From: Hayden Ausland
Sent: Thursday, December 10, 2020 10:58 AM
To: 'grluci@gmail.com'; Kim McMillan
Cc: 'JWLuci@gmail.com'; Tabitha Boschetti; Steve Koper
Subject: RE: Stormwater Master Plan - Public Comment Period

Hi Grace,

I'm certainly not the expert when it comes to Planning Commission or City Council Meetings, so I've reached out to a coworker (Tabitha) for some clarification on this and have also Cc'd her with this email in case I muck anything up.

The City Council meeting would be a public hearing with a formal opportunity for verbal testimony at the hearing, and/or written testimony. Anyone can testify. The packet of materials going to Council is published one week before the hearing. We would let you know ahead of time which Council Meeting the Stormwater Master Plan will be on the agenda. The specific date for the Planning Commission and the City Council meetings have not yet been set for approval of this document. Once these dates are confirmed, we would be happy to let you know.

The Planning Commission meeting would not be a formal hearing. The Planning Commission reviews proposed Plan Text Amendments in their role as an advisory body and can choose to make a recommendation to City Council. There is still a more general opportunity for members of the public to share comments with the Planning Commission during this meeting.

Although community members may provide comments and feedback during these meetings, it should be noted that the Stormwater Master Plan will be presented for adoption in its **Final Draft** form. Right now is probably the best opportunity to provide feedback and comments on the Stormwater Master Plan.

Although Kim is the new the Community Development Director, she is also continuing her role as the City Engineer (which us engineers are very happy about ☺).

Regards,

Hayden Ausland, EIT, CPSWQ
Engineering Associate - Water Quality
City of Tualatin
P 503.691.3037 | **C** 971.978.8217

From: G Lucini <grluci@gmail.com>
Sent: Monday, December 7, 2020 3:43 PM
To: Hayden Ausland <hausland@tualatin.gov>; Kim McMillan <kmcmillan@tualatin.gov>
Cc: John Lucini <JWLuci@gmail.com>
Subject: Re: Stormwater Master Plan - Public Comment Period

Hi Hayden,

I have a couple of quick questions as to how the City's proposed Stormwater Master Plan Update will be handled with regards to the role of Citizens and Citizen Input/Comments during the Plan Update process. We have had a few issues in the past years, and do appreciate your emails informing us of the ability to submit Citizen Comments on this Master Plan Update.

We want to gain a better understanding as to the City's process -and the role and actions Citizens may take to keep informed and participate in the Stormwater Management Master Plan Update.

I understand the City is providing a Citizen Comment period ending December 15th.
And I understand the proposed Master Plan will then be presented to the Planning Commission, and then to the City Council for adoption into the City's governing documents.

Questions:
1) Will Citizens be provided opportunities for additional Citizen Comments during those two Public Meetings (Planning Commission and/or City Council), as well as during this Comment Period ending on Dec 15th?

2) Should the City make revisions to the proposed plan currently being presented to the Public for comment--- will Citizens who provided Comments on the proposed Master Plan Update Citizen Comment Period ending 12-15-2020---be informed of changes or revisions (Major or minor) made to the proposed Update?

> **And will those Citizens who provided comment be provided reasonable advanced access and information as to any changes which may occur after December 15th---- and prior to the next Public Meeting where any proposed changes will be presented?**

3) I understand Kim has had a change in her responsibilities at the City, and was wondering who will be assuming her previous role as City Engineer?

As I have expressed previously, my husband and I would like to receive ***Actual Notice*** **of any Public Meeting/s regarding the proposed changes to the City's Master Plan for Stormwater Management- including but not limited to the City of Tualatin Planning Commission and/or the City of Tualatin City Council.**
As Interested Persons, and potentially affected downstream property owners in the Basalt Creek Area, we are again providing our contact information in order to be provided such a Notice. (ORS 192.640).

As our home and property are located in the Basalt Creek Area, outside the City of Tualatin City Limits, and we may potentially be directly or indirectly impacted by potential changes to the City's proposed update to the Stormwater Master Plan- we again express our appreciation of efforts taken to keep us informed regarding this action under consideration by the City of Tualatin.

Grace Lucini

23677 SW Boones Ferry Road

Tualatin OR 97062

GrLuci@gmail.com

John Lucini

23677 SW Boones Ferry Road
Tualatin OR 97062

JWLuci@gmail.com

Regards,
Grace

On Wed, Dec 2, 2020 at 11:07 AM G. Lucini <grluci@gmail.com> wrote:

> Thank you Hayden!
> I have skimmed the report.
> Working on putting together my comments when I can do a deeper review.
>
> Hope you and yours are well and having an opportunity to enjoy the holiday season.
> Grace
>
> Sent from my iPhone
>
> On Dec 2, 2020, at 9:59 AM, Hayden Ausland <hausland@tualatin.gov> wrote:
>
> Hi Grace,
>
> I just wanted to let you know that our virtual Stormwater Open House website is now live and the comment period is active. Here is a link to the Open House website: Stormwater Master Plan Virtual Open House.
>
> Regards,
>
> **Hayden Ausland, EIT, CPSWQ**
>
> Engineering Associate - Water Quality

City of Tualatin

P 503.691.3037 | **C** 971.978.8217

From: Hayden Ausland
Sent: Tuesday, November 24, 2020 4:55 PM
To: grluci@gmail.com
Cc: Kim McMillan <kmcmillan@tualatin.gov>; JWLuci@gmail.com
Subject: Stormwater Master Plan - Public Comment Period

Good afternoon Grace,

I wanted to let you know that Tualatin is scheduled to open the period for Public Comment on December 1st for the Stormwater Master Plan. The comment period will be open from Dec 1 through December 15. Once we have the website officially up and running, I will send you another email with a link to that website.

Hope you have an enjoyable Thanksgiving.

Regards,

Hayden Ausland, EIT, CPSWQ

Engineering Associate - Water Quality

City of Tualatin

P 503.691.3037 | **C** 971.978.8217

From: Hayden Ausland
Sent: Tuesday, December 15, 2020 4:32 PM
To: Megan George; Kelsey Lewis
Subject: FW: 2019 Stormwater Master Plan questions and thoughts

FYI,

More Stormwater Master Plan comments and questions.

Regards,

Hayden Ausland, CPSWQ
Engineering Associate - Water Quality
City of Tualatin
P 503.691.3037 | C 971.978.8217

-----Original Message-----
From: Marissa Houlberg <marissa@houlbergdevelopment.com>
Sent: Monday, December 14, 2020 1:57 PM
To: Engineering External Email <engineering@tualatin.gov>
Subject: 2019 Stormwater Master Plan questions and thoughts

Thank you for sharing the document with all and requesting feedback!

This document is dated April 2019 but we are reviewing December 2020. Why over a year to seek feedback when the document was completed early 2019?

There was an updated flood map issued for our area within the last ten years, I believe. Can this be included in the document?

Overview questions are:
I believe our TDC requires lawns in the Industrial/Mfg section of the city. Does it make sense now to not require lawns because of maintenance/herbicide/water issues and instead give guidance to native plantings? Native plantings require no chemicals, less maintenance and water in addition to protecting stream health.

Do most of our trails do double duty? Are some bioswales too? Can we educate Tualatin residents so that more residents are aware of the not so obvious stormwater street and rooftop work these greenways are performing?

I made notes as I read the plan so will write my comments and questions as listed in my notes.

Page x
Single Family LIDA. What is the purpose of this inspection program, what is included and what are the benefits?

Page 2-4; Table2-2

Impervious for Commercial and Industrial is 74% and 78%. Is this percentage high because of parking lots? Some percentages are as low as 43%.

Page 2-4 Basalt Creek planning timeframe is unknown? There is a residential development going in called Autumn Sunrise or a similar type of name. This residential development is not a part of Basalt Creek? There isn't a hydrological assessment for this development?

Page 2-6; Table 2-4 Inventory Pipers & Open Channels Diameter 0 - 72 inches Diameters of 42-72 inches are pipe or open channels? I seem to remember a very large pipe south side, parallel to Tualatin Sherwood Rd. Is this pipe 72 inches? What is the purpose of this pipe?

Water Quality Facility Maintenance, City Wide What does a Water Quality Facility look like? How does a WQ Facility function? What does maintenance require/entail?

Page 4-2; Why are culverts for Open Channel and ditch (potential road washout) designed for 100 year peak flow? Most appear to be designed for 2 & 10 year flooding. How often are our peak 100 year flows happening; seem like twenty-thirty year frequency?

Page 4-7 Warm Springs, Tonka existing pipes and open channels are undersized.
Can parking areas with pervious surfaces help lower flood occurrences?

How is a creek privately owned? Is it because the landowner owns the land on one or both sides and the creek is included? Is the creek itself owned by the Wetlands Conservancy and not the surrounding land? Considering creeks and rivers extend their boundaries during high water flow does creek ownership extend to the land on either side to accommodate the overflow?

Page 5-3; Table 5-1 Contributing existing Impervious (%) for Saum, Nyberg and Hedges Creeks I noted a 10% jump for contributing 'future' impervious - How do we keep the future number closer to 0%?

Page 6-3; Table 6-2
Contract landscape at 72 sites $108,300 How much maintenance is mowing? Can we replace flat areas with natives not requiring mowing?

Page 6-5, 6-6 Clearing trees
Seqouia Ridge, Sweet Drive Pond
What type of trees need to be cleared? Why? Isn't our goal to shade our watersheds and lower in stream water temperature?

Page 7-10 Stream Vegetation Mgmt.
Cost assumptions based on removing .5 acres of invasive vegetation per year at a unit cost $4.60/sq. ft.; $100,000 per year.
Can local volunteers assist in some of the smaller sites to remove invasives? Not just coordinated, one day removal but possible neighborhood project worked on over a more lax/when they want schedule, greater period of time with what needs to be removed and objectives defined? If residents knew how

much they were saving the city and themselves by doing the work perhaps those numbers would be motivational?

Thank you so much for reading!

Marissa

Submission #3

Print

Submission information

Form: Stormwater Master Plan Comment Form
Submitted by Visitor (not verified)
Tue, 12/15/2020 - 10:37am
50.126.107.254

Name

Marissa Houlberg

Email Address

marissa@houlbergdevelopment.com

Comment/Question *

I sent an email yesterday with a list of comments and questions. I truly appreciate being able to read and submit question on the Master Plan. I look forward to being educated on stormwater treatment and control.

Please provide comments and questions about the Tualatin Stormwater Master Plan for consideration before the plan goes to the Planning Commission and City Council for adoption.

What is your relationship with Tualatin? *

- [x] Live in Tualatin
- [x] Work in Tualatin
- [ ] Neither

Save

12-15-2020

For Public Record- Proposed Update to City of Tualatin Stormwater Management Master Plan

To: The City of Tualatin Department of Engineering

Cc: Members of the Tualatin City Council and City of Tualatin City Council
City of Tualatin Planning Commission

RE: **Proposed Update to City of Tualatin Stormwater Management Master Plan**

My husband and I appreciate the opportunity to provide Citizen Comments on this <u>first</u> opportunity for Public access and Comment Period on the proposed update to the City of Tualatin's Stormwater Management Master Plan being undertaken by the City. We support the efforts of the City to acknowledge and attempt to respond to the various changes and philosophies regarding Stormwater Management which have occurred since the current Master Plan was adopted several years ago.

We also recognize the City of Tualatin has undergone various changes since the City's Stormwater Master Plan was adopted in 1972. It would be expected the scope of the Land Use Master Plan would include all lands within the City limits- as well as lands identified within the future jurisdiction of the City- and assessment, analysis and stormwater management planning would be applied to all the lands within the scope of the project for both current and future needs.

The need for coordination of Land Use Planning between overlapping governments is necessary and mandated. As the northern portion of the Basalt Creek Area is identified as under the future jurisdiction of the City of Tualatin, and the City has already started the urbanization process, it is important for the City of Tualatin to identify a method for ensuring the effective coordination of Land Use Planning with other local governments- especially those with overlapping jurisdictions or responsibilities. The majority of the Basalt Creek Drainage flows south eventually through the City of Wilsonville and into the Willamette River. Very little of Stormwater drainage from the Basalt Creek Area flows north into the City's existing catchment and conveyance system.

Since Washington County currently has ownership and jurisdiction over the existing stormwater system within the Basalt Creek Area, and the County's stormwater conveyance and treatment systems are within lands under various ownerships, it is important for the City provide a well-crafted Stormwater Management Plan for the Basalt Creek Area.

The City already acknowledged in the Basalt Creek Concept Plan of the potential need to upgrade the existing stormwater system within the Basalt Creek Area to accommodate future development within the Area.

Neither my husband nor I are against development.

As citizens and residents of the Basalt Creek Area the ability to participate in this first solicitation for input/feedback by potentially affected Citizens on this proposed update to a City's Land Use Plan is welcomed. We are particularly interested in the creation of a well written fact-based Update to the City's Stormwater Management Master Plan, as our home and property is within the Basalt Creek Area –in an area which the City has future jurisdiction, and downstream from lands recently annexed into the City and are coming under consideration for development.

> As potentially affected Citizens and property owners within unincorporated Washington County, my husband and I have for many years attempted to work with both the City of Tualatin and with Washington County in recognizing and addressing our concerns regarding Stormwater Management within the Basalt Creek Area.

We have presented our concerns as to the need for a fact-based Stormwater Management Plan for the Basalt Creek Area for use as part of Land Use Planning Actions within the area. We have submitted these concerns numerous times, to the staff of the Cities of Tualatin and Wilsonville, to the City of Tualatin Planning Commission, and to the Tualatin City Council including:

- during the development of the Basalt Creek Concept Plan by the Cities of Tualatin and Wilsonville (2012-2018)
- written fact-based testimonies to the City of Tualatin during the City Council 2019 Hearings on the Basalt Creek Comprehensive Plan proposed adoption and integration into the City's governing documents as to the need for further- identification and documentation of Natural Resources, and the need for a Stormwater Plan --to specifically access and address the current and future needs within the scope of the lands to be included within the Comprehensive Plan
- on 3-21-2020 my husband and I submitted written testimony to the Tualatin City Council, again supported by documentation, as to the lack of pertinent facts and information on Land Use Planning for the Public Service of Stormwater Management relating to the application for annexation of 40+acres of lands within the Basalt Creek Area into the City of Tualatin.

My husband and I now present our concerns regarding the proposed Stormwater Management planning within the Basalt Creek Area as presented within the proposed Master Plan Update to the City of Tualatin, the City of Tualatin Planning Commission, and to the City of Tualatin City Council.

This is first opportunity provided by the City for Citizen review and comment on the proposed Update to the City's Stormwater Master Plan.

We note there are inconsistent, conflicting or omitted information between the proposed Update and the City's existing Governing Documents. The lack of relevant, accurate, consistent and necessary information between the proposed Stormwater Master Plan and many of the City's current documents may result in difficulties in the safe effective implementation of Stormwater Management by the City and coordination of Land Use Planning with other governmental units.

Recognizing that my husband and I do not have a professional working knowledge of Stormwater Management or hydraulic dynamics, we have obtained the services of Dave La Liberte, Principal Engineer of Liberte Environmental Associates to review and comment upon the technical aspects of the proposed Update to the City's Master Plan. David M. LaLiberte, P.E., Civil and Environmental Engineer is licensed in the State of Oregon, has compiled these comments under contract with us. Mr. La Liberte' has over 30 years of experience in stormwater, water quality and design solution analysis. His Cumuli Vitae (CV) identifying his education and experience are attached as (Attachment #1 Supplement C). He has personally conducted various hydrodynamic modeling scenarios within the Basalt Creek Area. We believe Mr. La Liberte to be highly qualified to provide relevant comments upon the proposed Update to the City of Tualatin Stormwater Management Master Plan (SWMP).

Mr. La Liberte's comments regarding the City's proposed Update to the SWMP are to be considered a part of our Citizen Comments and are attached.

Also included as an embedded Google Link are additional documents including studies and analysis conducted by Mr. La Liberte' in 2016, ***"Effects of SW Boones Ferry Road Construction (2013-2015) Stormflow Analysis for the Lucini Property Washington County, Oregon"*.**

To offer identification of issues and assistance in a Land Use planning action – allowing the City of Tualatin to gain future jurisdiction over the northern portion of the Basalt Creek Area--this Stormflow Analysis was submitted to the Cities of Tualatin and Wilsonville during the Basalt Creek Concept Planning process. This study has also been provided to the City of Tualatin staff on other subsequent occasions.

SEE EMAIL ATTACHMENT --LA LIBERTE' ENVORONMENTAL ATTACHMENTS #1, #2 & #3 (INCLUDES SUPPLEMENTS)

TECHNICAL COMMENTS RELATING PROPOSED UPDATE TO THE CITY'S MASTER PLAN (Summarization)

A summarization of Review of Document Comments
by Mr. La Liberte, Principle Engineer La Liberte' Environmental Associates:

Significant problems in the Plan for the BFR south area are:

- lack of identified stormwater facilities
- omission of hydrologic and hydraulic modeling analysis
- potential for misapplication of design alternatives
- absence of stormwater problem acknowledgement and evaluation
- no assessment of stormflows on steep slopes
- topography and soils suggest that infiltration is not a likely future runoff design solution in the Boones Ferry Road area
    - This is an important issue as to the elevation of lands, steep slopes, and drainage into Basalt Creek
    - The elevation of lands above the drinking water wells is of concern with impact upon the well from which the Lucini's obtain their water
- effect of stormflows on the Basalt Creek Concept Plan are neglected
- no existing and future development stormwater flows are compared
- protection of natural resources is unclear
- no designation of Capital Improvement Projects (CIPs9) in the BFR south area
- There is no assessment of peak and average stormflows on the steep slopes, which constitute the west flank of the BFR south area
    - These Tualatin stormflows discharge to the Basalt Creek Concept Plan area and their existence is not established in the SWMP.
    - Stormflows on these steep slopes have excessive peak and average flow velocities, which cause erosion
      SEE: Supplement B Part 1 Analysis Report Section 4.
      Stormflow Hydraulics and Part 2 Appendices A2 and I
- The Tualatin SWMP makes no provisions for temporary stormwater storage and discharge facilities when phasing-in large developments such as the Autumn Sunrise property in BFR south.
    - The concern is that arbitrary storage and discharge locations could occur in the interim, before the final stormwater facility is operable.
    - It needs to be specified in the Tualatin SWMP that new construction developments must use stormwater facilities and outfalls consistent only with its final specifications and drawings.

ADDITIONAL COMMENTS -MAPS WITHIN PROPOSED UPDATE TO THE CITY'S MASTER PLAN

PROPOSED MAPS:

- CONTAIN DATED INFORMATION
- OMISSION OF RELAVENT AND NESSARY INFORMATION REQUIRED FOR LAND USE PLANNING

SEE EMAIL ATTACHMENT #4 MAPS or Pages 13-20

CITIZEN COMMENTS- NARRITIVE
PROPOSED UPDATE TO STORMWATER MASTER PLAN – CITY OF TUALATIN

My husband and I are submitting these Citizen Comments regarding the newly posted first draft (December 1, 2020) of the proposed City of Tualatin Stormwater Management Master Plan Update. Utilizing the State's Land Use Planning Goals as a basis for our concerns. We mention there are multiple other related local, State and Federal mandates which exist and provide additional measures to address stormwater management, property rights and protections, safety, conservation and protection of Natural Resources, and coordination and integration of Public Services with other governmental units or agencies.

STATE OF OREGON STATEWIDE LAND USE GOALS- Used as basis and support of concerns being presented
OAR 660-015-0000 Oregon Statewide Land Use Planning Goals

The state of Oregon has established goals and provided mandates for Land Use Plans – including specific requirements which should be included within the Land Use Plans of local city governments- including City Master Plans.

These Land Use Planning Goals not only provide a framework for creating a Land Use Plan, but they also provide a method for evaluation of various Land Use elements to be included within a potential Plan, as well as mandates for compliance.

Included within our comments are references to these Land Use Planning requirements to provide a common understanding of the basis for our comments and as support for request for resolution to concerns provided within this correspondence.

Land Use Planning Goal #2- LAND USE PLANNING OAR 660-015-0000 (2) provides the framework for the development and requirements for the development of a Land Use Plan- such as the City's proposed Stormwater Management Master Plan Update. Included with Goal #2 are the following goals and mandates apropos to these comments: (emphasis added)

- To establish a land use planning process and policy framework ***as a basis for all decision and actions related to use of land*** and ***to assure an adequate factual base*** for such decisions and actions.
- City, county, state and federal agency and special district plans, and actions related to land use **shall be consistent with the comprehensive plans of cities and counties and regional plans** adopted under ORS Chapter 268.
- All land use plans shall include:
  - ***identification of issues and problems, inventories and other factual information*** for each applicable statewide planning goal,
  - **evaluation of alternative courses of action and ultimate policy choices**, taking into consideration social, economic, energy ***and environmental needs*****.**

- The required information ***shall be contained in the plan document or in supporting documents***

- **The plans shall be the basis for specific implementation measures.**
    - **These measures shall be consistent with and adequate to carry out the plans.**
    - All land-use plans, and implementation ordinances shall... be reviewed and as needed, revised on a periodic cycle ***to take into account changing public policies and circumstances***

It is important that accurate fact-based information relating to potential Land Use actions are obtained and provided as part of any Land Use action. Both Citizens and those who may ultimately be making Land Use decisions require accurate representative unbiased information so that they may understand and comprehend issues pertaining to proposed Land Use issues. This process assists and promotes the transparency of the governmental process, and informed decision making.

Unfortunately, after review of the City of Tualatin's proposed Update to the Stormwater Management Master Plan, my husband and I have found multiple issues which reduce compliance with the Oregon Land Use Planning Goals, as well as other local, State and Federal mandates-particularly with respect to the Land Use Planning for the Basalt Creek Area under the current or future jurisdiction of the City of Tualatin, and/or under other overlapping governmental units or agencies.

HISORICAL LAND USE PLANNING ACTIONS-BASALT CREEK AREA & STORMWATER MANAGEMENT

My husband and I strongly support the City's efforts to review and revise the City's dated Stormwater Management Master Plan which according to the City's website was adopted in 1972

https://www.tualatinoregon.gov/sites/default/files/fileattachments/engineering/page/13099/tualatin_drainage_plan_sept_1972.pdf

A request had to be submitted to the City for access to the Appendices for the proposed Plan.

In the decades since the City's Stormwater Management Plan was adopted in 1972, the type and level of assessment, knowledge and implementation of stormwater management has greatly expanded, and the potential impacts more fully understood. The relevance of impact of Land Use Actions upon the environment has also become more greatly understood, expanding the need for a more comprehensive assessment and analysis of potential outcomes as part of the Land Use Planning process.

In 2004 Metro 04-1040B authorized the addition of the "Tualatin Area" (part of which is now known as the Basalt Creek Area) into the UGB. Metro imposed multiple conditions and requirements for the conservation and protection of multiple natural resources as part of Metro 04-1040B as part of the responsibilities of the local governments.

In 2018 the Basalt Creek Concept Plan jointly authored and adopted by the Cities of Wilsonville and Tualatin -taking the initial steps in the Land Use Planning of over 800 acres within the Basalt Creek Area and included various assessments of Natural Resources within the Basalt Creek Area.

Included within the Basalt Creek Concept Plan are various statements relating to Land Use Planning within the Basalt Creek Area including:

"New stormwater infrastructure will be primarily integrated with the local road network"

..."It is assumed that the existing culverts may not have capacity for future urban conditions and will need to be upsized to provide adequate capacity for runoff from new impervious areas, unless onsite detention or

infiltration is required when the location of public drainage or the topography of the site make connection to the system not economically feasible." *(emphasis added)*

"The Cities and CWS will adopt an Intergovernmental Agreement that will address areas where cooperative stormwater management is needed."

It is unclear if and when such Stormwater Management Planning for the Basalt Creek Area between these three entities was conducted.

Both Cities also stated within the Concept Plan- they would have "Joint Management" of the "Natural Area" within the Basalt Creek Canyon.

It is unknown what further action has been taken to implement the "Joint Management" of the lands in the center portion of the Basalt Creek Area- where a high percentage of the Natural Resources are located within the Basalt Creek Canyon.

It is not known what Land Use elements of "management" were intended to be the focus of this joint statement, but the potential involvement of the City of Wilsonville within the Land Use Planning of the Basalt Creek Area may result in additional complexities in the determination and implementation of Land Use planning within the Basalt Creek Area.

As the Basalt Creek Canyon receives a majority of the stormwater drainage from the area, the potential involvement and coordination of the City of Wilsonville should be included within any Stormwater Management plan within the Basalt Creek area. The identification of this information was not included within the City's proposed Update to the Stormwater Master Plan.

Included within the Basalt Creek Concept Plan are numerous maps identifying the location of multiple Natural Resources existing within the Basalt Creek Area mainly generated from Metro 2001 data. This type of information regarding Natural Resources within the Basalt Creek Area was not included within the maps the City elected to adopt within the City of Tualatin Basalt Creek Comprehensive Plan and the subsequent adoption and integration into the City's Governing Documents.

A few examples of the maps from the Basalt Creek Concept Plan are included as attachments to this correspondence to help substantiate:

- the existence of these Resources,
- the need for the City of Tualatin to conduct a more current assessment and analysis of multiple Natural Resources known to exist within the Basalt Creek Area for fact-based decision making,
- the need for the City to memorialize the information into the City's Governing Documents to:
    - establish fact-based documents which have evaluated significant factors which exist within lands the City sought to gain future jurisdiction -which are equal to or exceeding the level provided to the majority of the lands within the City.
    - Provide consistency of fact-based documents within the City which various departments can utilize as part of a decision-making process
    - Provide an accurate fact-based reference for use by the Public to gain understanding of the basis for future decisions

These actions will provide greater consistency within all proposed Land Use Plans -including the Stormwater Management Master Plan and may provide greater compliance and positive outcomes in subsequent implementation actions.

Attachment #4 Maps

In 2019, the City of Tualatin Basalt Creek Comprehensive Plan, did not provide stormwater management plans specific for the Basalt Creek Area or a stormwater system map specific to the Basalt Creek Area.

The City has left developers to be responsible for on-site Stormwater Management.

<u>But the City did not identify what actions will be taken if financial costs become too high, if stormwater management requirements exceed onsite management and/or treatment capabilities or should other factors which might preclude full onsite stormwater management and/or treatment develop</u>.

The City did not provide specific guidance as to:

- feasibility of integration into the County's existing stormwater management system (which is already known to be at capacity)
- mechanisms for cooperative planning and integration into the County's existing stormwater management system
- the process and funding to collect, convey, treat and dispose of excess stormwater runoff off site, or
- the role for Citizen Involvement by downstream property owners or other stakeholders.

The proposed Update to the City of Tualatin's Stormwater Management Master Plan does not acknowledge these issues nor provide information as to this issue.

There are questions as to the consistency of the City's Land Use Plans for Stormwater Management planning and implementation for development.

Contrary to the efforts taken to meet compliance requirements within the Basalt Creek Concept Plan, the City of Tualatin elected as part of the Basalt Creek Comprehensive Planning process, to omit maps within the Basalt Creek Area which denoted the existence of multiple Natural Resources within the Basalt Creek Area- which had been included in the Concept Plan.

The lack of information as to the assessment and location of multiple Natural Resources which have requirements for their conservation and protection, causes significant issues as to the ability to comply and implement various Metro, State and Federal requirements to conserve and protect Natural Resources based upon facts.

Consequently, lacking the inclusion of the assessment of the Natural Resources within the City's Governing Documents, inhibits the ability to effectively identify and mitigate negative impacts from Stormwater Drainage as part of the Master Plan for Stormwater Management and in the planning and implementation of any Land Use Action.

Within the City's Basalt Creek Comprehensive Plan -included as a supporting document- is a letter dated 12-5-2006, titled **"City of Tualatin Title 13 and Tualatin Basin Plan Compliance Review."** (Exhibit 6 to Ordinance No. 1418-19

There are several concerns presented by the inclusion of this letter with issues relating to the Basalt Creek Area:

- Although the City has posted this letter on the City's Planning Department's Basalt Creek website, it is unclear as to the relevance of this letter to issues related to the Basalt Creek Area
- The letter is date specific and does not provide information as to changes which may have occurred within the 14 year since it was authored.
- The letter is dated 12-5-2006, prior to the City of Tualatin's right to conduct Land Use Planning for lands within the Basalt Creek area-outside its jurisdiction at the time. It is not known if the scope of subject matter within the review included lands within the Basalt Creek Area.
- It appears the intent of the letter was to evaluate a program, and not an evaluation of Title 13 resources- the letter clearly makes that statement.
- The letter included several statements as to additional actions required for compliance- including issues relating to the need for documentation of identification of various Natural Resources.
- The City did not attach documentation of successful implementation of actions required within the letter, nor application of results of the Tualatin Basin Program and application to the Basalt Creek Area.
- Of most importance the letter states: *"The compliance review by Metro is a review only of whether the amendments Tualatin is proposing are consistent with the UGMFP and <u>is not a review of whether Tualatin has complied, or will comply with the other requirements of Option 5 and the Tualatin Basin Program</u>.* (emphasis added)

In relevance to the proposed Stormwater Management Master Plan Update, the 2006 Metro letter included the following information:

> *<u>Stream crossings and detention ponds</u>:* We also note that for a number of HFDPs - such as minimizing stream crossings, encouraging perpendicular crossings, using habitat sensitive bridge and culvert designs, use of detention ponds, and allowance of narrow road widths through stream corridors - the City does not propose any code changes. Instead, the City states that its code is silent on such practices, but does not prohibit them, and mostly relies on its adoption of Metro's Title 3 and CWS requirements to meet Title 13's "encourage and facilitate" requirement.
>
> <u>Recommendation</u>: We recommend that the City amend its code to affirmatively support these HFDPs. Doing so would leave no doubt that the City is encouraging and facilitating these HFDPs.

It is not known if the City implemented this recommendation- or if the recommendation is still relevant.

If the use of this letter is intended to indicate compliance to mandates for the conservation and protection of Natural Resources within the Basalt Creek Area, it would seem prudent for the City to establish documentation of an assessment of the Natural Resources within the Basalt Creek Area, and documentation of actions taken by the City to comply with such mandates- based upon current facts and standards to meet compliance needs.

In 2020, the City of Tualatin started actions to annex large acres of land within the NE portion of the Basalt Creek Area. A large portion of these lands currently act as the stormwater catchment, retention, and reabsorption basin for the greater area. The City is currently taking Land Use Planning actions which will allow the development of over 60 acers of this current stormwater catchment area.

Along with the removal of several acres which contain many characteristic factors of a natural stormwater catchment area (which have decreased the flow and velocity of stormwater and increase its reabsorption), future development may remove these factors while significantly increasing impervious surfaces with the creation of buildings, streets, and parking lots.

CURRENT CONCERNS REGARDING THE PROPOSED STORMWATER MASTER PLAN UPDATE

TECHNICAL ISSUES

A summary of the Technical Issues presented within the Stormwater Master Plan Update are summarized at the beginning of this correspondence, with the full review included as a Google Link attachment #1, #2 #3.

It is readily apparent when reading the proposed Master Plan Update, that much of the information contained with the draft is dated, and not reflective of current issues, or needs.

Page 5-2 includes the following information:
"Basalt Creek runs north-south in the southern portion of the City. Much of the contributing land use is low-density and rural residential, ***but with pending adoption of the Basalt Creek Concept*** *Plan concept plan [sic], future development is anticipated to impact the contributing land use and stream condition. Ownership is currently private and public (City)." (emphasis added)*

The Basalt Creek Concept Plan was adopted by the Cities of Wilsonville and Tualatin in 2018, indicating the proposed plan may not have been revised as to changes within the Basalt Creek Area for over two years. Since that time, the City of Tualatin generated and adopted the Basalt Creek Comprehensive Plan.

Although the proposed Stormwater Management Plan readily identified and anticipated the negative impact future development within the Basalt Creek Area would have upon the stream condition- the proposed Plan did not identify actions to be taken to provide further assessment and/or alternative solutions to attempt to address and mitigate stormwater impact upon the "stream condition".

IMPACT NATURAL RESOURCES

A review of the City's newly proposed draft to Update the City of Tualatin Stormwater Management Master Plan, does not currently identify the evaluation of Natural Resources within the Basalt Creek Area, nor the methods to be utilized to ensure compliance with the various mandates for the conservation and protection of numerous Resources. The State Land Use Goal requires documentation of compliance with State Goal #5 NATURAL RESOURCES AND OPEN SPACES, and State Goal #6 AIR, WATER AND LAND RESOURCES QUALITY which are the basis upon many of our concerns regarding the proposed Update to the City's Stormwater Master Plan.

NEED FOR COORDINATION OF LAND USE PLANNING WITH OVERLAPPING GOVEMENTS- STATE GOAL #2

While both Cities had knowledge of, and participated within the decision making Land Use Planning process in planning the location of Washington County's proposed Basalt Creek Parkway Extension regional transportation 5+ lane expressway through the middle of the Basalt Creek Area--- neither the Basalt Creek Concept Plan nor the City of Tualatin

Basalt Creek Comprehensive Land Use Plans acknowledged, addressed or provided guidance as to coordination of stormwater management planning within the Basalt Creek Area for Washington County's proposed major transportation project within overlapping jurisdictions.

It is unclear as to the amount of land Washington County will require for their proposed project which will needed not only for road construction, but also a proportionally large amount of land for stormwater management and treatment within wetlands and other lands within the future jurisdiction of the City of Tualatin. Nor did either plan address or provide guidance (and intended compliance) as to how all local governments would ensure conservation and protection of various Natural Resources within the Basalt Creek Area from direct or indirect effects of stormwater or stormwater management which might be caused by the proposed project and potential impact upon Natural Resources within the future jurisdiction of the City of Tualatin.

Compounding the lack a clear plan for a coordinated Stormwater Management plan to address the permanent installation of this major transportation project through multiple Natural Resources, the Basalt Creek Concept Plan states, "joint management" management of the "Natural Area" within the Basalt Creek Area by the Cities of Wilsonville and Tualatin and introduces a possible intergovernmental agreement between the two Cities for stormwater management within the Basalt Creek Area.

Due to the proximity of the eastern terminus of the proposed Washington County Basalt Creek Parkway Extension on SW Boones Ferry Road, and the and anticipated City of Tualatin major residential development of 400+ units and Commercial Neighborhood development within approximately 1/4 mile, of each other on SW Boones Ferry Road, there will be significantly increased need and demand for Stormwater Management and treatment with a limited geographic area and in lands with over lapping governmental jurisdictions.

As my husband and I are potentially affected property owners, we have on multiple occasions reached out to the staff of both the City of Tualatin and of Washington County to gain a better understanding how the Land Use planning actions by both governments are coordinating Land Use planning within the area. We have expressed our desire to be able to have potentially affected property owners participate in the coordinated planning of major Land Use Projects on lands near overlapping jurisdictions due to various direct and indirect impacts upon our property. We have not gained much success in these actions.

Unfortunately, there appears to be a continued lack of coordination and communication between these two entities as to the conception, planning and design of major Land Use Projects within the Basalt Creek Area.

Recognizing the lack of effective coordination in Land Use Planning by these two local governments, and to promote better compliance with mandates for the coordination of planning for Public Services by local governments, a well authored Stormwater Management plan would include clear requisites to:

- identify major Land Use Projects under consideration by another government (as a potential constraint or added factor in Land Use Planning)
- provide guidance as to how to coordinate the provision of Public Services within overlapping jurisdictions.

The proposed Stormwater Management Plan does not address this issue or provide clear guidance for implementation.

CURRENT STORMWATER MANAGEMENT SYSTEM WITHIN BASALT CREEK AREA
- HAS PREVIOUSLY FAILED AND IS A LIMITATION AND CONSTRAINT FOR FUTURE DEVELOPMENT
- IS UNDER THE JURISDICTION OF --OR IMPACTED BY–
LAND USE PLANNING ACTIONS OF OTHER LOCAL GOVERMENT

The current Stormwater Management System along SW Boones Ferry Road within the Basalt Creek Area was designed and constructed as part of Washington County's SW Boones Ferry Road Improvement Project (2012-2015). During the design phase of this Land Use transportation project, my husband and I contacted the County on multiple occasions regarding our concerns of potential negative downstream stormwater impacts we identified within the proposed design. We were assured the outflow from the County's design would be equal or 10 % less than stormwater outflow which we previously experienced from a more primitive/less sophisticated stormwater system.

