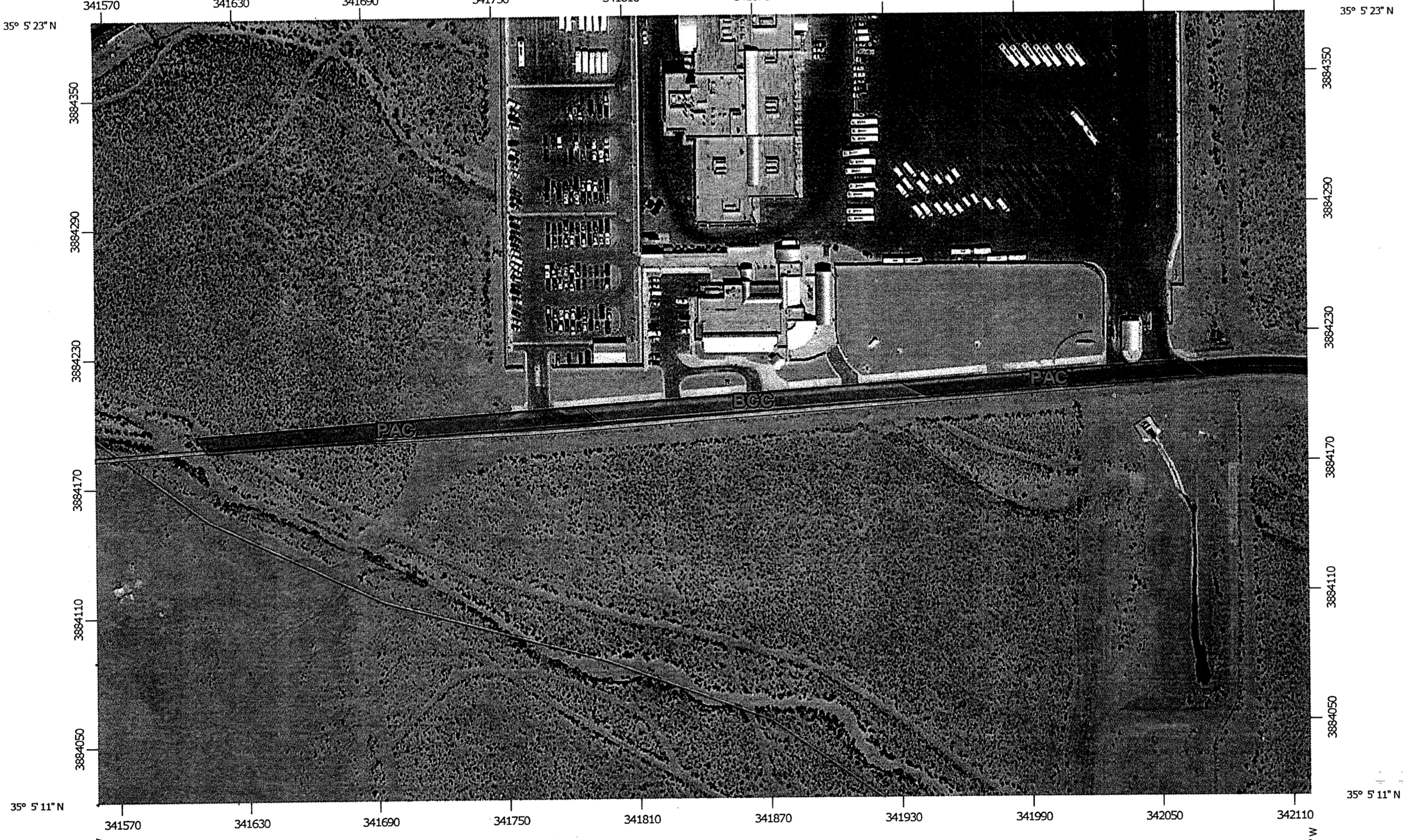
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group—Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
(Daytona)



Map Scale: 1:2,560 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes MLRA 42	A	0.3	32.3%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	0.6	67.7%
Totals for Area of Interest			0.9	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher


106° 44' 17" W
106° 43' 55" W
35° 5' 12" N
35° 5' 0" N
341560
341620
341680
341740
341800
341860
341920
341980
342040
342100
3884030
3883970
3883910
3883850
3883790
3883730
3883670
PAC
BKD
Santa Catalina Ave Nw
San Nicholas Ave Nw
Stein Dr Nw
90th St Nw
Map Scale: 1:2,610 if printed on A landscape (11" x 8.5") sheet.
Meters
0 35 70 140 210
Feet
0 100 200 400 600
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico
Survey Area Data: Version 10, Dec 17, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 23, 2011—May 4, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico (NM600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BKD	Bluepoint-Kokan association, hilly	A	0.6	32.1%
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	B	1.2	67.9%
Totals for Area of Interest			1.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Appendix A.4

Time of Concentration Calculations

EXISTING CONDITIONS HEC-HMS INPUT PARAMETERS

General Subbasin Data				Time of Concentration (Tc) Data																Lag Time Results		Tc and tp Results				
								Upper Reach or Entire Reach (0 to 400-ft length)							Middle Reach (400 to1600-ft length)						Lag Time	Lag Time	Actual Tc	Final Tc	Tp	Composite CN	Sub-basin
Sub-basin	Sub-basin Area	Sub-basin Area	Number of Reaches	L Length of Longest Water-course	Lca Centroid Length	Sc Composite Slope	Kc Composite K	Top Elevation at beginning of water course	Bottom Elevation	Length (L_1)	Slope (S_1)	K_{N1}	K_1	V_1	Elevation at lower end of water course	Length (L_2)	Slope (S_2)	K_{N2}	K_2	V_2							
	acres	sq mi		ft	ft	ft/ft		ft	ft	ft	ft/ft			ft/sec	ft	ft	ft/ft			ft/sec	(hours)	(minutes)	hours	hours	hours		
a	acres	a		a	a	i	j	a	a	a		d	b	e	a	a		d	b	e	(k)		f	g	h		a
A-1D	19.758	0.0309	2	1,642	NA	0.0292	1.4457	5258	5252	400	0.0150		1.0	1.22	5210	1,242	0.0338		2.0	3.68	0.15	9	0.18	0.20	0.13	69	A-1D
A-2D	11.581	0.0181	2	986	NA	0.0144	1.2671	5221.19	5210	400	0.0280		1.0	1.67	5207	586	0.0051		2.0	1.43	0.15	9	0.18	0.20	0.13	90	A-2D
A-3D	19.628	0.0307	2	878	NA	0.0207	1.4012	5203.2	5193	400	0.0255		1.0	1.60	5185	478	0.0167		2.0	2.59	0.15	9	0.12	0.20	0.13	91	A-3D
C-1D	6.581	0.0103	2	553	NA	0.0651	0.4480	5256	5250	400	0.0150		0.7	0.86	5220	153	0.1961		2.0	8.86	0.15	9	0.13	0.20	0.13	63	C-1D
C-2D.1	12.376	0.0193	2	844	NA	0.0332	0.8183	5216	5210	400	0.0150		0.7	0.86	5188	444	0.0495		2.0	4.45	0.15	9	0.16	0.20	0.13	65	C-2D.1
C-2D.2	26.803	0.0419	2	1,544	NA	0.0233	1.6145	5206	5192	400	0.0350		1.0	1.87	5170	1,144	0.0192		2.0	2.77	0.15	9	0.17	0.20	0.13	69	C-2D.2
D-1.1	0.556	0.0009	2	460	NA	0.0130	1.0571	5212	5207	400	0.0125		1.0	1.12	5206	60	0.0167		2.0	2.58	0.15	9	0.11	0.20	0.13	87	D-1.1
D-1.2	1.268	0.0020	2	953	NA	0.0210	1.3981	5206	5198	400	0.0200		1.0	1.41	5186	553	0.0217		2.0	2.95	0.15	9	0.13	0.20	0.13	87	D-1.2
LV-1	0.721	0.00113	2	607	NA	0.0478	1.2222	5217	5196	400	0.0525		1.0	2.29	5188	207	0.0386		2.0	3.93	0.15	9	0.06	0.20	0.13	87	LV-1
LV-2	1.225	0.00191	2	967	NA	0.0248	1.4428	5188	5175	400	0.0325		1.0	1.80	5164	567	0.0194		2.0	2.79	0.15	9	0.12	0.20	0.13	87	LV-2
O-1	2.852	0.00446	2	1,870	NA	0.0171	1.4742	5214	5200	400	0.0350		0.7	1.31	5182	1,470	0.0122		2.0	2.21	0.20	12	0.27	0.27	0.18	66	O-1
I40_1	7.3624	0.0115	2	1,479	NA	0.0176	1.0249	5276	5273.5	400	0.0063		0.7	0.55	5250	1079	0.0218		2.0	3.0	0.23	14	0.30	0.30	0.20	89	I40_1
I40_2	3.959	0.00619	2	806	NA	0.0199	1.0426	5250	5242	400	0.0200		0.7	0.99	5234	406	0.0197		2.0	3	0.15	9	0.15	0.20	0.13	89	I40_2
I40_3	2.0761	0.00324	2	409	NA	0.0171	0.6681	5234	5228	400	0.0150		0.7	0.86	5227	9	0.1111		2.0	7	0.15	9	0.13	0.20	0.13	89	I40_3
I40_4	1.9764	0.00309	1	341	NA	0.0176	0.7000	5227	5221	341	0.0176		0.7	0.93	5221	1	0.0000		2.0	0	0.15	9	0.10	0.20	0.13	83	I40_4

(a) All measurements were obtained from the Drainage Basin Maps, based on Lidar contour mapping dated 2010.
(b) Obtained from Table F-5 in the DPM, pg. 22-64.
(d) Obtained from Table F-6 in the DPM, , pg. 22-64.
(e) V= 10*K*S^0.5 - determined from V=K * (S*100)^0.5
(f) See DPM, pages 22-63 through 22-65 for following formulas :
If L < 4000 ft, then
Tc= (L1/V1 + L2/V2 + L3/V3)3600 sec/hour
If L is between 4,000 ft and 12,000 ft, then
Tc= ((12,000-L) / (72,000*K*s^0.5)) + ((L-4000)*Kn*(Lca/L)^0.33 / (552.2*s^0.165)) (ignore upper reach K - it is insignificant for long lengths and assume middle reach K for this equation)
If L > 12000 ft, then
Tc= (4/3)*26*Kn*((L*Lca/(5280^2*(s*5280)^0.5))^0.33)
(g) Tc= if Tc is computed to be less than 0.2 hours, then use 0.2 hours DPM pg. 22-37
(h) Tp= (2/3)*Tc per DPM pg. 22-36
(i) Sc= (L1*S1+L2*S2+L3*S3)/L per DPM pg. 22-65
(j) Kc= (L/S^0.5) / (L1/(K1*S1^0.5) + L2/(K2*S2^0.5) + L3/(K3*S3^0.5)) per DPM pg. 22-65

DEVEX CONDITIONS HEC-HMS INPUT PARAMETERS

General Subbasin Data				Time of Concentration (Tc) Data																Lag Time Results		Tc and tp Results				
								Upper Reach or Entire Reach (0 to 400-ft length)							Middle Reach (400 to1600-ft length)						Lag Time	Lag Time	Actual Tc	Final Tc	Tp	Composite CN	Sub-basin
Sub-basin	Sub-basin Area	Sub-basin Area	Number of Reaches	L Length of Longest Water-course	Lca Centroid Length	Sc Composite Slope	Kc Composite K	Top Elevation at beginning of water course	Bottom Elevation	Length (L_1)	Slope (S_1)	K_{N1}	K_1	V_1	Elevation at lower end of water course	Length (L_2)	Slope (S_2)	K_{N2}	K_2	V_2						
	acres	sq mi		ft	ft	ft/ft		ft	ft	ft	ft/ft			ft/sec	ft	ft	ft/ft			ft/sec	(hours)	(minutes)	hours	hours	hours		
a	acres	a		a	a	i	j	a	a	a		d	b	e	a	a		d	b	e	(k)		f	g	h		a
A-1D	19.758	0.0309	2	1,642	NA	0.0292	1.4457	5258	5252	400	0.0150		1.0	1.22	5210	1,242	0.0338		2.0	3.68	0.15	9	0.18	0.20	0.13	90	A-1D
A-2D	11.581	0.0181	2	986	NA	0.0144	1.2671	5221.19	5210	400	0.0280		1.0	1.67	5207	586	0.0051		2.0	1.43	0.15	9	0.18	0.20	0.13	90	A-2D
A-3D	19.628	0.0307	2	878	NA	0.0207	1.4012	5203.2	5193	400	0.0255		1.0	1.60	5185	478	0.0167		2.0	2.59	0.15	9	0.12	0.20	0.13	89	A-3D
C-1D	6.581	0.0103	2	832	NA	0.0433	0.9790	5256	5250	400	0.0150		1.0	1.22	5220	432	0.0694		2.0	5.27	0.15	9	0.11	0.20	0.13	89	C-1D
C-2D.1	12.376	0.0193	2	1,261	NA	0.0222	1.4201	5216	5210	400	0.0150		1.0	1.22	5188	861	0.0256		2.0	3.20	0.15	9	0.17	0.20	0.13	90	C-2D.1
C-2D.2	26.803	0.0419	2	1,544	NA	0.0233	1.6145	5206	5192	400	0.0350		1.0	1.87	5170	1,144	0.0192		2.0	2.77	0.15	9	0.17	0.20	0.13	91	C-2D.2
D-1.1	0.556	0.0009	2	460	NA	0.0130	1.0571	5212	5207	400	0.0125		1.0	1.12	5206	60	0.0167		2.0	2.58	0.15	9	0.11	0.20	0.13	87	D-1.1
D-1.2	1.268	0.0020	2	953	NA	0.0210	1.3981	5206	5198	400	0.0200		1.0	1.41	5186	553	0.0217		2.0	2.95	0.15	9	0.13	0.20	0.13	87	D-1.2
LV-1	0.721	0.0011	2	607	NA	0.0478	1.2222	5217	5196	400	0.0525		1.0	2.29	5188	207	0.0386		2.0	3.93	0.15	9	0.06	0.20	0.13	87	LV-1
LV-2	1.225	0.0019	2	967	NA	0.0248	1.4428	5188	5175	400	0.0325		1.0	1.80	5164	567	0.0194		2.0	2.79	0.15	9	0.12	0.20	0.13	87	LV-2
O-1	2.852	0.0045	2	1,870	NA	0.0171	1.4742	5214	5200	400	0.0350		0.7	1.31	5182	1,470	0.0122		2.0	2.21	0.20	12	0.27	0.27	0.18	66	O-1
I40_1	7.3624	0.0115	2	1,479	NA	0.0176	1.0249	5276	5273.5	400	0.0063		0.7	0.55	5250	1079	0.0218		2.0	3.0	0.23	14	0.30	0.30	0.20	89	I40_1
I40_2	3.959	0.0062	2	806	NA	0.0199	1.0426	5250	5242	400	0.0200		0.7	0.99	5234	406	0.0197		2.0	3	0.15	9	0.15	0.20	0.13	89	I40_2
I40_3	2.0761	0.0032	2	409	NA	0.0171	0.6681	5234	5228	400	0.0150		0.7	0.86	5227	9	0.1111		2.0	7	0.15	9	0.13	0.20	0.13	89	I40_3
I40_4	1.9764	0.0031	1	341	NA	0.0176	0.7000	5227	5221	341	0.0176		0.7	0.93	5221	1	0.0000		2.0	0	0.15	9	0.10	0.20	0.13	83	I40_4