The 2016 Stormwater Analysis within the Basalt Creek Area by Mr. La Liberte' which was the basis of the report, *"Effects of SW Boones Ferry Road Construction (2013-2015) Stormflow Analysis for the Lucini Property Washington County, Oregon"*, was generated due to my husband's and my desire to understand the cause of flooding into our property from stormwater emitting from a Washington County Stormwater Outflow an apparent failure of the stormwater management system in 2015. There have been no significant changes made to the County's Stormwater system since 2015 upstream from our property.

Currently a large percentage of the stormwater drainage from the NE portion of the Basalt Creek Area flows south- eventually through the City of Wilsonville and into the Willamette River. Much of the stormwater within the NE portion of the Basalt Creek Area is captured within a stormwater catchment basin on undeveloped lands east of SW Boones Ferry Road, and collected within Washington County's stormwater collection, conveyance and treatment system. A majority of the stormwater catchment basin on the east side of SW Boones Ferry Road and north of Greenhill Lane is on lands recently annexed into the City of Tualatin.

The stormwater drainage from this area flows away from the majority of lands within the City of Tualatin and outside of the City of Tualatin's existing stormwater collection, conveyance and/or treatment facilities.

Mr. La Liberte's study identified multiple factors which lead to the flooding of our property from the stormwater system which currently exists within Basalt Creek Area in the area around SW Boones Ferry Road.

From this investigation we gained knowledge that the **County's design and planning for the stormwater management system installed along SW Boones Ferry Road as part of the SW Boones Ferry Road Improvement Project, was:**

- **based upon drainage needs of undeveloped land, and**
- **not designed to meet anticipated drainage needs of developed lands with higher nonporous surfaces (buildings, streets, and sidewalks etc.) which cause higher stormwater runoff and less reabsorption into the land which has previously acted as a major stormwater catchment area.**

Both the City of Tualatin, and Washington County are undertaking Land Use planning actions within the Basalt Creek Area affecting properties under overlapping jurisdictions. My husband and have on multiple occasions attempted to gain insight as to the coordination of Stormwater Management Planning within the Basalt Creek Area from these two local governments.

As downstream property owners within Washington County, we have specifically expressed concerns and requested Land Use Planning information from the City of Tualatin as to the City's Stormwater Management Plan within the Basalt Creek Area and of potential impacts upon the current existing system under the jurisdiction of Washington County - during the Basalt Creek Concept Planning, during the City of Tualatin Basalt Creek Comprehensive Planning and as part of the City's annexation process for ANN 19-2002- without fact based information which would provide us understanding of the City's proposed Land Use actions and potential impacts caused by increased needs or changes to this Public Service. The Basalt Creek Concept Plan adopted by the City in 2018 acknowledged limitations within the existing Stormwater Management system within the Basalt Creek Area and identified the need for system upgrades with development of the Basalt Creek Area.

We have specifically asked the City of Tualatin and Washington County on multiple occasions how both of these two local governments have coordinated the Land Use Planning Goals for Washington County's proposed Basalt Creek Parkway Extension Project. Our questions have included how Stormwater Management will be integrated into the County's existing Stormwater System, how or where additional conveyance and/or treatment facilities will be located within lands with overlapping jurisdictions and of potential impacts to the City of Tualatin's Land Use Planning for the urbanization of the Basalt Creek Area and associated increased stormwater management needs on private or public lands. Again, my husband and I have received little fact-based information as to how these two local governments with over lapping jurisdictions have conducted Land Use Planning for a key Public Service of Stormwater Management within an area containing multiple known constraints and limitations.

My husband and I have reasonable concerns as to potential negative impacts from stormwater due to poorly planned and executed Land Use actions. The need for a well-developed integrated Stormwater Management plan for the Basalt Creek Area is necessary for the safety and protection of Citizens, property and surrounding Natural Resources.

Thank you for the opportunity for participating in this first Citizen Involvement Public event for the City's Proposed Update for the Stormwater Master Plan.

My husband and I look forward to hearing what steps the City will be taking the City's adoption process for this proposed Land Use Plan Action

As Citizens and potentially affected property owners, we request Actual Notice of any future Public Meetings-where this proposed Land Use Action may be an agenda topic--- including but not limited to the City of Tualatin Planning Commission, and/or the Tualatin City Council.

Respectfully submitted,

Grace Lucini
John Lucini
23677 SW Boones Ferry Road
Tualatin, OR 97062

ATTACHMENTS #1, #2, & # 3 Documents La Liberte' Environmental Associates (Google Link)
#4 MAPS (Google Link) & (Hard Copy Pages 13-20)

ATTACHMENT #4

MAPS WITHIN PROPOSED UPDATE TO THE CITY'S MASTER PLAN

PROPOSED MAPS:
-CONTAIN DATED INFORMATION
-OMISSION OF RELAVENT AND NESSARY INFORMATION REQUIRED FOR LAND USE PLANNING

An example of questionable information provided within many maps within the proposed Stormwater Management Plan for the City, is **Figure 2-2 Project Area Overview**.

T**he Legend within Figure 2-2 provides keys as to the location of**

- **Open Space-Parks/Greenways/Natural Areas/Private***
- **Open Space- WPA/Setbacks/NRPO/Wetlands**

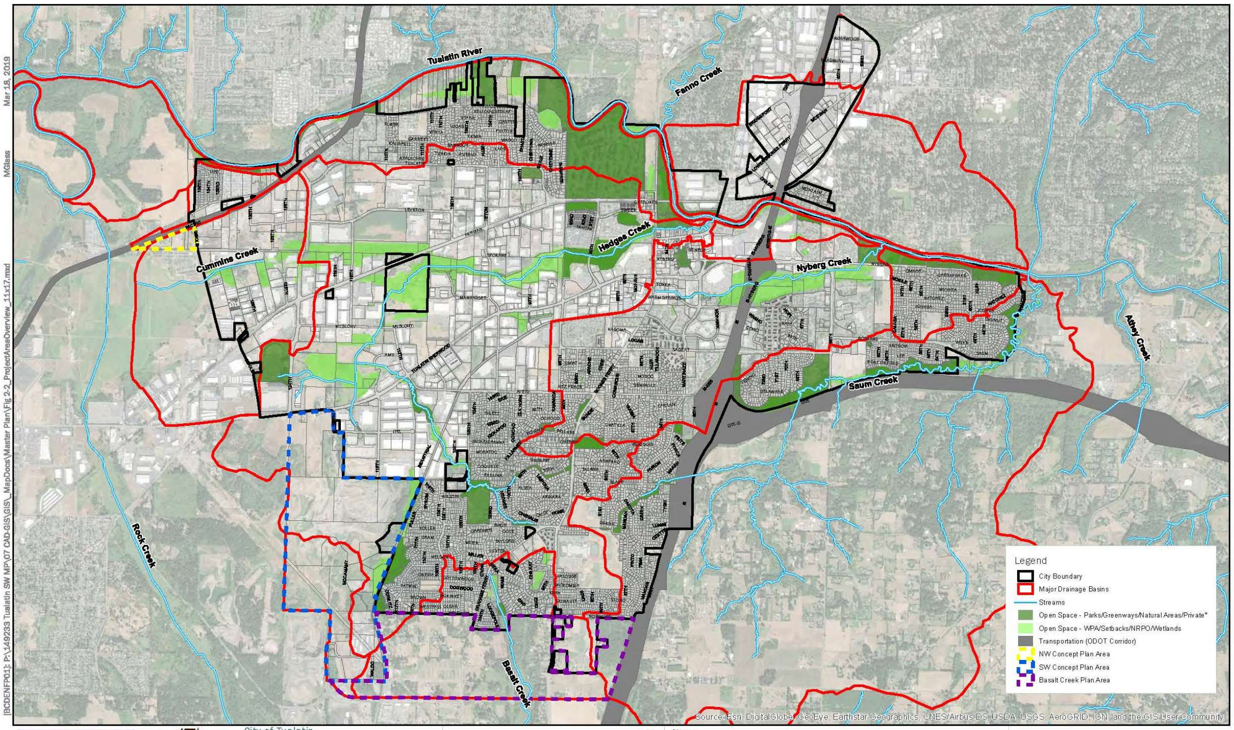
However, there is no indication of the wetlands, and multiple Natural Resources known to exist within the Basalt Creek Area and within the Basalt Creek Canyon.

Many of these types of Natural Resources may be negatively affected by stormwater drainage, and an accurate assessment as to the quantity, quality and location of Natural Resources which are to be conserved and protected should be assessed evaluated and memorialized within a Stormwater Management Plan and integrated into the City's Governing Documents for to provide and assure consistency within the City's various Land Use Plans.

Another factor not denoted within the maps within proposed Stormwater Management Plan, is the identification of the "Natural Area" within the Basalt Creek Canyon.

This area which contains wetlands and various Natural Resources requiring conservation and protection was identified within the Basalt Creek Concept Plan in which both Cities agreed to have "joint management" of the "Natural Area". It would seem reasonable this information which might impact Land Use Planning within the Basalt Creek Area and is downstream from the Basalt Creek lands already annexed into the City, would be identified on the Figure 2-2 map, and include additional information within the narrative of the proposed Stormwater Management Plan as a potential constraint or limitation in the planning of Stormwater Management in the area or upstream from the "Natural Area".

This map also includes the notation of "Brown and Caldwell City of Tualatin Stormwater Master Plan Date: April 2019 Project 149233 in the lower left corner of the map. An assumption would be that the information provided within this map would be current and accurate as of April 2019- the date indicated on the lower left corner of the map. It is unknown how current the information contained within this map may be but lacking the inclusion of information Basalt Creek Area lands already within the City's boundaries, makes one question when the data for this map was last collected.



Brown AND Caldwell

City of Tualatin

City of Tualatin
Stormwater Master Plan

Date: April 2019
Project: Project 149233

0 2,250 4,500 Feet

N

Notes:
1. Projection: NAD 1983 State Plane Oregon North (feet)

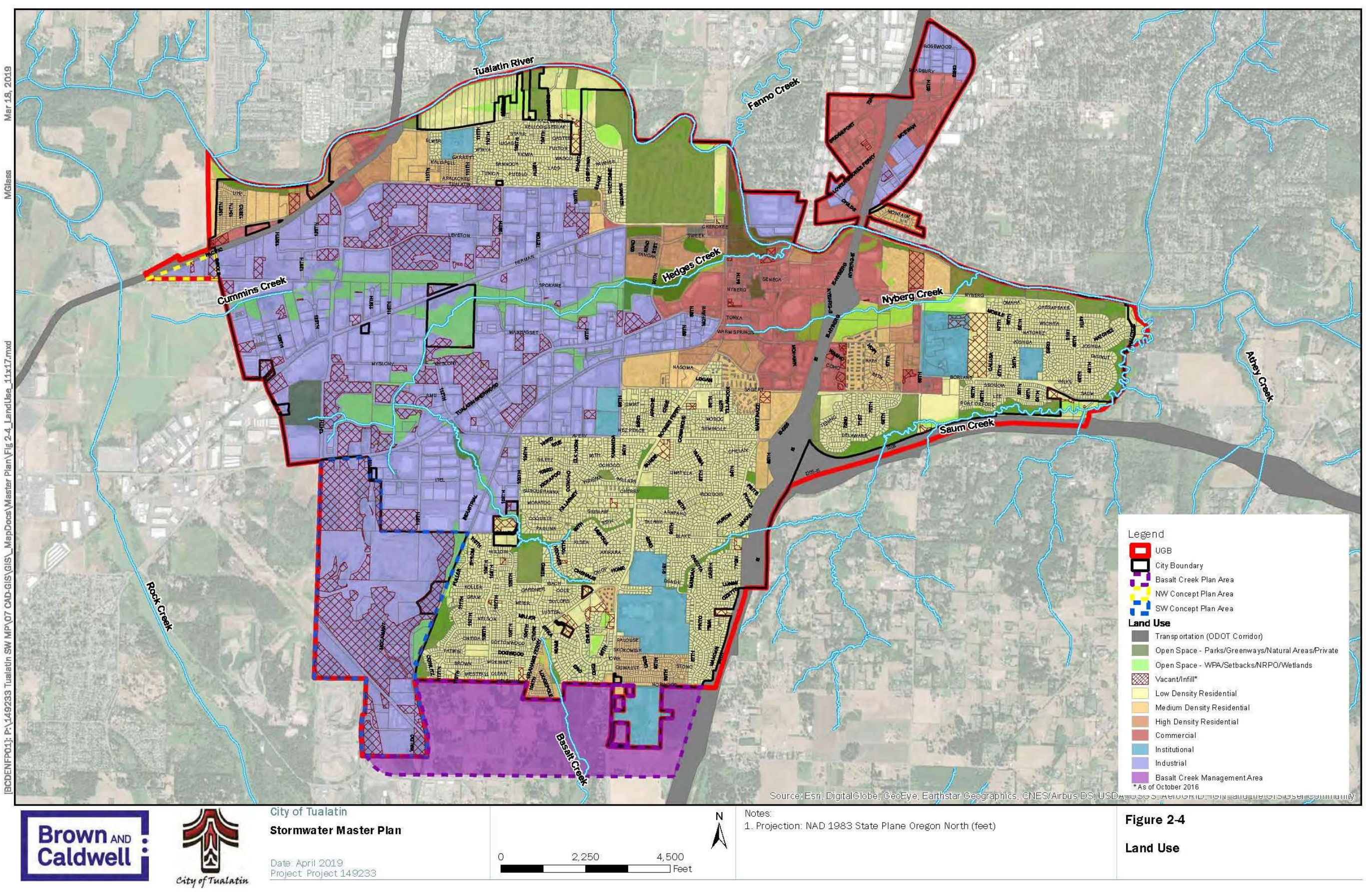
Figure 2-2

Project Area Overview

Figure 2-4 "Land Use" Map Not Consistent with City's Current Land Use Zoning
also provides the notation of "Brown and Caldwell City of Tualatin Stormwater Master Plan Date: April 2019 Project 149233 in the lower left corner of the map.

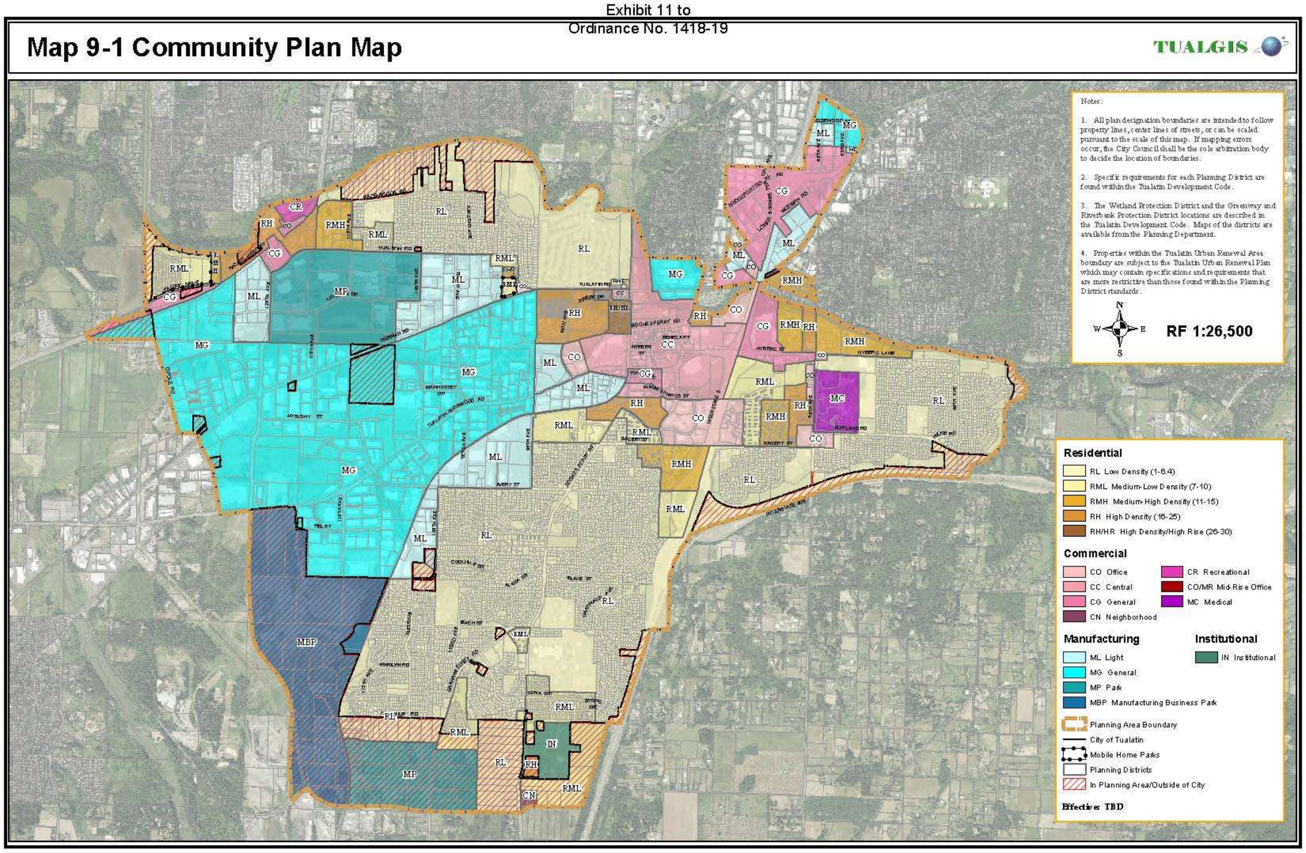
Yet, an asterisk notation within the Legend box states, "* As of October 2016".
Major changes have occurred as to Land Use within the City of Tualatin in the four years since this map was apparently generated.

The information provided as to the Land Use zoning or designations do not accurately reflect the Land Use Planning Actions of the Basalt Creek Concept Plan adopted in 2018, nor the City of Tualatin Basalt Creek Comprehensive Plan. Land Use Zoning within the Basalt Creek Area does not provide accurate information of current Land Use Zoning and Planning within the Basalt Creek Area and may hinder the planning for Stormwater Management in the assessment of current and future needs based upon type of land use. Approximately 60 acres within the Basalt Creek Area have already been annexed into the City of Tualatin, and into the responsibilities and regulations of the City for Land Use planning- including Stormwater Management.



The proposed Stormwater Master Plan Update is not consistent with the Land Use Plan adopted by the City in 2019 in Ordinance 1418-19, and consequently would not be compliant with Statewide Planning Goal #2

Exhibit 11 to
Ordinance No. 1418-19

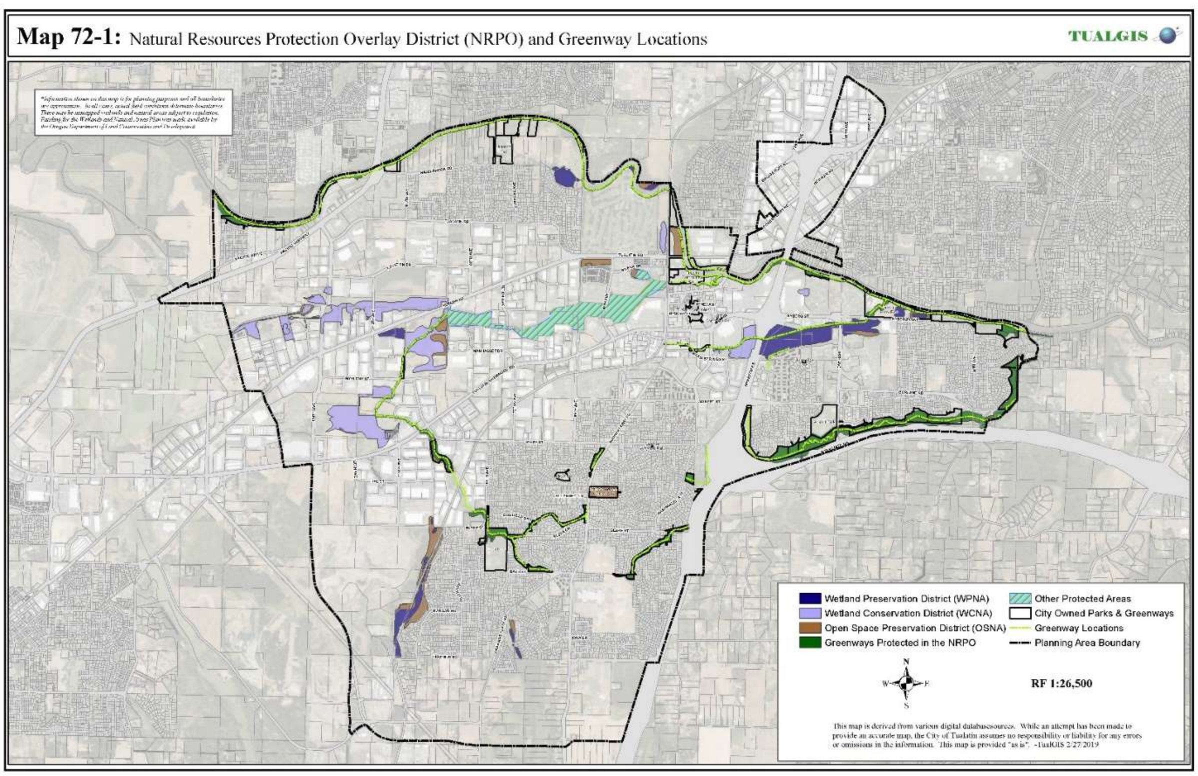


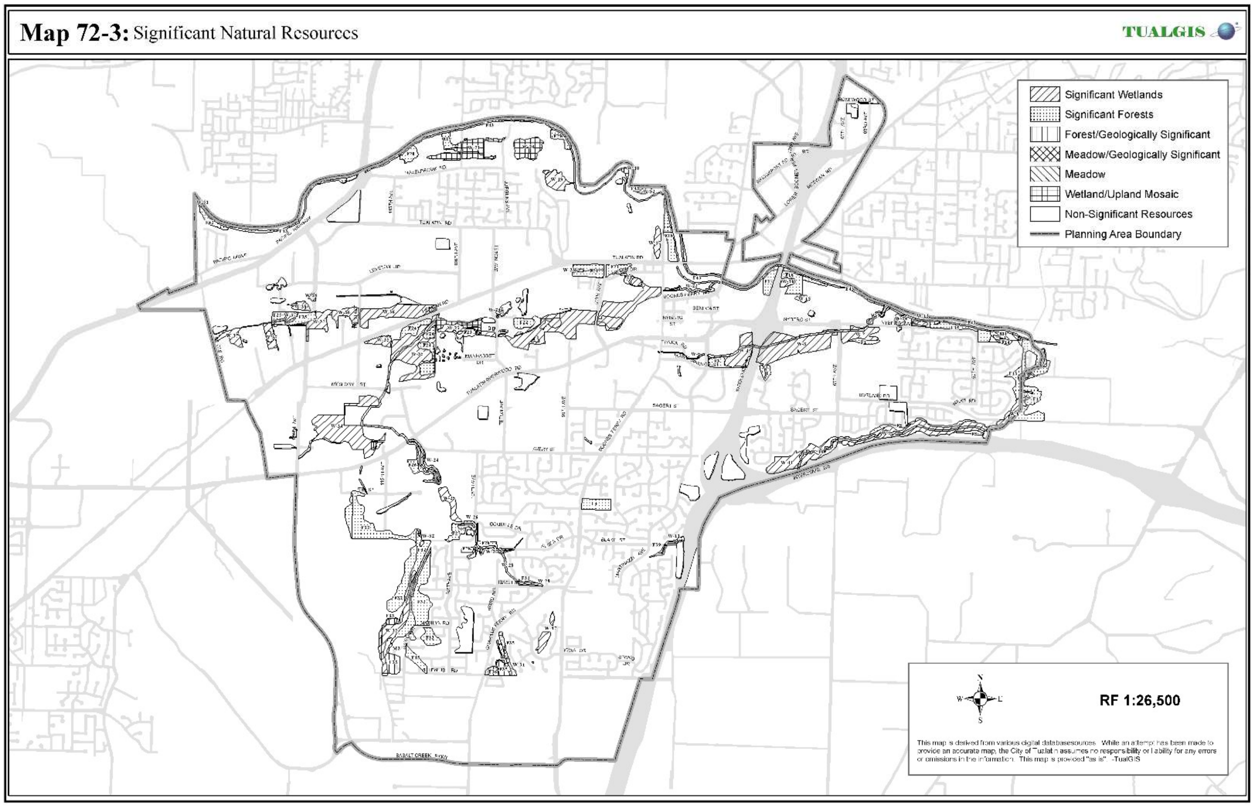
72-1 Natural Resources Protection Overlay district (NRPO) and Greenway Locations
72-3 Significant Natural Resources
There is an absence of necessary information provided for the Basalt Creek Area for Natural Resources

Lacking necessary evaluations as to the level, location and quality of Natural Resources within the Basalt Creek Area within the proposed Stormwater Management Master Plan Update, it would be difficult for the City of Tualatin to utilize the maps adopted into the City's Governing Documents (as part of the adoption of the Basalt Creek Comprehensive (Ord. 1427-19 , § 47, 11-25-19)), as supportive or back up documents to the proposed Update, as these maps obtained from the City's website do not identify or provide substantive information as to the multiple Natural Resources which are known to exist within the Basalt Creek Area.

City of Tualatin Maps downloaded from the City's municipal Code website
https://library.municode.com/or/tualatin/codes/development_code?nodeId=THDECOTUOR_APXAMA

also lack essential information necessary for the development of a Land Use Plan, or effective implementation of a Land Use Action within the Basalt Creek Area and are not suitable support documents for the proposed Update to the City's proposed Stormwater Management Master Plan Update.





There are signficant inconsistancies in the level of acknolwedgement and identification of various Natural Resourcse which are required to be evaluated for potential impact within all Land Use Plans, and Planning Actions. The omission of pertenant information regarding the existance of multipe Natural Resources within the northern portion of the Basalt Creek Area as presented within the City's Governing Documents, and within the City's proposed Stormwater Master Plan update are notable.

However, the City included the Basalt Creek Concept Plan document adopted by the City in 2018, and utilized as a supporting document to the Basalt Creek Comprehensive Plan in 2019 did provide needed information as to Land Use evaluative factors such as the Natural Resources and contraints which exist within the Basalt Creek Area.

Examples of pertenent documentation from the Basalt Creek Concept Plan as to the quanity and quality of these Natural Resources is provided including a summary of a rational for inclusion of this information into the Basalt Creek Land Use Concept Plan.

Metro Title 13: Nature in Neighborhoods

Title 13 requires local jurisdictions to protect and encourage restoration of a continuous ecologically viable streamside corridor system integrated with upland wildlife habitat and the urban landscape. Metro's regional habitat inventory in 2001 identified the location and health of fish and wildlife habitat based on waterside, riparian and upland habitat criteria. These areas were named Habitat Conservation Areas.

Table 7 Title 13 HCA Categories with Acreage

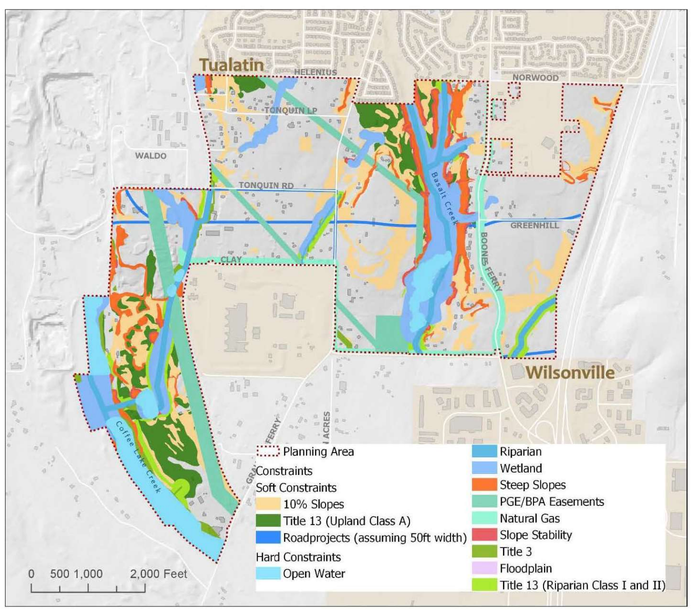
HCA Categories	Acres	Description
Riparian Wildlife Habitat Class I	130	Area supports 3 or more riparian functions
Riparian Wildlife Habitat Class II	31	Area supports 1 or 2 primary riparian functions
Riparian Wildlife Habitat Class III	7	Area supports only secondary riparian functions outside of wildlife areas
Upland Wildlife Habitat Class A	103	Areas with secondary riparian value that have high value for wildlife habitat
Upland Wildlife Habitat Class B	72	Area with secondary riparian value that have medium value for wildlife habitat
Upland Wildlife Habitat Class C	37	Areas with secondary riparian value that have low value for wildlife habitat
Designated Aquatic Impact	52	Area within 150 ft. of streams, river, lakes, or wetlands

Exhibit 2 to
Ordinance No. 1418-19

Environmental constraints are summarized below and unless otherwise noted were fully excluded from the developable land input in the scenario testing for the Basalt Creek Concept Plan:

- Open Water
- Streams
- Wetlands
- Floodplains (50% reduction of developable area)
- Title 3 Water Quality and Flood Management protections
- Title 13 Nature in Neighborhoods (20% reduction of developable area in areas designated Riparian Habitat Classes I and II)
- Steep Slopes (25% slopes and greater)

Figure 13 Natural Resources Map



It is unclear as to the rational for the omission of pertenent information required to be an evaluated compent in the development of all Land Use Plans and implmentation of Planning Actions have not been included within the proposed Stormwater Master Plan Update, nor in the City's Governing Documents as provided via the City's

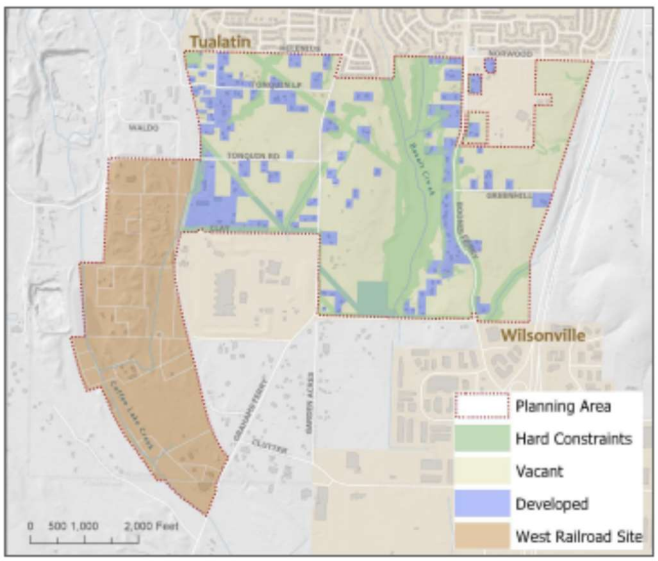
Exhibit 2 to
Ordinance No. 1418-19

The goal is to classify every parcel within the Planning Area into one of the categories described below:

Table 2 Land Supply within the Basalt Creek Planning Area by Type and with Acreage.

Land Supply by Type and Acreage		
Land Type	**Acres**	**Description**
Vacant Land	331	Unconstrained land that is ready to build with no major structures located on the site
Developed Land	125	Land already built upon which includes acreage covered by roadways
Constrained Land	153	Land that cannot be built upon due to environmental or other hard constraints
West Railroad Area	238	Excluded from development plan due to large amount of constraints and limited access
Total Land Supply	**847**	

Figure 6 Land Supply by Type.



21

LEA Comments
On the Draft Tualatin Stormwater Master Plan
(Dated April 2019)

Prepared for
John and Grace Lucini
23677 SW Boones Ferry Road
Tualatin, Oregon
97140

Prepared by
Dave LaLiberte
Principal Engineer
Liberte Environmental Associates, Inc.
Wilsonville, Oregon

LEA

December 14, 2020

Draft Comments on the Tualatin Stormwater Master Plan (Draft, April 2019)

Due December 15, 2020, by Dave LaLiberte, P.E., Liberte Environmental Associates (LEA)

Summary Comments

These comments are based on the Draft Tualatin Stormwater Master Plan (SWMP) dated April 2019. Comments highlight issues in the Plan concerning Southwest Boones Ferry Road (BFR) south of Norwood Road, referred to as “BFR south”.

Significant problems in the Plan for the BFR south area are: lack of identified stormwater facilities[1] omission of hydrologic and hydraulic modeling analysis[2], potential for mis-application of design alternatives[3], absence of stormwater problem acknowledgement and evaluation[4], no assessment of stormflows on steep slopes[5], effect of stormflows on the Basalt Creek Concept Plan are neglected[6], no existing and future development stormwater flows are compared[7], protection of natural resources is unclear[8], no designation of Capital Improvement Projects (CIPs[9]) in the BFR south area, and other Plan related problems.

Supplement documents collected by Liberte Environmental Associates (LEA) for these comments are identified as:

Supplement A - LEA Request for Tualatin SWMP Appendices

Supplement B - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016).
This report is included in two parts: Supplement B Part 1 (Report) and Part 2 (Appendices) under separate cover because of their size.

Supplement C –David M. LaLiberte, P.E., Cumuli Vitae (CV)

David M. LaLiberte, P.E., Civil and Environmental Engineer licensed in the State of Oregon, has compiled these comments under contract with John and Grace Lucini (see Comment LEA2 below). Dave has over 30 years of experience in stormwater, water quality and design solution analysis. His education and experience are attached as Supplement C – Cumuli Vitae (CV).

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[1] See Specific Comment LEA6.

[2] See Specific Comment LEA5.

[3] See Specific Comment LEA9.

[4] See Specific Comments LEA9, 11 and 14 as they pertain to the SWMP Table 3-1 and Figure 7-1.

[5] See Specific Comments LEA5, 7 and 8.

[6] See Specific Comments LEA6, 7, 8, 12 and 15.

[7] See Specific Comment LEA5.

[8] See Specific Comment LEA6.

[9] See Specific Comment LEA4, 9, 10 and 11.

Specific Comments

Comment LEA1. Many of the questions raised in these Tualatin SWMP comments focus on the area along BFR south. The BFR south area is shown within the city limits in all of the corresponding master plan figures. That is: Figures ES-1, 2-2 through 2-6 and 7-1.

Comment LEA2. Many of these comments refer to *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016), contracted by John and Grace Lucini, 23677 SW Boones Ferry Road, Washington County, Oregon, Tualatin, Oregon, 97140. This report is referred to as the "Stormflow Analysis" and is attached to these comments as Supplement B Part 1 (Report) and Part 2 (Appendices).

Comment LEA3. The Tualatin SWMP Appendices were obtained (Dec 10, 2020) from the City of Tualatin as part of this comment period ending December 15, 2020. A description of the SWMP Appendix request is contained in LEA Supplement A.

Comment LEA4. Some of the comments reference procedures in other areas of Tualatin. For example, Project Opportunity Area 6 – Alsea, aka Capital Improvement Project #17 (CIP17), calls for infiltration/retention that could be erroneously applied to the BFR south area. These procedures will potentially be applied to the hydrologic and hydraulic modeling in BFR south, and possibly any resulting CIP and stormwater design considerations.

Comment LEA5. The Tualatin SWMP does not include any hydrologic or hydraulic (H/H) modeling for stormwater flows in BFR south. The SWMP must include H/H modeling of the BFR south and affected areas such as the Basalt Creek corridor. Stormwater piping, channels, inlets, outfalls and other stormwater related facilities exist in BFR south (see LEA Supplement B Part 2: Appendices B through E) but are undocumented and un-analyzed in the SWMP. A perusal of the Tualatin SWMP Appendices A through C demonstrates that engineering data and analyses have all been omitted for the BFR south area. The SWMP must include stormwater facilities in Figure 2-6 – Stormwater System Overview for the BFR south and affected areas such as the Basalt Creek corridor. Comparison existing and developed future stormwater flow conditions are not performed. Evaluation of stormflows on hazardous steep slopes is omitted. Assessment of downstream conveyances below Tualatin outfalls is not conducted for the BFR south impacted areas.

Comment LEA6. The Tualatin SWMP does not include any wetlands in BFR south although they do exist. The SWMP Figure 2-5 - Stream Ownership omits the majority of stormwater impacted wetlands in Tualatin. Metro's Title 13 – Nature in Neighborhoods is intended to protect natural resources in urban areas but none of these opportunities are identified in the Plan for BFR south. The SWMP calls for protecting natural resources in subsections 1.1 Stormwater Master Plan Objectives and 2.2 Future Planning Areas. None of these opportunities are evaluated in the Plan for BFR south especially for the Basalt Creek Concept Plan area.

Comment LEA7. SWMP Figure 2-3 - Topography and Soils map contains too many TEXT overlays in the vicinity of Boones Ferry Road South of Norwood Road and the Lucini Property.

The sensitive steep slope topography in this vicinity can't be read. The "Boones Ferry" and "Basalt Creek" labels need to be moved from this visually important area of this map.

Comment LEA8. SWMP Table 2-1 (Page 2-3) in combination with Figure 2-3 - Topography and Soils suggests that infiltration is not a likely future runoff design solution in the BFR south. This is particularly important since this area is perched above steep slopes draining to Basalt Creek. This area is also above drinking water wells in the area including the Lucini property.

Comment LEA9. When the SWMP Appendix A - CIP Fact Sheets documentation is accessed for the Siuslaw Water Quality Retrofit, which includes the Alsea Road area (CIP17), there is no mention of infiltration in the design. But Table 3-1, Opportunity Area 6, aka CIP17, plainly refers to infiltration. The potential application of infiltration at the CIP17 site is of concern because it is inappropriate based on poorly draining soils (see next comment). As it relates to the BFR south area, applying the same inappropriate infiltration design approach will potentially cause significant problems (see next comment).

Comment LEA10. The BFR south area needs to exclude infiltration facilities as an alternative to reducing surface flow. Figure 7-1 (Page 3-2) does not show any CIP in the vicinity of BFR south although potential problems exist (see LEA Supplement B Part 2: Appendix A.2).

Comment LEA11. SWMP Figure 7-1 does show the location of CIP17, which is additionally described in Table 3-1 - City of Tualatin Stormwater Project Opportunities Number 6 as Alsea/BF Rd and 99th/Siuslaw Greenway. This CIP17 would drain to Hedges Creek and is comprised of "C" type soils as identified by Hydrologic Soil Group (see Section 2.4 -Soils, Table 3-1 and Figure 2-3). "C" type soils poorly drain and do not support functional infiltration facilities. The concern is that the "C" type soils above the Lucini property may be subjected to the same contradictory conclusion as the CIP17 site. This problem of misapplying design solutions may also exist for other conditions because BFR south has not been evaluated by Tualatin for hydrology and hydraulics as well as CIP.

Comment LEA12. SWMP Figure 2-6 - Stormwater System Overview omits the stormwater inlets, piping and other stormwater facilities in and around BFR south. The Stormwater Outfalls to the Basalt Creek Management Area and Greenhill Lane are not indicated (see LEA Supplement B Part 2: Appendix A.2). Downstream channels below the outfalls are not shown.

Comment LEA13. The SWMP Section 9 has incomplete References to Clean Water Services (CWS). The CWS document date and title are not current. For consistence in citing standards, the CWS reference must read "Design and Construction Standards" dated December 2019.

Comment LEA14. Nowhere in the Tualatin SWMP is a Stormwater Field Monitoring or Sampling program identified or proposed. This is despite the fact that Table 3-1 indicates numerous flooding and water quality problems resulting from stormwater flows. Table ES-1 – Capital Project Summary is being proposed without monitoring and sampling program basis.

Comment LEA15. There is no assessment of peak and average stormflows on the steep slopes, which constitute the west flank of the BFR south area. These Tualatin stormflows discharge to the Basalt Creek Concept Plan area and their existence is not established in the SWMP. Stormflows on these steep slopes have excessive peak and average flow velocities, which cause erosion (see Supplement B Part 1 Analysis Report Section 4. Stormflow Hydraulics and Part 2 Appendices A2 and I).

Comment LEA16. The Tualatin SWMP makes no provisions for temporary stormwater storage and discharge facilities when phasing-in large developments such as the Root property in BFR south. The concern is that arbitrary storage and discharge locations could occur in the interim, before the final stormwater facility is operable. It needs to be specified in the Tualatin SWMP that new construction developments must use stormwater facilities and outfalls consistent only with its final specifications and drawings.

Supplements

Supplements Contents

Supplement A

LEA Request for Tualatin SWMP Appendices

Subject:
Re: Review of Draft Tualatin SWMP by LEA
From:
Dave LaLiberte <dave@ee83.com>
Date:
12/10/2020 10:33 AM
To:
Hayden Ausland <hausland@tualatin.gov>
CC:
"grluci@gmail.com" <grluci@gmail.com>

Thanks Hayden.

The files downloaded just fine.

Dave

On 12/10/2020 10:05 AM, Hayden Ausland wrote:
> Good morning Dave,
>
> Due to large files sizes, I've had to upload the appendices to an online file sharing system. The appendices come in two separate files and I'm hoping both hyperlinks below will work for you. Please let me know if you have any issues or problems with accessing these files.
>
> - Appendices A-D: https://cityoftualatin-my.sharepoint.com/:b:/g/personal/hausland_tualatin_gov/EYCg3fA-dVpMrk_014xs9KwB0o-idA1Eo1MdnnKw6fufZw?e=u0CnNH
>
> - Appendices E-I: https://cityoftualatin-my.sharepoint.com/:b:/g/personal/hausland_tualatin_gov/ESQumWDmfCdGrAIq_nTWEgQBNGIFcmZuGrb670B-KzxMow?e=jwjpn9
>
> Regards,
>
> Hayden Ausland, EIT, CPSWQ
> Engineering Associate - Water Quality
> City of Tualatin
> P 503.691.3037 | C 971.978.8217
>
> -----Original Message-----
> From: Dave LaLiberte <dave@ee83.com>
> Sent: Thursday, December 10, 2020 8:55 AM
> To: Hayden Ausland <hausland@tualatin.gov>
> Subject: Review of Draft Tualatin SWMP by LEA
>
> Hi Hayden,
>
> I am an Engineer working with John and Grace Lucini reviewing the Draft Tualatin Stormwater Master Plan (April 2019). I need to obtain the Appendices that are referenced in the report but not included by the City in the report. These are:
>

> Appendix A: CIP Fact Sheets
>
....
....
> A-1
> Appendix B: Data Compilation and Preliminary Stormwater Project Development (TM1) ... B-1 Appendix C: Hydrology and Hydraulic Modeling Methods and Results (TM2)
> C-1
> Appendix D: Nyberg Creek Flood Reduction Modeling (TM3)
.... D-1 Appendix E: Capital Project Modeling Results...
....
> E-1
> Appendix F: Stream Assessment (TM4)
>
....
....
> F-1
> Appendix G: CIP Detailed Cost Estimates
....
....
> G-1
> Appendix H: Staffing Analysis
>
....
....
> H-1
> Appendix I: Clean Water Services Review Comments
.... I-1
>
> Please let me know at your earliest convenience when I may receive these documents for my review.
>
> Thanks,
> David (Dave) LaLiberte, P.E.
> LIberte Environmental Associates, Inc. (LEA) WIlsonville, Oregon
> 503.582.1558
>

Supplement B: Part 1 – Analysis Report

Included under separate cover because of size.

Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property (LEA, November 2016)

Contracted by John and Grace Lucini, 23677 SW Boones Ferry Road, Washington County, Oregon, Tualatin, Oregon, 97140.
This report is referred to as the "Stormflow Analysis" throughout these comments.

Supplement B: Part 2 – Rpt Appendices

Included under separate cover because of size.

Appendices - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016)

Supplement C

CV for David M. LaLiberte, P.E.

David M. LaLiberte, P.E.
Principal Engineer

Summary:

Mr. LaLiberte's qualifications comprise over 30 years of experience in surface water quality analysis and evaluation, hydrology and hydraulics, stormwater system analysis, biological criteria for water and sediments, environmental quality control, sewage and industrial pollution abatement, effluent treatment alternatives and design, discharge requirements for NPDES wastewater and stormwater permits, mixing zone assessment, water intake and thermal discharges and environmental design. He has managed and performed on many environmental project teams assisting state and federal agencies, as well as municipal and industrial facilities, and non-governmental organizations in Oregon, California, Washington, Alaska and throughout the USA.

Education: M.S., Civil Engineering, Portland State University, 1990
B.S., Civil Engineering, Portland State University, 1988

Registration: Professional Engineer, Oregon (Civil and Environmental)

Liberte Environmental Associates, Inc. Experience:

Water Quality Evaluation of the Stormwater Management Plan (SWMP) Proposed for The Dalles, Oregon Wal-Mart Super Center for Karl Anuta, Attorney representing the plaintiff Citizens for Responsible Development in The Dalles. The effect on receiving water quality from stormwater discharges from a large retail facility was assessed in a report submitted to the Circuit Court of the State of Oregon. The detailed Expert Report was developed identifying the discharge conditions, storm flows based on local precipitation, storm flow mapping and routes, potential treatment levels using mechanical filtration and swales and other WQ issues. Water quality effects on receiving wetlands and tributaries of the Columbia River were investigated because of increased solids, toxics and bacterial loadings to be released from the proposed facility. Expert Testimony was provided in court supporting the evaluation report. This project was conducted in 2012 and 2013.

NPDES Mixing Zone and Water Quality Evaluations for Trident Seafoods Corporation, Alaska – Effluent characterization, discharge system configuration, receiving waterbody consideration, biological criteria and mixing zone evaluations were performed. Acting as subconsultant for Steigers Corporation. Facility operations generating wastewater discharges include: stormwater runoff inflow, seafood-processing wastewater, non-contact cooling water, treated sanitary effluent and other sources of industrial effluents. The MZ evaluations conformed to NPDES permit requirements and mixing zone guidelines for Trident facilities in Alaska at Akutan and Sandpoint. This project was performed from 2010 through 2012.

NPDES Water Quality Technical Assistance and Alternative Design Evaluations for North Slope Borough, Alaska – Evaluation of US Environmental Protection agency NPDES permit for discharges from oil and gas facilities including discharges from: stormwater system, drilling operations, cooling water intake and discharge, storage facilities, pipelines, gravel pits, treated sewage discharges, maintenance requirements, and other types of discharges. These discharges include stormwater affected deck drainage, cooling water intake and thermal discharges, treated sewage discharges and drill cuttings disposal to marine sediments. Water quality evaluation of the Camden Bay Exploration Plan for the Beaufort Sea of the Arctic Ocean was conducted for discharge impacts on the marine aquatic environment and relative to BOEMRE/MMS EIS. Analysis of the Chukchi Sea Exploration Plan of the Arctic Ocean was conducted for discharge impacts on the marine aquatic environment and relative to BOEMRE/MMS EIS. These evaluations were based on water quality and treatment alternatives assessment, and comparison to biological criteria. This project was conducted in 2010 through 2011.

Aurora STP NPDES Assessment for CRAG Law Center - Review of documents related to the design, operation and monitoring of the Aurora, Oregon Sewage Treatment Plant. Documents include: NPDES permit; stormwater inflow and infiltration, design related plans and specifications including recent headworks unit design; discharge monitoring reports, irrigation using effluent reuse, biosolids monitoring reports; effluent reuse plan and additional information relating to the design and operation of the Aurora STP. The review provided a basis for assessing potential causes of facility underperformance and discharge violations. An STP site visit was performed during this project to investigate facility aeration treatment, reuse equipment and capacities. This project was conducted from 2008 through 2010.

Review of the Medford STP Nutrient Related Discharges, for CRAG Law Center in Portland, Oregon. Evaluation of treatment facility and nutrient discharges from the Medford Sewage Treatment Plant (STP) into the Rogue River in Jackson County, Oregon. Existing discharges were evaluated for nutrient concentrations based on the discharger's CORMIX mixing zone analysis. Facility costs to upgrade for nutrient removal, including nitrogen and phosphorus, were developed. This project was performed in 2015 through 2017.

Evaluation of Sewage Treatment Plant Discharges to the Illinois River, Oregon, for the City of Cave Junction. Mixing zone analysis using EPA CORMIX was performed to determine the effects of temperature and other discharge parameters on river quality. Hydraulic analysis of river flow conditions was conducted to support the MZ analysis particularly for critical summertime conditions. This project was performed in 2013 through 2014.

Draper Valley Farms, Inc. Chicken Processing Industrial Discharge to Municipal Sewage System, for Smith and Lowney, PLLC representing the plaintiff Waste Action Project Citizens Suit. The effects on sewage treatment processes were evaluated relative to high biochemical oxygen demand (BOD) from Draper Valley Farms (DVF). A key focus of this analysis was the operational consequences of excess BOD on treatment in the aeration basins of the Mt. Vernon, WA municipal facility. The pass-through impact on the Skagit River was assessed for increased BOD from the industrial discharge. This project was conducted in 2014 and 2015.

Coal Discharge Investigation for the Columbia River and Selected Tributaries, for the Sierra Club supported by the Columbia Riverkeepers. Prospective coal samples were collected from sediments along 18 miles of the Columbia River located at the confluences of selected tributaries from Rock Creek (RM 150.0) to the White Salmon River (RM 168.3). Sampling locations corresponded to Burlington Northern Santa Fe (BNSF) railroad crossings at or near tributaries. The distribution of coal discharges into the Columbia River were mapped. Samples were analyzed by a third-party laboratory. Sample parameters were: moisture content, fixed carbon, volatile matter, ash and total sulfur. This was based on ASTM Proximate Analysis plus sulfur. Coal identification, to determine potential sources of coal, was completed for this investigation with the support of supplemental analysis advised by the laboratory. Supplemental analysis included ASTM D-388 requirements for heating value, sulfur in ash, free swelling index (carbonization physical characteristic) and classification of coal by rank. A deposition was provided in 2016 to defend the results of coal report. This project was performed in 2012 through 2013 and 2016.

Oregon Department of Environmental Quality - WQ Technical Assistance: Industrial discharge effluent evaluation of the Port of St. Helens, Oregon ethanol and power generating plants. Outfall mixing zone analysis with design assessment was developed. Provided water quality evaluation and environmental engineering assistance to the Oregon DEQ. Work included receiving WQ analysis, operations review, thermal discharge evaluation, biological criteria comparison and mixing zone analysis. NPDES requirements were based on EPA *Quality Criteria for Water*, EPA *Technical Support Document for Water-based Toxics Control* (TSD) and State Administrative Rules. The mixing zone models CORMIX and PLUMES were evaluated relative to the cases at hand. Potential discharge chlorine residual and temperature requirements were evaluated. The effect of potential temperature Total Maximum Daily Loads (TMDLs) in the Columbia River was also evaluated. This project was performed in 2003 through 2004.

Wauna Pulp and Paper Mill Outfall 003 and Columbia River Field Survey Locations and Sampling Results for Columbia Riverkeeper including sampling. In coordination with staff and volunteers, water samples were collected in the vicinity of the paper mill outfall for laboratory analysis. The physical outfall mixing zone was mapped using in-situ Hydrolab water quality measurements taken with depth for temperature, dissolved oxygen, pH, conductivity and turbidity. Laboratory samples were analyzed for potentially toxic concentrations of dioxins, total residual chlorine (TRC) and metals including aluminum, arsenic, copper, iron, lead, mercury and zinc. Additional information sources were investigated using the Oregon DEQ permit file and including the mill's NPDES permit and the mutual agreement and order (MAO) compliance schedule. This project was conducted in 2004.

Review of Draft and Final NPDES General Permit Cook Inlet, Alaska Oil and Gas Operators for Cook Inletkeeper - Evaluation of the draft National Pollutant Discharge Elimination System (NPDES) permit proposed by the U.S. Environmental Protection Agency (EPA) authorizing wastewater discharges from oil and gas exploration, development, and production facilities into Cook Inlet, Alaska. There are 18 existing facilities discharging into Cook Inlet with new facilities capable of being brought on line under the draft permit. Technical analysis of these discharges, which can contain toxic and bioaccumulating contaminants, was performed relative to the potential to adversely affect Cook Inlet water quality and sediments. This project was conducted from 2007 through 2009.

Water Quality Evaluations and NPDES Permit Requirements for the four (4) WES publicly owned treatment works (POTW) discharges (2000-2004, 1999) performed for Water Environment Services, Clackamas County, Oregon. These included evaluation of discharge effects on the Willamette River (2 outfalls), Sandy River and a tributary of the Clackamas River. Field water quality sampling including detailed outfall mixing zone investigations. Water quality assessment was conducted relative to effluent temperature, disinfection and ammonia requirements to protect fish and aquatic organisms. Effluent mixing zone simulation and analysis was performed. Treatment alternatives analysis and costing were undertaken to ensure existing and future discharge conditions were protective of river WQ. River outfall piping alignment and diffuser design was provided including construction management of river installation.

Expert Analysis of Surimi and Seafood Industrial Wastewater Discharge into the Skipanon and Columbia Rivers, Oregon (2003-2006) was conducted for the National Environmental Law Center. Water quality analysis evaluating the effects of seafood and surimi wastewater discharges on the Skipanon and Columbia Rivers, Oregon. Field data collection was performed to support water quality technical analysis. Investigation included mixing zone analysis of historic seafood and surimi wastewater discharges into the Skipanon River, and new discharges to the Columbia River. Evaluations were performed for various discharge scenarios, monitoring and sampling requirements, potential treatment options, and alternative outfall pipeline alignments. Effluent and instream dissolved oxygen (DO), biochemical oxygen demand (BOD), ammonia, hydrogen sulfide, nutrients nitrogen and phosphorus, oil and grease, and total suspended solids (TSS) were evaluated in detail. Expert witness analysis and reporting was provided.

Westport Sewer Service District, Clatsop County, Oregon - MZ Evaluation with Alternative Disinfection (2003-2004). This project assessed water quality and mixing zone effects of disinfected treated wastewater discharged to Westport Slough, a segment of the Columbia River. Chlorine residual reduction or elimination was a key evaluation concern to satisfy Oregon DEQ requirements. Comparisons of alternative disinfection treatment scenarios and costs were performed that would allow the discharger to continue to meet WQ requirements. Ultraviolet disinfection, chlorination-dechlorination, and outfall diffuser feasibility were all investigated with comparison costs. In particular, the existing chlorination system was evaluated relative to how easily it could be retrofitted to function with dechlorination. The alternatives analysis aided the discharger in making a determination as to course of action.

Public Employees for Environmental Responsibility preparation of report Effect On Puget Sound Chinook Salmon of NPDES Authorized Toxic Discharges as Permitted by Washington Department of Ecology (2005-2006). Industrial, municipal, stormwater and general facility NPDES permits were reviewed and analyzed relative to the presence of toxic contaminants in Puget Sound. Toxic contaminants evaluated included metals, hydrocarbons, and chlorinated hydrocarbons.

Citizens for Responsibility v. Izaak Walton League, Circuit Court of the State of Oregon for Lane County, Expert Analysis for Plaintiff evaluating the effects of lead contamination from shooting range into South Fork Spencer Creek (2004-2005). Sediment sampling was conducted for metals including lead, arsenic, copper and polynuclear aromatic hydrocarbons (PAH). This information was evaluated for pollutant distribution and transport from the contaminated site and relative to upstream and downstream properties. Expert testimony was given at trial in 2004. Expert analysis and testimony was also provided in the subsequent equitable relief phase. Participation in the settlement conference was also provided.

Canby Utility Board - Industrial Discharge from Water Treatment Plant Study and Predesign (1999-2000) addressing Molalla River water quality issues with Oregon DEQ including treatment alternatives: filter backwash sedimentation basin, disinfected effluent de-chlorination, river infiltration gallery design, intake piping system, and sediment and riparian effects mitigation.

Water Environment Services of Clackamas County Hoodland WWTP Outfall Project Descriptions and Costs (2000); FEMA engineering, budgeting and negotiations is intended to reimburse Clackamas County for flood damage to their wastewater treatment plant outfall on the Sandy River. Numerous regulatory issues affected costs including an ACE 404 permit for instream construction work, NMFS ESA Section 7 Consultation, and NEPA documentation including environmental and biological assessments.

City of Bremerton, CSO Projects --A comprehensive review of the City of Bremerton, Washington collection system model was performed (2000). Hydraulic modeling was used to update information for the main sewer lines, combined sewer overflows and discharge conditions. Selected CSO reduction alternatives were evaluated and implemented. The purpose of the CSO reduction alternatives was accomplished and potential early action projects were identified. These projects yielded substantial CSO reductions while being quickly implemented at reasonable cost. Revised CSO baselines were produced conforming to Washington Department of Ecology requirments for Bremerton's 17 CSO outfalls. Expert witness testimony supporting the findings of the CSO baselines was provided in a hearing at the Federal Court in Seattle.

Previous Experience (Montgomery Watson Americas)
In addition, I have performed as project manager and/or project engineer on the following undertakings:

- Project Manager/Engineer evaluating stormwater hydrologic, hydraulic and quality conditions in Balch Creek Basin for the City of Portland, Bureau of Environmental Services, Oregon. The Army Corps of Engineers (COE) hydrographic model, (HEC-1) and hydraulic model (HEC-2) were applied to establish design criteria for flood magnitude, stormwater detention, water quality facility hydraulics and fish passage culvert hydraulics.

- Project Engineer evaluating stormwater hydrologic, hydraulic and quality conditions in Clackamas County for the CCSD#1. The graphically enhanced model, XP-SWMM, was used to develop the hydrology and hydraulics for the Kellogg and Mt. Scott Creeks basins in CCSD#1.

- *City of Portland, Bureau of Environmental Services* included Water Quality Evaluations and Diffuser Designs (2000-2001, 1997,1994) for wet and dry weather flows with chlorine residual discharges, and wet weather stormwater runoff for suspended solids and metals with potentially affected agencies including US Corps of Engineers, Oregon Division of State Lands, NOAA Fisheries, Oregon Dept. of Fish and Wildlife and US Fish and Wildlife.

- Project Manager/Engineer for the Kensington Mine in Alaska. PLUMES mixing zone modeling was used to evaluate the conditions affecting this industrial outfall. Sedimentation basin design for removal of mine tailings prior to discharge to Lynn Canal.

- City of Bremerton Corrosion and Fluoridation Facility detention facility design. An on-site detention facility was designed pursuant to Washington Department of Ecology's requirements as specified in the *Puget Sound Stormwater Management Manual*.

- Project Engineer for Water Environment Services of Clackamas County Kellogg Creek WWTP Odor Control Project. Participated as team engineer to design malodorous air collection system for headworks, primary clarifiers, secondary clarifiers, and dissolved air floatation thickening (DAFT) building. Malodorous air was passed through a biofilter for treatment.

- Project Engineer for Crescent City, California WWTP outfall mixing zone analysis. A major consideration of this project was developing alternative outfall pipeline alignments and an effective discharge location to optimize mixing.

- Project Manager/Engineer for the Hoodland WWTP Outfall project, which includes outfall diffuser design and construction (1998) in a sensitive Sandy River corridor.

- Project Task Manager—Jefferson County (Birmingham, Alabama) stream water quality analysis was performed relating to recommended NPDES permit limits for dry and wet weather conditions. Collection system analysis and treatment plant design constraints are also considerations in this potentially very large project.

- Project Engineer using Pizer's HYDRA, data compatible with the City of Portland, Oregon's XP-SWMM format, to evaluate gravity flow conditions in the proposed dual outfall system consisting of two connected parallel outfall systems over one mile each and including wet weather (CSO) hydraulic structures such as flow control structures, mix boxes and outfall diffusers.

- *City of Madison, Wisconsin* - stream water quality modeling analysis of POTW discharge relative to NPDES permitting requirements (1995-1996). A key objective of this study was restoration of base flows to the Sugar River Basin using high quality POTW effluent. An EPA QUAL2E model was developed for Badger Mill Creek and the Sugar River. Physical, chemical and biological simulation included temperature, algae, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS) and ammonia. Particular attention was focused on the inter-relationships between temperature, climatological conditions, stream shading and channel conditions, DO, BOD and algal activity. Temperature and discharge point design alternatives were investigated using the model. It was demonstrated that, with minimal WWTP facility upgrading and cost, the City could beneficially discharge high quality effluent to surface streams. This assurance was primarily accomplished through detailed modeling analysis and model approach consensus building with regulators (WDNR). Some keys to the success of this project were in identifying important NPDES permitting issues, evaluating them with the model, recommending permit effluent limits and negotiating with regulators.

- *Washington Beef, Incorporated* in Toppenish, Washington – Development of an NPDES permit under the direction of the EPA (1993-94). The project objective was development of receiving water based permit effluent limits for this food-products industry discharger using dissolved air floatation (DAF) treatment. Important project elements were: interfacing with regulatory (EPA Region 10 and Washington Ecology) and public agencies; evaluation of the effect of effluent parameters on receiving water using modeling analysis (EPA QUAL2E and EPA CORMIX); and providing long-term treatment system design recommendations. Fishery issues were of key concern for this project. Receiving water modeling was used to analyze the discharge effects of on stream dissolved oxygen and temperature on the aquatic environment. The inter-relationship between temperature, climatological conditions, stream shading and channel conditions, DO and algal activity were thoroughly investigated. Temperature and discharge design alternatives were evaluated using the water quality model.

Previous Experience (Other Firm)

- *Oregon Department of Environmental Quality and Oregon Department of State Land Conservation and Development* - Non-point Source Pollution Control Guidebook for Local Government (1994) evaluation of non-point runoff pollution and control measures including detention facilities, sedimentation basins, water quality ponds and marshes; City of Portland, Bureau of Environmental Services (1989-90) - evaluated effects of combined sewer overflows and stormwater discharges on the Columbia Slough of the Columbia River. Hydrologic and water quality modeling support was provided including sampling.

- Project Engineer for NPDES waste discharge permit review and support related to permit effluent limits for the City of Vancouver, Washington. Two tracer dye studies were performed at their two municipal WTP outfalls. The key project objective was to determine actual outfall dilution and provide a physical, receiving water basis for setting permit effluent limits. The mixing zone evaluations showed that actual dilution was greater than estimated by the regulatory agency (Washington Department of Ecology) and higher permit effluent limits were recommended.

- Project Task Manager and Engineer for a comprehensive hydraulic and water quality compliance evaluation and recommendations. The City of Portland's Columbia Boulevard WTP, the largest municipal discharger in Oregon (300 MGD), required assistance in meeting their water quality compliance needs. A highly detailed Columbia River tidal flow evaluation was performed in the outfall vicinity to serve as the basis for the mixing zone simulation and diffuser design. EPA CORMIX, and the EPA supported PLUME model family (including UDKHDEN), were used in the modeling analysis. A thorough investigation of water quality compliance options led to regulatory (ODEQ) approval of the multi-port diffuser design, the lowest cost compliance option.

- Project Engineer for Kehei, Hawaii Water Reuse Facility (1992). Participated as team engineer to design upgrades to the facility's aeration basin including aeration blower design and aeration basin air piping with small bubble diffusion.

- Project Engineer for the Columbia Slough flow augmentation project for the City of Portland Bureau of Environmental Services, Oregon. Dynamic water quality modeling (COE CE-QUAL-W2), water quality sampling, and hydrodynamic sampling were performed for this dynamic "freshwater" estuary. This project was driven by the City's need to evaluate the impact of water quality limited conditions on the Columbia Slough and was coupled to the City's EPA SWMM model. The objective was to propose best management practices (BMP) and evaluate design alternatives. The effect of temperature on the aquatic environment was examined in detail. The sophisticated two-dimensional (vertical and longitudinal) dynamic model evaluated temperature regimes and their effect on in-stream water quality. In-stream temperature design alternatives were investigated via simulation of climatological conditions, stream shading and channel conditions, algal processes and kinetics, and instream DO.

- Project Engineer conducting stormwater hydrologic and hydraulic simulation to evaluate flood effects for the City of Beaverton, Oregon. HEC-1 hydrographic modeling was conducted to generate peak flow values from surface runoff for existing and future conditions. HEC-1 model results for 2, 5, 10, 25, 50 and 100-year storm events were supplied to the HEC-2 model for detailed hydraulic analysis. The HEC-2 modeling was required as part of a cost assessment that included potential flood damage of key storms.

- Project Manager and Engineer for a mixing zone evaluation and diffuser design for the City of Albany, Oregon. An outfall pipeline and 40 MGD capacity multi-port diffuser was designed for this municipal discharger using EPA CORMIX. Simulation was performed to optimize the diffuser design. The DEQ approved design will meet water quality compliance needs for chlorine and ammonia.

- Project Engineer mixing zone modeling and design for the City of Gresham, Oregon. Alternative disinfection and multiport diffuser design were evaluated. Modeling (EPA CORMIX) was utilized to optimize multiport diffuser design for this WWTP outfall. Simulation offered the flexibility to test numerous design conditions.

- Project Manager and Engineer for a mixing zone evaluation and diffuser design for the Unified Sewerage Agency, Washington County, Oregon. Analysis of four municipal treatment facility outfalls was conducted according to DEQ NPDES requirements. Model simulation was performed to determine revised wet weather chlorine residual effluent limits. The models were calibrated to dye study results. Wet weather stream surveys were also performed at two sites, Hillsboro and Forest Grove. Alternative disinfection was evaluated and diffuser design recommendations were also made.

- Project Manager and Engineer for outfall mixing zone simulation and water quality compliance evaluation for the Oak Lodge Sanitary District, Oregon. As part of NPDES permit requirements, model simulation was performed to characterize the municipal discharge-mixing zone. Available dilution values and recommended permit effluent limits for chlorine, ammonia and metals were derived from the study.

- Project Manager for a mixing zone evaluation and diffuser recommendations for Electronic Controls Devices, Incorporated. A mixing zone field evaluation of this circuit board manufacturer's discharge was performed. Very low amounts of organics and metals from the facility discharge needed to be discharged to a small stream in a responsible manner. This study illustrated that the discharge was well within compliance requirements.

Previous Experience (Portland State University Research Assistant)
City of Portland, Bureau of Environmental Services (1989-90) - evaluated effects of combined sewer overflows and stormwater discharges on the Columbia Slough of the Columbia River. Hydrologic and water quality modeling support was provided including field sampling.

- Project Engineer for evaluation of fish screen approach velocities and hydraulic design analysis for the Eugene Water and Electric Board, Leaburg, Oregon. The effects of downstream baffles on velocities through fish screens at the Leaburg Power Canal Facility were evaluated for fish passage.

- Project Engineer evaluating combined sewer overflows (CSO) and stormwater discharges on the Columbia Slough. Hydrologic and water quality modeling, using the City's EPA SWMM model data, of urban runoff from sub-basins discharging to the Columbia Slough was supplied as input to the Army Corps of Engineers in-stream surface water model, CE-QUAL-W2. This study was performed for the City of Portland, Bureau of Environmental Services in Oregon.

- Project Engineer for the South Slough National Estuarine Reserve Hydrodynamic and Water Quality Study, State of Oregon, Division of State Lands, Charleston, Oregon. Dynamic water quality modeling, water quality sampling, and hydrodynamic sampling were performed for this southern section of the Coos Bay estuary. Tracer (rhodamine) dye study results were used to calibrate the Army Corps of Engineers CE-QUAL-W2 model.

- Project Engineer for design of stream flow measurement structures on two tributaries of the South Slough National Estuarine Reserve (State of Oregon, Division of State Lands) in Charleston, Oregon. Analysis and design of stream flow measurement structures was required as part of a study assessing the hydrology and hydraulics of this pristine estuary.

- Project Engineer for a hydrologic, hydraulic and water quality assessment of Smith and Bybee Lakes in Portland, Oregon. Lake sampling and modeling was performed. The objective of the study was to evaluate the potential for water quality impairment due to the close proximity of St. John's municipal landfill and Columbia (North) Slough inflow. A hydraulic model of possible flow control structures was incorporated into the Army Corps of Engineers CE-QUAL-W2 hydrodynamic and water quality model. Recommended actions were advanced for improving lake water quality based on simulation scenarios. This study was conducted as part of a larger study for the Port of Portland, Metropolitan Service District, and City of Portland, Bureau of Environmental Services, Portland, OR.

- Project Manager and Engineer assessing the water quality impact of urban runoff from the Leadbetter storm outfall discharge to Bybee Lake. This study was conducted for the Port of Portland, Portland, Oregon.

- Project Engineer assisting in initial field work and model development for assessing impact of landfill leachate on surrounding surface waters. Conducted for the Metropolitan Service District (METRO) as part of the St. Johns Landfill closure.

Publications and Presentations

Stream Temperature Trading, Presented at the Pacific Northwest Pollution Control Annual Conference, 2001, Bend, Oregon.

Winter Temperature Gradients in Circular Clarifiers (January 1999), *Water Environment Research*, **70**, 1274.

Wet Weather River Diffuser Port Velocities: The Energetic Debate, Presented at the Pacific Northwest Pollution Control Annual Conference 1998, Portland, Oregon.

Near Field Mixing and Regulatory Compliance Implications Presented at Portland State University, February, 1998.

Whither the Wet Weather Flow, Presented at the Pacific Northwest Pollution Control Annual Conference 1997, Seattle, Washington.

Supplement B: Part 1 – Analysis Report

Included under separate cover because of size.

Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property (LEA, November 2016)

Contracted by John and Grace Lucini, 23677 SW Boones Ferry Road,
Washington County, Oregon, Tualatin, Oregon, 97140.
This report is referred to as the "Stormflow Analysis" throughout these comments.

Effects of SW Boones Ferry Road Construction (2013-2015)
Stormflow Analysis for the Lucini Property
Washington County, Oregon

Prepared for
John and Grace Lucini
23677 SW Boones Ferry Road
Tualatin, Oregon
97140

REGISTERED PROFESSIONAL ENGINEER
18,645
OREGON
JULY 20 1993
DAVID M La LIBERTE

Prepared by
Dave LaLiberte
Principal Engineer
Liberte Environmental Associates, Inc.
Wilsonville, Oregon

LEA

November 1, 2016

1. Summary

Beginning in about 2015, Washington County, Oregon re-routed and increased the portion of stormwater flows passing through its road culvert (Outfall #5). These increased stormflows are associated with the County's SW Boones Ferry Road (BFR) Improvement Project. A location map is presented in Figure 1 showing the Lucini property relative to the County's road project. The re-routed portion and increased stormwater ultimately discharge onto the Lucini property[1]. Figures 2 and 3 show the stormwater conveyance through the steeply sloped Lucini property, which is composed of pipes and ditches. The photos in Appendix A document drainage condition problems on the Lucini property associated with the road project.