(a) All measurements were obtained from the Drainage Basin Maps, based on Lidar contour mapping dated 2010.
(b) Obtained from Table F-5 in the DPM, pg. 22-64.
(d) Obtained from Table F-6 in the DPM, , pg. 22-64.
(e) V= 10*K*S^0.5 - determined from V=K * (S*100)^0.5
(f) See DPM, pages 22-63 through 22-65 for following formulas :
If L < 4000 ft, then
Tc= (L1/V1 + L2/V2 + L3/V3)3600 sec/hour
If L is between 4,000 ft and 12,000 ft, then
Tc= ((12,000-L) / (72,000*K*s^0.5)) + ((L-4000)*Kn*(Lca/L)^0.33 / (552.2*s^0.165)) (ignore upper reach K - it is insignificant for long lengths and assume middle reach K for this equation)
If L > 12000 ft, then
Tc= (4/3)*26*Kn*((L*Lca/(5280^2*(s*5280)^0.5))^0.33)
(g) Tc= if Tc is computed to be less than 0.2 hours, then use 0.2 hours DPM pg. 22-37
(h) Tp= (2/3)*Tc per DPM pg. 22-36
(i) Sc= (L1*S1+L2*S2+L3*S3)/L per DPM pg. 22-65
(j) Kc= (L/S^0.5) / (L1/(K1*S1^0.5) + L2/(K2*S2^0.5) + L3/(K3*S3^0.5)) per DPM pg. 22-65

Appendix A.5

Rating Curve Data for Ponds

EX POND 4 RATING CURVE		
Elevation	Storage	Disharge
ft.	ac-ft.	cfs
5147	0	0
5148	0.08	0
5149	0.51	3
5150	1.3	5.7
5151	2.29	7.5
5151.9	3.26	8.7
5152	3.37	11.7
5152.5	3.94	50.6
5153	4.52	92.5
5154	5.76	104.3
5155	7.18	115.9
5156	8.51	124.6
DATA FROM MASTER DRAINAGE PLANE FOR THE WEST SIDE TRANSIT FACILITY		

EX POND 5 RATING CURVE		
Elevation	Storage	Disharge
ft.	ac-ft.	cfs
5160	0	0
5161	0.02	4
5162	0.37	6.5
5163	0.76	8.2
5164	1.19	9.7
5164.5	1.42	41.6
5165	1.66	93
5165.5	1.89	106.3
5166	2.12	116.7
5167	2.74	132.6
5168	3.35	146.8
5168.8	3.87	157.2
5169	4.01	160
5170	4.73	172

DATA FROM MASTER DRAINAGE PLANE
FOR THE WEST SIDE TRANSIT FACILITY

EX POND 6 RATING CURVE		
Elevation	Storage	Disharge
ft.	ac-ft.	cfs
5170	0	0
5171	0.14	4
5172	0.83	6.2
5173	1.77	7.9
5174	2.79	9.2
5175	3.87	10.4
5176	5.04	11.5
5177	6.27	79.5
5178	7.46	86.1
5179	9.01	93.2
DATA FROM MASTER DRAINAGE PLANE FOR THE WEST SIDE TRANSIT FACILITY		

DEVEX Option 1 POND 5 RATING CURVE WITH 12 IN. ORIFICE		
Elevation	Storage	Discharge
ft.	ac-ft.	cfs
a	a	b
5160	0	0.0
5161	0.02	3.8
5162	0.37	5.3
5163	0.76	6.5
5164	1.19	7.6
5164.5	1.42	8.0
5165	1.66	8.5
5165.5	1.89	8.9
5166	2.12	9.3
5167	2.74	10.0
5168	3.35	10.7
5168.8	3.87	11.2
5169	4.01	11.3
5170	4.73	12.0
a- DATA FROM MASTER DRAINAGE PLAN FOR THE WEST SIDE TRANSIT FACILITY b- DISCHARGE BASED ON ORIFICE EQN. SEE APPENDIX B.4 FOR COMPUTATION		

Appendix A.6

NRCS Rainfall Distribution

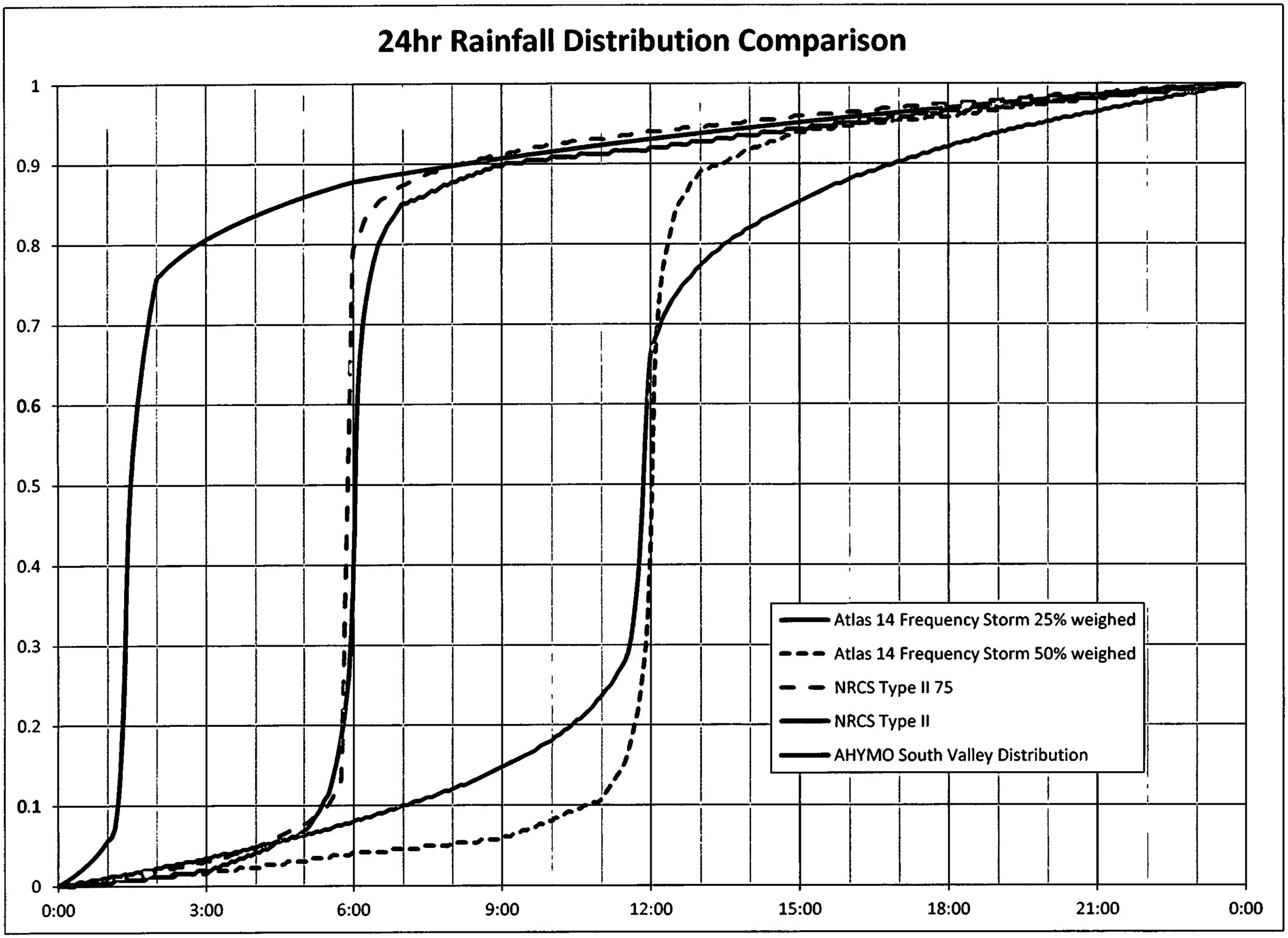

24hr Rainfall Distribution Comparison
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Atlas 14 Frequency Storm 25% weighed
Atlas 14 Frequency Storm 50% weighed
NRCS Type II 75
NRCS Type II
AHYMO South Valley Distribution

TABLE 7.8 NRCS RAINFALL DISTRIBUTIONS

Time hours	I	IA	II	III	Time hours	I	IA	II	III
0.5	0.008	0.010	0.0053	0.0050	12.5	0.706	0.683	0.7351	0.7020
1.0	0.017	0.020	0.0108	0.0100	13.0	0.728	0.701	0.7724	0.7500
1.5	0.026	0.035	0.0164	0.0150	13.5	0.748	0.719	0.7989	0.7835
2.0	0.035	0.050	0.0223	0.0200	14.0	0.766	0.736	0.8197	0.8110
2.5	0.045	0.067	0.0284	0.0252	14.5	0.783	0.753	0.8380	0.8341
3.0	0.055	0.082	0.0347	0.0308	15.0	0.799	0.769	0.8538	0.8542
3.5	0.065	0.098	0.0414	0.0367	15.5	0.815	0.785	0.8676	0.8716
4.0	0.076	0.116	0.0483	0.0430	16.0	0.830	0.800	0.8801	0.8860
4.5	0.087	0.135	0.0555	0.0497	16.5	0.844	0.815	0.8914	0.8984
5.0	0.099	0.156	0.0632	0.0568	17.0	0.857	0.830	0.9019	0.9095
5.5	0.112	0.180	0.0712	0.0642	17.5	0.870	0.844	0.9115	0.9194
6.0	0.126	0.206	0.0797	0.0720	18.0	0.882	0.858	0.9206	0.9280
6.5	0.140	0.237	0.0887	0.0806	18.5	0.893	0.871	0.9291	0.9358
7.0	0.156	0.268	0.0984	0.0905	19.0	0.905	0.844	0.9371	0.9432
7.5	0.174	0.310	0.1089	0.1016	19.5	0.916	0.896	0.9446	0.9503
8.0	0.194	0.425	0.1203	0.1140	20.0	0.926	0.908	0.9519	0.9570
8.5	0.219	0.480	0.1328	0.1284	20.5	0.936	0.920	0.9588	0.9634
9.0	0.254	0.520	0.1467	0.1458	21.0	0.946	0.932	0.9653	0.9694
9.5	0.303	0.550	0.1625	0.1659	21.5	0.956	0.944	0.9717	0.9752
10.0	0.515	0.577	0.1808	0.1890	22.0	0.965	0.956	0.9777	0.9808
10.5	0.583	0.601	0.2042	0.2165	22.5	0.974	0.967	0.9836	0.9860
11.0	0.624	0.624	0.2351	0.2500	23.0	0.983	0.978	0.9892	0.9909
11.5	0.655	0.645	0.2833	0.2980	23.5	0.992	0.989	0.9947	0.9956
12.0	0.682	0.664	0.6632	0.5000	24.0	1.000	1.000	1.0000	1.0000

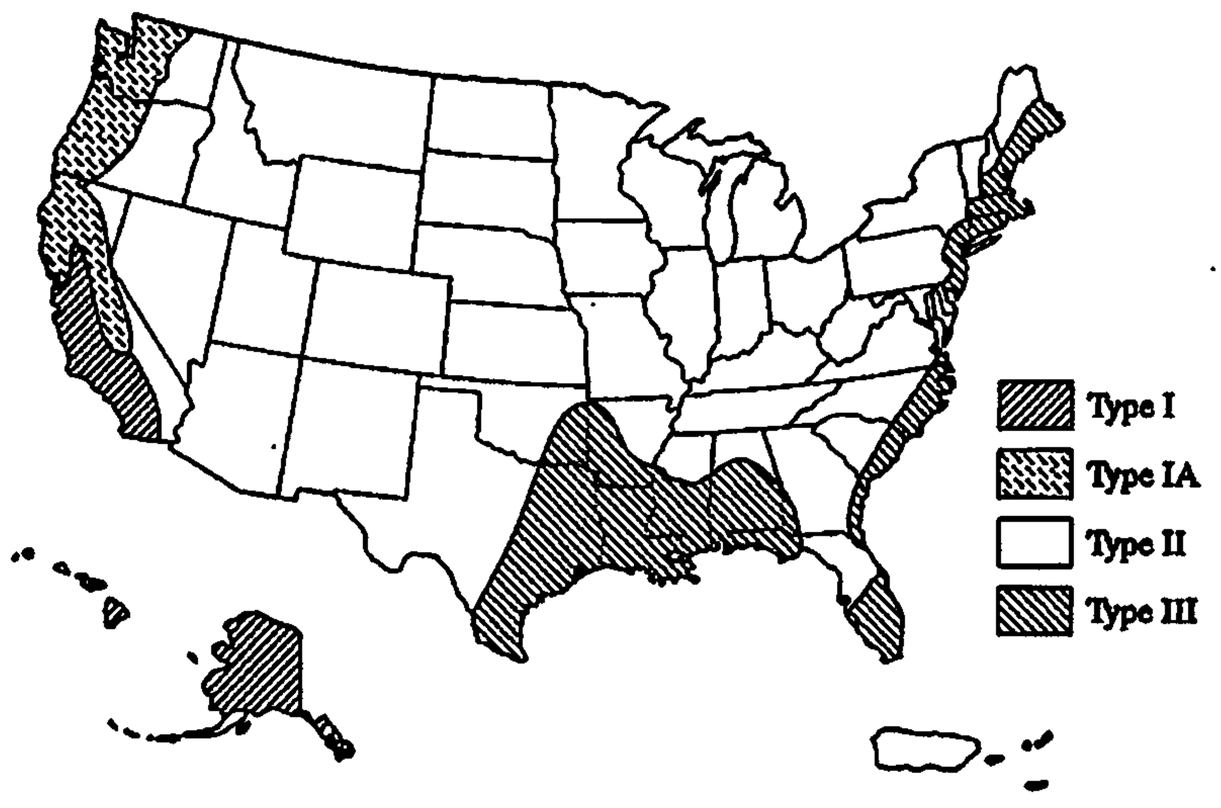


Figure 7.15 Regions of applicability for the NRCS rainfall distributions (NRCS, 1986).