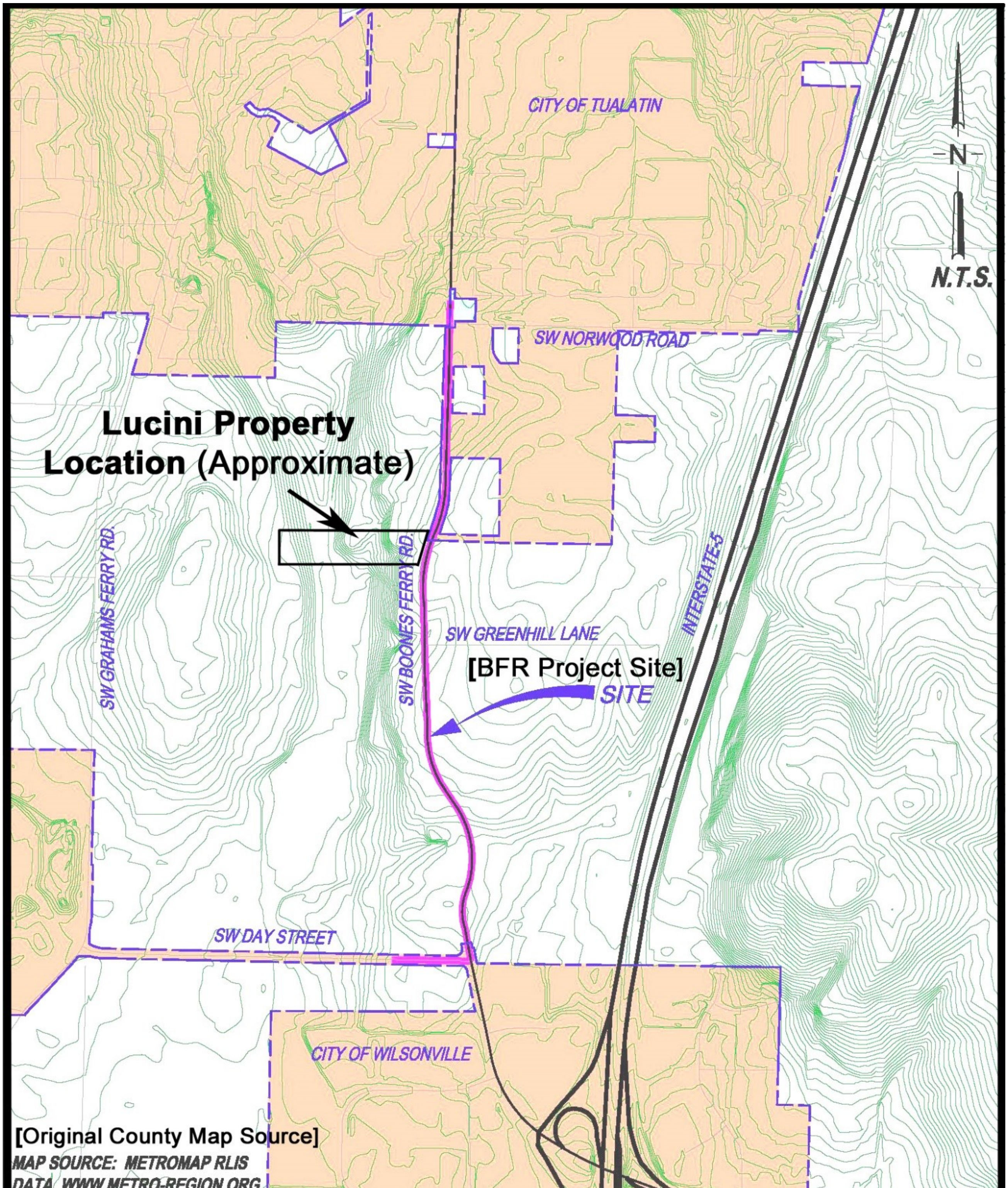
Increased portions of stormflows are now routed to the Lucini property but the County did not acknowledge this condition in its planning document, which is identified throughout this report as the *Drainage Report* (2013).[2] Figure 4 shows the erroneous subbasin boundaries used by the County in its Drainage Report. Figure 5 shows the necessary corrections to the faulty subbasin boundaries. These corrected subbasin boundaries demarcate a smaller actual subbasin acreage draining to the Lucini property, which results in lower stormflows than those projected by the County for ORIGINAL conditions prior to 2013. Appendix B provides the Drainage Report figures pertaining to overall subbasin boundaries for "Existing Conditions Hydrology", called throughout this report as the ORIGINAL conditions; and the "Proposed Conditions Hydrology", i.e., IMPLEMENTED conditions.

Photos and Drawings Documentation
The County claims in the Drainage Report that the ORIGINAL Boones Ferry Road above the Lucini property prior to 2013 was curbed and included storm sewers. However, the photos in Appendix A1 show that there are no curbs or storm sewer inlets. The County's mischaracterization of stormflow conditions, and depriving the public of accurate land contour information, allowed the County to shift a portion of flows from the adjacent and sensitive Greenhill Lane subbasin and into the subbasin above the Lucini property generating significant problems with erosion and flooding.

Appendix C contains the "Existing Conditions Plan" (June 2012) from the County's 70 percent drawings submittal related to the subbasin above the Lucini property. The drawings contain no elevation labeling nor do the unlabeled contour lines support the County's claim that the majority of stormflows in this area originally ended up passing onto the Lucini property.

[1] John and Grace Lucini property is located at: 23677 SW Boones Ferry Road, Tualatin, Oregon, 97140.

[2] Drainage Report (2013), <u>Storm Drainage Report – SW Boones Ferry Road (SW Day Road to SW Norwood Road</u>, by MacKay Sposito for Washington County, Capital Project Management (CPM), Final January 31, 2013.



Background Image from Washington County's *Storm Drainage Report for SW Boones Ferry Road* Appendix A2 - Site Map figure on PDF page 27 of 152 (January 31, 2013).

Figure 1. Location Map Showing Lucini Property Overlay and Proximity to the SW Boones Ferry Road Improvement Project

These problems were not corrected in the construction plans for the project related to the subbasin above the Lucini property as shown in the final as-built drawings (November 2014) available in Appendix D. The County's "Erosion and Sediment Control Plan" from the as-built drawings as it relates to the subbasin draining to the Lucini property are contained in Appendix E. These drawings show that the original contours allowed stormflow to enter the road right-of-way and then flow south into the adjacent Greenhill Lane subbasin, not the subbasin draining into the Lucini property.

The storm flow increases overwhelmed the existing downstream conveyance system causing substantial erosion and flood damage to the property in May 18, 2015. Photos of flood damage are presented in Appendix A2. Still more flood damage is threatened in future years as the County has not protected the Lucini property from increased flows in an area that is rapidly urbanizing. Appendix A3 contains photos of erosion damage on the Lucini property resulting from increased stormflows that erode soil, widen the conveyance ditch into the adjacent embankment and expose tree roots.

In its Drainage Report, the County has departed from its stated stormwater guidance identified in Clean Water Services (CWS).[3] In particular, the County did not carry-out a Downstream System[4] evaluation for the Lucini property as necessitated in its guidance. This evaluation process is used to determine the potential effects of increased storm flows on the property. The effects of ongoing and future development in the drainage above the Lucini property are neglected in the County's Drainage Report for the ORIGINAL (pre-2013) and IMPLEMENTED (2015) subbasin conditions.

The County disregarded increased stormflow effects, above the Lucini property, resulting from more intense ongoing and future urbanization in the subbasin. Near-term increases in land use intensity were also neglected as the Drainage Report did not acknowledge the County's own construction impact on the subbasin above the property. Increased stormflows, generated from the more intensely urban "Institutional" category associated with the City of Tualatin, are entirely overlooked by the County.

Purpose of this Stormflow Analysis

This Stormflow Analysis report is performed in lieu of Washington County carrying-out an accurate assessment of ORIGINAL (prior to 2013) and IMPLEMENTED (2015) drainage conditions upstream and through the Lucini property.

The U.S. Army Corps of Engineers (Corps) model, HEC-HMS[5], is used in this analysis to evaluate rainfall hydrology. Model inputs include precipitation time distributions and amounts, drainage area sizes, land use and soil conditions, runoff time-of concentration,

[3] CWS (2007), *Design and Construction Standards for Sanitary Sewer and Surface Water Management*, for Clean Water Services (CWS), Hillsboro, Oregon, June 2007.

[4] Ibid, see Chapter 2, Page 12 under the 2.04.2 subsection heading "3. Review of Downstream System", i.e., this is subsection 2.04.2.3.

[5] HEC refers to the U.S. Army Corps of Engineers Hydrologic Engineering Center; and the HMS refers to the Hydrologic Model System.

stormwater routing and other parameters are considered for evaluating storm flows onto and through the Lucini property.

The hydrologic analysis performed in this report was first adjusted to the Washington County hydrologic results presented in its Drainage Report for the corresponding Soil Conservation Service (SCS) Type IA 25-year design storm. Then the corrected subbasin areas and land use conditions were supplied to the HEC-HMS hydrologic model so that realistic storm flow conditions could be simulated.

The County's Drainage Report did not perform a hydraulic analysis to assess the effects of stormflows above and through the Lucini property. The Corps hydraulic model, HEC-RAS[6], is used in this analysis to overcome the lack of hydraulic information. Peak flows from 25-year rainfall runoff, generated by the hydrologic model HEC-HMS, are supplied as inputs to the HEC-RAS hydraulic model. HEC-RAS is run in steady state mode, i.e., peak stormflows are held constant for each run. This process allows for the consideration of the impact of stormflows on piping, ditches and other features of the drainage system. Specifically, the hydraulic effects resulting from stormflows passing through the drainage system subbasins, stormflow routing, ditches, culverts (piping), land use conditions, ditch and piping materials, and other parameters can be assessed.

Hydrologic Modeling Results

The hydrologic simulation inputs and stormflow results generated by HEC-HMS for the subbasin above the Lucini property are contained in Appendix H.

The hydrologic modeling considered a number of probable realistic cases unexamined in the Drainage Report for the 25-year design storm. The ORIGINAL subbasin configuration as depicted in Figure 4, which is corrected as shown in Figure 5. The hydrologic model was then run with the more accurate drainage area as the ORIGINAL subbasin configuration. This comparison demonstrates that the realistic (actual) peak flow value of 0.89 cubic-feet-second (cfs) discharging to the Lucini property is 31.5 percent less (see the Figure 6 column chart) than peak flow of 1.17 cfs claimed in the County's Drainage Report. This is critically important because the County is inflating the ORIGINAL stormflows and makes it seem like the ORIGINAL condition had higher flows. This is an adverse condition for the Lucini's because the Drainage Report analysis later claims to reduce the ORIGINAL stormflow amount that it previously inflated as part of the IMPLEMENTED project.

Stormflow values are graphically compared in the Figure 6 through Figure 8 column charts. Figures 9 and 10 show the subbasin boundaries for IMPLEMENTED conditions, which permanently re-rout stormflows from a portion of the Greenhill Lane subbasin ultimately onto the Lucini property

Still greater stormflow inaccuracies are introduced by the County because it did not consider fundamental increases in impervious land areas resulting from ongoing and future land use. This is a basic necessity identified in the CWS (2007) guidance, which

[6] HEC-RAS refers to the River Analysis System hydraulic model developed by the Corps.

the County is claiming it is relying upon. It can be seen that ongoing land use and future full build-out development conditions result in much larger stormflows being discharged to the Lucini property.

Ongoing land use considerations include road construction activities and large facility support conditions necessitated by the Horizon Community Church. These land use conditions can be seen in the aerial view presented in Figures 13 and 14. Appendix F also displays additional land use characteristics in the subbasin above the Lucini property. Road construction activities result in soil compaction from heavy equipment movement and parking as well as materials staging and other provisions necessitated by road construction. Figures 13 and 14 also show the sprawling Horizon Community Church complex that relies in part on the subbasin draining to the Lucini property. The church facilities include a driveway, service roads, vehicle parking, facility support buildings and other impervious features affecting runoff.

When realistic ongoing land use is considered, stormflows discharged to the Lucini property are projected to inflate to 92.1 percent of the ORIGINAL conditions (see middle column in Figure 7). When stormflows from ongoing land use are compared to IMPLEMENTED conditions, the Lucini property is projected to receive 204.7 percent of the realistic (actual) original stormflows based on implemented conditions (see middle column in Figure 8).

The majority of the subbasin above the Lucini property is slated for intense future development allowed within the 20-year future development (FD20) planning. The County disregarded this condition in its Drainage Report and is subjecting the Lucini property to significant burdens from future erosion and flooding. When realistic future full build-out development is considered, stormflows discharged to the Lucini property are projected to inflate to 220.2 percent of the ORIGINAL conditions (see right column in Figure 7). When stormflows from full build-out conditions are compared to IMPLEMENTED conditions, the Lucini property is projected to receive 414.1 percent of the realistic (actual) original stormflows based on implemented conditions (see right column in Figure 8).

Hydraulic Modeling Results

The hydraulic modeling presented in this analysis evaluates the ORIGINAL and IMPLEMENTED piping and ditches on the Lucini property (see Figures 2 and 3) as well as the County's system above the Lucini property (see Figures 11 and 12).

Figure 11 shows the hydraulic conditions for connecting piping and the original road culvert locations for the ORIGINAL configuration. Figure 12 illustrates the IMPLEMENTED hydraulic conditions consisting of connecting piping and the new culvert comprising the County's Outfall #5. Figure 12 also shows the juxtaposition of the old and new Boones Ferry Road that hydraulically affects flows to the Lucini property.

The hydraulic simulation inputs and results, including stormflow water surface profiles and velocities, generated by HEC-RAS are available in Appendix I. The hydraulic modeling assessing pipe and ditch flow conditions shows that excessive stormflow velocities are created on the steep slopes of the Lucini property. The estimated land profiles of the storm water conveyance is illustrated in Figure 15 and Appendix I).

Stormflow velocities shown in Figure 16, for a range of land use conditions and the ORIGINAL subbasin configuration, demonstrate many instances where values exceed velocities that cause erosion on the Lucini property. These velocities exceed 4.0 feet-per-second (fps) and cannot be maintained. This deleterious situation requires measures to reduce peak flows coming through the County's culvert (Outfall #5) and onto the Lucini property. The physical conditions of excessive and increased streamflow on steep slopes existing on the Lucini property, and compared to the ORIGINAL conditions, were not evaluated by the County in its Drainage Report.

Stormflow velocities shown in Figure 17, for a range of land use conditions and the IMPLEMENTED subbasin configuration, demonstrate that values exceed velocities that cause erosion on the Lucini property for the ongoing land use and full build-out development conditions. These velocities exceed 4.0 feet-per-second (fps) and cannot be maintained. This harmful condition requires methods to reduce peak flows, including sediment and debris transport, passing through the County's culvert and onto the Lucini property. The physical conditions of excessive and increased streamflow on steep slopes existing on the Lucini property, and compared to IMPLEMENTED conditions, were not evaluated by the County in its Drainage Report.

Planning Level Costs
Three levels of estimated capital costs are related to remedying problems on the Lucini property resulting from the County's SW Boones Ferry Road widening project:

1) Immediate Shorter Term Remedy using Orifice Plate ($4,500 to $6,500 installed)
2) Ongoing Flow and Water Quality Control Facilities ($12,157 to $17,560 installed)
3) Longer Term Detention/Retention Facilities (to several hundred thousand dollars)

These capital costs include equipment, materials, labor, and construction contractor overhead and profit. Design, engineering and construction management costs are separately considered. An estimate of 20 percent of the final construction capital cost for this relatively small scale project is considered. For the high range estimates above, the design cost estimates are $1,300 for number 1 and $3,572 for number 2.

Notes:
[1] Background aerial image source from 2012-04-02 Map Boones Fry Rd FINAL_ EXHIBIT_AERIAL WA County.pdf. Five (5)-foot contours overlaid from 2013 Boones Ferry Road Wetlands and Contours from Metro Data Resource Center.
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).
[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlay from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

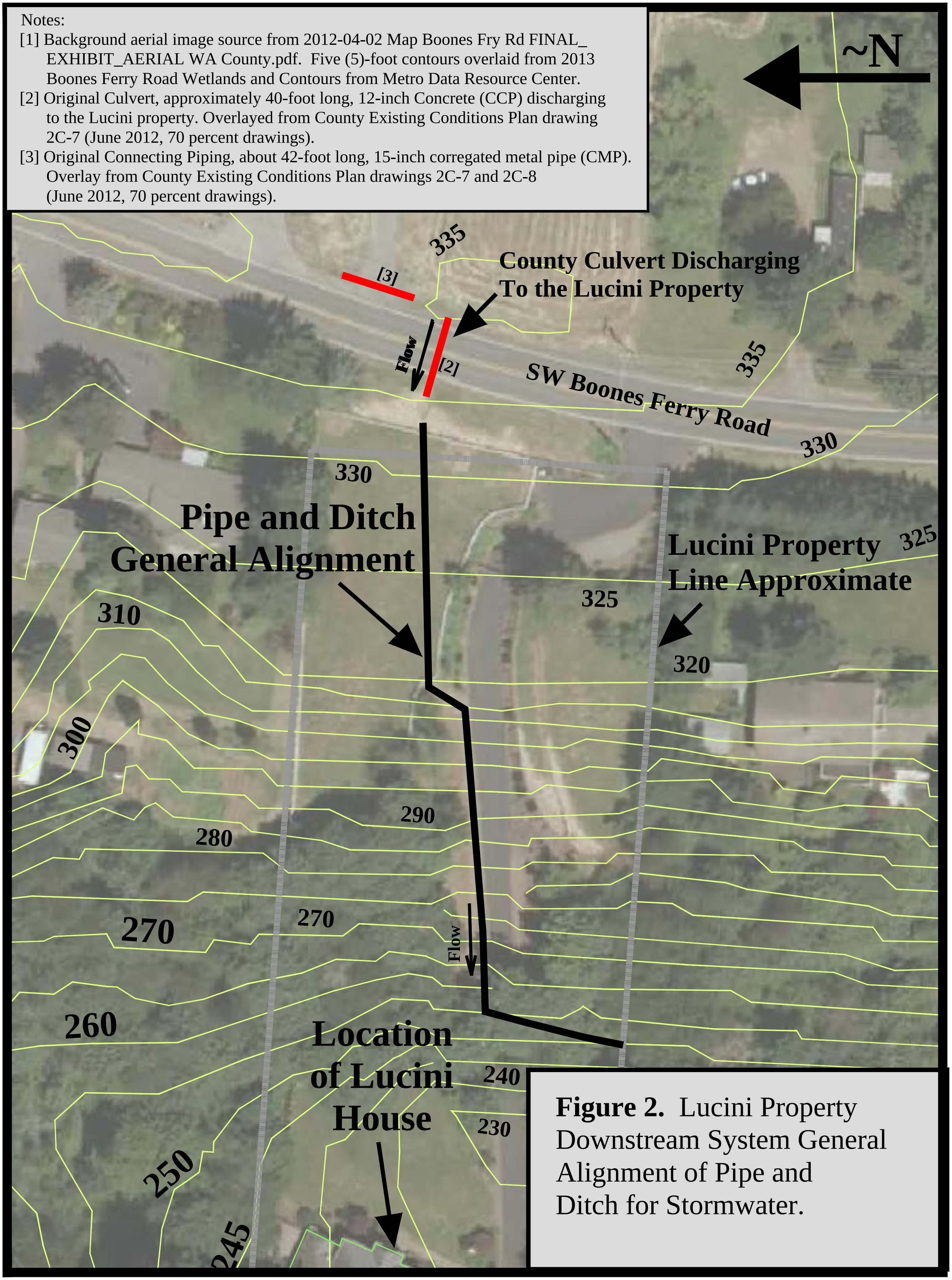


Figure 2. Lucini Property Downstream System General Alignment of Pipe and Ditch for Stormwater.

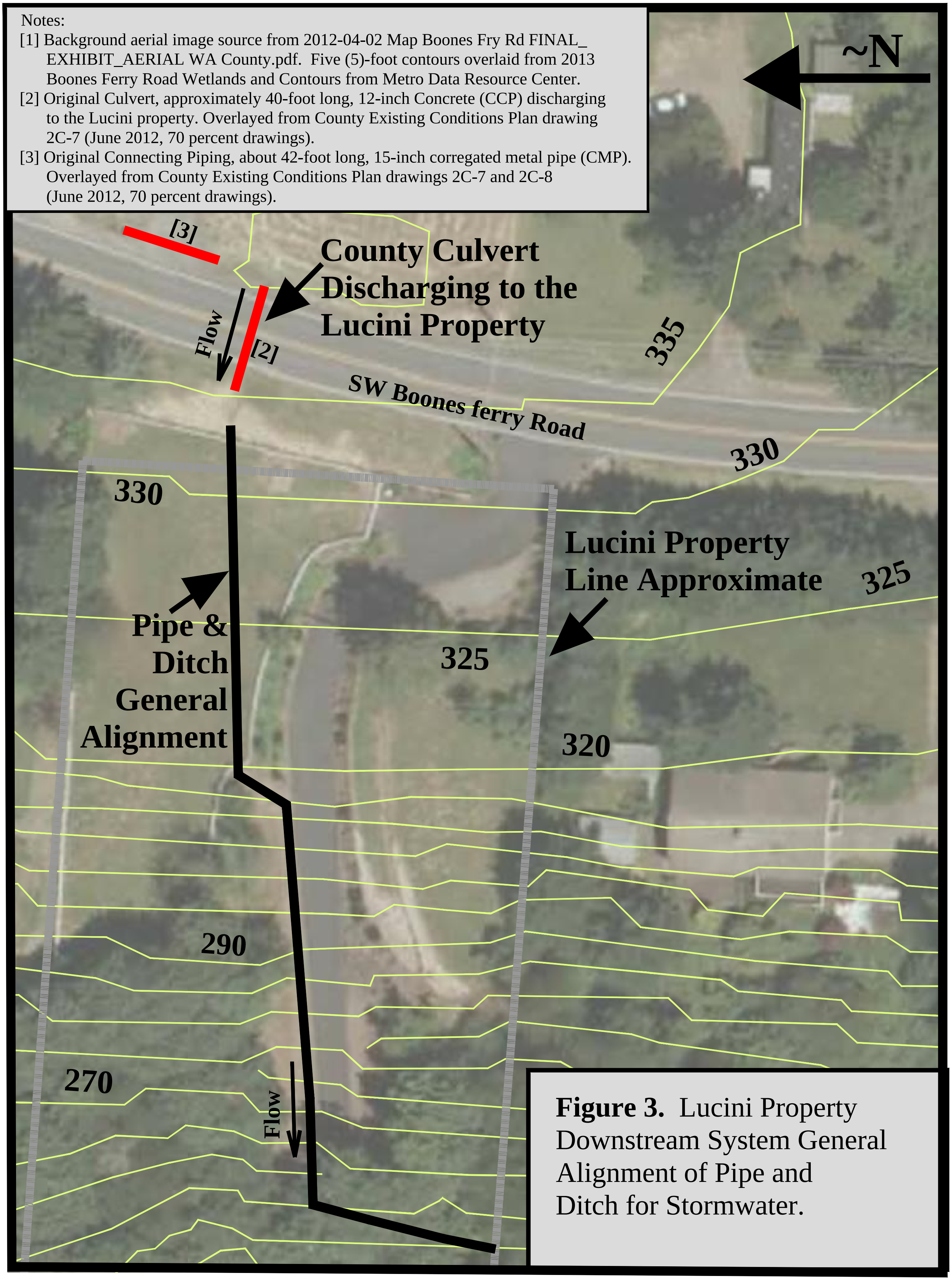


Figure 3. Lucini Property Downstream System General Alignment of Pipe and Ditch for Stormwater.

2. Background

This investigation begins with the ORIGINAL subbasin (Figures 4 and 5) stormflow conditions affecting the Lucini property and resulting from the SW Boones Ferry Road improvements project (approximately years 2013-2015). Unlike the County's Drainage Report (2013) that only considered very limited runoff hydrology, this study includes comprehensive stormflow hydrology and hydraulics comprised of the pipes and ditches upstream of, and on, the Lucini property.

Hydrology and Hydraulics

The hydrologic analysis performed in this report employs the U.S. Army Corps of Engineers (Corps) model called HEC-HMS.[7] The LEA model analysis was adjusted to the Washington County results for the initial corresponding design storm. The same Soil Conservation Service (SCS) design storm event[8] was used for both the Washington County and the LEA hydrologic analysis presented in this report.

The Washington County storm flow results affecting the Lucini property are compared in Tables 2 and 3, and are based on the SCS 25-year design storm event for ORIGINAL and IMPLEMENTED stormflow conditions, respectively.

For Original conditions, the County stated a peak storm flow of 1.17 cubic-feet-per-second (cfs) for the design storm event. The LEA hydrologic model analysis employing HEC-HMS produced the same storm flow results as the County. This LEA-County results calibration used the same model inputs as the County[9], for the supposed ORIGINAL drainage area, runoff curve numbers, and other corresponding parameters.

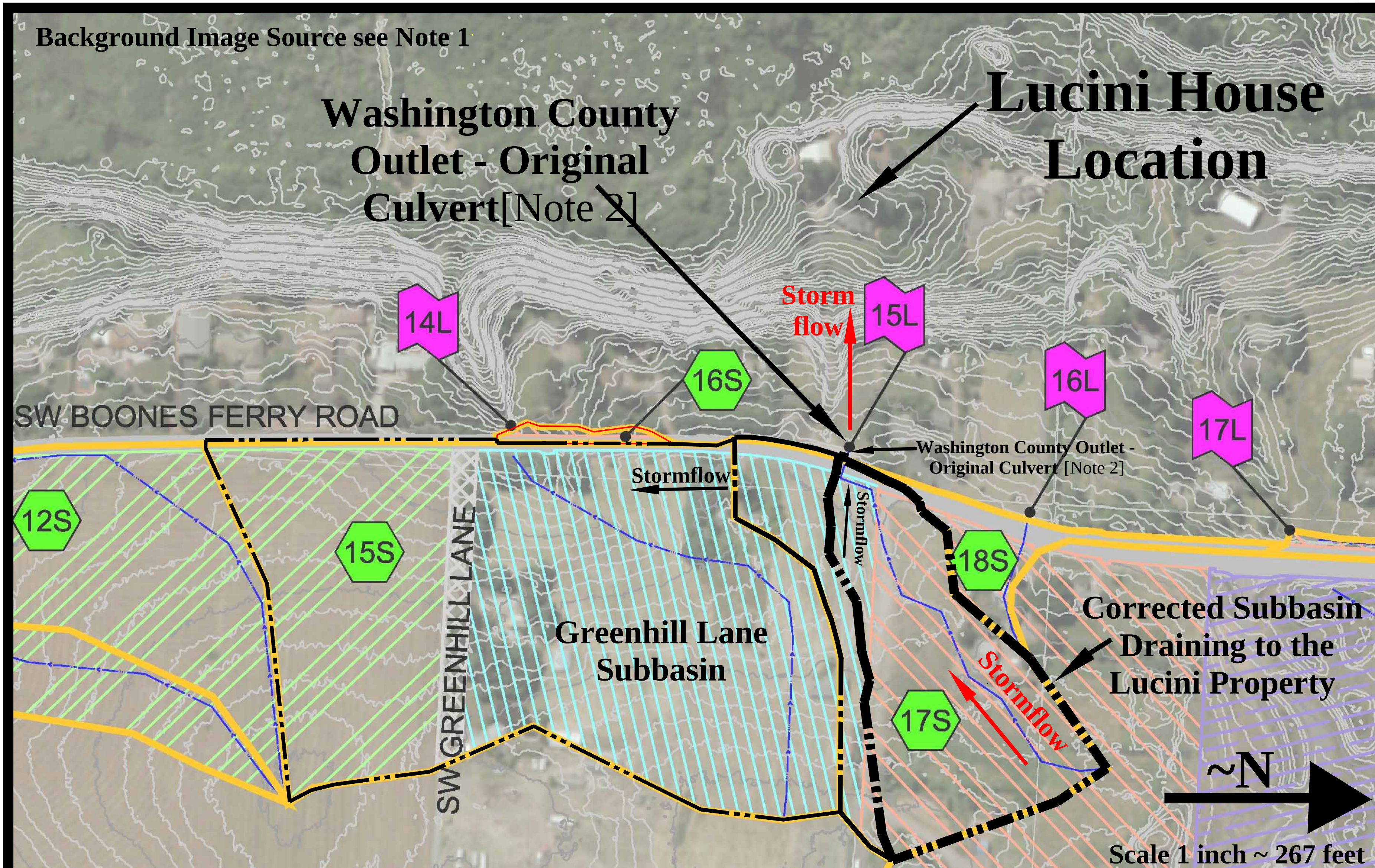
For IMPLEMENTED conditions, the County projected a peak storm flow of 0.85 cfs for the design storm event. The LEA hydrologic model analysis, employing HEC-HMS, produced the same storm flow results as the County. This LEA-County results calibration used the same inputs for the Implemented drainage area, runoff curve numbers, and other corresponding parameters.

Photos of the Lucini Property taken during the May 18, 2015 storm event are shown in Appendix A2. These photos demonstrate the excessive flow velocities generated at the site for storms even less than the 25-year event.

[7] HEC refers to the U.S. Army Corps of Engineers Hydrologic Engineering Center. HMS refers to the Hydrologic Model System.

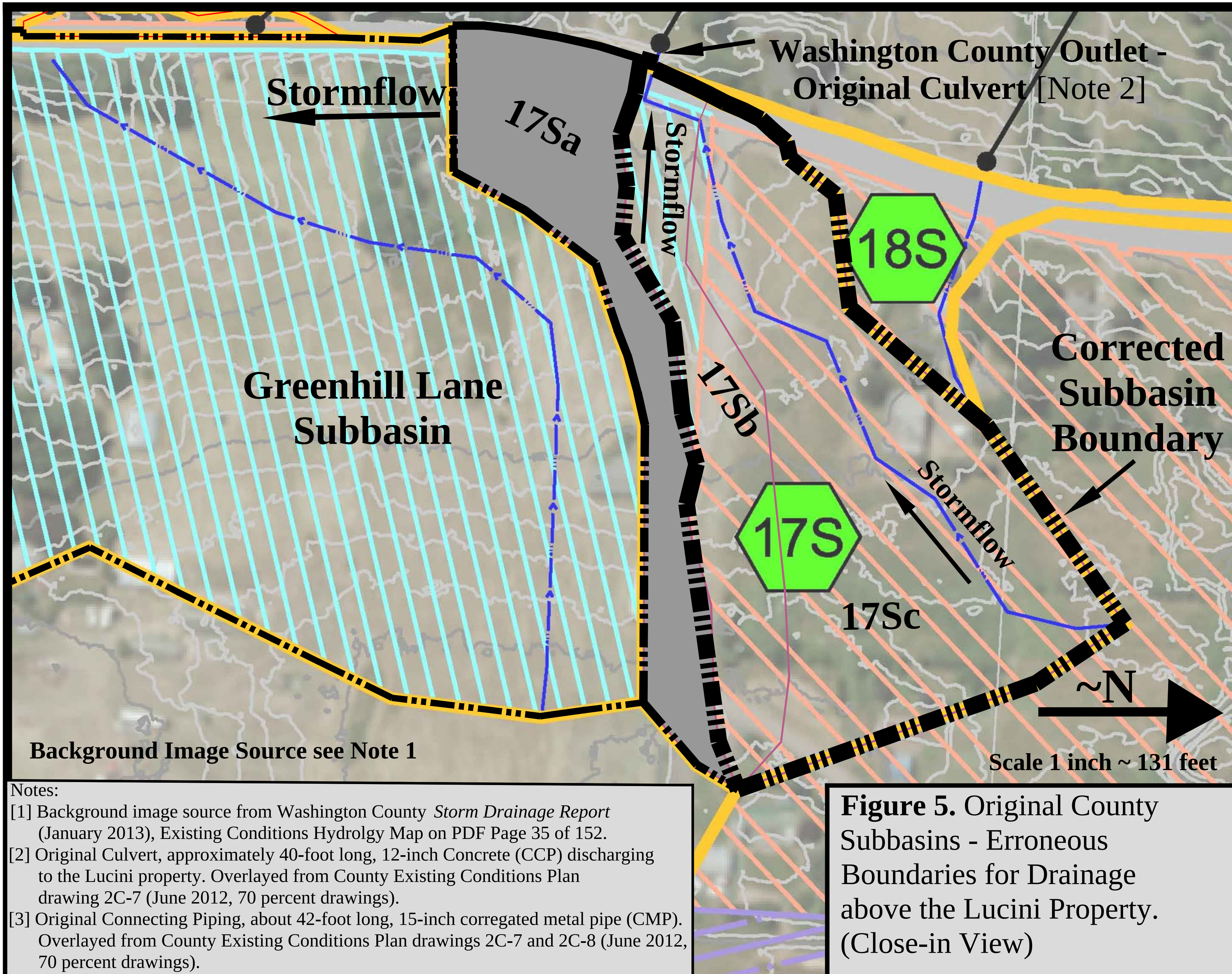
[8] The design storm is defined herein as the 24-hour, 25-year Type IA developed by the Soil Conservation Service (SCS). This the same design storm event as used by Washington County in its Drainage Report.

[9] The County employed the commercially available HydroCAD software program to carry out the hydrologic calculations using the SCS design storm method.



Notes:
[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).
[3] Original Connecting Piping, about 42-foot long, 15-inch coregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 4. Original County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property.



Notes:

[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrolgy Map on PDF Page 35 of 152.

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 5. Original County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property. (Close-in View)

The County's Drainage Report (2013) indicates it is relying upon CWS 2007 for storm flow evaluation methodology, which requires a "Review of Downstream System"[10], especially when flow increases are likely under present and future conditions. No Downstream System review exists in the Drainage Report for the storm water culvert flow draining to the Lucini property.

Despite supposed lower stormflows based on erroneous sub-basin delineation and land use conditions being reported in the Drainage Report[11], the storm inlet capacity for the culvert has been substantially increased. Stormflows are now conveyed to the storm inlets, and hence onto the property, much more rapidly than prior to the Boones Ferry Road widening project. This problem will worsen in the future because the Drainage Report and construction design did not take into account the future effects of full build-out conditions.

Flooding problems at the Lucini property are additionally aggravated because existing and future development conditions were disregarded in the Drainage Report. As CWS 2007 standards require:[12]

> 5.05 Storm Conveyance Design Considerations
>
> 5.05.1 Design for Full Build Out
>
> Storm drainage facilities shall be designed and constructed to accommodate all future full build-out flows generated from upstream property.

The Drainage Report did not evaluate the full build out stormflow conditions that will affect the property. Increased discharges from future development, routed through the County's road culvert, will result in worse flooding than presently exists.

[10] CWS 2007, see Chapter 2, Page 12 under the 2.04.2 subsection heading "3. Review of Downstream System", i.e., this is subsection 2.04.2.3.

[11] See Drainage Report on Page 11, Table under heading 5.5 - Hydrologic Analysis Results. Specifically, see the table results for Discharge Location 15L that indicates a reduction in stormflows.

[12] CWS 2007, Chapter 5, Page7, see 1st paragraph in section 5.05.

3. Drainage Boundaries and Hydrologic Modeling

An evaluation of the stormflow drainage above the Lucini property establishes that the County's delineation of subbasin boundaries is crucially inaccurate. As broken down numerically in Table 1 for ORIGINAL conditions, the south section area of the County's Subbasin 17S is erroneously depicted as draining to the Lucini property. The south section is labeled Subbasin 17Sa in Table 1 below.

The faulty subbasin delineations in the County's Drainage Report (2013) are illustrated in Figures 4 and 5. The ORIGINAL drawings in the County's report were digitized by LEA into the computer aided design software, AutoCAD. This allowed for the making of the scale model to evaluate the subbasins affecting the Lucini property. Conversion of subbasin area into HEC-HMS compatible units in square-miles (mi^2) was also performed. The County's errors in its stated original runoff areas, draining to the Lucini property, overestimate the original stormflows that the property can convey.

Table 1. Land Area Inputs for Subbasins above the Lucini Property
For ORIGINAL and IMPLEMENTED Subbasin Boundaries

		Original Drainage Areas				
	Washington County Subbasin ID	Scale Model AutoCAD in^2	HEC-HMS Input mi^2	Subbasin Size ft^2	Subbasin Size acres
Corrected South Section	17Sa	9117253	0.002267	63314	1.45
Corrected North Section	17Sb+c	27264059	0.006781	189334	4.35
Original County Total	17S	36381312	0.009048	252648	**5.8**
Corrected South Section	17Sa	9117253	0.002267	63314	1.45
Central-Section	17Sb	7464200	0.001856	51835	1.19
North-Section	17Sc	19799859	0.004924	137499	3.16
Original County Total (OK, check on total above)	17S	36381312	0.009048	252648	**5.8**
		Implemented Drainage Areas			
	Washington County Subbasin ID	Scale Model AutoCAD in^2	HEC-HMS Input mi^2	Subbasin Size ft^2	Subbasin Size acres
South-Section	59Sa	7999004	0.001989	55549	1.28
North-Section	59Sb	23991460	0.005967	166607	3.82
Implemented County Total	59S	31990464	0.007956	222156	**5.1**

This resulted in erroneously concluding that the Boones Ferry Road right-of-way to the south of the original culvert[13] flowed into the Lucini property. The actual Original subbasin excluded all of the rainfall runoff from the southern strip of the County's wrongly depicted subbasin. This condition is illustrated in Figure 5, which more accurately shows the ORIGINAL stormflow from the southern strip as being routed to the Greenhill Lane subbasin.[14]

Original and Implemented Stormflows
Table 2 compares realistic ORIGINAL stormflows, as determined in this analysis, to the County's erroneous stormflows based on faulty subbasin drainage boundaries. For Original peak storm flows, it is estimated that the increased drainage area depicted in the County's Drainage Report results in a storm flow increase of about 31.5 percent that is discharged to the Lucini property. The hydrologic model inputs and results for HEC-HMS realistic Original conditions are contained in Appendix H.

Table 2. ORIGINAL Peak Stormflows
County Values Compared to HEC-HMS

Percent Increases for Projected County versus Actual Drainage Area Conditions

	Washington County Flows Based on Boones Fy. Road Drainage Analysis (cfs)	**HEC-HMS Flows Based on Actua1 BFR Drainage Areas** (cfs)	**Increase of Storm Flows to Lucini Property** (Percent)
Original Washington County - Pre-construction (prior to 2013)	1.17	0.89	31.5% [15]
Original Wash. CO Land Area - Ongoing Land Use (LU)	*County did Not Consider*	1.71	92.1%
Original Wash. CO Land Area - Projected Full Build-out (BO)	*County did Not Consider*	2.85	220.2%

The County's Drainage Report did not consider on-going land use changes other than the existing farming and single dwelling 2-acre lots. When actual ongoing urbanization and more intense land use are considered, the increased stormflows to the Lucini property are projected to increase by about 92.1 percent.

[13] This is the original 12-inch diameter concrete cylinder pipe (CCP) culvert, which is about 40-foot long, and identified as the County's Outfall #5.

[14] This is identified in the County's Drainage Report (2013) as Subbasin "17s". See the background image of Figure 4, which uses HexBox labels to identify subbasins.

[15] The calculation is: [(0.1.17 – 0.89) / 0.89] equals 0.315 or 31.5 percent.

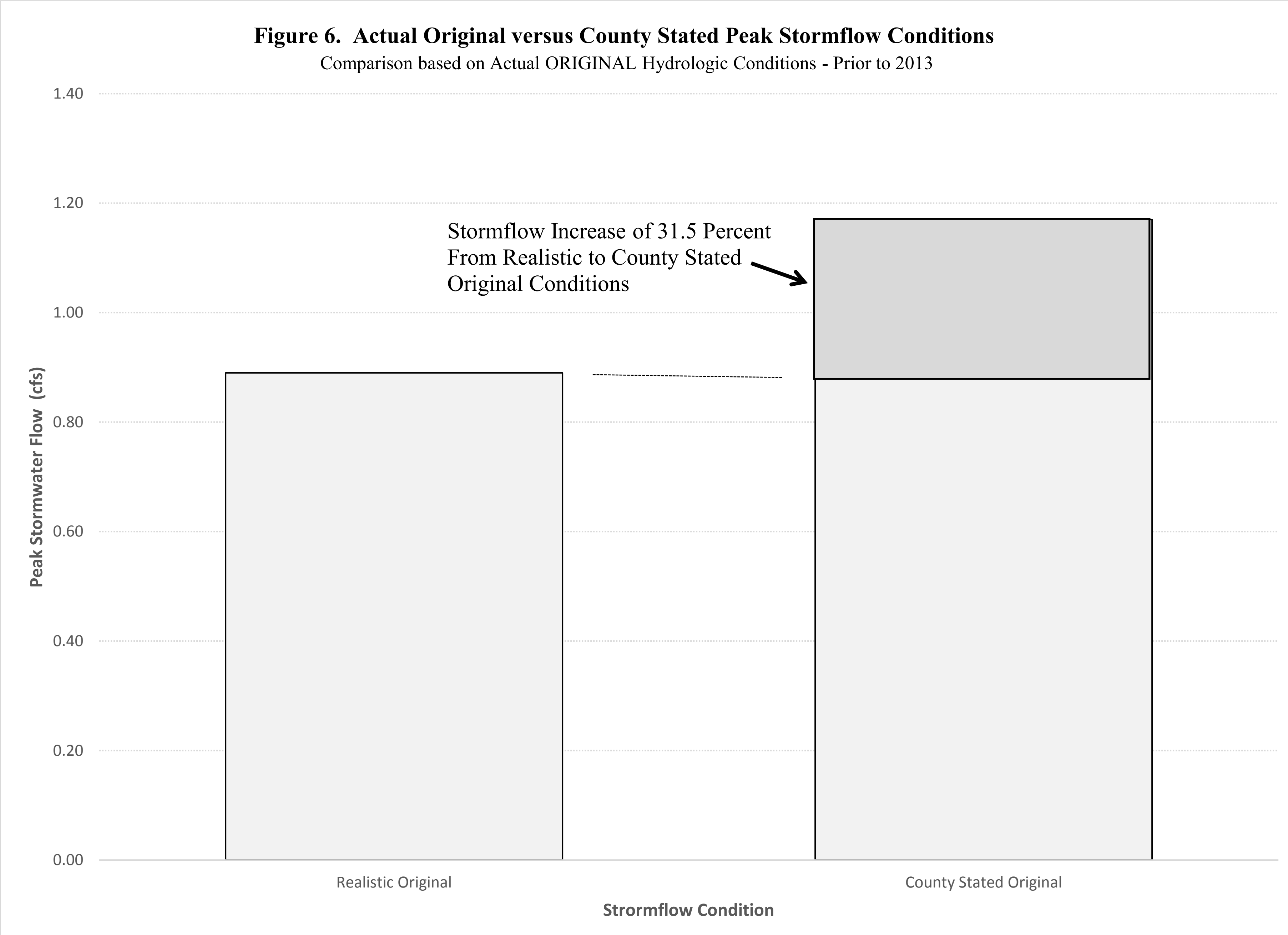


Figure 6. Actual Original versus County Stated Peak Stormflow Conditions
Comparison based on Actual ORIGINAL Hydrologic Conditions - Prior to 2013
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Peak Stormwater Flow (cfs)
Stormflow Increase of 31.5 Percent
From Realistic to County Stated
Original Conditions
Realistic Original
County Stated Original
Stormflow Condition

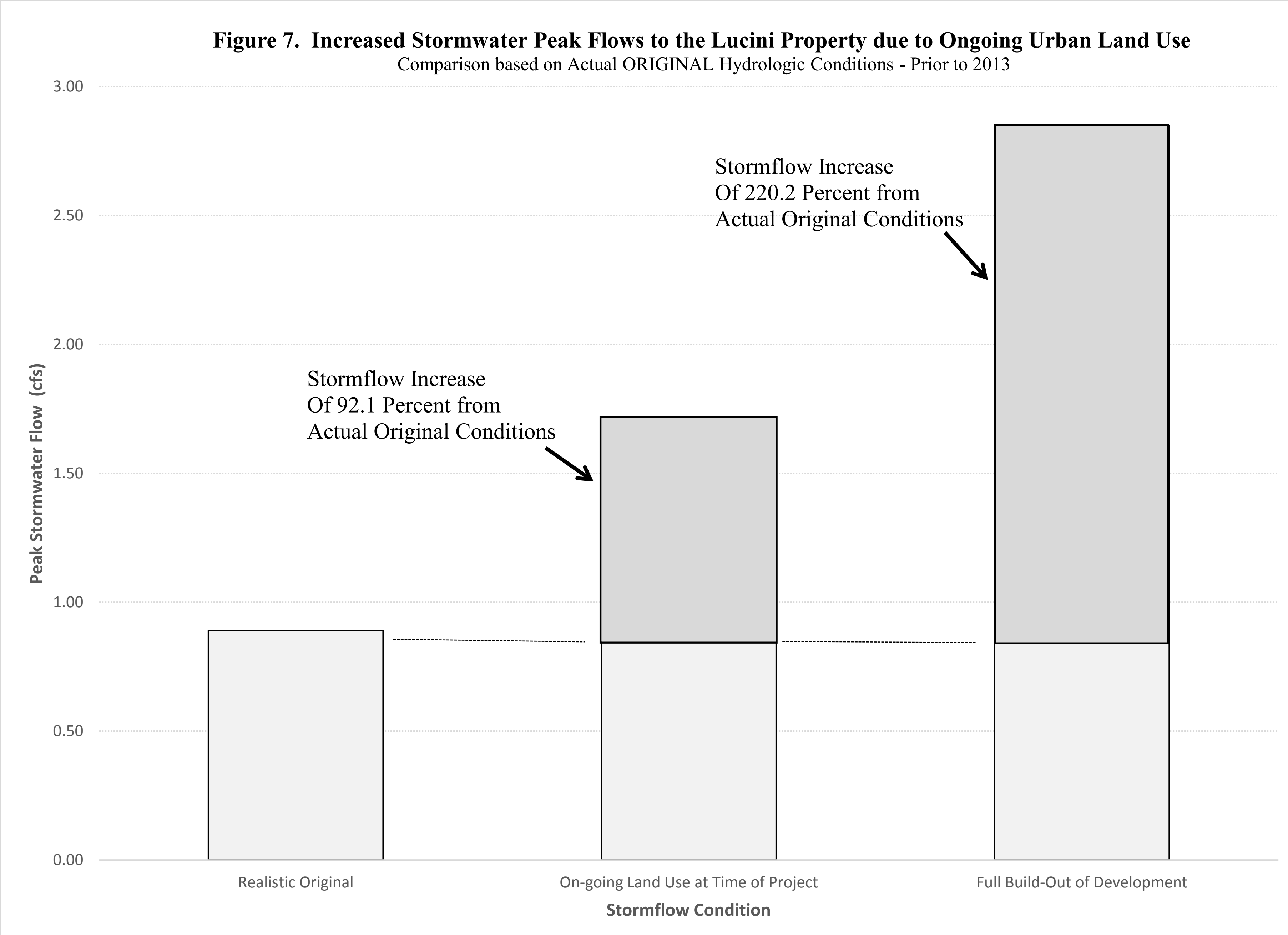


Figure 7. Increased Stormwater Peak Flows to the Lucini Property due to Ongoing Urban Land Use
Comparison based on Actual ORIGINAL Hydrologic Conditions - Prior to 2013
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Peak Stormwater Flow (cfs)
Stormflow Increase
Of 220.2 Percent from
Actual Original Conditions
Stormflow Increase
Of 92.1 Percent from
Actual Original Conditions
Realistic Original
On-going Land Use at Time of Project
Full Build-Out of Development
Stormflow Condition

The County did not consider future full build-out construction conditions slated for the drainage above the Lucini property. When this necessary evaluation based on the CWS guidance is considered, the County will be increasing storm flows to the Lucini property by about 220.2 percent.

Table 3 compares IMPLEMENTED stormflows, as determined in this analysis, to the County's stormflows based on faulty subbasin drainage boundaries (see Figures 9 and 10). For the Implemented condition under previous land use, the LEA analysis and the County's analysis of peak flows are equal and no increase in flows is reported.

Table 3. IMPLEMENTED Peak Stormflows
County Values Compared to HEC-HMS

Percent Increases of Projected versus Actual Conditions

	Peak Storm Flow from HEC-HMS		
	Washington County Flows Based on Boones Fy. Road Drainage Analysis (cfs)	**HEC-HMS Flows Based on Actua1 BFR Drainage Areas** (cfs)	**Increase of Storm Flows to Lucini Property** (Percent)
Implemented Washington County - Post-construction (after about early 2015)	*County did not Consider* [16, 17]	0.64	32.8% [18]
Implemented Wash. CO Land Area - Ongoing Land Use (LU)	*County did Not Consider*	1.95	204.7%
Implemented Wash. CO Land Area - Projected Full Build-out (BO)	*County did Not Consider*	3.29	414.1%

The County's Drainage Report did not consider on-going land use changes. Only farming was evaluated. For Implemented peak storm flows, when on-going urbanization and more intense land use are considered, the increased storm flows to the Lucini property increase by about 204.7 percent.

The County did not consider future full build-out conditions construction scheduled for the drainage above the Lucini property. When this necessary evaluation based on the CWS guidance is considered, the County will be increasing storm flows to the Lucini property by about 414.1 percent.

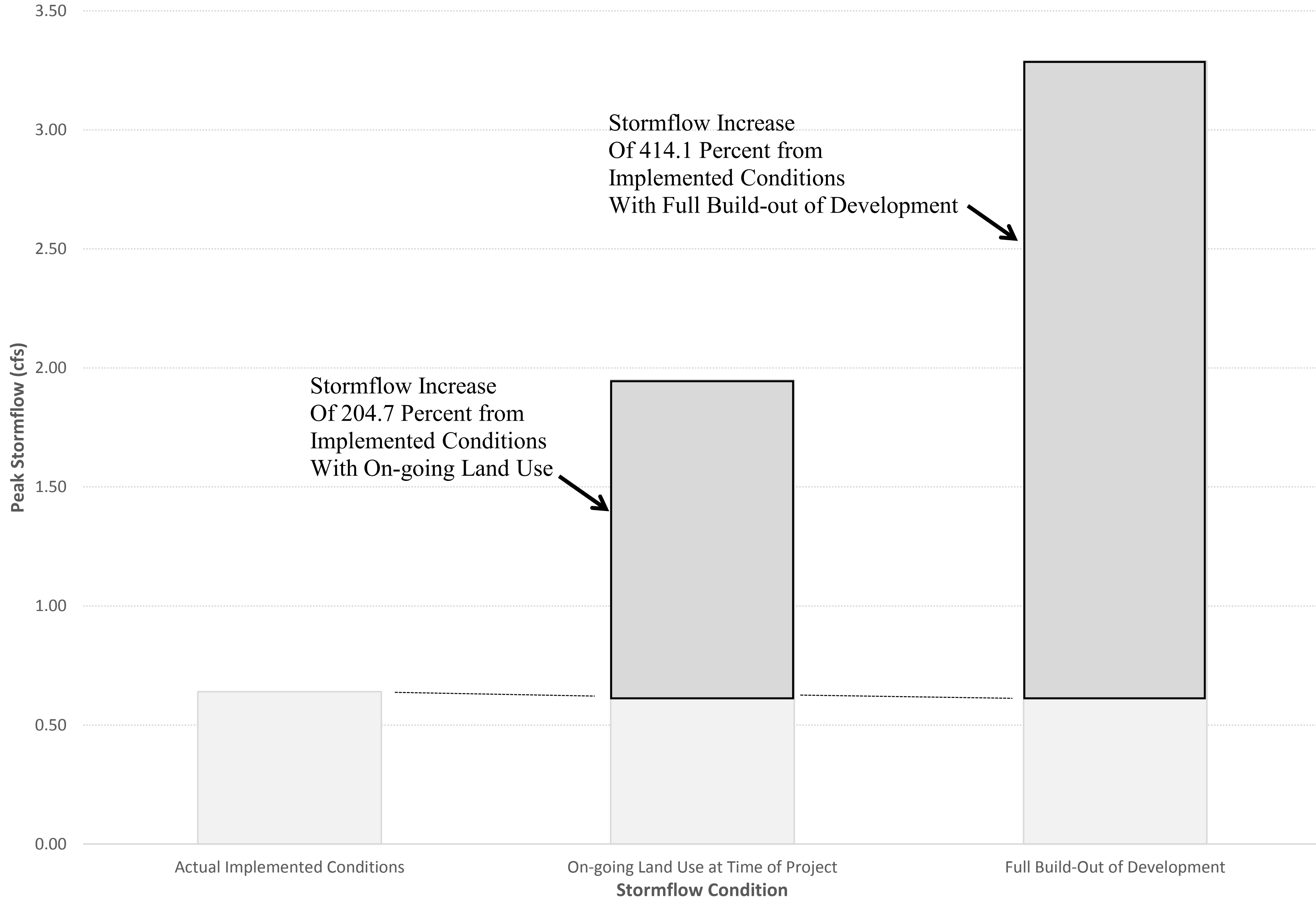
[16] The County simulated Implemented conditions that resulted in a stormflow of 0.85 cfs. The LEA hydrologic model was adjusted to the County's implemented conditions and stormflow of 0.85 cfs.

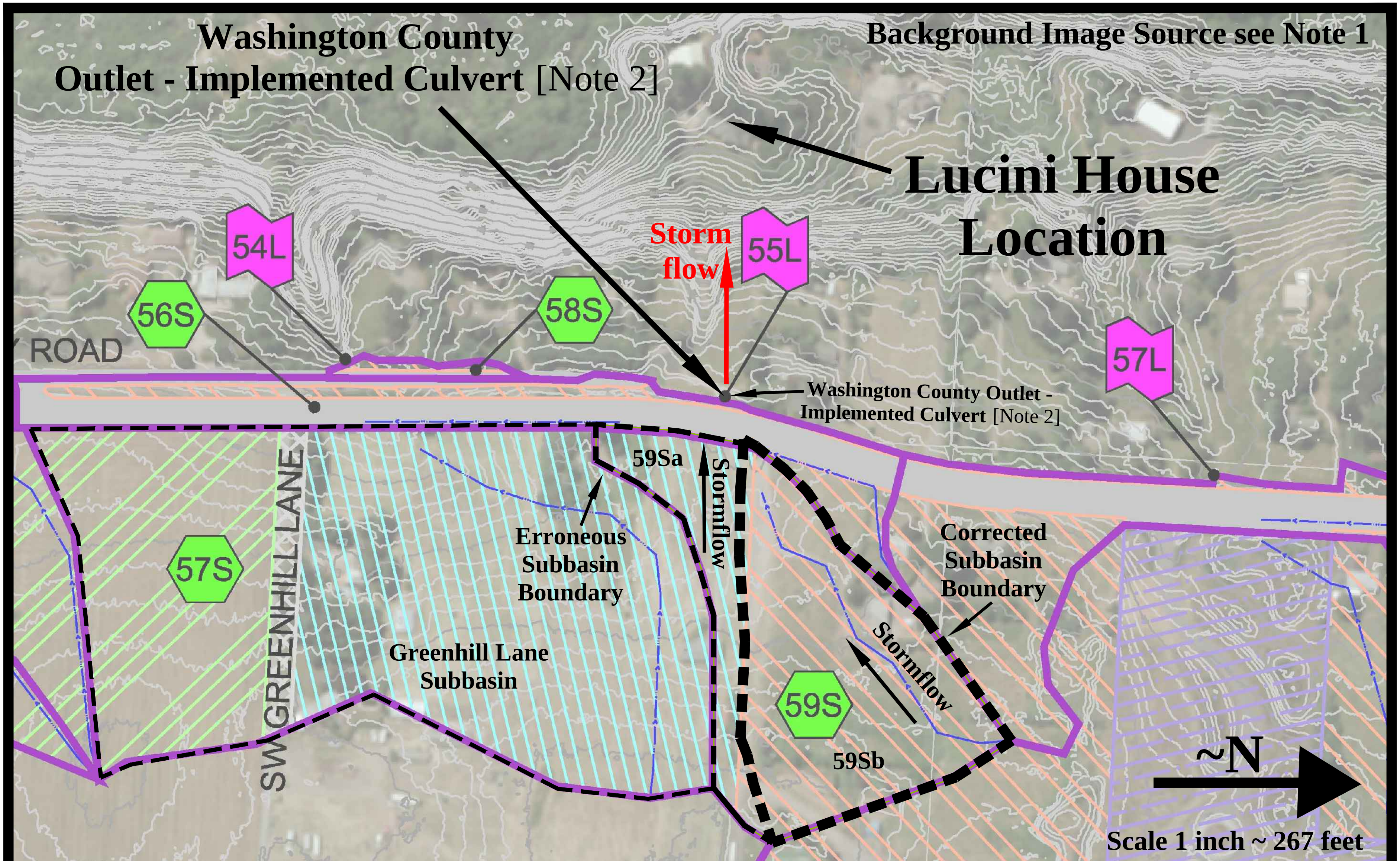
[17] Stormflows less than Original conditions were not considered by the County. The County claimed in its Drainage Report (2013) that it was reducing Original stormflows by about 10 percent.

[18] The calculation is (0.85 – 0.64) / 0.64 equals 0.328 or 32.8 percent. Where 0.85 cfs is the lowest velocity considered by Washington County.

Figure 8. Increased Stormwater Peak Flows to the Lucini Property due to Full Build-Out Land Use

IMPLEMENTED (post-2015) Hydrologic Conditions Comparison to Actual Implemented Hydrologic Conditions based on pre-2013



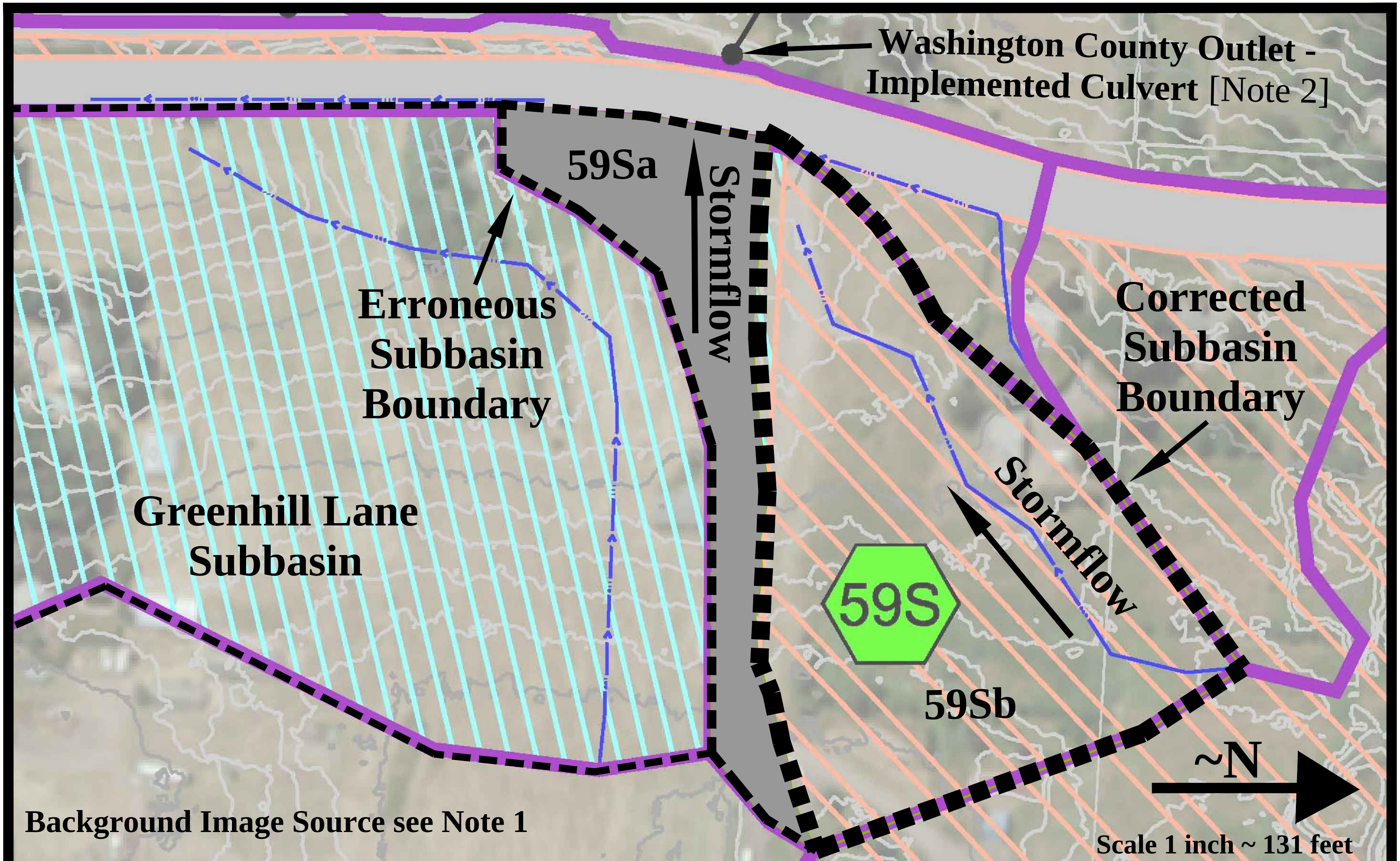


Notes:

[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 36 of 152.

[2] Implemented Culvert, approximately 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Overlayed from As-built construction plan drawings 232-233 of 385.

Figure 9. IMPLEMENTED County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property.



Notes:

[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 36 of 152.

[2] Implemented Culvert, approximately 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Overlayed from As-built construction plan drawings 232-233 of 385.

Figure 10. IMPLEMENTED County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property. (Close-in View)

Defective County Topography and Inaccurate Original Curb and Storm Sewer Claims
Stormflows originally directed south into the Greenhill Lane subbasin, through the road right-of-way, were re-routed by the road improvement project onto the Lucini property via the County's Storm Outfall #5. As shown in Figures 4 and 5, the subbasin drainage drawings for the ORIGINAL conditions[19] do not show the actual topography affecting drainage conditions. The IMPLEMENTED drainage basin conditions then re-route increased storm flows to the Lucini property.[20]

The County's Drainage Report says that the original road had curbs and storm sewers routing flows.[21] This is incorrect as there were no curbs or storm sewers for SW Boones Ferry Road above the Lucini property. Drawings 2C-7 and 2C-8 excerpted in Appendix C demonstrate there were no curbs and storm sewers upstream of the Lucini property.[22] Additionally, the photos in Appendix A1 taken by as part of the County's Wetland Delineation Report[23] and by the Lucini's also reveal the lack of curbs and storm sewers above the Lucini property. This is a crucial detail because it determines whether a portion of stormflows go south into the Greenhill Lane subbasin, or north into the subbasin above the Lucini property. In its Drainage Report the County erroneously claims that a portion of the Greenhill Lane subbasin stormwater drains into the Lucini property.

The photos contained in Appendix A1 show the ORIGINAL Drainage of Storm Water from SW Boones Ferry Road. Photo A1a was taken by Washington County September 28, 2012; and Photo A1b was taken by John & Grace Lucini on Dec. 20, 2012. Portions of the subbasins to the east (on the left) historically drained into the Road Alignment and then south away from the Lucini property. This is contrary to the analysis contained in the County's Drainage Report (2013), which wrongly states this road section is curbed including storm sewers, with portions of stormflows being directed into the Lucini property.

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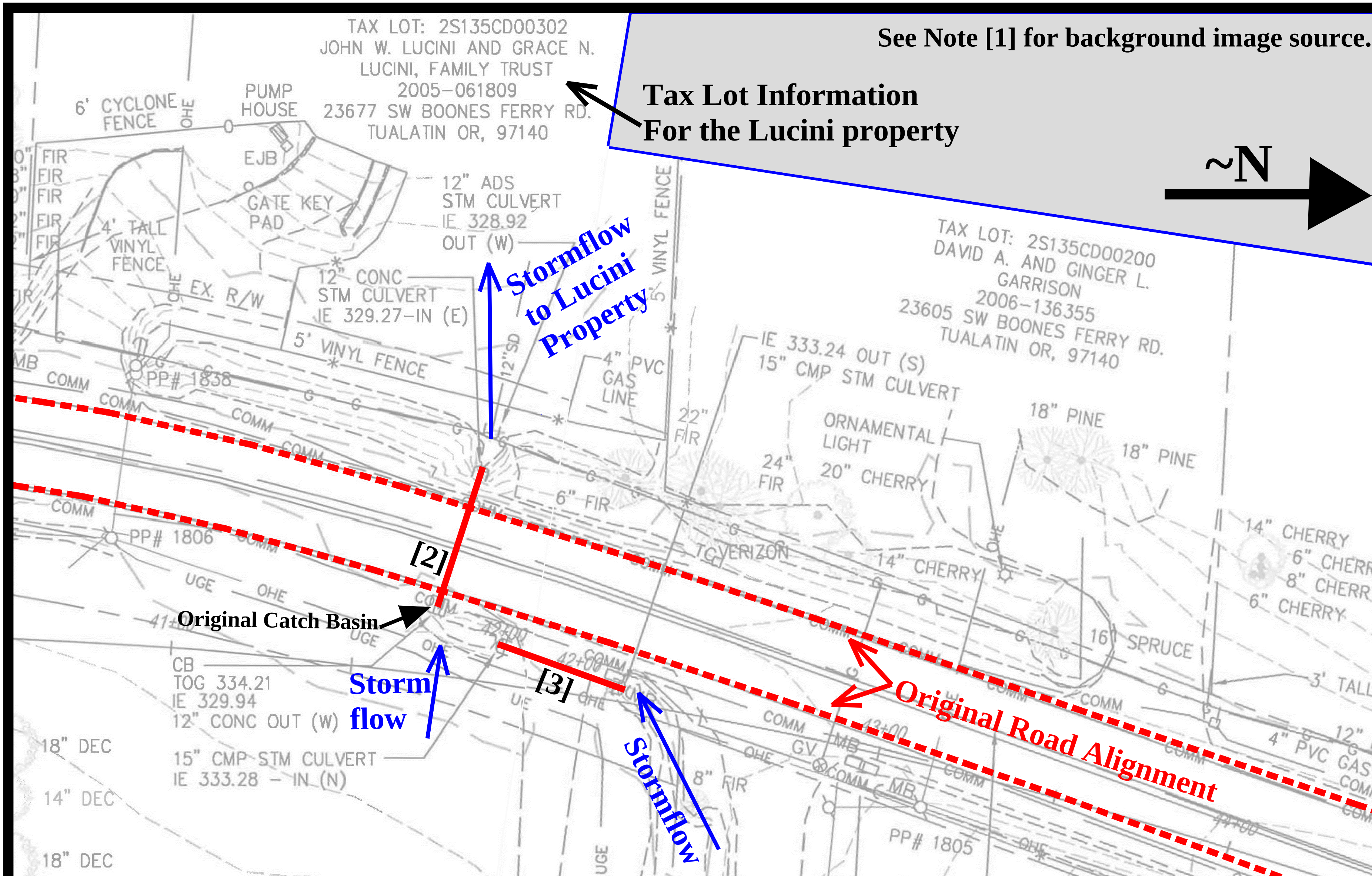
[19] Drainage Report (2013), Sheet No. 1 of 3 labeled "Existing Conditions Hydrology Map" on PDF page 35 of 152.

[20] Ibid, see Sheet No. 2 of 3 labeled "Proposed Conditions Hydrology Map" on PDF page 36 of 152.

[21] Drainage Report (2013), Storm Drainage Report – SW Boones Ferry Road (SW Day Road to SW Norwood Road, by MacKay Sposito for Washington County, Capital Project Management (CPM), Final January 31, 2013. See PDF page 59 of 152 under Summary of Subcatchment 17S, which is the drainage above the Lucini property. The Drainage Report erroneously states that the drainage is "w/curbs & sewers" which did not exist above the Lucini property. This faulty information and its implications were used in the County's hydrologic analysis.

[22] County 2012a, Drawings from MacKay Sposito submittal to the County contained in file: 2012 June Existing Conditions 70% Plans.pdf.

[23] County 2012b, See PDF page 81 of 90 in file: 2012 Dec Wetland Delineation Report-Boones Ferry Rd Improvement Project WD2013-0002.pdf.



Notes:
[1] Background image from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).
[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 11. County Existing Plan Drawings with Annotations Highlighting the ORIGINAL Conditions and Piping

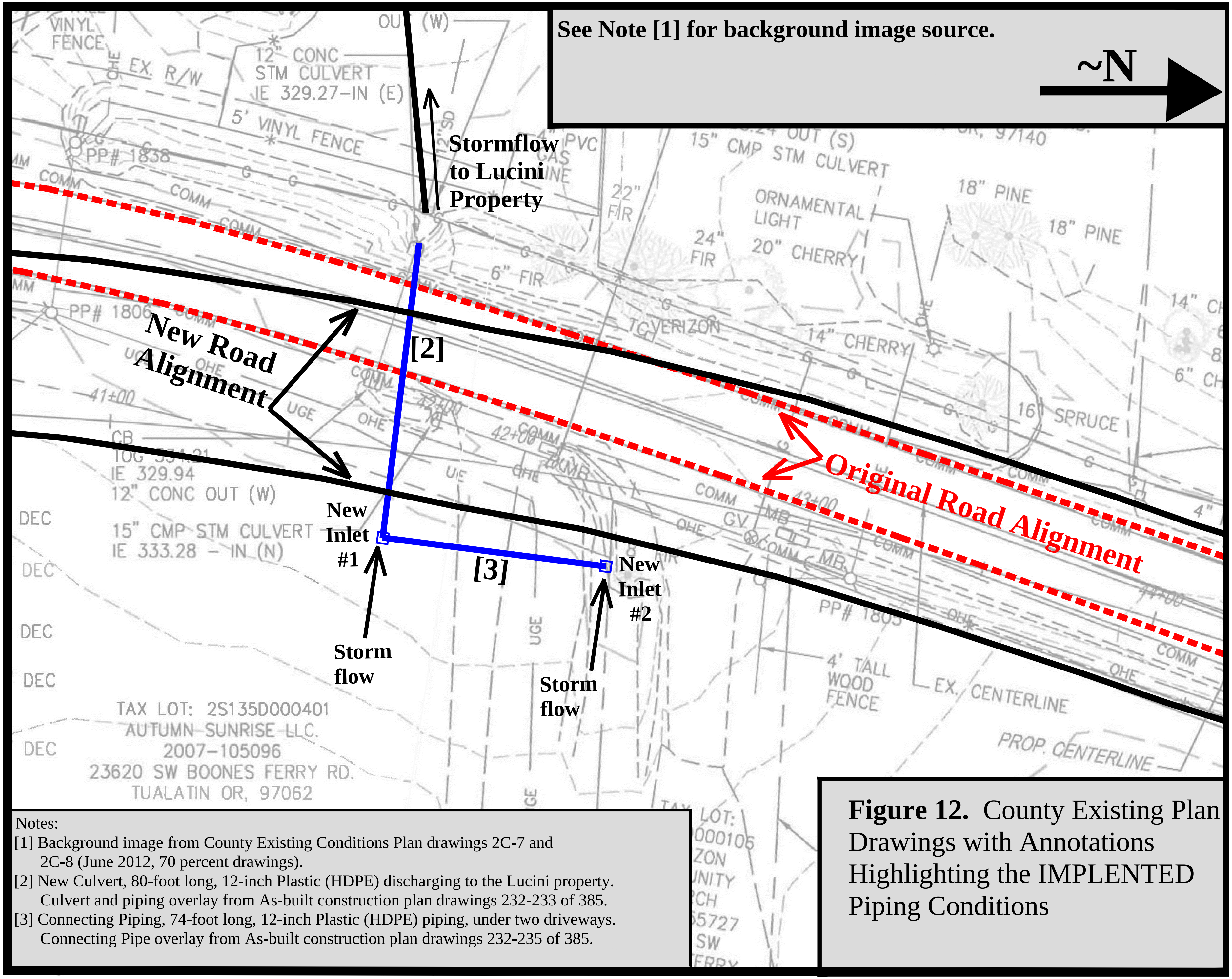


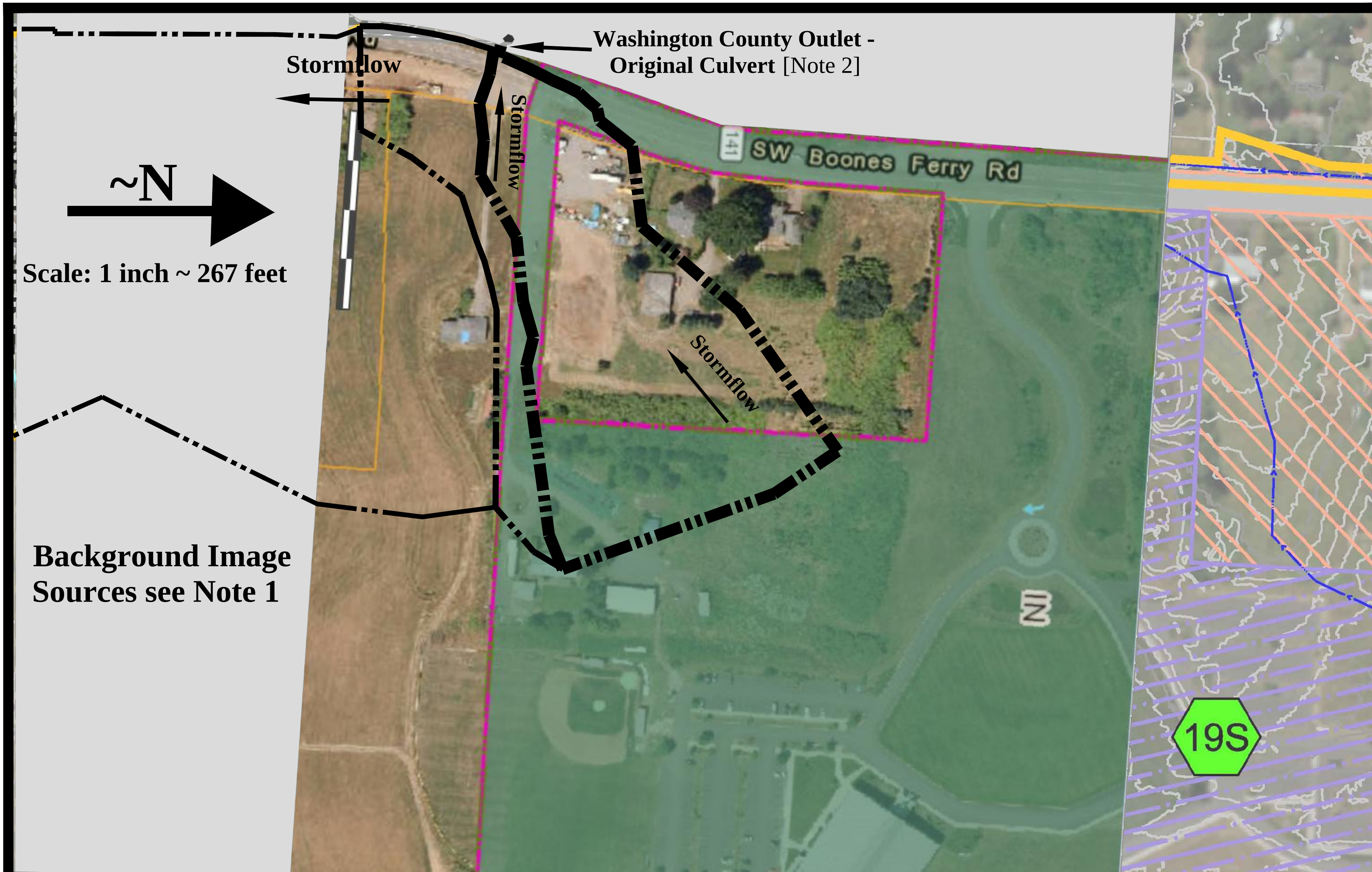
Figure 12. County Existing Plan Drawings with Annotations Highlighting the IMPLENTED Piping Conditions

Notes:
[1] Background image from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).
[2] New Culvert, 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Culvert and piping overlay from As-built construction plan drawings 232-233 of 385.
[3] Connecting Piping, 74-foot long, 12-inch Plastic (HDPE) piping, under two driveways. Connecting Pipe overlay from As-built construction plan drawings 232-235 of 385.