Appendix "B"

Appendix B.1

HEC-HMS Model

(Refer to DVD)

Appendix B.2

HEC-HMS Global Summary for:

- Existing Conditions
- DEVEX_SMITH
- DEVEX1
- DEVEX2
- DEVEX_OPTION 1

Existing Conditions

EXISTING GLOBAL SUMMARY

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	9.759	23Mar2014, 06:15	0.708
A-2D	0.0181000	42.263	23Mar2014, 06:10	2.338
A-3D	0.0307000	71.403	23Mar2014, 06:10	3.954
AP-1	0.0739218	99.576	23Mar2014, 06:15	6.232
AP-1.1	0.0433038	33.329	23Mar2014, 06:15	2.288
AP1.2	0.0125180	28.962	23Mar2014, 06:10	1.605
AP-2	0.0759218	102.735	23Mar2014, 06:15	6.456
AP-3	0.1110818	170.129	23Mar2014, 06:15	10.488
AP-4	0.0103000	1.566	23Mar2014, 06:20	0.138
AP-5	0.0114300	3.020	23Mar2014, 06:20	0.261
AP5.1	0.0193000	3.858	23Mar2014, 06:20	0.314
AP-6	0.0307300	6.871	23Mar2014, 06:20	0.575
AP-7	0.0745400	22.409	23Mar2014, 06:15	1.745
AP7.1	0.0419000	14.192	23Mar2014, 06:15	0.960
AP-8	0.1856218	63.623	23Mar2014, 06:35	12.234
C-1D	0.0103000	1.566	23Mar2014, 06:20	0.138
C-2D.1	0.0193000	3.858	23Mar2014, 06:20	0.314
C-2D.2	0.0419000	14.192	23Mar2014, 06:15	0.960
D-1_R	0.0739218	99.436	23Mar2014, 06:15	6.234
D-1.1	0.0009000	1.789	23Mar2014, 06:10	0.098
D-1.1_R	0.0309000	9.700	23Mar2014, 06:20	0.708
D-1.2	0.0020000	3.976	23Mar2014, 06:10	0.218
D-1.2R	0.0433038	33.120	23Mar2014, 06:15	2.288
D-1.3_R	0.0739218	99.280	23Mar2014, 06:15	6.235
D-1.4_R	0.0739218	98.946	23Mar2014, 06:15	6.238
I40_1	0.0115038	21.931	23Mar2014, 06:15	1.481
i40_2	0.0061859	14.387	23Mar2014, 06:10	0.797
I40_3	0.0032439	7.545	23Mar2014, 06:10	0.418
I40_4	0.0030882	7.030	23Mar2014, 06:10	0.391
J-1	0.0739218	99.436	23Mar2014, 06:15	6.234
J-2	0.0739218	99.280	23Mar2014, 06:15	6.235
LV_2R	0.0307300	6.780	23Mar2014, 06:25	0.577
LV-1	0.0011300	2.246	23Mar2014, 06:10	0.123
LV1_R	0.0103000	1.549	23Mar2014, 06:25	0.138
LV-1_R2	0.0114300	3.013	23Mar2014, 06:20	0.261
LV-2	0.0019100	3.797	23Mar2014, 06:10	0.208
O-1	0.0044600	0.933	23Mar2014, 06:20	0.079
POND 4	0.1856218	19.611	23Mar2014, 07:15	12.233

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POND 6	0.1110818	50.362	23Mar2014, 06:35	10.488

DEVEX_SMITH

HEC-HMS DEVEX_SMITH GLOBAL SUMMARY

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	9.759	23Mar2014, 06:15	0.708
A-2D	0.0181000	42.263	23Mar2014, 06:10	2.338
A-3D	0.0307000	71.403	23Mar2014, 06:10	3.954
AP-1	0.0739218	99.576	23Mar2014, 06:15	6.232
AP-1.1	0.0433038	33.329	23Mar2014, 06:15	2.288
AP1.2	0.0125180	28.962	23Mar2014, 06:10	1.605
AP-2	0.0759218	102.735	23Mar2014, 06:15	6.456
AP-3	0.1110818	170.129	23Mar2014, 06:15	10.488
AP-4	0.0103000	1.566	23Mar2014, 06:20	0.138
AP-5	0.0114300	3.020	23Mar2014, 06:20	0.261
AP5.1	0.0193000	3.858	23Mar2014, 06:20	0.314
AP-6	0.0307300	6.871	23Mar2014, 06:20	0.575
AP-7	0.0745400	22.409	23Mar2014, 06:15	1.745
AP7.1	0.0419000	14.192	23Mar2014, 06:15	0.960
AP-8	0.1856218	63.623	23Mar2014, 06:35	12.234
C-1D	0.0103000	1.566	23Mar2014, 06:20	0.138
C-2D.1	0.0193000	3.858	23Mar2014, 06:20	0.314
C-2D.2	0.0419000	14.192	23Mar2014, 06:15	0.960
D-1_R	0.0739218	99.436	23Mar2014, 06:15	6.234
D-1.1	0.0009000	1.789	23Mar2014, 06:10	0.098
D-1.1_R	0.0309000	9.700	23Mar2014, 06:20	0.708
D-1.2	0.0020000	3.976	23Mar2014, 06:10	0.218
D-1.2R	0.0433038	33.120	23Mar2014, 06:15	2.288
D-1.3_R	0.0739218	99.280	23Mar2014, 06:15	6.235
D-1.4_R	0.0739218	98.946	23Mar2014, 06:15	6.238
I40_1	0.0115038	21.931	23Mar2014, 06:15	1.481
i40_2	0.0061859	14.387	23Mar2014, 06:10	0.797
I40_3	0.0032439	7.545	23Mar2014, 06:10	0.418
I40_4	0.0030882	7.030	23Mar2014, 06:10	0.391
J-1	0.0739218	99.436	23Mar2014, 06:15	6.234
J-2	0.0739218	99.280	23Mar2014, 06:15	6.235
LV_2R	0.0307300	6.780	23Mar2014, 06:25	0.577
LV-1	0.0011300	2.246	23Mar2014, 06:10	0.123
LV1_R	0.0103000	1.549	23Mar2014, 06:25	0.138
LV-1_R2	0.0114300	3.013	23Mar2014, 06:20	0.261
LV-2	0.0019100	3.797	23Mar2014, 06:10	0.208
O-1	0.0044600	0.933	23Mar2014, 06:20	0.079
POND 4	0.1856218	19.611	23Mar2014, 07:15	12.233

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POND 6	0.1110818	50.362	23Mar2014, 06:35	10.488

DEVEX1

HEC-HMS DEVEX1 GLOBAL OUTPUT SUMMARY

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	72.151	23Mar2014, 06:10	3.992
A-2D	0.0181000	42.263	23Mar2014, 06:10	2.338
A-3D	0.0307000	71.403	23Mar2014, 06:10	3.954
AP-1	0.0739218	162.365	23Mar2014, 06:10	9.533
AP-1.1	0.0433038	91.918	23Mar2014, 06:10	5.589
AP1.2	0.0125180	28.962	23Mar2014, 06:10	1.605
AP-2	0.0759218	162.239	23Mar2014, 06:15	9.798
AP-3	0.1110780	231.448	23Mar2014, 06:10	13.830
AP-4	0.0103000	23.956	23Mar2014, 06:10	1.326
AP-5	0.0114266	25.236	23Mar2014, 06:15	1.472
AP5.1	0.0193000	45.065	23Mar2014, 06:10	2.493
AP-6	0.0307266	69.234	23Mar2014, 06:10	3.966
AP-7	0.0326407	72.086	23Mar2014, 06:15	4.213
AP-8	0.1856187	203.529	23Mar2014, 06:20	23.474
AP-P5	0.1529780	143.593	23Mar2014, 06:20	19.261
AP-P6	0.1110780	83.133	23Mar2014, 06:30	13.830
C-1D	0.0103000	23.956	23Mar2014, 06:10	1.326
C-2D.1	0.0193000	45.065	23Mar2014, 06:10	2.493
C-2D.2	0.0419000	98.227	23Mar2014, 06:10	5.431
D-1_R	0.0739218	159.661	23Mar2014, 06:10	9.536
D-1.1	0.0009000	2.077	23Mar2014, 06:10	0.115
D-1.1_R	0.0309000	71.794	23Mar2014, 06:10	3.992
D-1.2	0.0020000	4.617	23Mar2014, 06:10	0.256
D-1.2R	0.0433038	91.194	23Mar2014, 06:15	5.589
D-1.3_R	0.0739218	157.968	23Mar2014, 06:10	9.538
D-1.4_R	0.0739218	157.929	23Mar2014, 06:15	9.542
I40_1	0.0115038	21.931	23Mar2014, 06:15	1.481
i40_2	0.0061859	14.387	23Mar2014, 06:10	0.797
I40_3	0.0032439	7.545	23Mar2014, 06:10	0.418
I40_4	0.0030882	7.030	23Mar2014, 06:10	0.391
J-1	0.0739218	159.661	23Mar2014, 06:10	9.536
J-2	0.0739218	157.968	23Mar2014, 06:10	9.538
LV_2R	0.0307266	67.961	23Mar2014, 06:15	3.968
LV-1	0.0011266	2.601	23Mar2014, 06:10	0.144
LV1_R	0.0103000	22.808	23Mar2014, 06:15	1.328
LV-1_R2	0.0114266	25.213	23Mar2014, 06:15	1.473
LV-2	0.0019141	4.418	23Mar2014, 06:10	0.245
O-1	0.0044562	0.932	23Mar2014, 06:20	0.079

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POND 4	0.1856187	109.309	23Mar2014, 06:45	23.474
POND 6	0.1110780	83.133	23Mar2014, 06:30	13.830

DEVEX2

HEC-HMS DEVEX 2 GLOBAL SUMMARY

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	72.151	23Mar2014, 06:10	3.992
A-2D	0.0181000	42.263	23Mar2014, 06:10	2.338
A-3D	0.0307000	71.403	23Mar2014, 06:10	3.954
AP-1	0.0739218	162.365	23Mar2014, 06:10	9.533
AP-1.1	0.0433038	91.918	23Mar2014, 06:10	5.589
AP1.2	0.0125180	28.962	23Mar2014, 06:10	1.605
AP-2	0.0759218	162.239	23Mar2014, 06:15	9.798
AP-3	0.1110780	231.448	23Mar2014, 06:10	13.830
AP-4	0.0103000	23.956	23Mar2014, 06:10	1.326
AP-5	0.0114266	25.236	23Mar2014, 06:15	1.472
AP5.1	0.0193000	45.065	23Mar2014, 06:10	2.493
AP-6	0.0307266	69.234	23Mar2014, 06:10	3.966
AP-7	0.0326407	72.086	23Mar2014, 06:15	4.213
AP-8	0.1856187	215.929	23Mar2014, 06:20	23.474
AP-P5	0.1529780	155.993	23Mar2014, 06:20	19.261
AP-P6	0.1110780	83.133	23Mar2014, 06:30	13.830
C-1D	0.0103000	23.956	23Mar2014, 06:10	1.326
C-2D.1	0.0193000	45.065	23Mar2014, 06:10	2.493
C-2D.2	0.0419000	98.227	23Mar2014, 06:10	5.431
D-1_R	0.0739218	159.661	23Mar2014, 06:10	9.536
D-1.1	0.0009000	2.077	23Mar2014, 06:10	0.115
D-1.1_R	0.0309000	71.794	23Mar2014, 06:10	3.992
D-1.2	0.0020000	4.617	23Mar2014, 06:10	0.256
D-1.2R	0.0433038	91.194	23Mar2014, 06:15	5.589
D-1.3_R	0.0739218	157.968	23Mar2014, 06:10	9.538
D-1.4_R	0.0739218	157.929	23Mar2014, 06:15	9.542
I40_1	0.0115038	21.931	23Mar2014, 06:15	1.481
i40_2	0.0061859	14.387	23Mar2014, 06:10	0.797
I40_3	0.0032439	7.545	23Mar2014, 06:10	0.418
I40_4	0.0030882	7.030	23Mar2014, 06:10	0.391
J-1	0.0739218	159.661	23Mar2014, 06:10	9.536
J-2	0.0739218	157.968	23Mar2014, 06:10	9.538
LV_2R	0.0307266	67.961	23Mar2014, 06:15	3.968
LV-1	0.0011266	2.601	23Mar2014, 06:10	0.144
LV1_R	0.0103000	22.808	23Mar2014, 06:15	1.328
LV-1_R2	0.0114266	25.213	23Mar2014, 06:15	1.473
LV-2	0.0019141	4.418	23Mar2014, 06:10	0.245
O-1	0.0044562	0.932	23Mar2014, 06:20	0.079

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POND 4	0.1856187	106.901	23Mar2014, 06:45	23.474
Pond 5	0.0419000	78.427	23Mar2014, 06:20	5.431
POND 6	0.1110780	83.133	23Mar2014, 06:30	13.830

DEVEX_OPTION1

HEC-HMS DEVEX-OPTION 1 GLOBAL SUMMARY

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
A-1D	0.0309000	72.151	23Mar2014, 06:10	3.992
A-2D	0.0181000	42.263	23Mar2014, 06:10	2.338
A-3D	0.0307000	71.403	23Mar2014, 06:10	3.954
AP-1	0.0739218	162.365	23Mar2014, 06:10	9.533
AP-1.1	0.0433038	91.918	23Mar2014, 06:10	5.589
AP1.2	0.0125180	28.962	23Mar2014, 06:10	1.605
AP-2	0.0759218	162.239	23Mar2014, 06:15	9.798
AP-3	0.1110780	231.448	23Mar2014, 06:10	13.830
AP-4	0.0103000	23.956	23Mar2014, 06:10	1.326
AP-5	0.0114266	25.236	23Mar2014, 06:15	1.472
AP5.1	0.0193000	45.065	23Mar2014, 06:10	2.493
AP-6	0.0307266	69.234	23Mar2014, 06:10	3.966
AP-7	0.0326407	72.086	23Mar2014, 06:15	4.213
AP7.1	0.0419000	98.227	23Mar2014, 06:10	5.431
AP-8	0.1856187	147.128	23Mar2014, 06:20	23.474
AP-P5	0.1529780	93.377	23Mar2014, 06:35	19.261
AP-P6	0.1110780	83.133	23Mar2014, 06:30	13.830
C-1D	0.0103000	23.956	23Mar2014, 06:10	1.326
C-2D.1	0.0193000	45.065	23Mar2014, 06:10	2.493
C-2D.2	0.0419000	98.227	23Mar2014, 06:10	5.431
D-1_R	0.0739218	159.661	23Mar2014, 06:10	9.536
D-1.1	0.0009000	2.077	23Mar2014, 06:10	0.115
D-1.1_R	0.0309000	71.794	23Mar2014, 06:10	3.992
D-1.2	0.0020000	4.617	23Mar2014, 06:10	0.256
D-1.2R	0.0433038	91.194	23Mar2014, 06:15	5.589
D-1.3_R	0.0739218	157.968	23Mar2014, 06:10	9.538
D-1.4_R	0.0739218	157.929	23Mar2014, 06:15	9.542
I40_1	0.0115038	21.931	23Mar2014, 06:15	1.481
i40_2	0.0061859	14.387	23Mar2014, 06:10	0.797
I40_3	0.0032439	7.545	23Mar2014, 06:10	0.418
I40_4	0.0030882	7.030	23Mar2014, 06:10	0.391
J-1	0.0739218	159.661	23Mar2014, 06:10	9.536
J-2	0.0739218	157.968	23Mar2014, 06:10	9.538
LV_2R	0.0307266	67.961	23Mar2014, 06:15	3.968
LV-1	0.0011266	2.601	23Mar2014, 06:10	0.144
LV1_R	0.0103000	22.808	23Mar2014, 06:15	1.328
LV-1_R2	0.0114266	25.213	23Mar2014, 06:15	1.473
LV-2	0.0019141	4.418	23Mar2014, 06:10	0.245

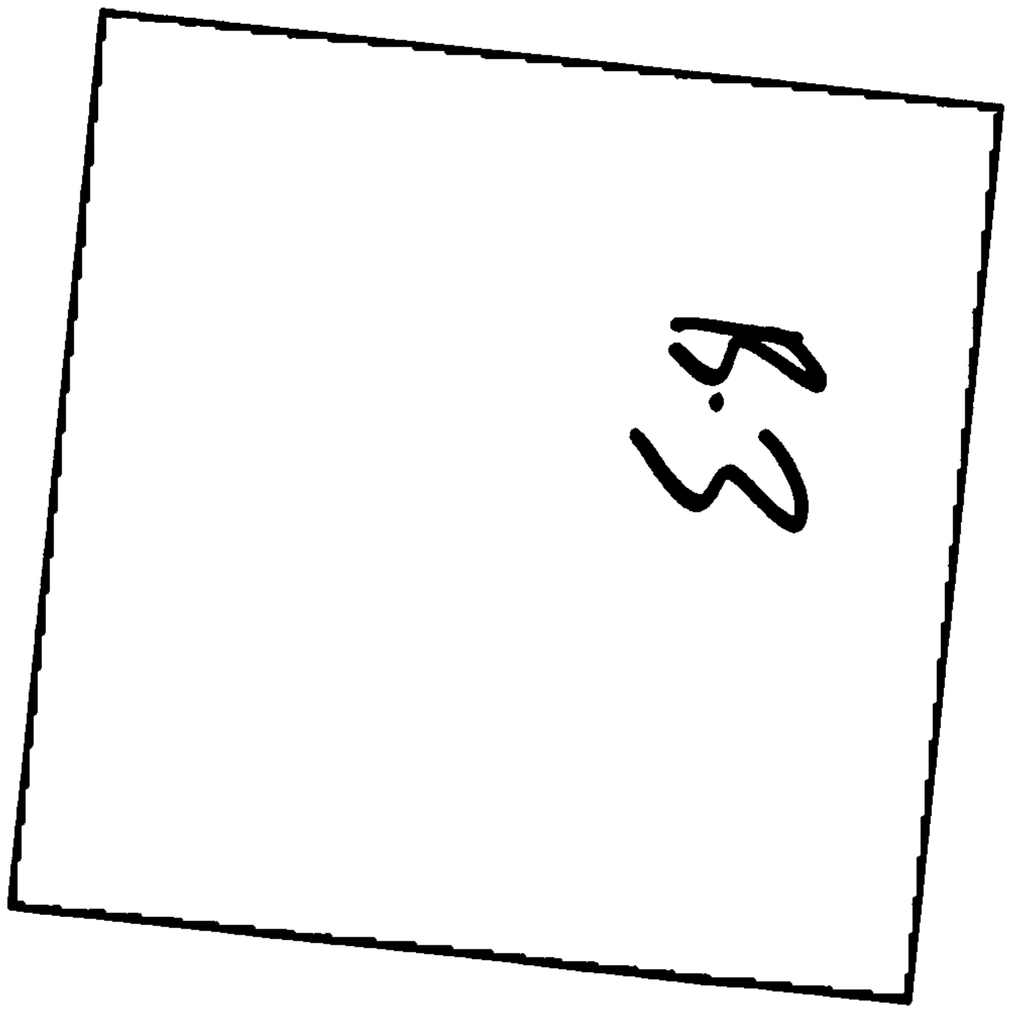
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
O-1	0.0044562	0.932	23Mar2014, 06:20	0.079
POND 4	0.1856187	96.443	23Mar2014, 06:50	23.474
Pond 5	0.0419000	10.462	23Mar2014, 06:45	5.431
POND 6	0.1110780	83.133	23Mar2014, 06:30	13.830

Appendix B.3

Pond Routing Summary Table and HEC-HMS Pond Summary Results

Summary of Pond Routings

Pond	Model Description	Design Volume	100 Yr-24 Hr Peak Storage Volume	100 Yr-24 Hr Inflow Volume	100 Yr-24 Hr Outflow Volume	100 Yr-24 Hr Inflow	100 Yr-24 Hr Outflow	Elevation of Emergency Spillway	100 Yr-24 Hr Peak Water Surface Elevation	Freeboard from Emergency Spillway	Available Storage	Comments
		ac-ft	ac-ft	ac-ft	cfs	cfs	cfs	ft	ft	ft	ac-ft	
		a						a		b		
Pond 4	Ex Conditions HEC-HMS	8.51	3.49	12.2	12.2	63.6	19.6	5155.1	5152.1	3.0	5.02	Model uses current watershed conditions using latest NOAA 14 100 Yr-24 Hr rainfall depth of 2.52 in. Pond 5 not modeled
Pond 6	Ex Conditions HEC-HMS	9.01	5.74	10.5	10.5	170.1	50.4	5177.9	5176.57	1.3	3.27	
Pond 4	*Smith DEVEX Conditions Results from Report*	*8.51*	*4.50*	--	--	--	--	*5155.1*	*5152.9*	*2.2*	*4.01*	*All values reported on this table are taken directly from The Master Drainage Plan for the West Side Transit Facility by Smith Engineering Company, 2001.*
Pond 6	"	*9.01*	*6.20*	--	--	--	--	*5177.9*	*5176.7*	*1.2*	*2.81*	
Pond 4	DEVEX Conditions Using Smith Parameters in HEC-HMS	8.51	5.69	23.1	23.1	178.0	103.6	5155.1	5153.95	1.2	2.82	Smith Engineering subbasin parameters were used for subbasin land treatments under fully developed conditions, 100yr-24 hr precipitation depth was adopted from Smiths AHYMO_97 model (2.66 inches)
Pond 6	"	9.01	6.88	14.5	14.5	153.7	82.9	5177.9	5177.52	0.4	2.13	


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Summary of Pond Routings

Pond	Model Description	Design Volume	100 Yr-24 Hr Peak Storage Volume	100 Yr-24 Hr Inflow Volume	100 Yr-24 Hr Outflow Volume	100 Yr-24 Hr Inflow	100 Yr-24 Hr Outflow	Elevation of Emergency Spillway	100 Yr-24 Hr Peak Water Surface Elevation	Freeboard from Emergency Spillway	Available Storage	Comments
		ac-ft	ac-ft	ac-ft	cfs	cfs	cfs	ft	ft	ft	ac-ft	
		a						a		b		
Pond 4	DEVEX 1 Conditions **Modeled with** most current data using HEC-HMS	8.51	6.37	23.4	23.4	203.5	109.3	5155.1	5154.43	0.7	2.14	Watershed modeled as fully developed commercial/business site at 90% impervious, using latest **NOAA 14 100-Yr-24Hr rainfall** depth of 2.52 in. Same basin configuration as Smiths AHYMO DEVEX conditions. Pond 5 is not inlcuded as part of the system
Pond 6	"	9.01	6.90	13.8	13.8	231.4	83.1	5177.9	5177.5	0.4	2.11	
Pond 4	DEVEX 2 Conditions **Modeled with** most current data using HEC-HMS	8.51	6.07	23.5	23.5	215.9	106.9	5155.1	5154.2	0.9	2.44	Watershed modeled as fully developed commercial/business site at 90% impervious, using latest **NOAA 14 100-Yr-24Hr rainfall** depth of 2.52 in. Basin C-2D.2 drains to Pond 5 with existing outfall structure
Pond 5	"	4.73	1.59	5.4	5.4	98.2	78.4	5168.8	5164.86	3.9	3.14	
Pond 6	"	9.01	6.90	13.8	13.8	231.4	83.1	5177.9	5177.5	0.4	2.11	

Summary of Pond Routings

Pond	Model Description	Design Volume	100 Yr-24 Hr Peak Storage Volume	100 Yr-24 Hr Inflow Volume	100 Yr-24 Hr Outflow Volume	100 Yr-24 Hr Inflow	100 Yr-24 Hr Outflow	Elevation of Emergency Spillway	100 Yr-24 Hr Peak Water Surface Elevation	Freeboard from Emergency Spillway	Available Storage	Comments
		ac-ft	ac-ft	ac-ft	cfs	cfs	cfs	ft	ft	ft	ac-ft	
		a						a		b		
Pond 4	DEVEX Option 1	8.51	4.93	23.5	23.5	147.1	96.4	5155.1	5153.33	1.8	3.58	Watershed modeled as fully developed commercial/business site at 90% impervious, using latest NOAA 14 100-Yr-24Hr rainfall depth of 2.52 in. Basin C-2D.2 drains to Pond 5 with modified outfall restricting discharge using a 12" outlet pipe as principal spillway
Pond 5	DEVEX Option 1	4.73	3.14	5.43	5.4	98.2	10.5	5168.8	5167.66	1.1	1.59	
Pond 6	DEVEX Option 1	9.01	6.90	13.8	13.8	231.4	83.1	5177.9	5177.5	0.4	2.11	

a- All values reported on this table are taken directly from The Master Drainage Plan for the West Side Transit Facility
100 Yr 24 Hr rainfall depth based on lates NOAA Atlas 14 data
b - Freeboard = Elevation of Emergency Spillway - Peak Water Surface Elevation

Existing Conditions

Project: Kelleher I-40 South
Simulation Run: Existing Reservoir: POND 4

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_EX
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	11Jul2014, 16:48:37	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	63.623 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:35
Peak Outflow :	19.611 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 07:15
Total Inflow :	12.234 (AC-FT)	Peak Storage :	3.486 (AC-FT)
Total Outflow :	12.233 (AC-FT)	Peak Elevation :	5152.10 (FT)

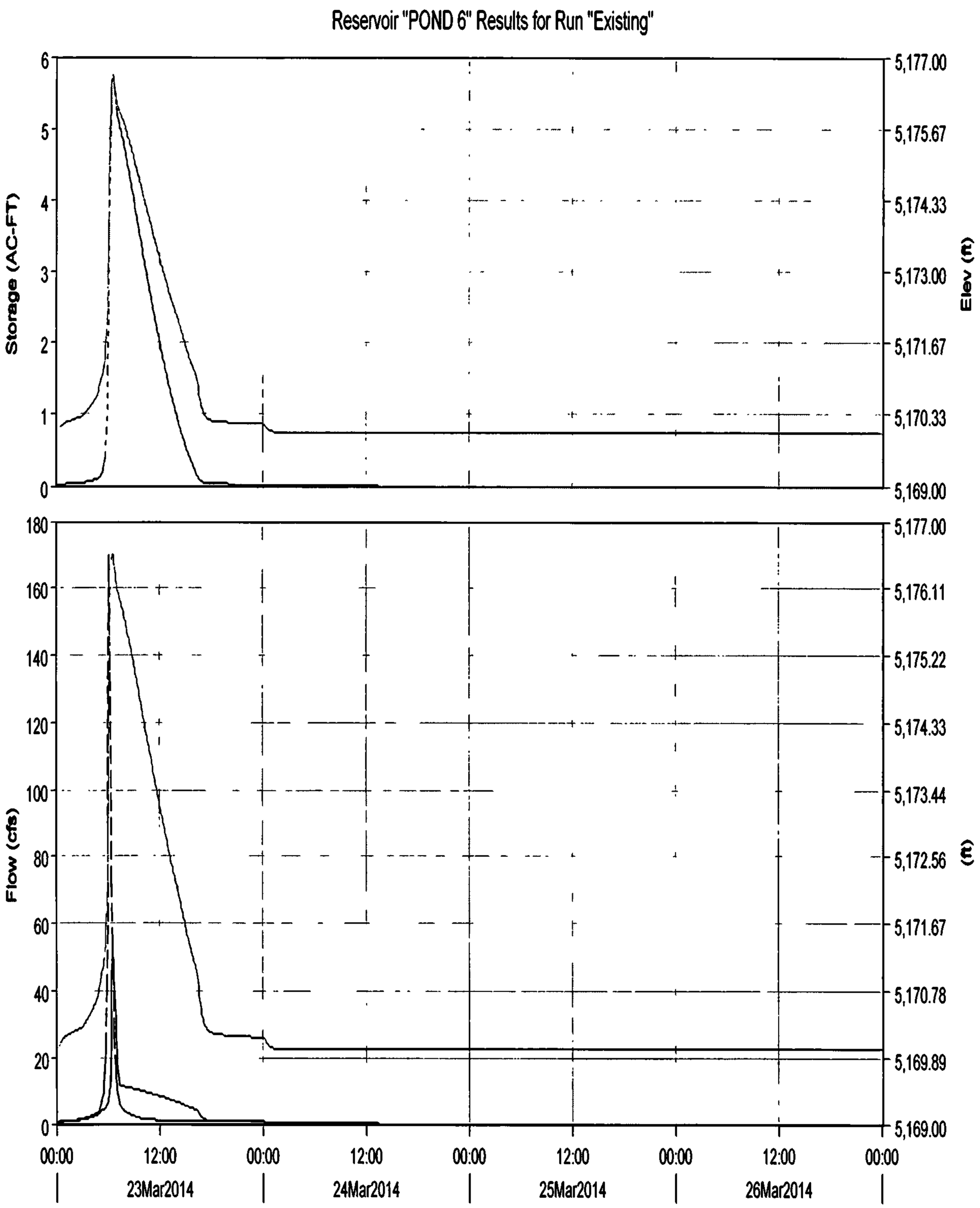
Project: Kelleher I-40 South
Simulation Run: Existing Reservoir: POND 6