Hydrologic Modeling and Construction Development
The County's Drainage Report disregarded construction development that increases run-off in the drainage upstream of the Lucini property. The County's hydrologic modeling of the upstream subbasin was characterized as "Farmstead" and single dwelling 2-acre lots. However, the actual additional use of a majority of the subbasin is to support heavy road construction and on-going use as commercial (Institutional), a more intense land-use from a stormwater generation standpoint. This relationship between the subbasin boundary delineation and active road construction (in 2012), equipment parking and material staging can be plainly seen in the aerial view presented in Figures 13 and 14.

The Natural Resources Conservation Service (NRCS) has commented on this problem of disturbed soil effectively raising runoff flows and has stated:

> **630.0702 Disturbed soils**
>
> As a result of **construction and other disturbances**, the soil profile can be altered from its natural state and the listed group assignments generally no longer apply, nor can any supposition based on the natural soil be made that will accurately describe the **hydrologic properties of the disturbed soil**. In these circumstances, an onsite investigation should be made to determine the hydrologic soil group. A general set of guidelines for estimating **saturated hydraulic conductivity** from field observable characteristics is presented in the Soil Survey Manual (Soil Survey Staff 1993).
>
> [Bold by LEA except subsection title.]

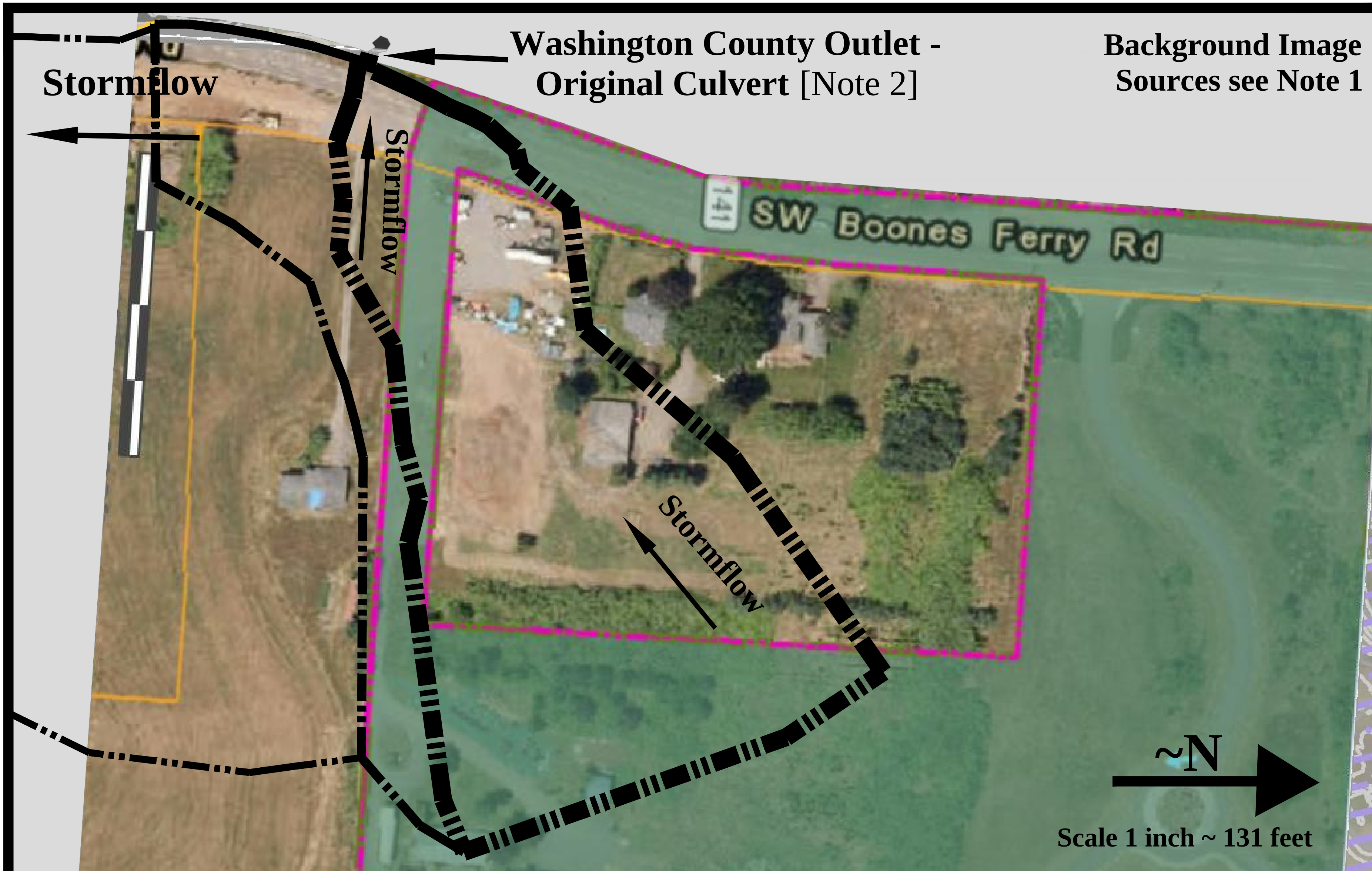


Notes:

[1] Background image sources are: 1) Aerial Map compiled by City of Tualatin, TualGIS and State of Oregon GEO; and 2) Washington County *Storm Drainage Report* (Jan 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

Figure 13. Aerial View Showing Impact of Road Construction and Ongoing Commercial (Institutional) Land Use.



Notes:

[1] Background image sources are: 1) Aerial Map compiled by City of Tualatin, TualGIS and State of Oregon GEO; and 2) Washington County *Storm Drainage Report* (Jan 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

Figure 14. Aerial View Showing Impact of Road Construction and Ongoing Commercial (Institutional) Land Use. (Close-in View)

4. Stormflow Hydraulics

The County's Drainage Report did not perform a hydraulic analysis to assess the effects of its stormflow above and through the Lucini property. The Corps hydraulic model, HEC-RAS[24], is used in this analysis to partly[25] fill-in this crucial lack of stormflow hydraulic information.

Rainfall runoff flows generated by the hydrologic model HEC-HMS are supplied as inputs to the HEC-RAS hydraulic model to consider the impact on drainage channels, piping, and other features of the drainage system. Specifically, the hydraulic effects resulting from stormflows passing through the drainage system subbasins, stormflow routing, channels, culverts (piping), land use conditions, channel and piping materials, and other parameters can be assessed.

Cross-sections and Other Hydraulic Information

The HEC-RAS hydraulic model requires the input of cross-sectional information that demarcate the channel with elevation versus distance from the bank. Additional information supplied to the model includes distance between cross-sections, hydraulic losses and other stormflow parameters.

The County has not provided the public with complete topography of the subbasin draining to the Lucini property, and other properties, below its Boones Ferry Road project site. Accordingly, channel and pipe cross-section information are estimated for input into the HEC-RAS hydraulic model. Summary input and output hydraulic information for the HEC-RAS simulation is contained in Appendix I.

The County did not consider the hydraulic effects of increased stormflow conditions on the Lucini property resulting from its Boones Ferry Road Improvement construction project. As discussed previously, increased stormflows onto the Lucini project are likely because of inaccurate subbasin delineation by the County. The County also failed to consider the effects of ongoing and future development, with increasingly intense land use and full-build-out conditions, contributing to increased stormflows.

Hydraulic Analysis Results

The County did not consider stormflow cases that take into account greater land use conditions and future development above the Lucini property. For example, the County disregarded the impact of its own road construction efforts, plainly visible in the aerial views in Figures 13 and 14 as well as Appendix F, on lands draining to the Lucini property. The County characterizes these activities as "farming" or single dwelling 2-acre lots.

[24] HEC-RAS refers to the River Analysis System hydraulic model developed by the Corps.

[25] This hydraulic analysis using HEC-RAS performs a steady-state evaluation for a range of peak stormflow conditions inputted from the HEC-HMS hydrologic model. A more detailed time-varying analysis employing unsteady stormflow conditions, with stormflow storage, may be warranted in future evaluation with additional planning information but is beyond the timing and scope of this report.

The analysis presented herein does take into account actual land use intensity and development circumstances as previously discussed in the Hydrologic Modeling section. This analysis evaluates conditions for both ORIGINAL and IMPLEMENTED hydraulic configurations for the range of runoff conditions presented in Tables 2 and 3, respectively. Appendix I contains the results of the hydraulic analysis.

Figure 15 depicts the hydraulic profile generated by HEC-RAS for the ORIGINAL configuration using runoff stormflows based on future full build-out development conditions at 2.85 cfs. Stormflow existing prior to the County's road project[26] (0.89 cfs) and additional profiles are also contained in Appendix I.

A key consideration in reviewing these figures is that the ground slope goes from moderate above (east) the Lucini property to very steep (west) on the Lucini property. The County's Drainage Report (2013) analysis did not consider this substantial change of slope and its likely effect, which is to cause high stormflow velocities and extremely erosive conditions, on the Lucini property.

Comparing velocities with likely stormflows demonstrates the value of reducing runoff flow peaks. High stormwater flows cause erosion and clog ditch and pipe locations. In this HEC-RAS analysis, 25-yr design storm events were varied by correcting for actual subbasin areas and using genuine land use conditions as described in the hydrologic Tables 2 and 3 of this report for the ORIGINAL and IMPLEMENTED configurations, respectively.

Figure 16 for the ORIGINAL configuration illustrates velocities for the upstream and downstream stations along the Lucini property approximate 150-foot ditch[27]. This figure shows that as stormflows increase from 0.89 cfs to 2.85 cfs, highly erosive storm velocities occur.

As charted in Figure 16, flow velocities in excess of 4.0 feet-per-second (fps) produce adverse conditions that erode soil.[28] This is consistent with the stormwater damage to the ditches, and pipe blockage, on the Lucini property (see photos in Appendix A2).

Figure 17 for the IMPLEMENTED configuration illustrates velocities for the upstream and downstream stations along the Lucini property approximate 150-foot ditch. This figure shows that as stormflows increase from 0.85 cfs to 3.29 cfs, highly erosive storm velocities will occur into the future.

The two lower flow conditions at 0.64 cfs and 0.85 cfs do not produce excessive storm velocities. The 0.64 cfs value is what the peak 25-year storm event should be if the County was actually reducing stormflows onto the Lucini property consistent with what it

[26] Prior to early 2013.

[27] This ditch is alongside the Lucini driveway and runs generally from east to west. See Figures 2 and 3 for the alignment of this drainage ditch relative to the County's road construction and the Lucini property.

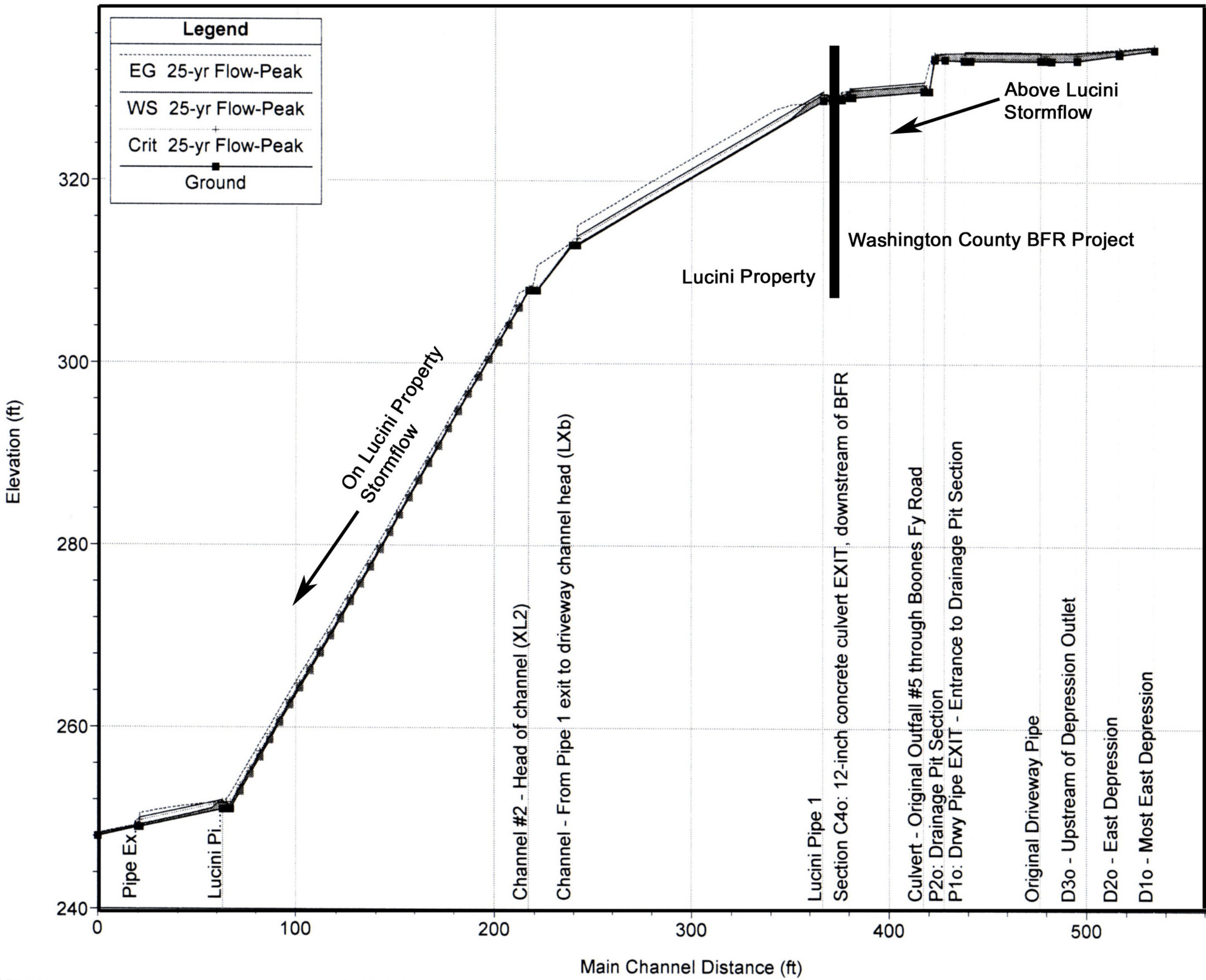
[28] Linsley, Ray K. and Franzini, Joseph B., Water-Resources Engineering, published by McGraw-Hill, 1979.

is saying in its Drainage Report. The 0.85 cfs value simulated by the County is for farmland only and does not include actual urbanization and increased runoff in the subbasin above the Lucini property. When actual ongoing land use is considered, stormflow of 1.95 cfs more accurately reflects actual runoff being discharged from the County's culvert (Outfall #5) onto the Lucini property.

An orifice plate can be used to reduce storm pipe flow diameter and flow area during peak flow events. This physical measure decreases peak stormflows and lowers storm flow velocities on the Lucini property. The location of the proposed orifice plate is shown in Figure 12 as indicated in the IMPLEMENTED new storm inlet #1.

The construction and installation plans for the orifice plate is shown in the guidance document relied upon by the County (CWS 2007). For convenience, the orifice plate drawings are presented in Appendix G (see CWA Drawings Nos. 720 and 730).

Figure 15. HEC_RAS Hydraulic Profile of ORIGINAL Pipe and Ditch Conditions at 2.85 cfs
Above and On the Lucini Property



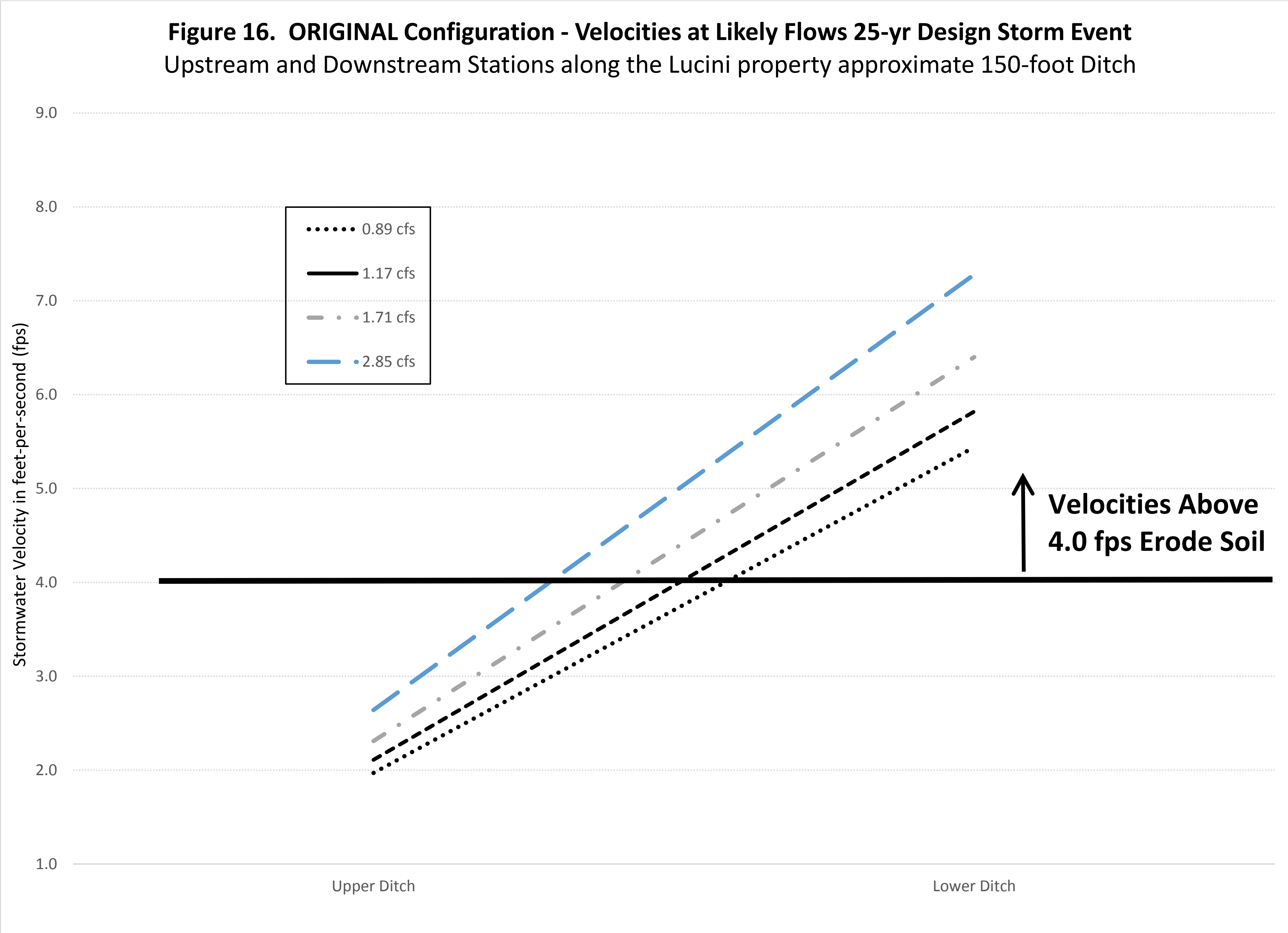


Figure 16. ORIGINAL Configuration - Velocities at Likely Flows 25-yr Design Storm Event
Upstream and Downstream Stations along the Lucini property approximate 150-foot Ditch
Stormwater Velocity in feet-per-second (fps)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.89 cfs
1.17 cfs
1.71 cfs
2.85 cfs
Velocities Above
4.0 fps Erode Soil
Upper Ditch
Lower Ditch

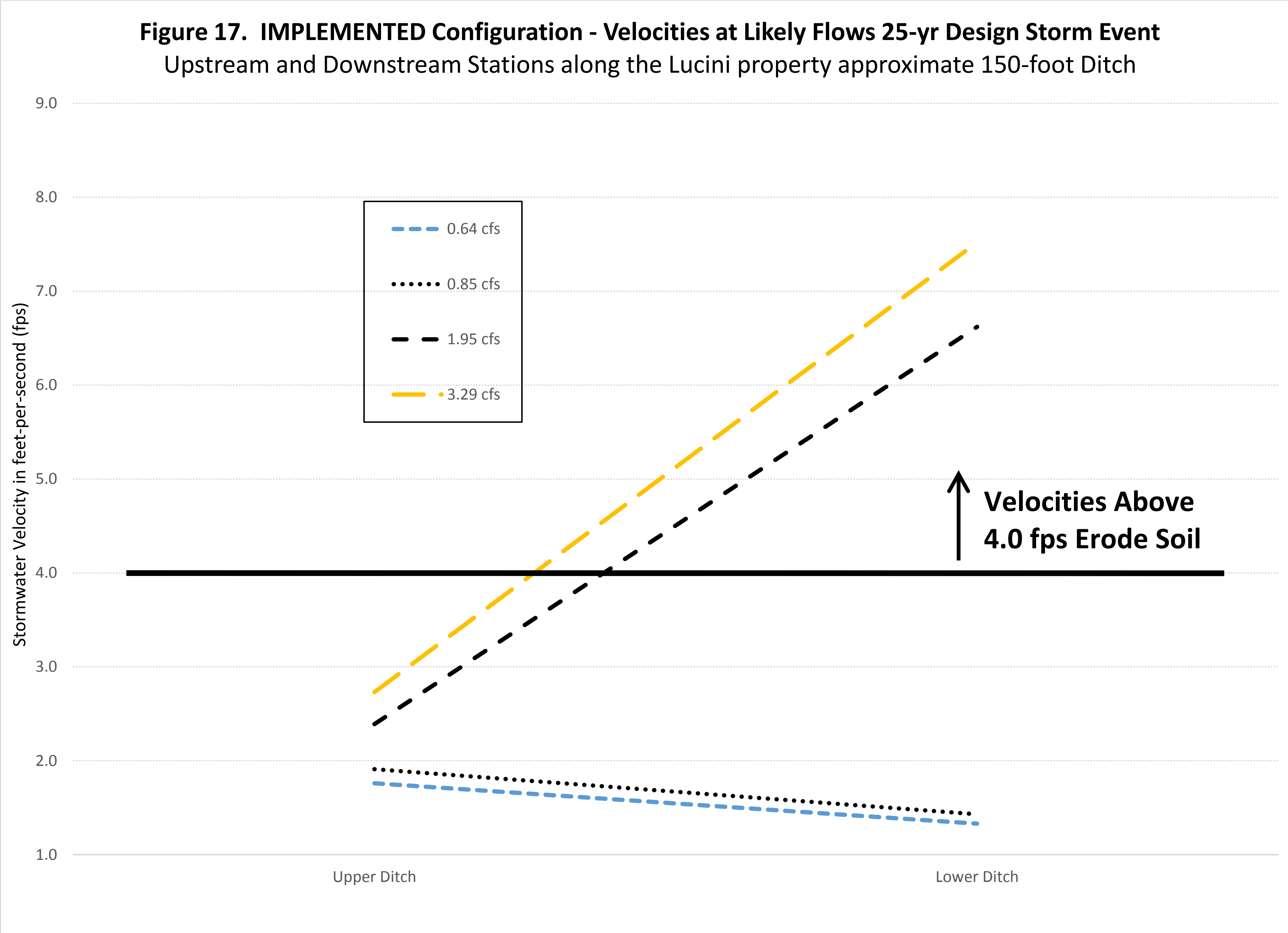


Figure 17. IMPLEMENTED Configuration - Velocities at Likely Flows 25-yr Design Storm Event
Upstream and Downstream Stations along the Lucini property approximate 150-foot Ditch
Stormwater Velocity in feet-per-second (fps)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.64 cfs
0.85 cfs
1.95 cfs
3.29 cfs
Velocities Above
4.0 fps Erode Soil
Upper Ditch
Lower Ditch

5. Planning Level Costs

There are three levels of estimated capital costs associated with fixing problems on the Lucini property resulting from the County's SW Boones Ferry Road project:

1) Immediate Shorter Term Remedy using Orifice Plate ($4,500 to $6,500 installed)
2) Ongoing Flow and Water Quality Control Facilities ($12,157 to $17,560 installed)
3) Longer Term Detention/Retention Facilities (to several hundred thousand dollars)

These capital costs include equipment, materials, labor, and construction contractor overhead and profit. Design, engineering and construction management costs are separately considered. An estimate of 20 percent of the final construction capital cost for this relatively small scale project is considered. For the high range estimates above, the design cost estimates are $1,300 for number 1 and $3,572 for number 2.

These are planning level capital costs and are presented in a range between the lower cost that is 10 percent below the estimated base cost; and the high cost that is 30 percent above the estimated base cost. Presenting only a single estimated base cost is not adequate for planning purposes and providing costs as a range is more convenient. Planning level costs for construction are presented using this cost range method because direct bid costs are not part of this study. While actual bid costs may come in lower (e.g., 10 percent), if actual potential bid costs are higher (e.g., up to 30 percent) then the outcome is undesirable if unaccounted for.

1) Immediate Shorter Term Remedy
This remedy alleviates the immediate problem on a short-term basis by reducing peak stormflows and consequent erosion on the Lucini property. This can be accomplished by using an orifice plate at the County's New Inlet #1 (this is the south inlet). The proposed orifice location is shown in Figure 12 at the New Inlet #1. The orifice would be installed at the upstream end of the implemented 80-foot long, 12-inch diameter culvert comprising the County's Outfall #5.

The County has indicated it is using CWS 2007 for guidance, which contains the Drawing No. 730 "Orifice Plate and Guide" that can be installed in New Inlet #1. For convenience, the CWS Drawing No. 730 is contained in Appendix G of this report. Orifice plate openings of 6, 8 and 10 inches can be fabricated and each used separately until it is determined which size best reduces peak flows and most efficiently uses storage in the IMPLEMENTED pipes, ditches and depressions.

The installed orifice fits into the new inlet without structural changes to the inlet. Construction materials are not extensive or expensive. Accordingly, the cost of installation of this immediate remedy is estimated in the range of $4,500 to $6,500.

2) Ongoing Flow and Water Quality Control Facilities

Estimated costs of the intermediate remedy facilities are listed in Table 4.[29] Both flow and water quality (WQ) control are needed because high stormflow velocities cause erosion upstream as well as on the Lucini property. Debris and sediment transport are a significant threat to the Lucini property because it clogs downstream piping and causes flooding. The County did not evaluate stormwater conveyance from its road project through the Lucini property. Increased amounts of runoff directed to the Lucini property, and its effects, were disregarded in the County's drainage assessment.

Table 4. Capital Costs of Ongoing Flow and Water Quality Control Facilities

Control Unit	**Base Cost**
Flow Control Manhole Installed to the East of BFR at the south New Inlet #1 location.	$8,046
Water Quality Manhole Installed to the West of BFR just above the Lucini property.	$5,462
Total Estimated Base Costs	**$13,800**
Estimation Range Between (-10% and +30%)	**$12,157** to **$17,560**

The County provided storm grates on its two new stormwater inlets in the subbasin above the Lucini property as shown in Figure 12. The County neglected to provide a storm grate for the pipe entrance to the Lucini property (see Figure 12). The Lucini property drainage receives stormwater passing through SW Boones Ferry Road culvert (Outfall #5). The County supposed that its generated stormflow will be conveyed successfully through the Lucini property. The Corps HEC-HMS and HEC-RAS demonstrate that this is not the case for the 25-year design storm cases presented in this analysis.

It is important to note that the Greenhill Lane subbasin, to the south of the Lucini property, has received flow and water quality control. The Greenhill Lane subbasin and the Lucini property both drain to the Basalt Creek wetlands. For the Greenhill Lane subbasin, which has dual outfalls the County used at least three (3) manholes to control

[29] Costs are based on *RS Means Building Construction Cost Data* (2010). Costs are adjusted for inflation based on the cost index as published by the Engineering News Review (ENR). In this case the index is set at 8800.66 for 2010 and 10337.05 for 2016. This is calculated as an inflation ratio of 1.175, i.e., an inflation rate of 17.5 percent from 2010 to 2016.

flow and a water quality manhole to control pollution. The subbasin draining to the Lucini property has no manholes to control flow nor a water quality manhole to control pollution including eroded sediment and debris.

While the Greenhill Lane subbasin typically will have greater stormflows, the necessity of controlling excess stormflows to the Lucini property is no less significant. This is especially true because the County performed no downstream system evaluation for hydraulic conditions on the Lucini property and has no basis for discharging excess flows to the Lucini property.

The County has indicated it is using CWS 2007 for guidance, which contains: Drawing No. 270 "Flow Control Structure Detail" that can be installed at the New Inlet #1 location; and Drawing No. 240 "Water Quality Manhole (Mechanical)" that can be installed just upstream of the Lucini property pipe entrance. For convenience, CWS Drawing Nos. 270 and 240 are contained in Appendix G of this report. See Figure 12 for the locations of these proposed flow and water quality control facilities.

3) Longer Term Detention/Retention Facility

Future full build-out development in the subbasin draining to the Lucini property was not considered by the County's Drainage Report (2013). This is surprising because the subbasin is zoned for future development (FD-20)[30] and includes Tualatin's Institutional (IN) development as characterized by the Horizon Community Church with its large buildings, extensive driveways, parking lots, and numerous support facilities. Ongoing development in the subbasin above the Lucini's, including the construction of the BFR widening project itself, demonstrate that the trend of more intense urban development is already underway and having an effect on the Lucini property.

As shown in the hydrologic and hydraulic evaluations in this report, ongoing urban development is already producing stormflows that exceed ORIGINAL conditions, by about 220 percent, that the Lucini property has historically been subjected to (see Figure 7). Urban development above the Lucini property, under full build-out conditions, pose a still greater threat. These stormflow projections exceed, by about 414 percent, the ORIGINAL stormflow conditions that the Lucini property has historically been subject to as depicted in Figure 8.

Stormflows with ongoing development and full build-out conditions draining to the Lucini property require substantial detention (flow control) and retention (WQ control) measures. These stormwater control units are absent from the Drainage Report (2013) and have not been considered by the County.

The design and detailed costing of detention/retention facilities is beyond the scope of this report but construction and land costs could be as high as several hundred thousand dollars.

[30] Washington County 20-year Future Development (FD-20), see PDF Page 33 of 152

Supplement B: Part 2 – Rpt Appendices

Included under separate cover because of size.

Appendices - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016)

Appendices

Appendix A

Appendix A1

Photos of ORIGINAL SW Boones Ferry Road
Above and just south of the Lucini Property

Photos taken prior to BFR Road Widening Project of 2013. The County's photo was taken on September 28, 2012 and the Lucini's photo was taken on December 20, 2012.

Photo A1a. This photo is from the County's Wetland Delineation Report (December 2010, PDF Page 81 of 90), which indicates the view is: "Looking south at the north - central portion of the study area." The County identifies this photo as "Photo K" taken on September 28, 2012. The mailbox on the right (to the west) identifies the Lucini property at 23677 SW Boones Ferry Road. The approach sign indicates the Greenhill Lane entrance is ahead but it is not visible because of the vertical curve in the road. There are no curbs or storm sewers in this section of the Boones Ferry Road contrary to the County's Drainage Report (2013).

Photo A1b. Drainage from the ORIGINAL Boones Ferry Road (December 2012). Looking northerly with ponding on the eastern (right) portion of the road. The white fence line of the Lucini property can be seen in the distance in the upper left of the photo, i.e., looking to the northwest. There are no curbs or storm sewers in this section of the ORIGINAL Boones Ferry Road contrary to the claim made in the County's Drainage Report (January 2013).

Appendix A2

Photos taken by John and Grace Lucini on May 18, 2015.
Showing the Downstream System conveying stormflows from
the SW Boones Ferry Road widening project

Excessive storm flows on May 18, 2015 overwhelmed the Lucini property.

Photo A2a. Storm flood waters directed to the Lucini property from Boones Ferry Road (5-18-15).

Photo A2b. Channel conveying Boones Ferry Road drainage across the Lucini property (5-18-15).

Photo A2c. The junction for the ditch and driveway pipe are overwhelmed and flood waters drain into the front yard toward the house (5-18-15).

Photo A2d. Flooding storm water ultimately found its way onto the porch and steps of the house and into the lower driveway area (5-18-15).

Photo A2e. The front lawn drained its flood waters into the walkway and porch in front of the house.

Photo A2f. The front walkway steps drain into the lower driveway and garage area.

Photo A2g.
Flooding stormwater ultimately found its way into the lower driveway and garage area.