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_EX
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	11Jul2014, 16:48:37	Control Specifications:	Control 1

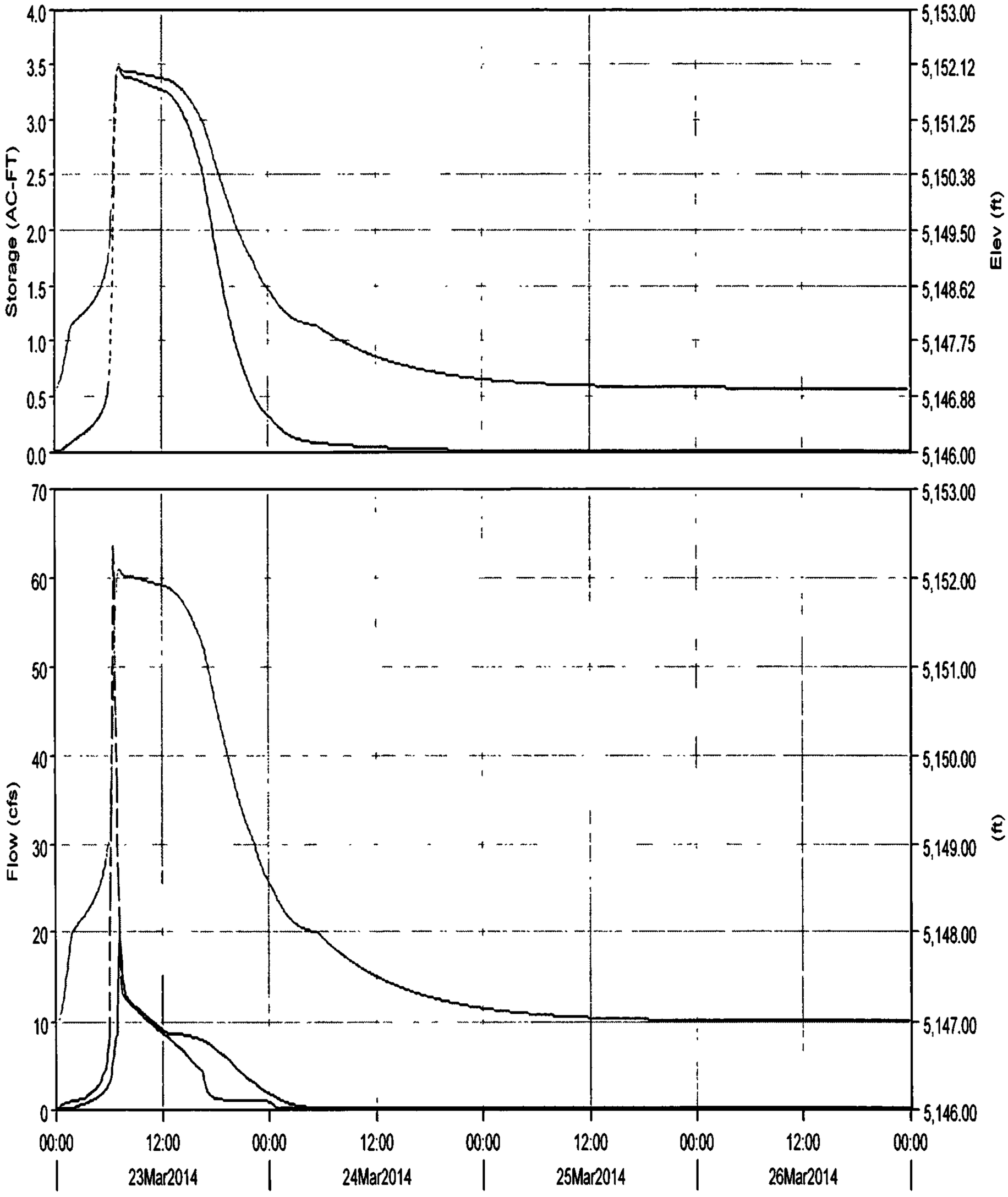
Volume Units: AC-FT

Computed Results

Peak Inflow :	170.129 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:15
Peak Outflow :	50.362 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:35
Total Inflow :	10.488 (AC-FT)	Peak Storage :	5.743 (AC-FT)
Total Outflow :	10.488 (AC-FT)	Peak Elevation :	5176.57 (FT)


Reservoir "POND 6" Results for Run "Existing"
Storage (AC-FT)
Elev (ft)
Flow (cfs)
Elev (ft)
6
5
4
3
2
1
0
5,177.00
5,175.67
5,174.33
5,173.00
5,171.67
5,170.33
5,169.00
180
160
140
120
100
80
60
40
20
0
5,177.00
5,176.11
5,175.22
5,174.33
5,173.44
5,172.56
5,171.67
5,170.78
5,169.89
5,169.00
00:00
12:00
00:00
12:00
00:00
12:00
00:00
12:00
00:00
23Mar2014
24Mar2014
25Mar2014
26Mar2014
Run:Existing Element:POND 6 Result:Storage
Run:Existing Element:POND 6 Result:Outflow
Run:Existing Element:POND 6 Result:Stage
Run:Existing Element:POND 6 Result.Pool Elevation
Run:Existing Element:POND 6 Result.Combined Flow

Reservoir "POND 4" Results for Run "Existing"



Run:Existing Element:POND 4 Result:Storage

Run:Existing Element:POND 4 Result:Outflow

Run:Existing Element:POND 4 Result:Stage

Run:Existing Element:POND 4 Result:Pool Elevation

Run:Existing Element:POND 4 Result:Combined Flow

DEVEX_SMITH

Project: Kelleher I-40 South
Simulation Run: DEVEX_SMITH Reservoir: POND 4

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_DEVEX_SMITH
End of Run:	27Mar2014, 00:05	Meteorologic Model:	Smith Rainfall
Compute Time:	11Jul2014, 16:57:02	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results—

Peak Inflow :	178.024 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 07:05
Peak Outflow :	103.659 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 07:20
Total Inflow :	23.127 (AC-FT)	Peak Storage :	5.693 (AC-FT)
Total Outflow :	23.127 (AC-FT)	Peak Elevation :	5153.95 (FT)

Project: Kelleher I-40 South
Simulation Run: DEVEX_SMITH Reservoir: POND 6

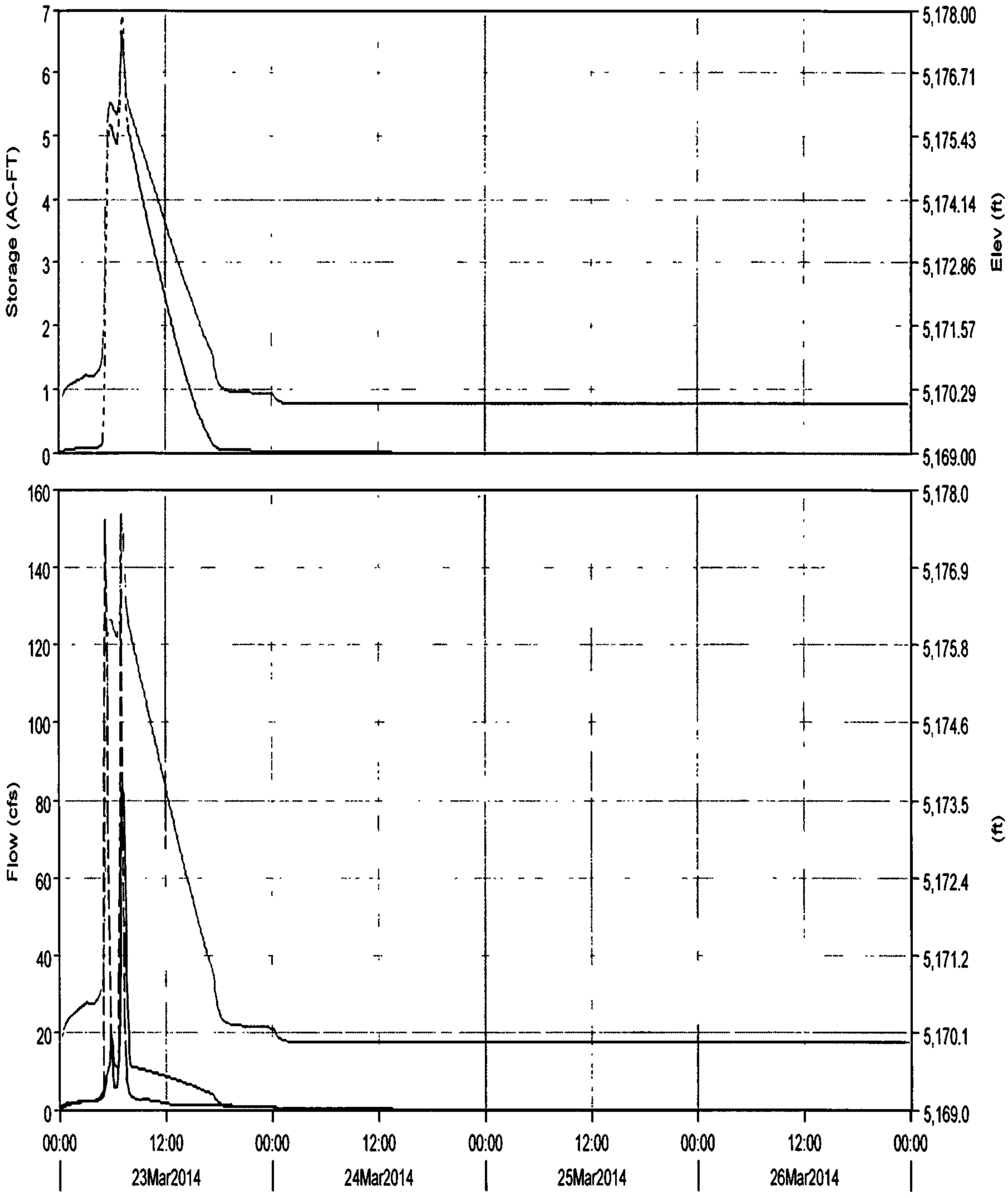
Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_DEVEX_SMITH
End of Run:	27Mar2014, 00:05	Meteorologic Model:	Smith Rainfall
Compute Time:	11Jul2014, 16:57:02	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	153.715 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 07:05
Peak Outflow :	82.916 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 07:15
Total Inflow :	14.539 (AC-FT)	Peak Storage :	6.886 (AC-FT)
Total Outflow :	14.539 (AC-FT)	Peak Elevation :	5177.52 (FT)

Reservoir "POND 6" Results for Run "DEVEX_SMITH"



Run:DEVEX_SMITH Element:POND 6 Result:Storage

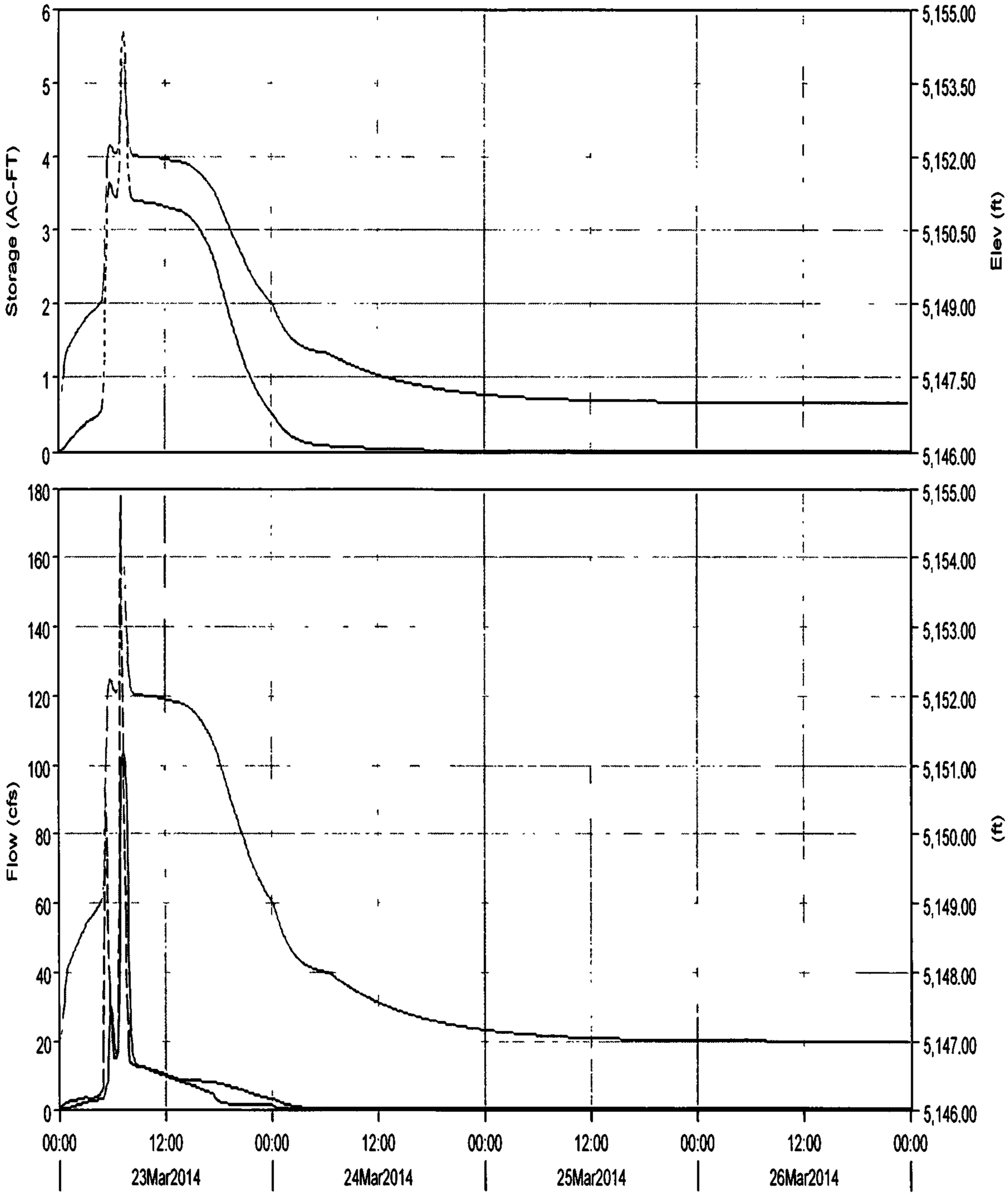
Run:DEVEX_SMITH Element:POND 6 Result:Outflow

Run:DEVEX_SMITH Element:POND 6 Result:Stage

Run:DEVEX_SMITH Element:POND 6 Result.Pool Elevation

Run:DEVEX_SMITH Element.POND 6 Result.Combined Flow

Reservoir "POND 4" Results for Run "DEVEX_SMITH"



Run:DEVEX_SMITH Element:POND 4 Result:Storage

Run.DEVEX_SMITH Element:POND 4 Result.Outflow

Run:DEVEX_SMITH Element:POND 4 Result:Stage

Run.DEVEX_SMITH Element:POND 4 Result.Pool Elevation

Run:DEVEX_SMITH Element:POND 4 Result:Combined Flow

DEVEX1

Project: Kelleher I-40 South
Simulation Run: DEVEX_1 Reservoir: POND 4

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 South_DEVEX1
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	14Jul2014, 07:32:19	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	203.529 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:20
Peak Outflow :	109.309 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:45
Total Inflow :	23.474 (AC-FT)	Peak Storage :	6.373 (AC-FT)
Total Outflow :	23.474 (AC-FT)	Peak Elevation :	5154.43 (FT)

Project: Kelleher I-40 South
Simulation Run: DEVEX_1 Reservoir: POND 6

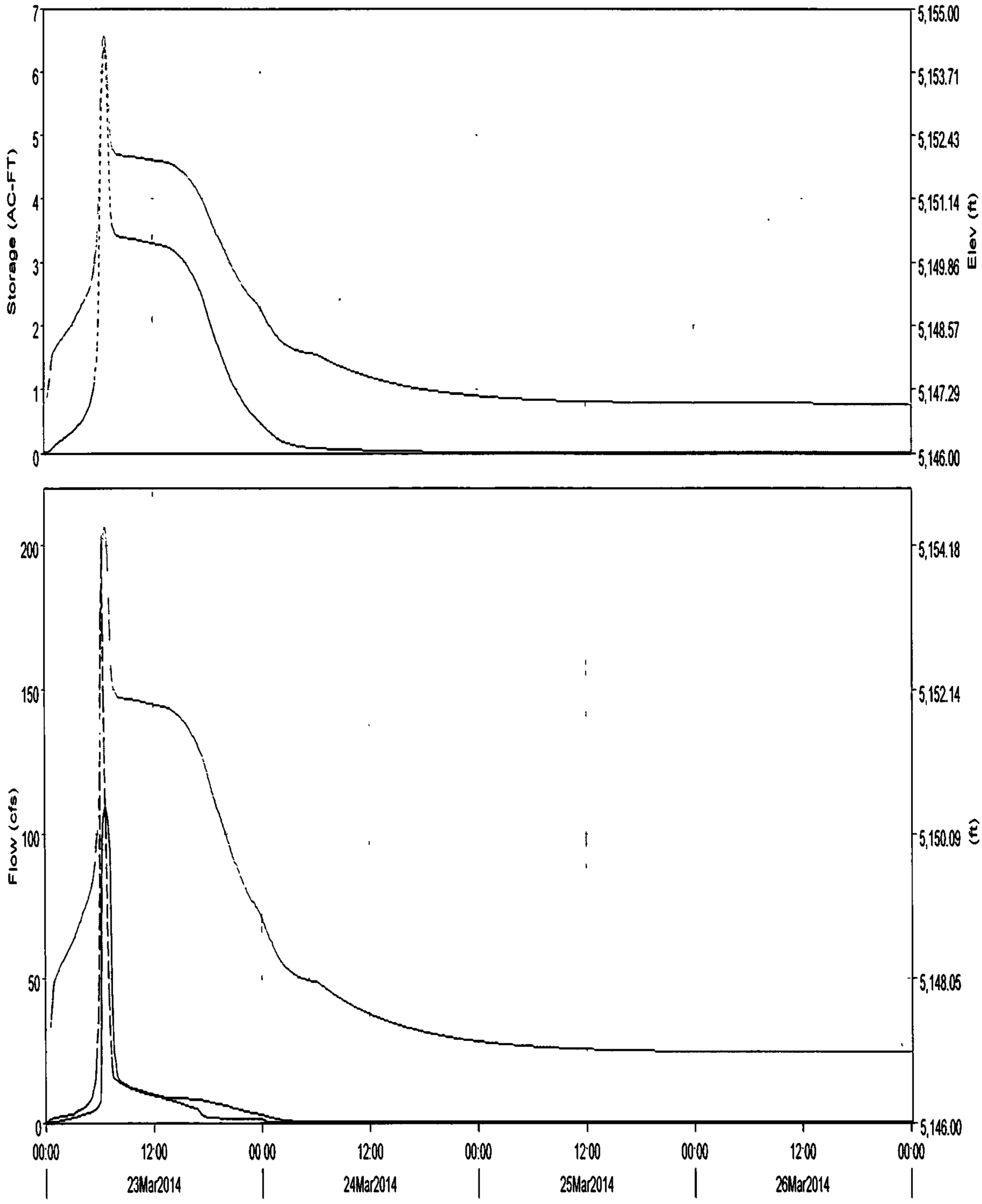
Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 South_DEVEX1
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	14Jul2014, 07:32:19	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	231.448 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:10
Peak Outflow :	83.133 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:30
Total Inflow :	13.830 (AC-FT)	Peak Storage :	6.925 (AC-FT)
Total Outflow :	13.830 (AC-FT)	Peak Elevation :	5177.55 (FT)

Reservoir "POND 4" Results for Run "DEVEX_1"



Run:DEVEX_1 Element:POND 4 Result:Storage

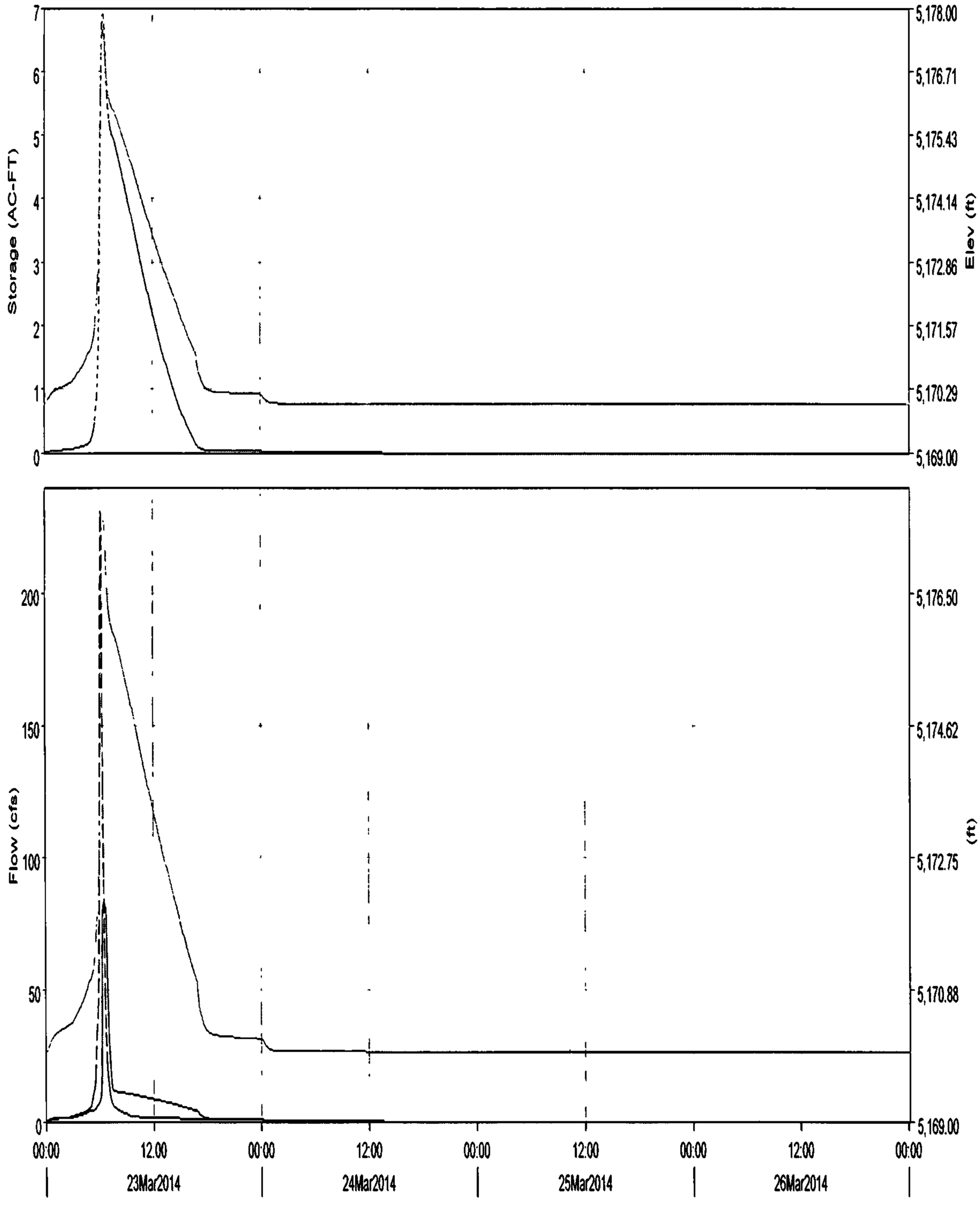
Run:DEVEX_1 Element:POND 4 Result:Pool Elevation

Run.DEVEX_1 Element.POND 4 Result:Outflow

Run:DEVEX_1 Element:POND 4 Result:Combined Flow

Run:DEVEX_1 Element:POND 4 Result:Stage

Reservoir "POND 6" Results for Run "DEVEX_1"



Run:DEVEX_1 Element:POND 6 Result:Storage

Run:DEVEX_1 Element:POND 6 Result:Pool Elevation

Run:DEVEX_1 Element:POND 6 Result:Outflow

Run DEVEX_1 Element:POND 6 Result:Combined Flow

Run:DEVEX_1 Element:POND 6 Result:Stage

DEVEX2

Project: Kelleher I-40 South
Simulation Run: DEVEX_2 Reservoir: POND 4

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_DEVEX2
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	14Jul2014, 07:35:09	Control Specifications:	Control 1

Volume Units: AC-FT

-Computed Results

Peak Inflow :	215.929 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:20
Peak Outflow :	106.901 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:45
Total Inflow :	23.474 (AC-FT)	Peak Storage :	6.078 (AC-FT)
Total Outflow :	23.474 (AC-FT)	Peak Elevation :	5154.22 (FT)

Project: Kelleher I-40 South
Simulation Run: DEVEX_2 Reservoir: Pond 5

Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_DEVEX2
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	14Jul2014, 07:35:09	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	98.227 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:10
Peak Outflow :	78.427 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:20
Total Inflow :	5.431 (AC-FT)	Peak Storage :	1.592 (AC-FT)
Total Outflow :	5.431 (AC-FT)	Peak Elevation :	5164.86 (FT)

Project: Kelleher I-40 South
Simulation Run: DEVEX_2 Reservoir: POND 6

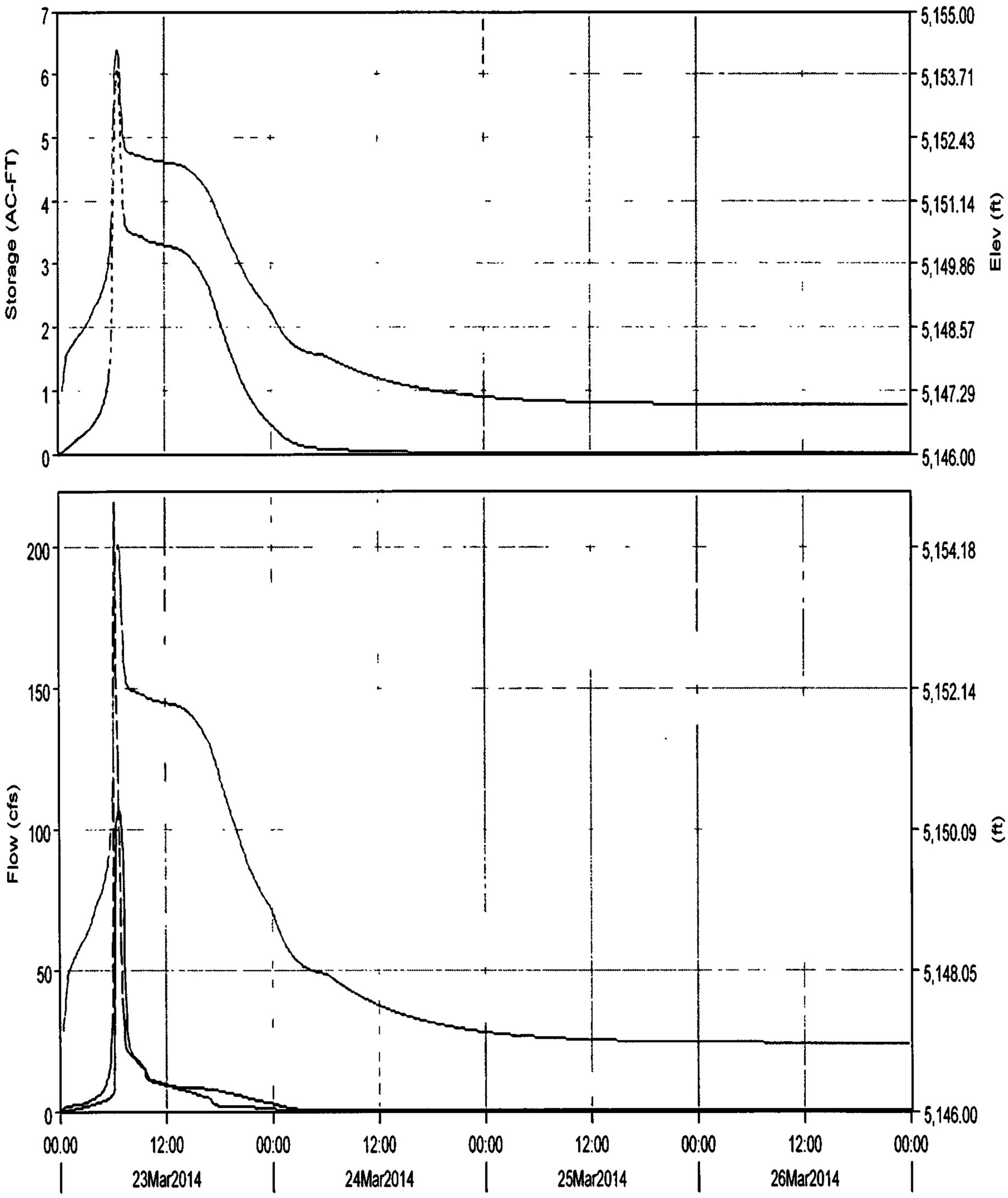
Start of Run:	23Mar2014, 00:00	Basin Model:	I-40 SOUTH_DEVEX2
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	14Jul2014, 07:35:09	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	231.448 (CFS)	Date/Time of Peak Inflow :	23Mar2014, 06:10
Peak Outflow :	83.133 (CFS)	Date/Time of Peak Outflow :	23Mar2014, 06:30
Total Inflow :	13.830 (AC-FT)	Peak Storage :	6.925 (AC-FT)
Total Outflow :	13.830 (AC-FT)	Peak Elevation :	5177.55 (FT)