Appendix A3

Photos of Ongoing Erosion on Lucini Property (taken August 19, 2016)

Photo A3a. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally northeast up the slope to the pipe end exiting from the County's road project. This photo shows the continuing effects of erosion with the ditch spreading east and west into the embankment where bare soil and tree roots are exposed. To slow flows the owner has placed riprap and concrete block in the ditch to reduce stormwater flow velocities that continue to erode the channel requiring ongoing repairs. This photo corresponds to the flood location in photo A2a of the previous Appendix A2, which shows high velocity storm flows into the Lucini property.

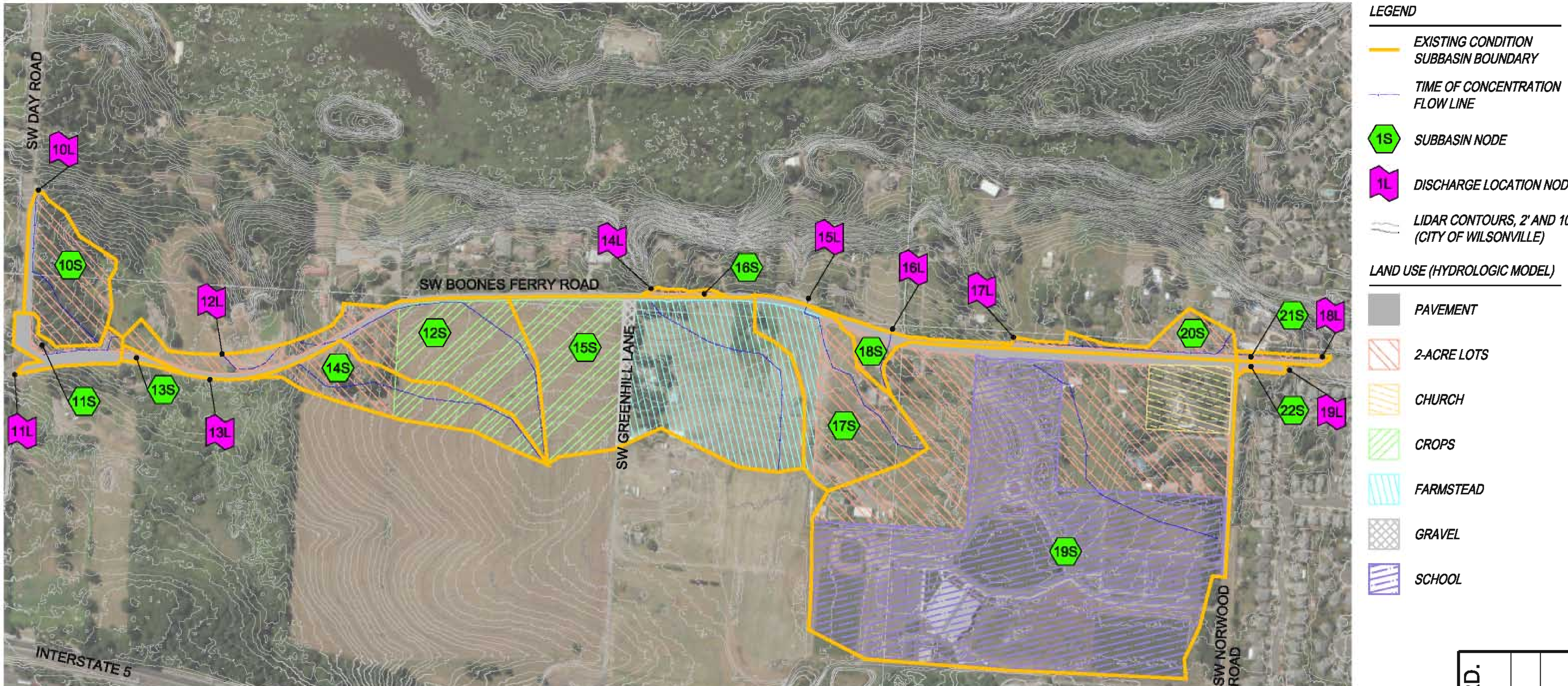
Photo A3b. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally east up the slope of the driveway. This photo shows the continuing effects of erosion with the ditch spreading south toward the driveway, and north into the embankment where bare soil and tree roots are exposed. To slow flows and reduce erosion, the owner has placed riprap in the ditch and gravel next to the driveway. However, very high stormwater velocities continue to erode the channel requiring ongoing repairs.

Photo A3c. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally northeast up the slope. This photo shows the continuing effects of erosion with the ditch spreading north into the embankment where bare soil and tree roots are exposed. To slow flows the owner has placed riprap in the ditch to reduce stormwater flow velocities that continue to erode the channel requiring ongoing repairs. This photo corresponds to the flood location in Photo A2c of the previous Appendix A2. The entrance to the 12-inch driveway culvert, which carries stormflows to the right (to the south), is hidden from view by the large rock at the bottom of the photo. See the next photo (A3d) for a view of the entrance to the driveway culvert).

Photo A3d. This photo of the westernmost base of the ditch was taken on August 19, 2016 and looks generally west toward the Lucini house. Shown the basin where stormwater collects and is routed into the entrance of the 12-inch corrugated plastic pipe (CPP), which is visible in the center of the photo. This pipe entrance allows flows to go south into the driveway culvert. Although a reversed view, this photo corresponds to the flood location in Photo A2c of the previous Appendix A2.

Appendix B

EXISTING CONDITIONS HYDROLOGY MAP



EXISTING CONDITIONS HYDROLOGY

DISCHARGE LOCATION	PRIMARY SITE CONVEYANCE	DOWNSTREAM RECEIVING ENTITY	CONTRIBUTING SUBBASINS
10L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	10S
11L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	11S
12L	MISC SURFACE FLOW	EXISTING DRAW, WEST	12S
13L	MISC SURFACE FLOW	EXISTING DRAW, SOUTHEAST	13S,14S
14L	CULVERT(S)	EXISTING RAVINE, WEST	15S, 16S
15L	CULVERT(S)	EXISTING PIPE CONVEYANCE, WEST	17S
16L	PAVEMENT RUNOFF	NON-POINT SHEET FLOW	18S
17L	CULVERT(S)	EXISTING CHANNEL, SOUTHWEST	19S, 20S
18L	MISC SURFACE FLOW	EXISTING ROADSIDE LOWPOINT, WEST	21S
19L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	22S

N

0 400 800

SCALE: 1" = 400'

SW BOONES FERRY RD.

SW DAY ST. TO SW NORWOOD RD.
WASHINGTON COUNTY

HYDROLOGY MAPS

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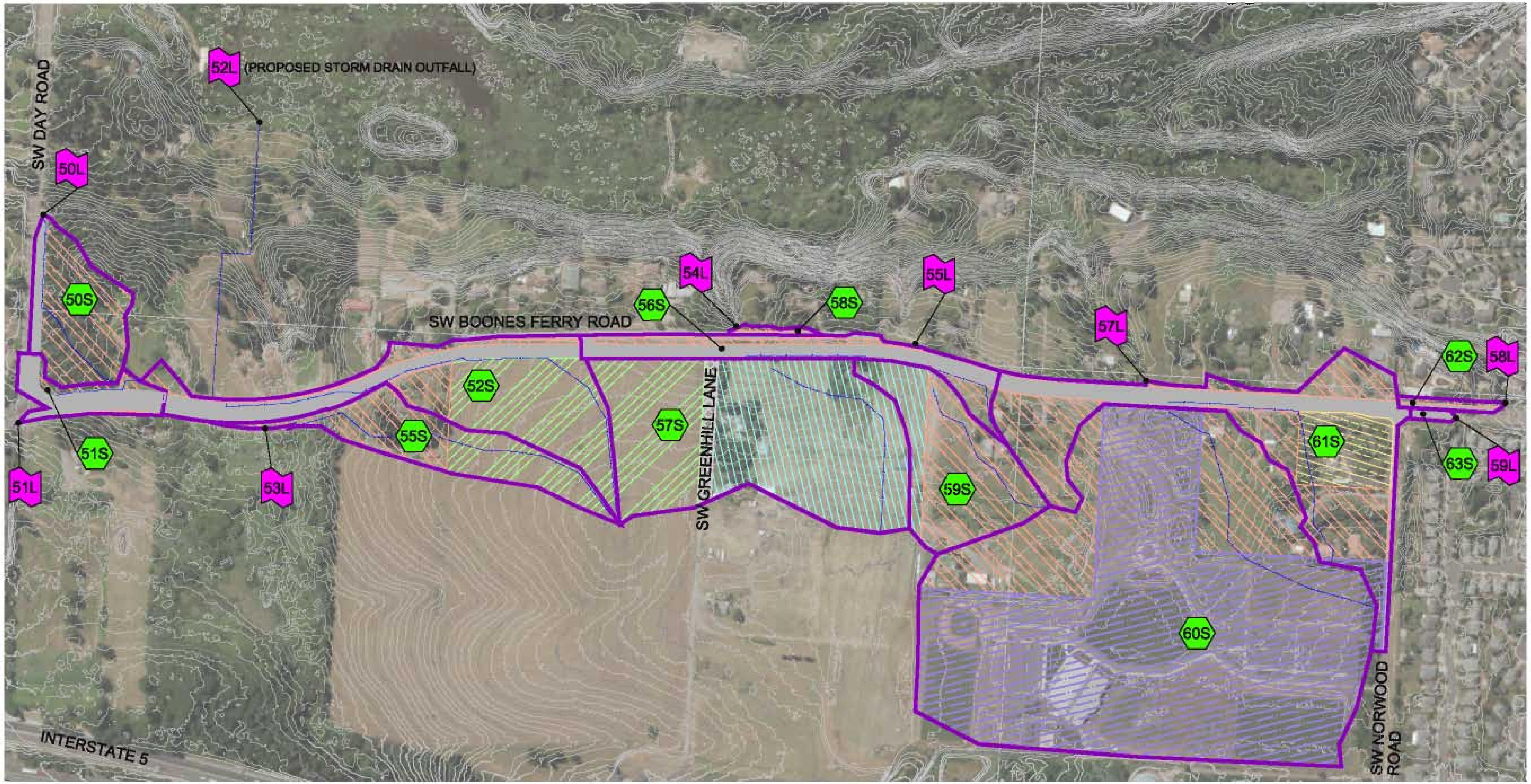
PROJECT NUMBER
100096

SHEET NO.
1 OF 3

SHEET TITLE
HYD1

PROPOSED CONDITIONS HYDROLOGY MAP



LEGEND

- *PROPOSED CONDITION SUBBASIN BOUNDARY*
- *TIME OF CONCENTRATION FLOW LINE*
- 1S *SUBBASIN NODE*
- 1L *DISCHARGE LOCATION NODE*
- *LIDAR CONTOURS, 2' AND 10' (CITY OF WILSONVILLE)*

LAND USE (HYDROLOGIC MODEL)

- *PAVEMENT*
- *2-ACRE LOTS*
- *CHURCH*
- *CROPS*
- *FARMSTEAD*
- *GRAVEL*
- *SCHOOL*

PROPOSED CONDITIONS HYDROLOGY

DISCHARGE LOCATION	PRIMARY SITE CONVEYANCE	DOWNSTREAM CONVEYANCE DESCRIPTION	CONTRIBUTING SUBBASINS
50L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	50S
51L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	51S
52L	PROPOSED STORM DRAIN	BASALT CREEK MARSH	52S
53L	MISC SURFACE FLOW	EXISTING DRAW, SOUTHEAST	55S
54L	PROPOSED STORM DRAIN	EXISTING RAVINE, WEST	56S, 57S, 58S
55L	CULVERT(S)	EXISTING PIPE CONVEYANCE, WEST	59S
56L	NOT USED	NON-POINT SHEET FLOW	NOT USED
57L	PROPOSED STORM DRAIN	EXISTING CHANNEL, SOUTHWEST	60S, 61S
58L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	62S
59L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	63S

N

0 400 800

SCALE: 1" = 400'

SW BOONES FERRY RD.
SW DAY ST. TO SW NORWOOD RD.
WASHINGTON COUNTY

HYDROLOGY MAPS

PLOT STAMP: 01/31/13 4:46A BTHAYNE
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PROJECT NUMBER
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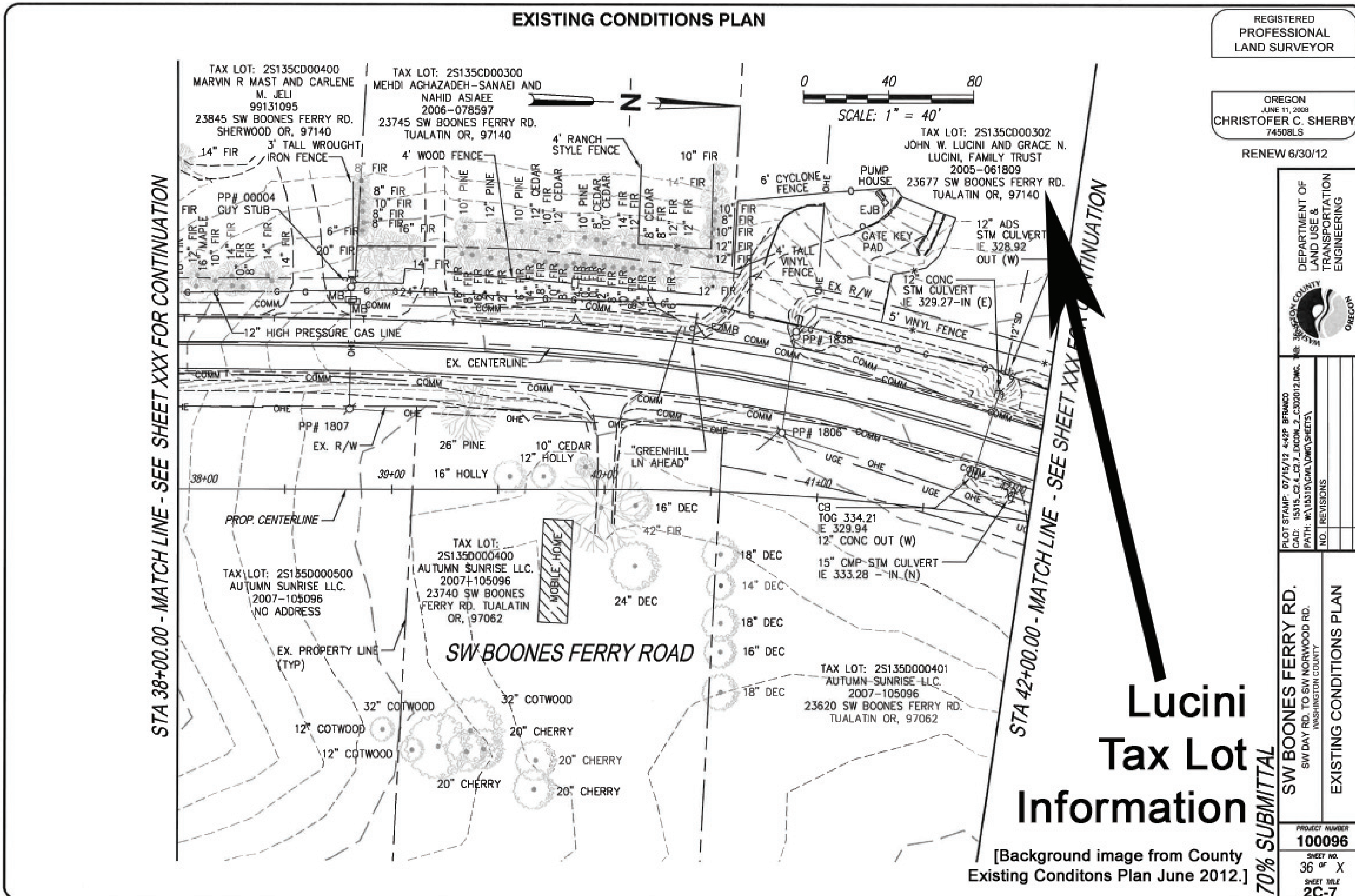
SHEET NO.
2 OF 3

SHEET TITLE
HYD2

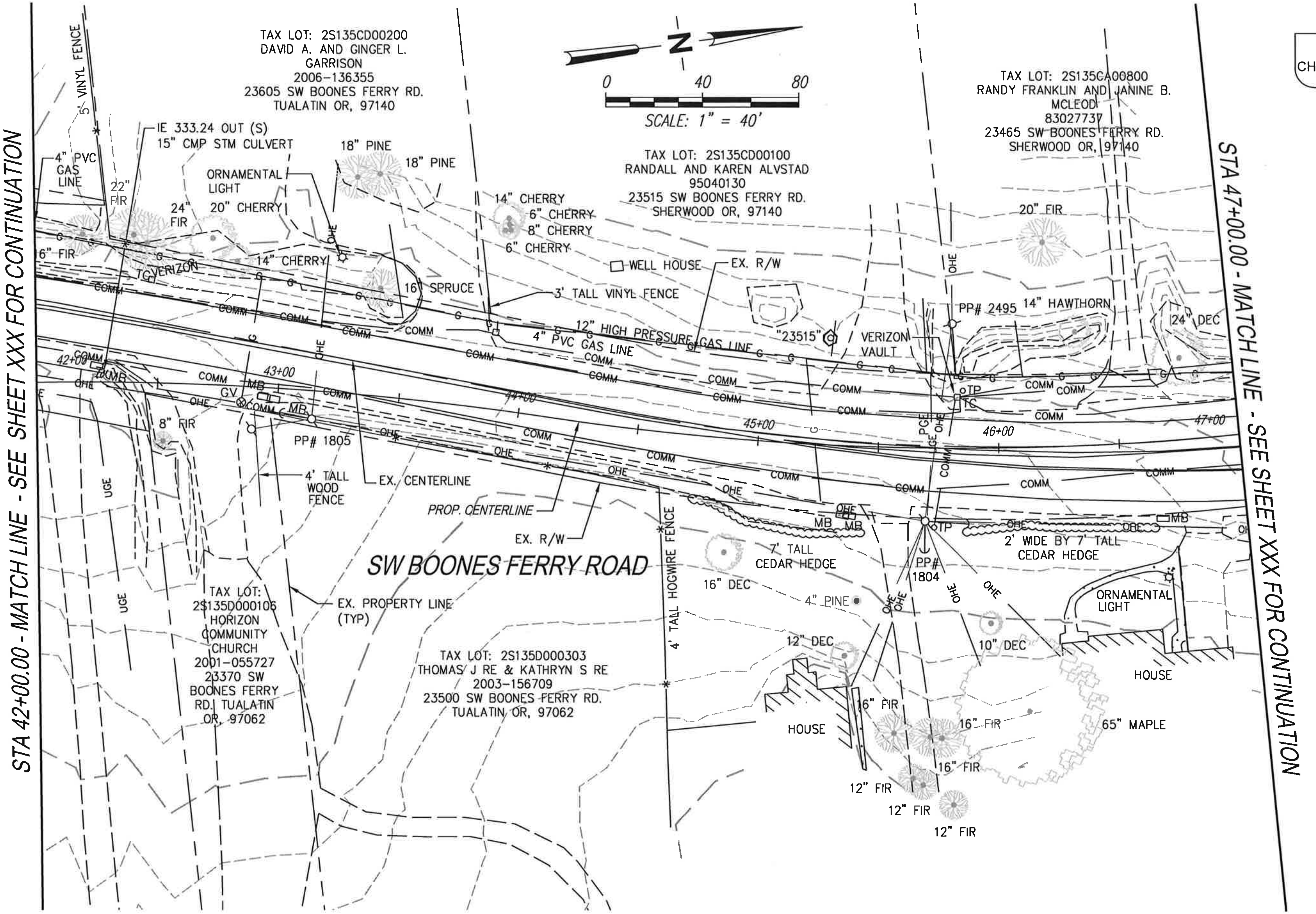
Appendix C



Lucini Tax Lot Information

[Background image from County Existing Conditons Plan June 2012.]

EXISTING CONDITIONS PLAN



REGISTERED PROFESSIONAL LAND SURVEYOR

OREGON
JUNE 11, 2008
CHRISTOFER C. SHERBY
74508LS

RENEW 6/30/12

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING

WASHINGTON COUNTY OREGON

PLOT STAMP: 07/15/12 4:42P BFRANCO
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NO.	REVISIONS

70% SUBMITTAL

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EXISTING CONDITIONS PLAN

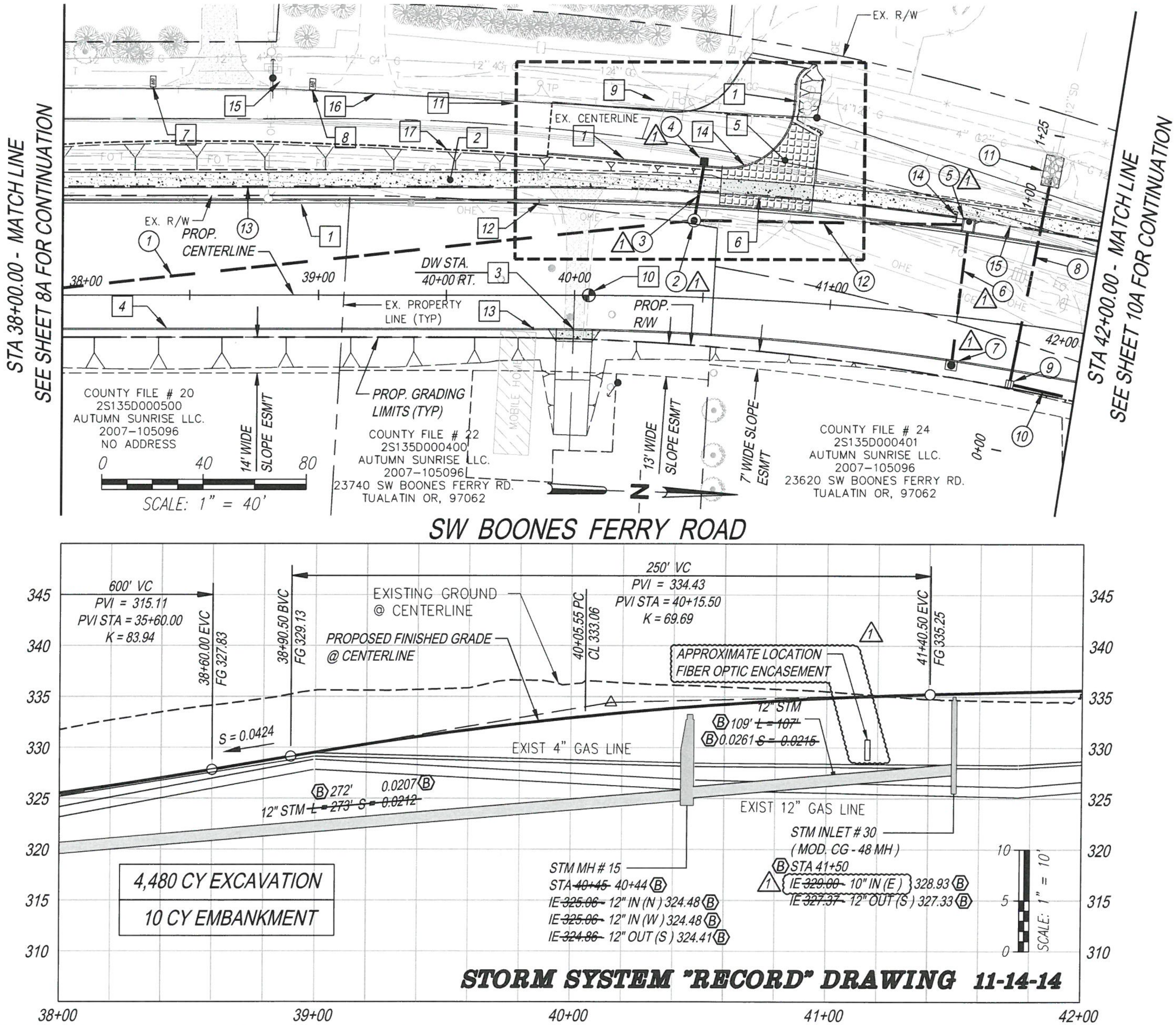
PROJECT NUMBER 100096

SHEET NO. 37 OF X

SHEET TITLE 2C-8

Appendix D

CONSTRUCTION PLAN AND PROFILE



STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER 15552PE
OREGON
JULY 25, 1991
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING

WASHINGTON COUNTY OREGON

PLOT STAMP: 11/17/14 7:47A ASTAICH
CAD: 15315_9_11A_ST_PL_PR.DWG, TAB: 9A
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NO.	REVISIONS	
1	REVISION NO. 3	5-20-2013 RRM
B	STORM SYSTEM "RECORD" DATA 11-14-14	

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

CONSTRUCTION PLAN AND PROFILE

PROJECT NUMBER 100096

SHEET NO. 145 OF 274

SHEET TITLE 9A

CONSTRUCTION NOTES

THIS SHEET TO FACE SHT. 9A

1. CONST. P.C. CONC. CURB & GUTTER
   SEE SHEET 2B-4 FOR DETAILS
2. CONST. POROUS P.C. CONC. WALK
   SEE SHEET 2B-6 FOR DETAILS
3. CONST. P.C. RESIDENTIAL DRIVEWAY
   SEE SHEET 2B-1 & 2B-2 FOR DETAILS
4. CONST. P.C. CONC. MOUNTABLE VERTICAL CURB
   SEE SHEET 2B-4.1 FOR DETAILS
5. INSTALL UNIT PAVERS AS SPECIFIED IN BOOK 2
6. CONST. CONC. COMMERCIAL DRIVEWAY
   SEE SHEET 2B-6 FOR DETAILS
7. CONST. SINGLE MAILBOX
   STATION 38+35
   MB ADDRESS "23845"
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
8. CONST. SINGLE MAILBOX
   STATION 38+97
   MB ADDRESS "23745"
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
9. CONST. SINGLE MAILBOX
   STATION 40+30
   MB ADDRESS "23677"
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
10. INSTALL CENTERLINE SURVEY MONUMENT
    WITH FRAME AND COVER
    @ STA 40+05.55 - CL PC
    SEE SHEET NO 2B-7 FOR DETAIL
11. SEE SHEET 17A FOR DETAIL
    OF THIS AREA.
12. 39+85.89 PC (37.00' LT)
    TC 332.05
13. 39+65.87 PC (13.00' RT)
    TC 332.62
14. CONST LOW PROFILE MOUNTABLE CURB
    SEE SHEET 2B-6 FOR DETAILS
15. POWER POLE BY PGE (TYP)
16. OVERHEAD POWER BY PGE (TYP)
17. SAWCUT EXIST AC PAVEMENT
    AND REMOVE (N)

(1) 12" STM SEWER ~~L = 273' S = 0.0212~~ B 272' 0.0207 B

1 (2) STM MH # 15
@ STA ~~40+45~~ (30' LT) 40+44 B
RIM = ~~333.22~~ 333.16 B
IE ~~325.06~~ 12" IN (N) 324.48 B
IE ~~325.06~~ ~~12" IN (W)~~ 324.48 B
10" IN (W) 1
IE 324.86 - 12" OUT (S) 324.41 B

1 (3) ~~10" STM SEWER L = 23' S = 0.1270~~
1 10" STM SEWER L = 23' ~~S = 0.2626~~
B 0.2535 B

1 (4) STM CB # 29 (AREA DRAIN TYPE II)
@ STA ~~40+50~~ (53' LT) 40+47 B
~~TC 334.27~~ TOG 333.71 B
~~IE 330.00~~ - 10" OUT (E)
1 IE ~~331.15~~ 330.31 B

1 (5) STM CB # 30 (MOD. CG - 48 MH)
B @ STA 41+50 (36' LT)
RIM = ~~334.98~~ 334.95 B
~~IE 327.54 10" IN (E)~~ IE ~~329.00~~ - 10" IN (E) 1 328.93 B
IE ~~327.37~~ 12" OUT (S) 327.33 B

1 (6) 10" STM SEWER ~~L = 58' S = 0.0483~~ L = 54' ~~S = 0.0100~~ 1
B 0.0081 B

1 (7) STM CB # 31 (CG-30)
B @ STA 41+50 (22' RT)
TC ~~335.32~~ 335.38 B
~~IE 330.32 10" OUT (W)~~ IE ~~329.54~~ - 10" OUT (W) 1 329.37 B

(8) 12" STM CULVERT ~~L = 83' S = 0.0162~~
STM OUTFALL #5 B 80' 0.0148 B

(9) STM INLET # 32 (DITCH INLET)
B @ STA 41+74 (24' RT)
~~TC 335.45~~ RIM 334.66 (BOTTOM OF GRATE) B
IE ~~330.81~~ - 12" IN (N) 331.11 B
IE ~~330.61~~ - 12" OUT (W) 330.55 B

(10) 12" STM SEWER ~~L = 77'~~ S = 0.0101
B 74' B

(11) RIP RAP PAD
CLASS 50 RIP RAP
8' LONG x 7' WIDE x 1.5' DEEP
PLACE 1' ABOVE PIPE CROWN

(12) 12" STM SEWER ~~L = 107' S = 0.0215~~
B 109' 0.0261 B

(13) 4" PP STM SEWER L = 373'

(14) STA 41+45 (39' LT)
PLUG 4" PP

(15) 4" PP STM SEWER L = 349'

STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER 15552PE
OREGON
JULY 25, 1991
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 11/17/14 7:46A ASTAICH
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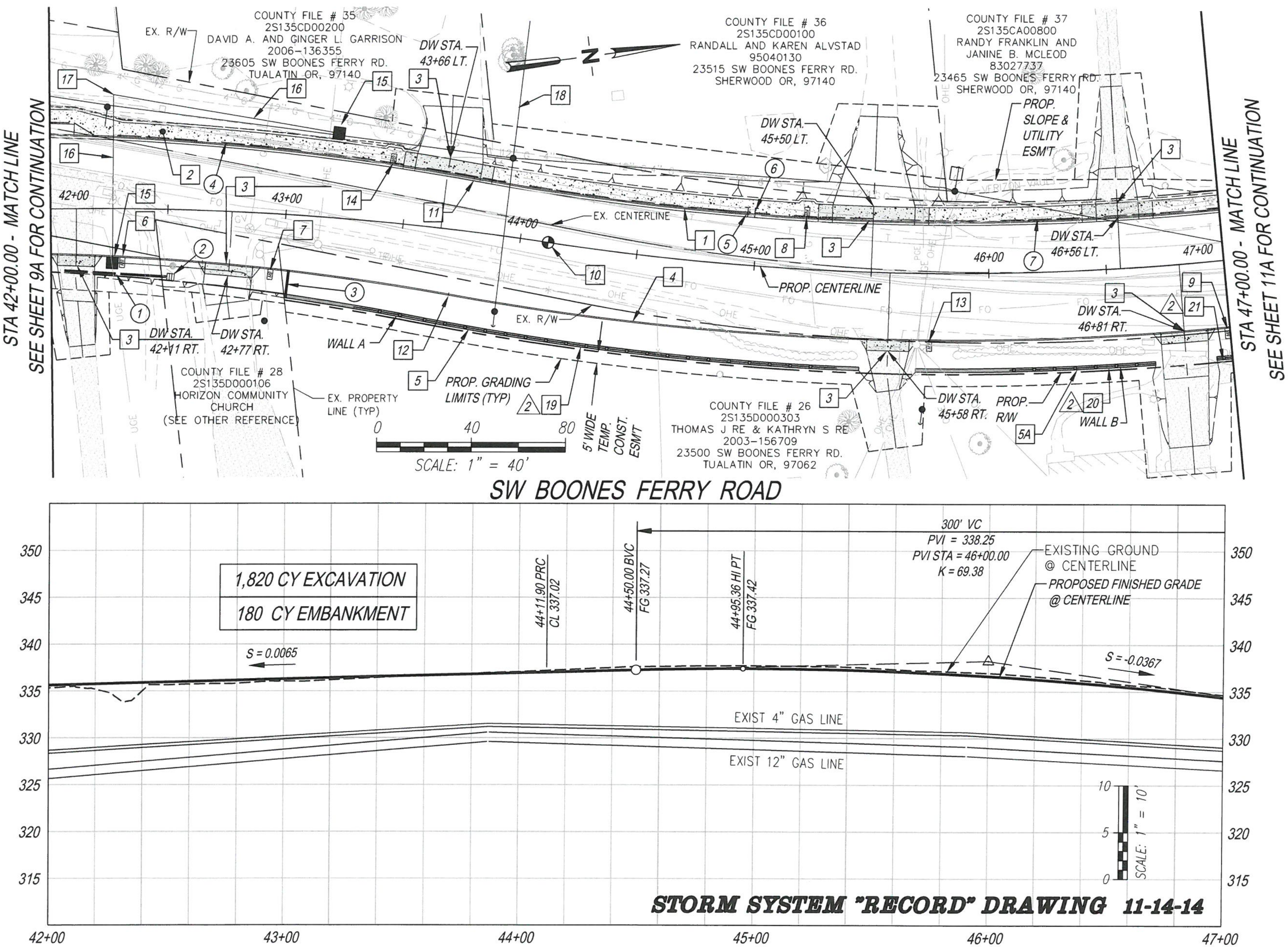
NO.	REVISIONS	
1	REVISION NO. 3	5-20-2013 RRM
B	STORM SYSTEM "RECORD" DATA 11-14-14	

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY
CONSTRUCTION NOTES

PROJECT NUMBER 100096
SHEET NO. 144 OF 274
SHEET TITLE 9

CONSTRUCTION PLAN AND PROFILE



REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1984
RAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING

WASHINGTON COUNTY OREGON

PLOT STAMP: 11/17/14 7:48A ASTAICH
CAD: 15315_9_11A_ST_PL_PR.DWG, TAB: 10A
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NO.	REVISIONS	
2	ADDENDUM NO. 2	RRM 4-16-2013
B	STORM SYSTEM "RECORD" DATA 11-14-14	

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ENERGY PUBLIC WORKS LAND DEVELOPMENT
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SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

CONSTRUCTION PLAN AND PROFILE

PROJECT NUMBER 100096

SHEET NO. 147 OF 274

SHEET TITLE 10A

CONSTRUCTION NOTES

THIS SHEET TO FACE SHT. 10A

1 CONST. P.C. CONC. CURB & GUTTER
SEE SHEET 2B-4 FOR DETAILS

2 CONST. POROUS P.C. CONC. WALK
SEE SHEET 2B-6 FOR DETAILS

3 CONST. P.C. RESIDENTIAL DRIVEWAY
SEE SHEET 2B-1 & 2B-2 FOR DETAILS

4 CONST. P.C. CONC. MOUNTABLE VERTICAL CURB
SEE SHEET 2B-4.1 FOR DETAILS

5 CONST. PREFAB. MODULAR RETAINING WALL A
SEE SHEET 28A FOR DETAILS

5A CONST. PREFAB. MODULAR RETAINING WALL B
SEE SHEET 28A FOR DETAILS

6 CONST. SINGLE MAILBOX
STATION 42+31
MB ADDRESS " 23620 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

7 CONST. DOUBLE MAILBOX
STATION 42+95
MB ADDRESS " 23560 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

8 CONST. SINGLE MAILBOX
STATION 45+21
MB ADDRESS " 23515 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

9 CONST. SINGLE MAILBOX
STATION 46+99
MB ADDRESS " 23500 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

10 INSTALL CENTERLINE SURVEY MONUMENT
WITH FRAME AND COVER
@ STA 44+11.90 - CL PRC
SEE SHEET NO 2B-7 FOR DETAIL

11 43+77.26 PRC (22.52' LT)
TC 336.58

12 43+58.83 PRC (34.82' LT)
TC 336.30

13 CONST. SINGLE MAILBOX
STATION 45+75
MB ADDRESS " 23550 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

14 CONST. SINGLE MAILBOX
STATION 43+43
MB ADDRESS " 23605 "
SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS

15 PROPOSED POWER VAULT BY PGE

16 PROPOSED POWER CONDUIT BY PGE

17 POWER POLE BY PGE (TYP)

18 OVERHEAD POWER BY PGE (TYP)

19 BLACK VINYL COATED CHAINLINK FENCE
WALL A: STA. 0+30 TO STA. 2+37
2 ~~3" FROM BACK OF WALL~~
REFER TO ODOT STD DRAWING
RD815. INSTALL FENCE ON WALL.