Reservoir "POND 4" Results for Run "DEVEX_2"



Run:DEVEX_2 Element:POND 4 Result:Storage

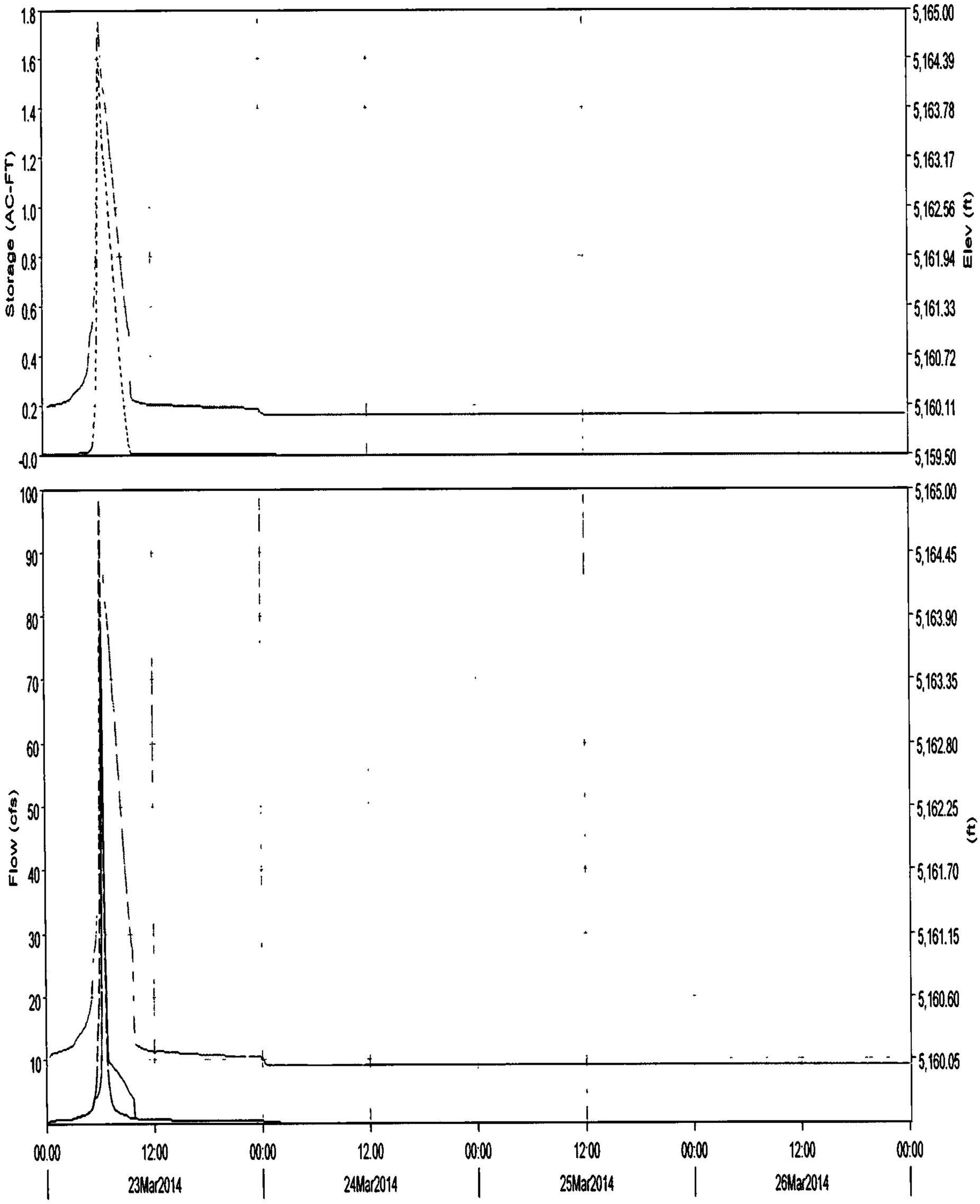
Run:DEVEX_2 Element:POND 4 Result:Outflow

Run:DEVEX_2 Element:POND 4 Result:Stage

Run:DEVEX_2 Element:POND 4 Result:Pool Elevation

Run:DEVEX_2 Element:POND 4 Result:Combined Flow

Reservoir "Pond 5" Results for Run "DEVEX_2"



Run:DEVEX_2 Element:POND 5 Result:Storage

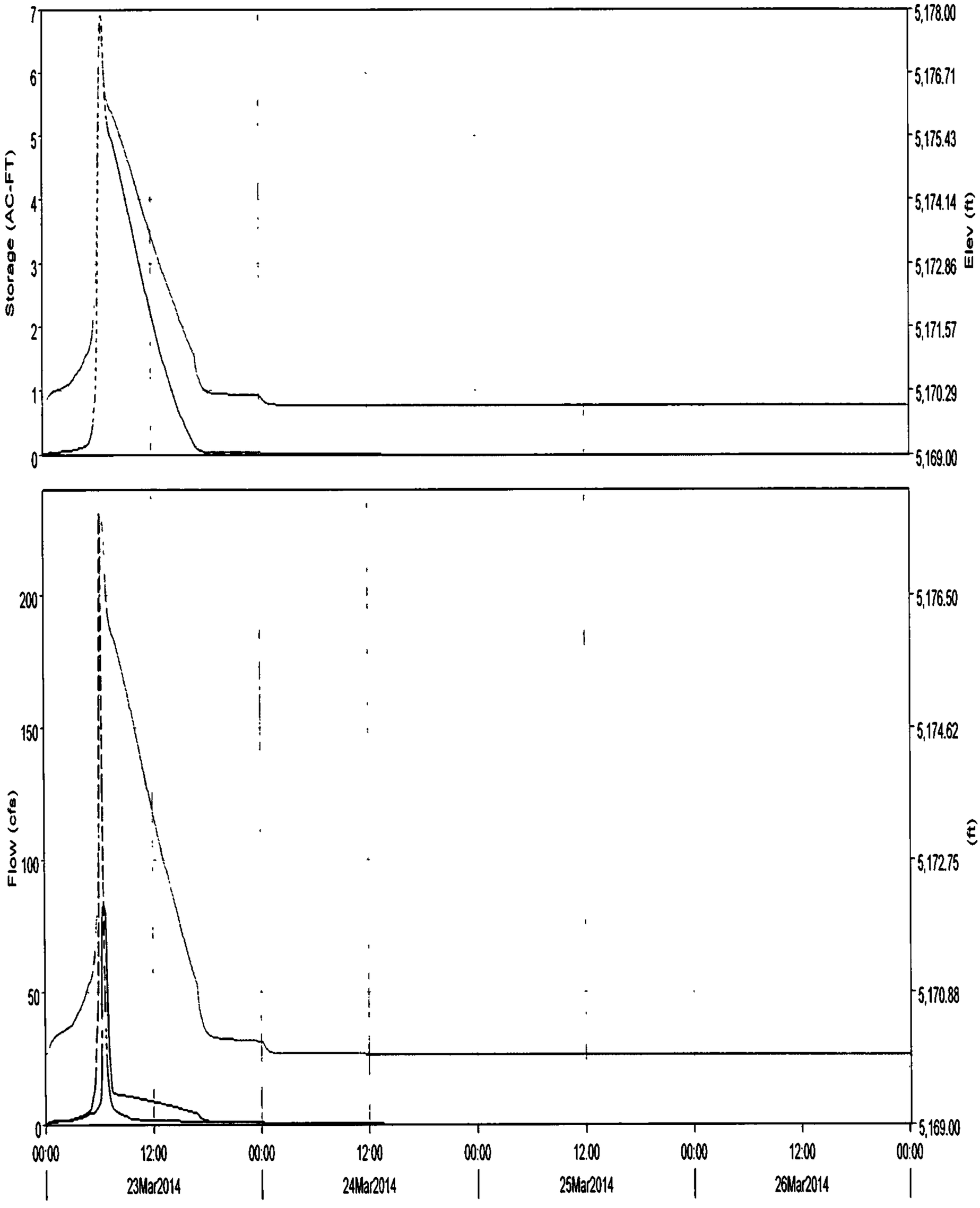
Run:DEVEX_2 Element:POND 5 Result:Pool Elevation

Run:DEVEX_2 Element POND 5 Result:Outflow

Run:DEVEX_2 Element:POND 5 Result:Combined Flow

Run:DEVEX_2 Element:POND 5 Result:Stage

Reservoir "POND 6" Results for Run "DEVEX_2"



Run:DEVEX_2 Element:POND 6 Result:Storage

Run:DEVEX_2 Element:POND 6 Result:Pool Elevation

Run:DEVEX_2 Element:POND 6 Result:Outflow

Run:DEVEX_2 Element POND 6 Result:Combined Flow

Run:DEVEX_2 Element:POND 6 Result:Stage

DEVEX_OPTION1

Project: Kelleher I-40 South
Simulation Run: DEVEX_OPTION1 Reservoir: POND 4

Start of Run:	23Mar2014, 00:00	Basin Model:	DEVEX-Option1
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	11Jul2014, 16:14:32	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	**147.128 (CFS)**	**Date/Time of Peak Inflow :**	**23Mar2014, 06:20**
Peak Outflow :	**96.443 (CFS)**	**Date/Time of Peak Outflow :**	**23Mar2014, 06:50**
Total Inflow :	**23.474 (AC-FT)**	**Peak Storage :**	**4.934 (AC-FT)**
Total Outflow :	**23.474 (AC-FT)**	**Peak Elevation :**	**5153.33 (FT)**

Project: Kelleher I-40 South
Simulation Run: DEVEX_OPTION1 Reservoir: Pond 5

Start of Run:	23Mar2014, 00:00	Basin Model:	DEVEX-Option1
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	11Jul2014, 16:14:32	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	98.227 (CFS)	**Date/Time of Peak Inflow :**	23Mar2014, 06:10
Peak Outflow :	10.462 (CFS)	**Date/Time of Peak Outflow :**	23Mar2014, 06:45
Total Inflow :	5.431 (AC-FT)	**Peak Storage :**	3.143 (AC-FT)
Total Outflow :	5.431 (AC-FT)	**Peak Elevation :**	5167.66 (FT)

Project: Kelleher I-40 South
Simulation Run: DEVEX_OPTION1 Reservoir: POND 6

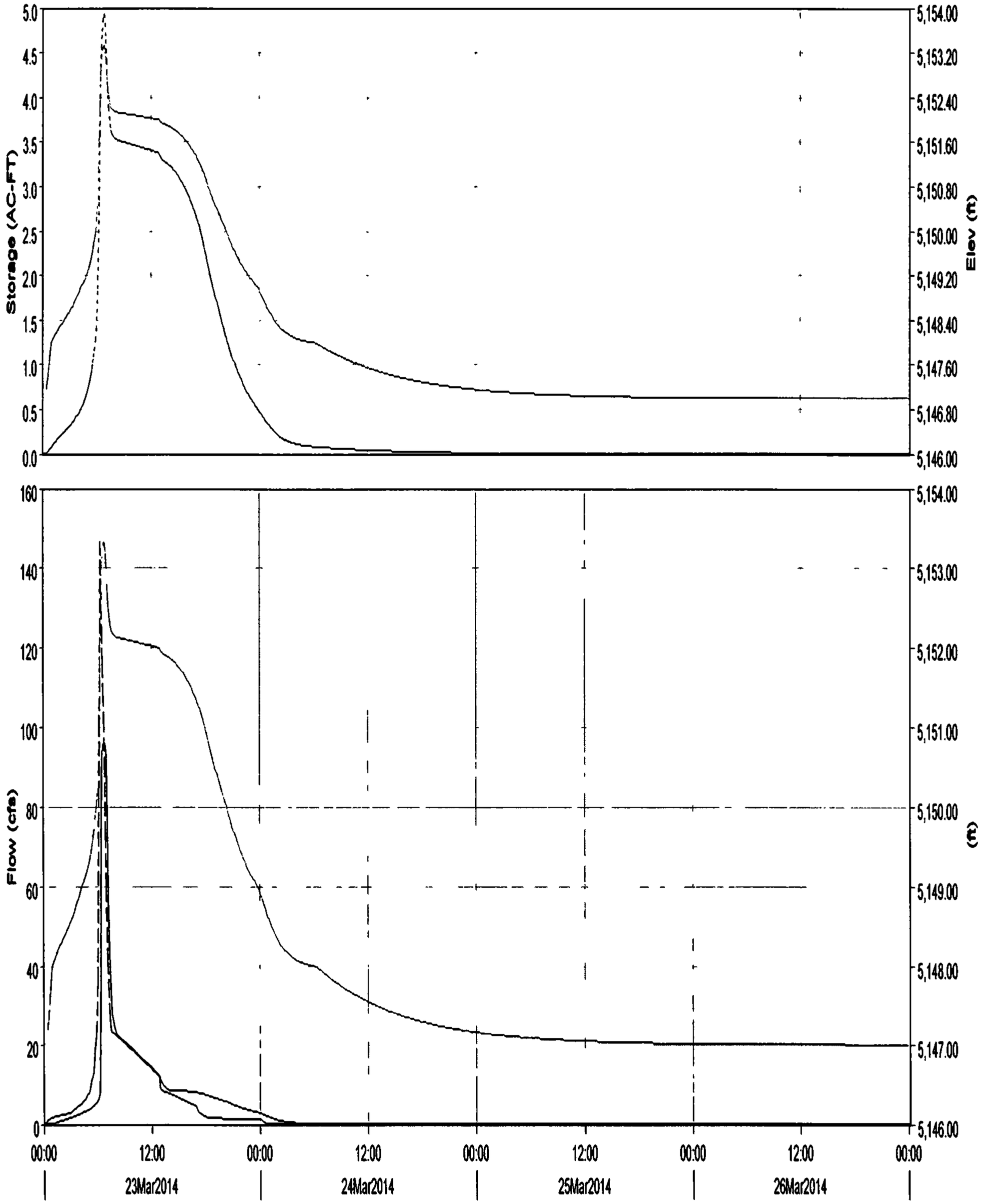
Start of Run:	23Mar2014, 00:00	Basin Model:	DEVEX-Option1
End of Run:	27Mar2014, 00:05	Meteorologic Model:	100Yr-24Hr NOAA 14
Compute Time:	11Jul2014, 16:14:32	Control Specifications:	Control 1

Volume Units: AC-FT

Computed Results

Peak Inflow :	**231.448 (CFS)**	**Date/Time of Peak Inflow :**	**23Mar2014, 06:10**
Peak Outflow :	**83.133 (CFS)**	**Date/Time of Peak Outflow :**	**23Mar2014, 06:30**
Total Inflow :	**13.830 (AC-FT)**	**Peak Storage :**	**6.925 (AC-FT)**
Total Outflow :	**13.830 (AC-FT)**	**Peak Elevation :**	**5177.55 (FT)**

Reservoir "POND 4" Results for Run "DEVEX_OPTION1"



Run:DEVEX_OPTION1 Element:POND 4 Result:Storage

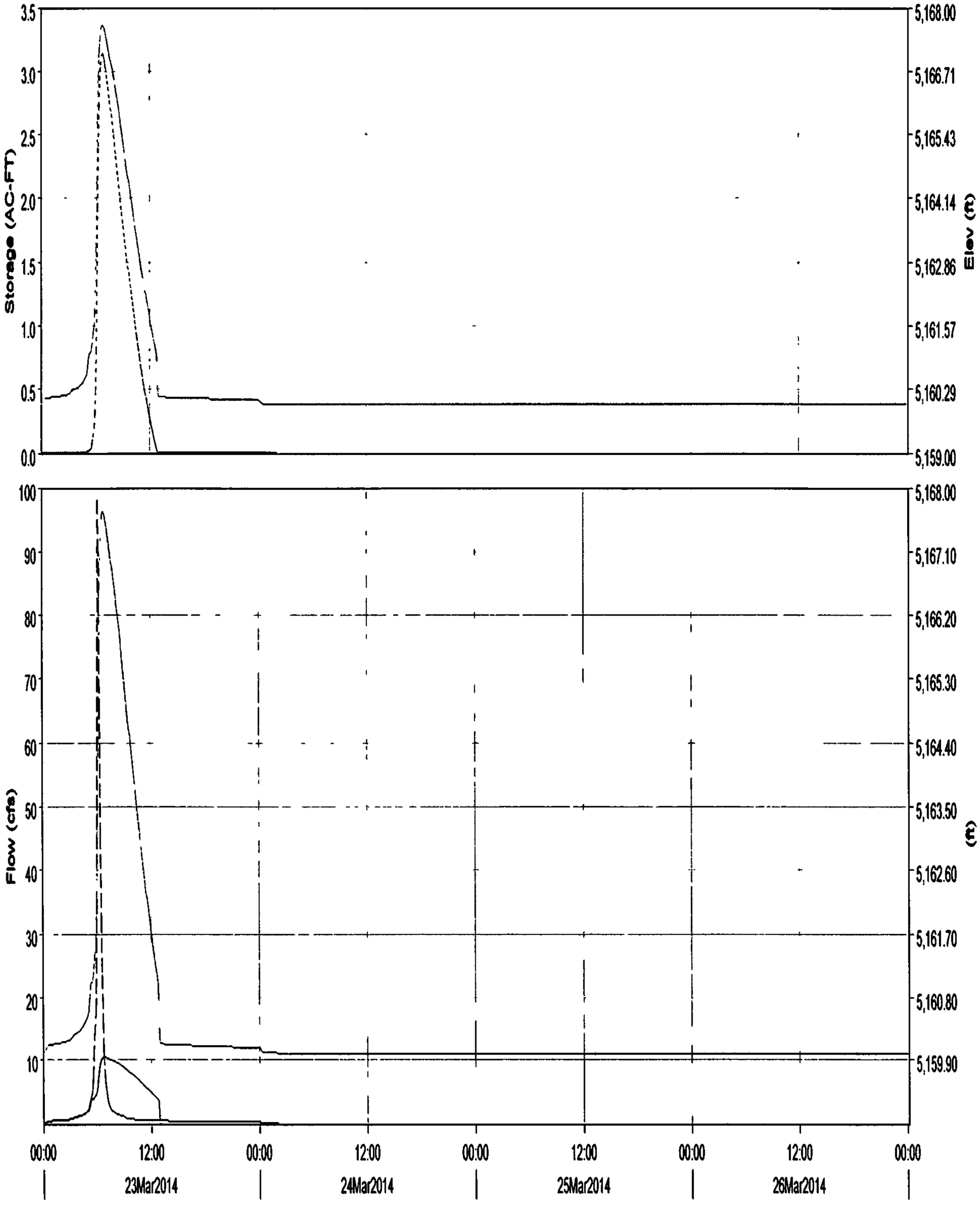
Run:DEVEX_OPTION1 Element:POND 4 Result:Pool Elevation

Run:DEVEX_OPTION1 Element:POND 4 Result:Outflow

Run:DEVEX_OPTION1 Element:POND 4 Result:Combined Flow

Run:DEVEX_OPTION1 Element:POND 4 Result:Stage

Reservoir "Pond 5" Results for Run "DEVEX_OPTION1"



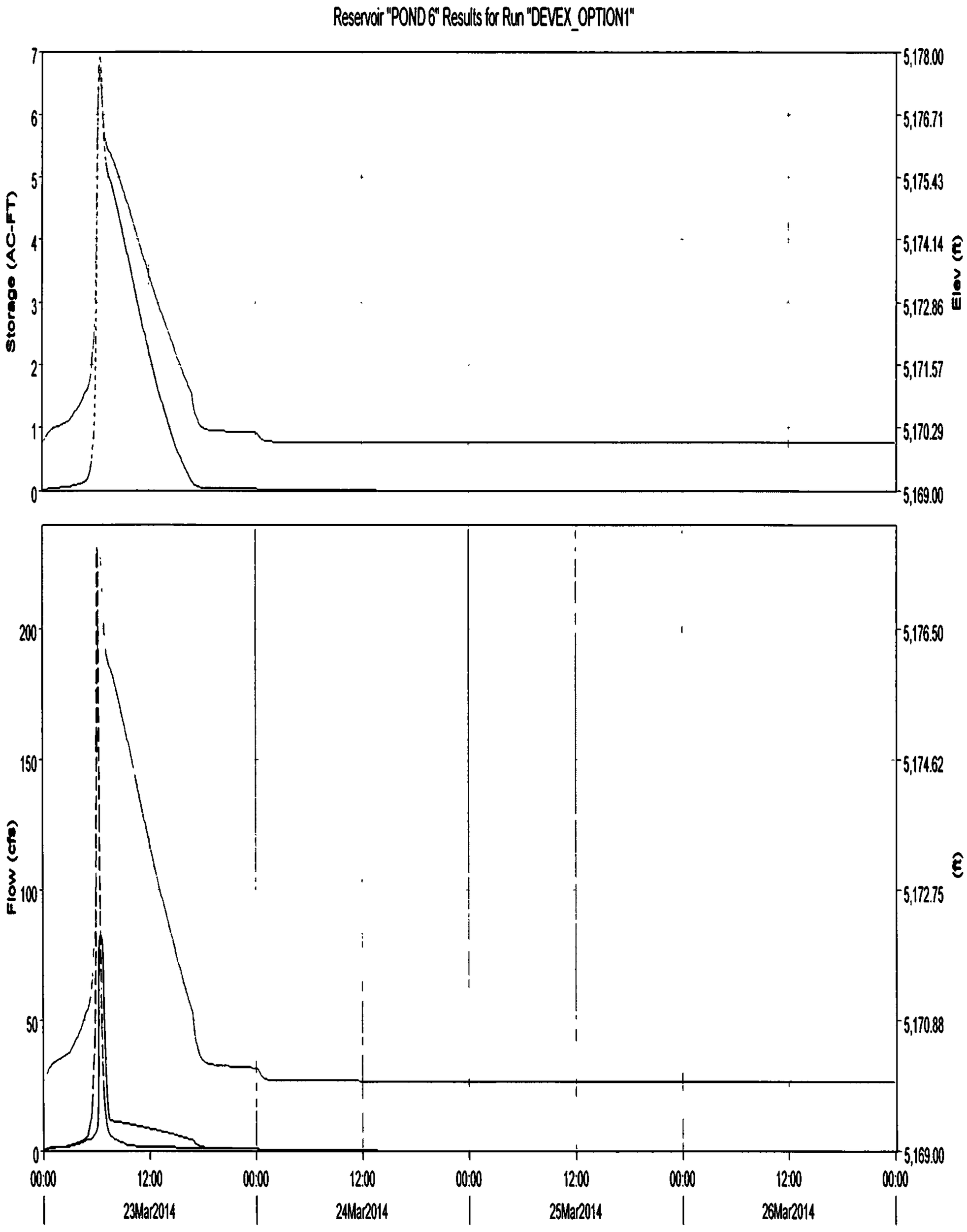
Run:DEVEX_OPTION1 Element.POND 5 Result:Storage

Run.DEVEX_OPTION1 Element:POND 5 Result.Pool Elevation

Run:DEVEX_OPTION1 Element.POND 5 Result:Outflow

Run:DEVEX_OPTION1 Element.POND 5 Result:Combined Flow

Run:DEVEX_OPTION1 Element:POND 5 Result:Stage


Reservoir "POND 6" Results for Run "DEVEX_OPTION1"
Storage (AC-FT)
7
6
5
4
3
2
1
0
5,178.00
5,176.71
5,175.43
5,174.14
5,172.86
5,171.57
5,170.29
5,169.00
Elev (ft)
Flow (cfs)
200
150
100
50
0
5,176.50
5,174.62
5,172.75
5,170.88
5,169.00
00:00
12:00
00:00
12:00
00:00
12:00
00:00
12:00
00:00
23Mar2014
24Mar2014
25Mar2014
26Mar2014
Run:DEVEX_OPTION1 Element:POND 6 Result:Storage
Run:DEVEX_OPTION1 Element:POND 6 Result:Pool Elevation
Run:DEVEX_OPTION1 Element:POND 6 Result:Outflow
Run:DEVEX_OPTION1 Element:POND 6 Result:Combined Flow
Run:DEVEX_OPTION1 Element:POND 6 Result:Stage

Appendix B.4

Hydraulic Computations

CAPACITY CALCULATION FOR 36" STORM DRAIN FROM POND 6 TO POND 4.

GIVEN (FROM AS-BUILT FOR ANSER DIVERSION CHANNEL SHEET 6/25)

ϕ = 36" = 3 ft
SLOPE = 0.027 ft/ft
n = 0.013

COMPUTE AREA → $A = \pi r^2$
$A = \pi (1.5)^2 = 7.07 \text{ ft}^2$

COMPUTE PERIMETER → $P = 2\pi r$
$= 2\pi (1.5) = 9.42 \text{ ft}$

COMPUTE HYDRAULIC RADIUS ASSUMING FULL FLOW →

$R = A/P$

$R = \frac{7.07 \text{ ft}^2}{9.42 \text{ ft}} = 0.75 \text{ ft}$

COMPUTE Q_{MAX} USING MANNINGS EQUATION ASSUMING FULL FLOW.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$Q = \left(\frac{1.49}{0.013}\right)(7.07)(0.75)^{2/3}(0.027)^{1/2}$$

$Q_{MAX} = 109.9 \text{ CFS} \approx 110 \text{ CFS}$

Use Mannings Equation to Iteratively Determine the Size of Storm drain in Los Volcanes to drain future developed flows from subbasins C-1D and C-2D.1 to Pond 4 Assuming Pipe Flowing Full		
Mannings Equation [a]		Q=(1.49/n)*A*R^2/3*S^1/2
Paramters		Comments
Diameter (ft)	3.00	Guess diameter (d) until Qcalculated is > Qdesign
n value	0.013	Assumes new RCP pipe conditions
Constant	1.49	From Manning's Equation
Radius (ft)	**1.50**	Computes r = d/2
Perimeter (ft)	**9.44**	Computes P = 2*π*r
Area (ft^2)	**7.08**	Compute A= (π/4)*d^2
Hyraulic Radius (R) (ft)	**0.75**	Computes R= A/P
Slope (S) (ft/ft)	0.020	Assumes SD slope will approximte Los Volcanes Rd slope
Elevation 1	5218.00	From LiDAR
Elevation 2	5150.00	From LiDAR/ Unser Diversion As-built drawing for Pond 4
Length (ft)	1400.00	From LiDAR
Q Calculated (cfs)	**94.7**	Uses equation Listed above to compute Q
Q (cfs) Design	69.00	From HEC-HMS DEVEX Model AP-6 west of FEDEX Site
Q (cfs) Design	72.00	From HEC-HMS DEVEX Model AP-7
Since Q calculated is less then Q design, 36 inch storm drain should have adequate capacity to carry DEVEX flows		
[a] Handbook for Hydraulics by Brater/King, page 7.22 Eqn 7.34		
Indicates cell that need data input		
Indicates cell that performs calculations		

B.4

Orifice Equation [a]			
q = CA(2gH)^1/2			
Orifice Diameter (inches)			12
Orifice Area ft^2)			0.79
Orifice Coeffecient			0.6
Elevation (ft)	Head (ft)	Discharge (cfs)	
5160	0	0.0	
5161	1	3.8	
5162	2	5.3	
5163	3	6.5	
5164	4	7.6	
5164.5	4.5	8.0	
5165	5	8.5	
5165.5	5.5	8.9	
5166	6	9.3	
5167	7	10.0	
5168	8	10.7	
5168.8	8.8	11.2	
5169	9	11.3	
5170	10	12.0	
[a] Handbook of Hydraulics by Brater/King, page 4.28, Eqn 4.10			

Appendix "C"

Appendix C

Reference Projects

(Refer to DVD)

Appendix D

Full Size Plates 1 and 2