20 BLACK VINYL COATED CHAINLINK FENCE
WALL B: STA. 0+40 TO STA. 1+12
2 ~~3" FROM BACK OF WALL~~
REFER TO ODOT STD DRAWING
RD815. INSTALL FENCE ON WALL.

21 BLACK VINYL COATED CHAINLINK FENCE
WALL C: STA. 0+00 TO STA. 0+36
2 ~~3" FROM BACK OF WALL~~
REFER TO ODOT STD DRAWING
RD815. INSTALL FENCE ON WALL.

1 12" STM SEWER ~~L = 77'~~ B 74' S = 0.0101 B

2 STM INLET # 33 (DITCH INLET)
@ STA ~~42+52~~ (29' RT) 42+50 B
~~TC 335.83~~ RIM 334.68 (BOTTOM OF GRATE) B
IE ~~331.58~~ - 12" OUT (S) 331.86 B

3 4" D.I.P. FOOTING DRAIN CONNECTION
THRU CURB FACE - L = 12' UNABLE TO VERIFY

4 4" PP STM SEWER L = 349'

5 STA 44+95 (23' LT)
PLUG 4" PP

6 STA 44+98 (23' LT)
PLUG 4" PP

7 4" PP STM SEWER L = 335'

STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1995
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

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NO.	REVISIONS	
2	ADDENDUM NO. 2	RRM 4-16-2013
B	STORM SYSTEM "RECORD" DATA 11-14-14	

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

CONSTRUCTION NOTES

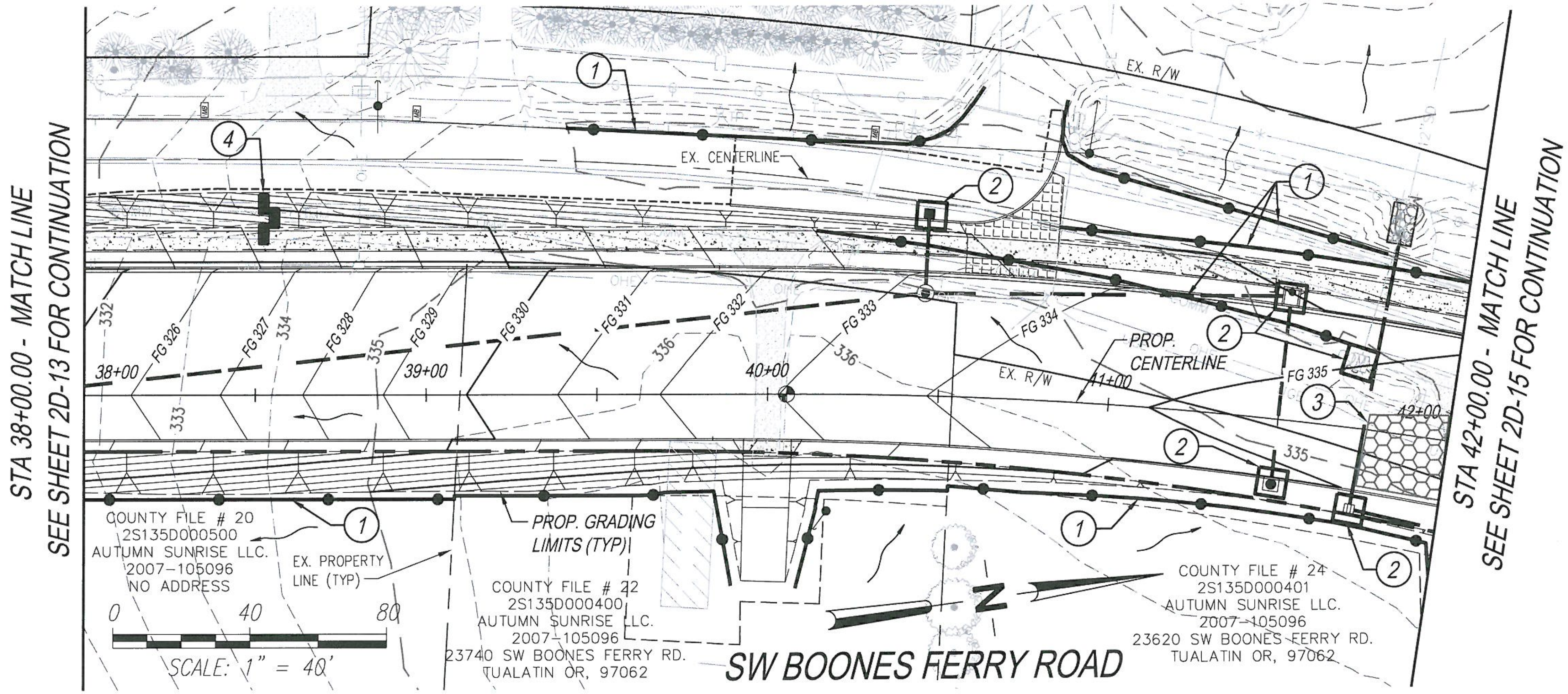
PROJECT NUMBER 100096
SHEET NO. 146 OF 274
SHEET TITLE 10

www.mackaysposito.com

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

Appendix E

EROSION & SEDIMENT CONTROL PLAN



LEGEND

---280---	EXISTING CONTOUR
FG 281	FINISHED CONTOURS (MINOR)
FG 280	FINISHED CONTOURS (MAJOR)
	SILT FENCE
	CHECK DAM BIO-FILTER BAG
	DIRECTION OF FLOW
	TEMPORARY STORM INLET PROTECTION
	GRAVEL CONSTRUCTION ENTRANCE

EROSION & SEDIMENT CONTROL NOTES

1. CONSTRUCT SEDIMENT FENCE
SEE SHEET 2D-3 & 2D-4 FOR DETAILS
2. CONSTRUCT INLET PROTECTION
SEE SHEET 2D-4 FOR DETAILS
3. CONSTRUCT GRAVEL CONSTRUCTION ENTRANCE
SEE SHEET 2D-3 FOR DETAILS
4. CONSTRUCT CHECK DAM BIO-FILTER BAG
SEE SHEET 2D-3 FOR DETAILS

"RECORD" DRAWING 11-14-14

NOTE:
EROSION AND SEDIMENT CONTROLS SELECTION AND PLACEMENT MUST BE CONSISTENT AND APPROPRIATE FOR CONSTRUCTION PHASING AT ALL TIMES. CONTROLS SHOWN ON PLANS MAY NOT APPLY TO ALL CONSTRUCTION PHASES.

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1991
DAMON C. WEBSTER
1/31/13
EXPIRES: 6/30/14

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 01/31/13 10:12A BFRANCO
CAD: 15315_2D-15_2D-17_ESC_3.DWG, TAB: 2D-14
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NO. | REVISIONS

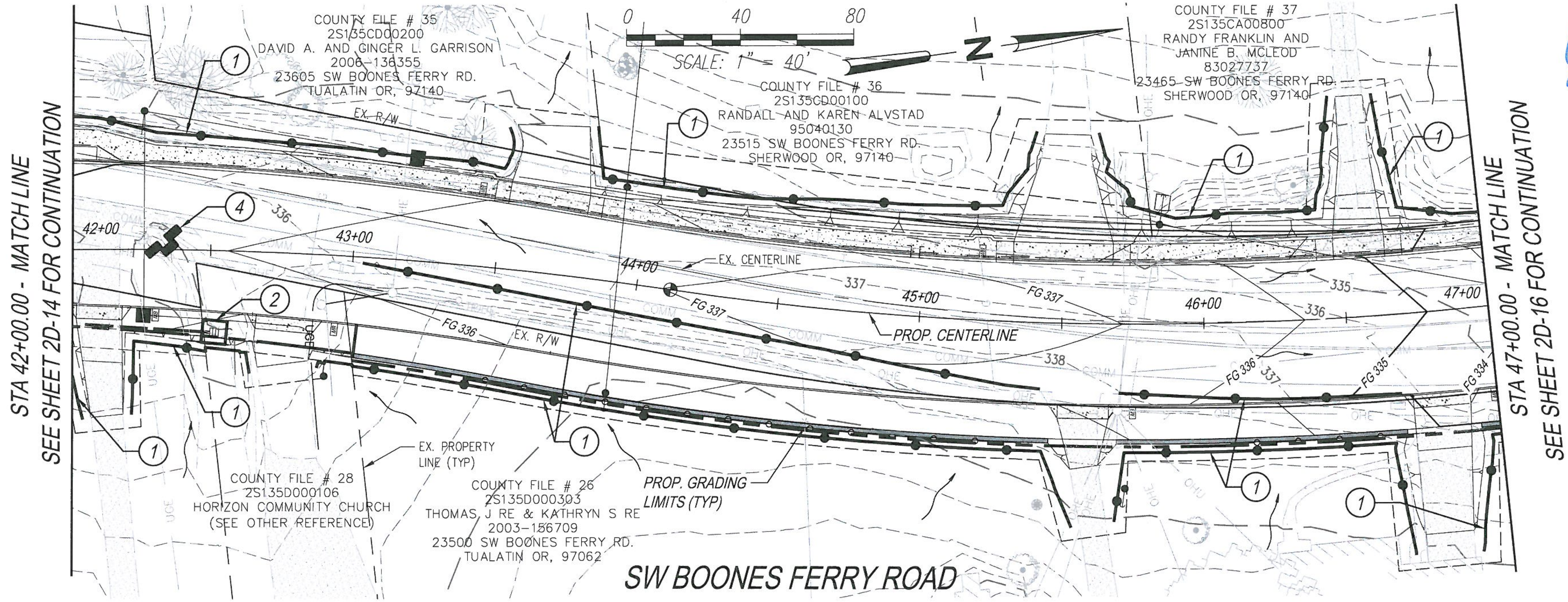
SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EROSION & SEDIMENT CONTROL PLAN

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

PROJECT NUMBER 100096
SHEET NO. 80 OF 274
SHEET TITLE 2D-14

EROSION & SEDIMENT CONTROL PLAN



LEGEND

— — —280— — —	EXISTING CONTOUR
——FG 281——	FINISHED CONTOURS (MINOR)
——FG 280——	FINISHED CONTOURS (MAJOR)
	SILT FENCE
	CHECK DAM BIO-FILTER BAG
	DIRECTION OF FLOW
	TEMPORARY STORM INLET PROTECTION
	GRAVEL CONSTRUCTION ENTRANCE

EROSION & SEDIMENT CONTROL NOTES

1. CONSTRUCT SEDIMENT FENCE
SEE SHEET 2D-3 & 2D-4 FOR DETAILS
2. CONSTRUCT INLET PROTECTION
SEE SHEET 2D-4 FOR DETAILS
3. CONSTRUCT GRAVEL CONSTRUCTION ENTRANCE
SEE SHEET 2D-3 FOR DETAILS
4. CONSTRUCT CHECK DAM BIO-FILTER BAG
SEE SHEET 2D-3 FOR DETAILS

"RECORD" DRAWING 11-14-14

NOTE:
EROSION AND SEDIMENT CONTROLS SELECTION AND PLACEMENT MUST BE CONSISTENT AND APPROPRIATE FOR CONSTRUCTION PHASING AT ALL TIMES. CONTROLS SHOWN ON PLANS MAY NOT APPLY TO ALL CONSTRUCTION PHASES.

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1997
DAMON C. WEBSTER
1/31/13
EXPIRES: 6/30/14

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 01/31/13 10:12A BFRANCO
CAD: 15315_2D-15_2D-17_ESC_3.DWG, TAB: 2D-15
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NO.	REVISIONS

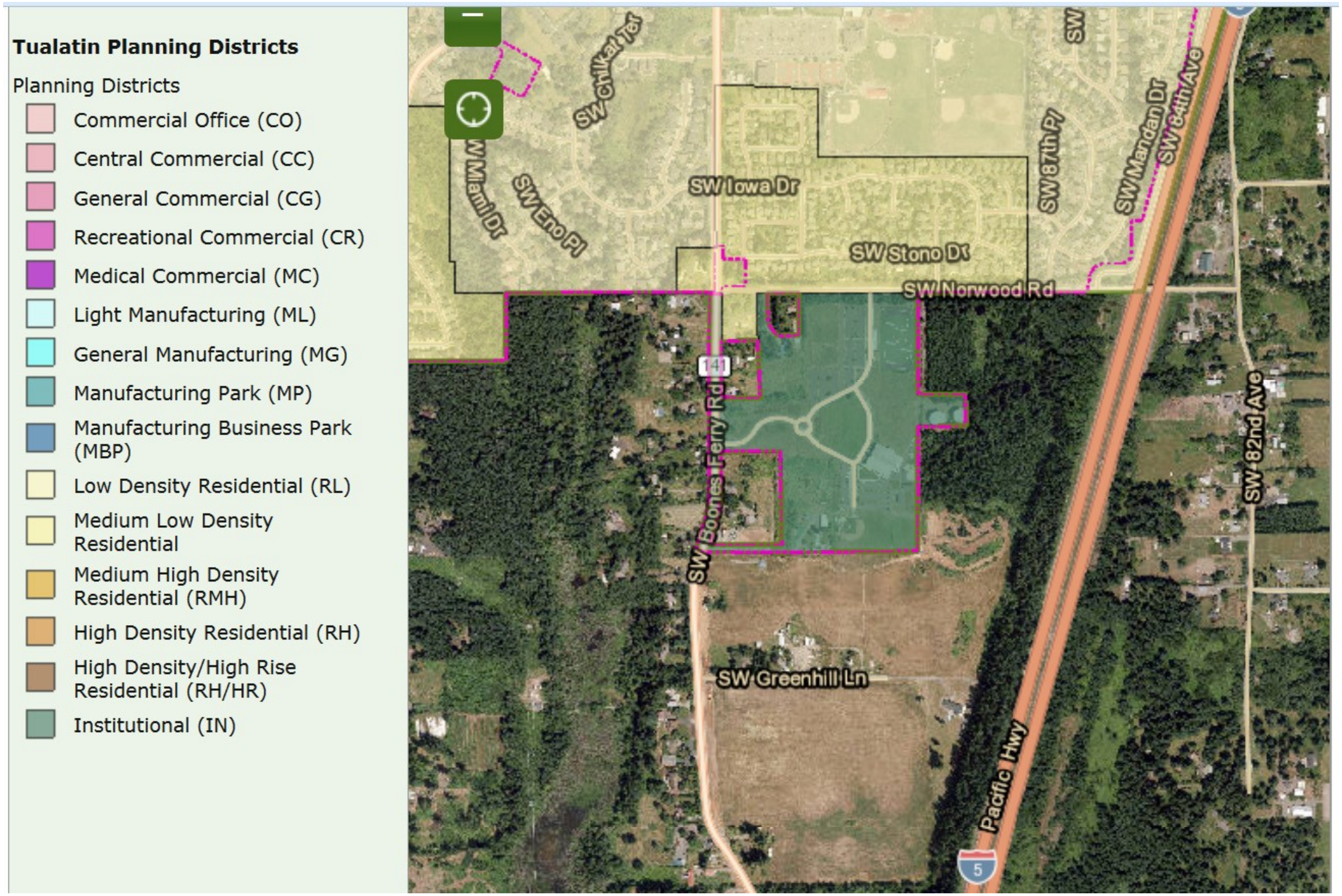
MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

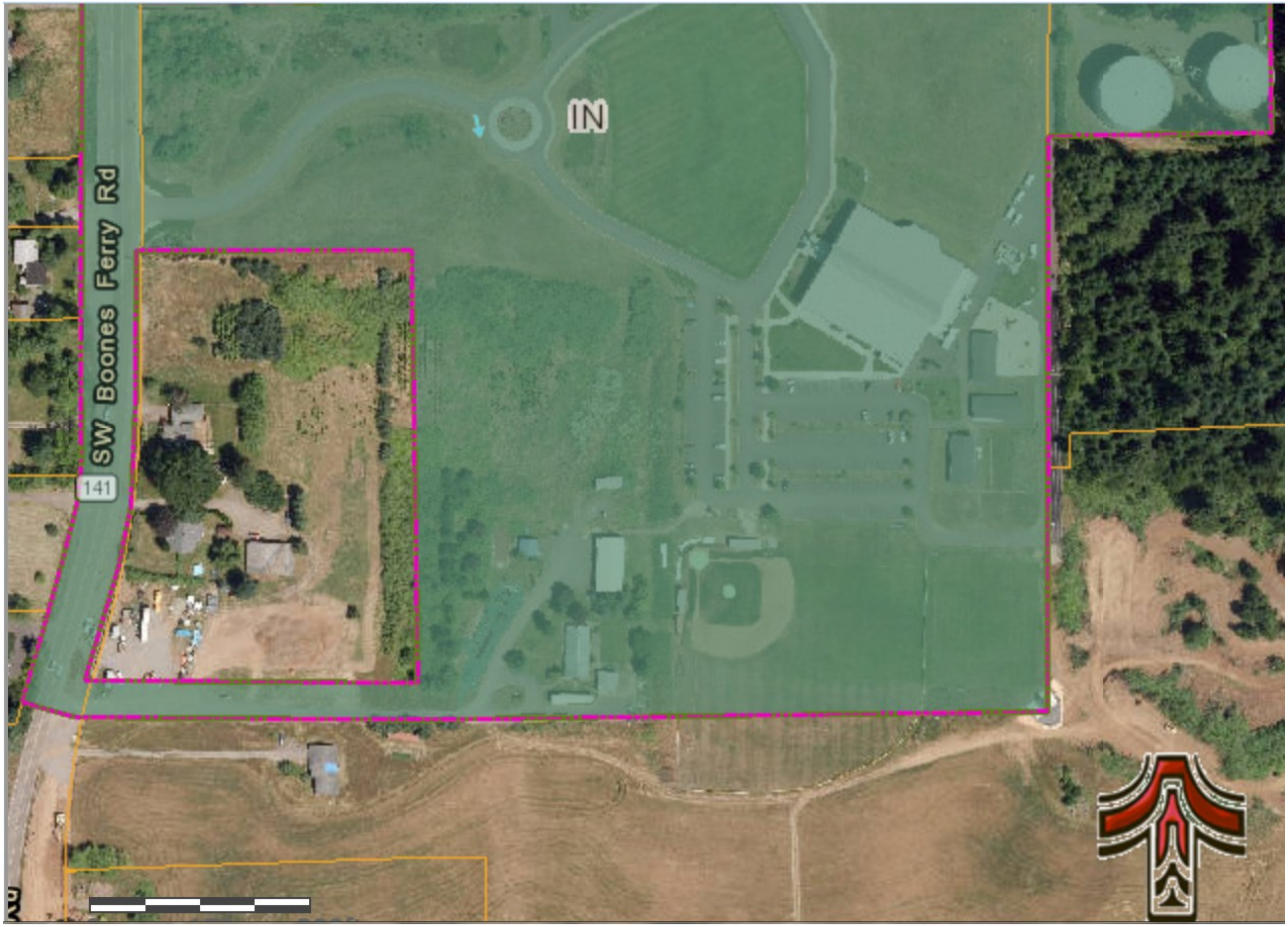
SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EROSION & SEDIMENT CONTROL PLAN

PROJECT NUMBER 100096
SHEET NO. 81 OF 274
SHEET TITLE 2D-15

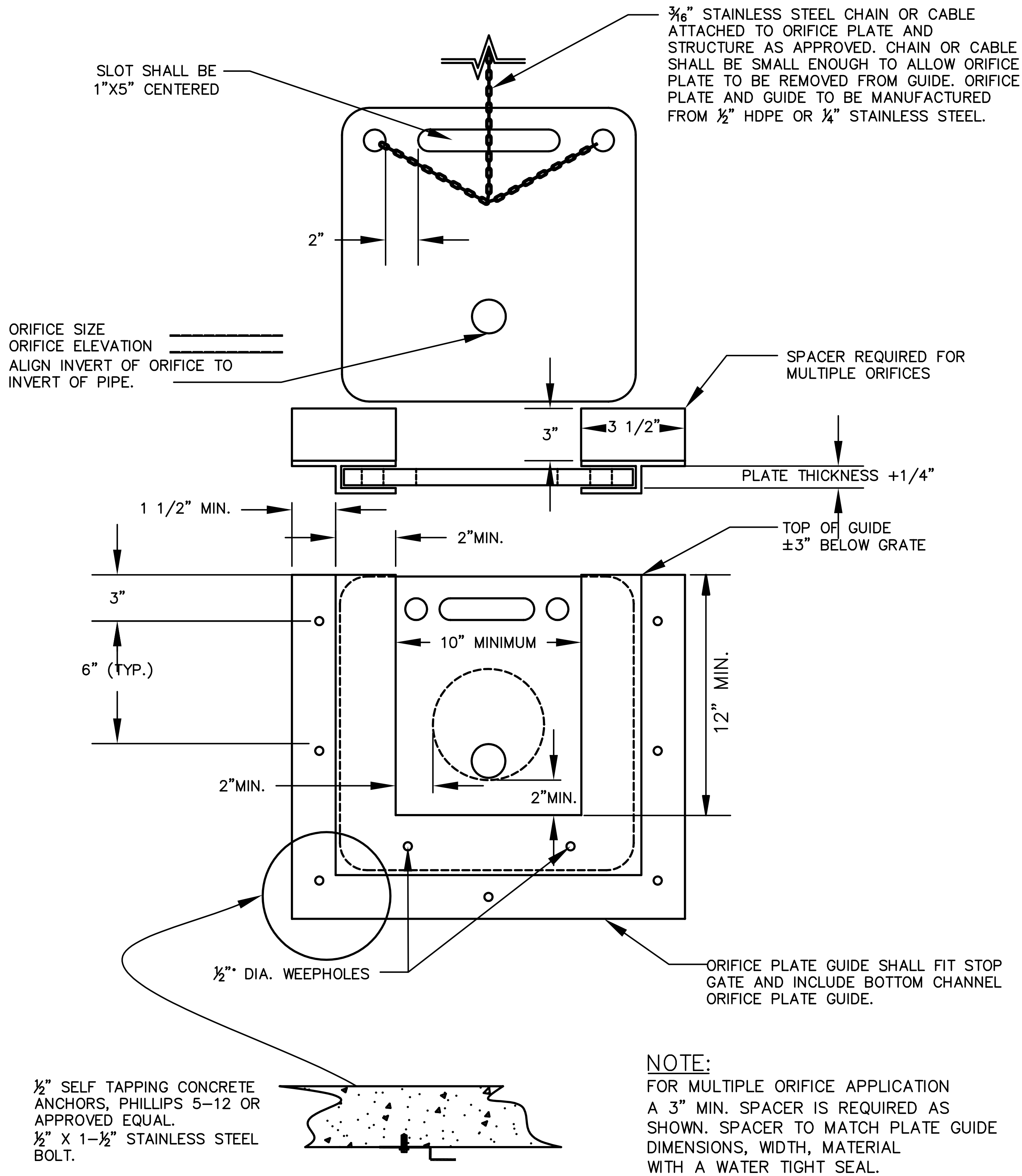
Appendix F


Tualatin Planning Districts
Planning Districts
Commercial Office (CO)
Central Commercial (CC)
General Commercial (CG)
Recreational Commercial (CR)
Medical Commercial (MC)
Light Manufacturing (ML)
General Manufacturing (MG)
Manufacturing Park (MP)
Manufacturing Business Park (MBP)
Low Density Residential (RL)
Medium Low Density Residential
Medium High Density Residential (RMH)
High Density Residential (RH)
High Density/High Rise Residential (RH/HR)
Institutional (IN)
SW Chilkat Ter
SW Miami Dr
SW Eno Pl
SW Iowa Dr
SW Stono Dr
SW Norwood Rd
SW 87th Pl
SW Mandan Dr
SW 84th Ave
SW Boones Ferry Rd
141
SW Greenhill Ln
Pacific Hwy
5
SW 82nd Ave


IN
SW Boones Ferry Rd
141


141
23643
SW Boones Ferry Rd

Appendix G



ORIFICE PLATE AND GUIDE

DRAWING NO. 730

REVISED 12–06

Clean Water Services
our commitment is clear.

FLOW CONTROL STRUCTURE DETAIL

DRAWING NO. 270

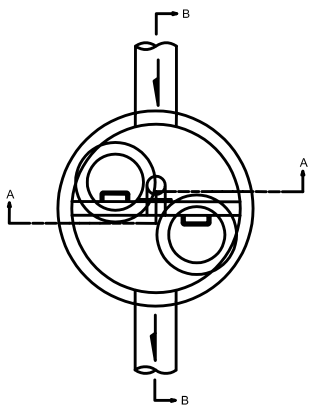
REVISED 12-06

CleanWater Services

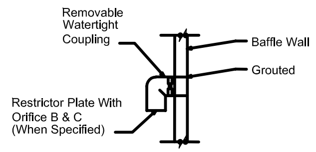
Our commitment is clear.

NOTES:

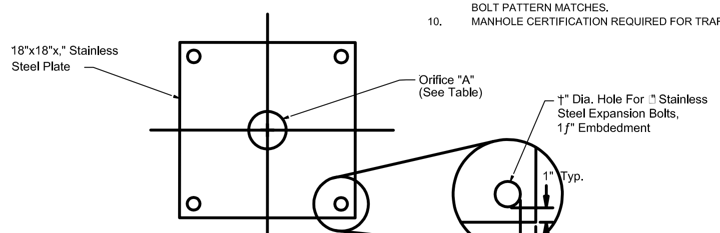
1. BAFFLE WALL SHALL HAVE #4 BAR AT 12" SPACING EACH WAY.
2. PRECAST BAFFLE SHALL BE KEYED AND GROUTED IN PLACE. JOINT BETWEEN CONCRETE BAFFLE AND MANHOLE WALL SHALL BE WATERTIGHT.
3. UPPER FLOW ORIFICE SHALL BE ALUMINUM, ALUMINIZED STEEL OR GALVANIZED STEEL. GALVANIZED STEEL SHALL HAVE TREATMENT 1.
4. FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT: SHEAR GATE IS VISIBLE FROM THE TOP; CLIMB-DOWN SPACE IS CLEAR OF RISER AND GATE; FRAME IS CLEAR OF CURB.
5. MULTI-ORIFICE ELBOWS SHALL BE PREINSTALLED TO INSURE LADDER CLEARANCE.
6. RESTRICTOR PLATE WITH ORIFICE AS SPECIFIED IN THE CONTRACT. OPENING IS TO BE CUT ROUND AND SMOOTH. NEOPRENE GASKET SHALL BE INSTALLED BETWEEN THE ORIFICE PLATE AND CONCRETE BAFFLE TO PROVIDE A WATERTIGHT SEAL.
7. SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCRDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION Zg32A 0R CAST IRON IN ACCORDANCE WITHASTM A 48, CLASS 30B. LIFT HANDLE MAY BE SOLID ROD OR HOLLOW TUBING WITH ADJUSTABLE HOOK AS REQUIRED. NEOPRENE RUBBER GASKET REROUIRED BETWEEN RISER MOUNTING FLANGE AND GATE FLANGE. MATING SURFACES OF LID AND BODY SHALL BE MACHINED FOR PROPER FIT. FLANGE MOUNTING BOLTS SHALL BE....."DIAMETER STAINLESS STEEL.
8. SHEAR GATE MAXIMUM OPENING SHALL BE CONTROLLED BY LIMITED HINGE MOVEMENT, STOP TAB OR SOME OTHER DEVISE.
9. ALTERNATE SHEAR GATES DESIGNS AREACCEPTABLE, IF MATERIAL SPECIFICATIONS ARE MET AND FLANGE BOLT PATTERN MATCHES.
10. MANHOLE CERTIFICATION REQUIRED FOR TRAFFIC LOADING.



PLAN



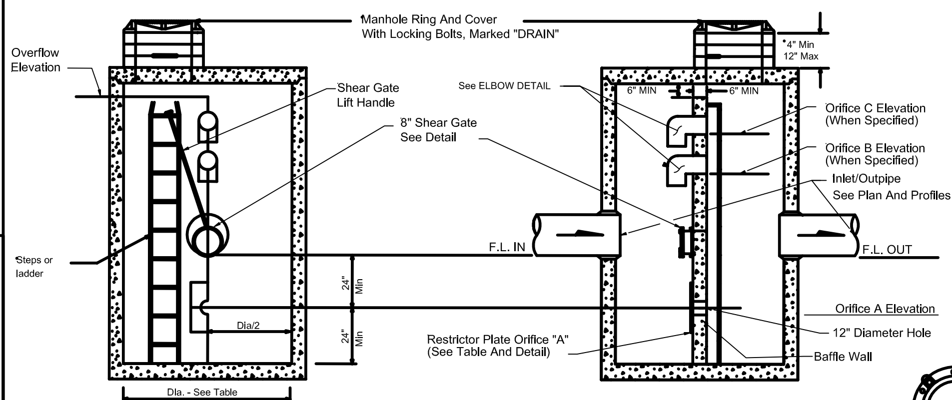
ELBOW DETAIL



RESTRICTOR PLATE, ORIFICE "A"

FLOW CONTROL STRUCTURE TABLE

Diameter Of Manhole (In.)	
F.L. (In)	
F.L. (Out)	
Outlet Pipe Diameter (In.)	
Number Of Orifice	
Orifice A Elevation	
Diameter Of Orifice A (In.)	
Orifice B Elevation	
Diameter Of Orifice B (In.)	
Orifice C Elevation	
Diameter Of Orifice C (In)	
Overflow Elevation	
Rim Elevation	
Riser Diameter (In.)	



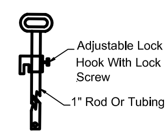
SECTION A-A

ELEVATION

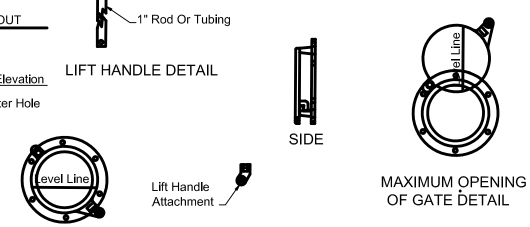
SECTION B-B

FLOW CONTROL STRUCTURE DETAIL

NTS



LIFT HANDLE DETAIL



FRONT

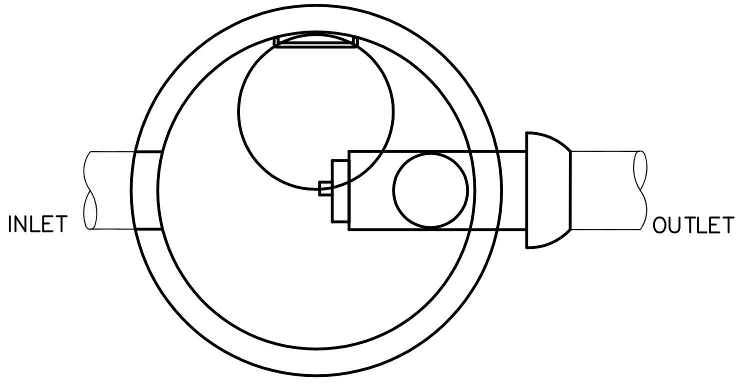
MAXIMUM OPENING OF GATE DETAIL

SHEAR GATE

AS MANUFACTURED BY KENNEDY VALVE OR EQUAL

DRAINAGE DETAILS

2B-2



PLAN

NOTES:
1. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C–478 AND APPLICABLE PROVISIONS OF STD. MANHOLE DRAWING NO. 010
2. INLET AND OUTLET PIPE NOT TO EXCEED 18"DIA.
3. PROVIDE SPECIAL DETAIL FOR OUTLET FLOW CONTROL EXCEEDING 18" DIA.
4. ALL OUTLETS SHALL HAVE FLOW CONTROL DEVICE.

SUMP VOLUME AVAILABLE

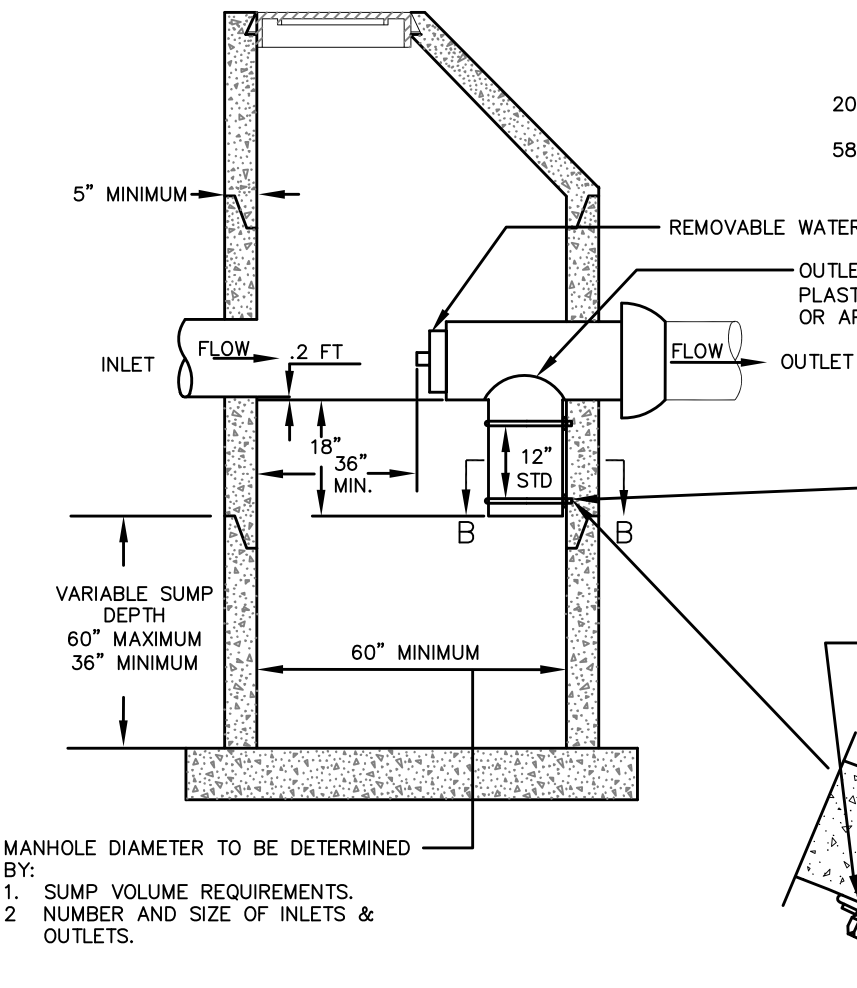
	MINIMUM	MAXIMUM
60" M.H.=	58.9 CF	98.1 CF
72" M.H.=	84.8 CF	141.3 CF
84" M.H.=	115.4 CF	192.3 CF

PROVIDE SPECIAL DETAIL FOR VOLUME REQUIREMENTS EXCEEDING 192.3 CF

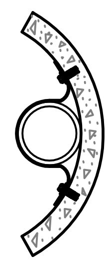
SUMP VOLUME REQUIREMENTS

20 CF/1.0 CFS OF INFLOW

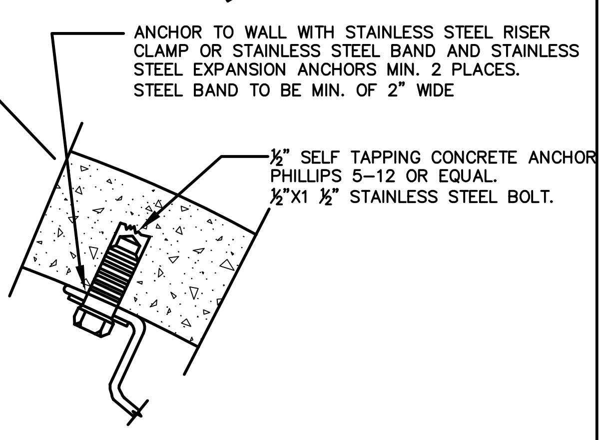
58.9 CF MINIMUM REQUIRED



MANHOLE DIAMETER TO BE DETERMINED BY:
1. SUMP VOLUME REQUIREMENTS.
2 NUMBER AND SIZE OF INLETS & OUTLETS.



SECTION B–B



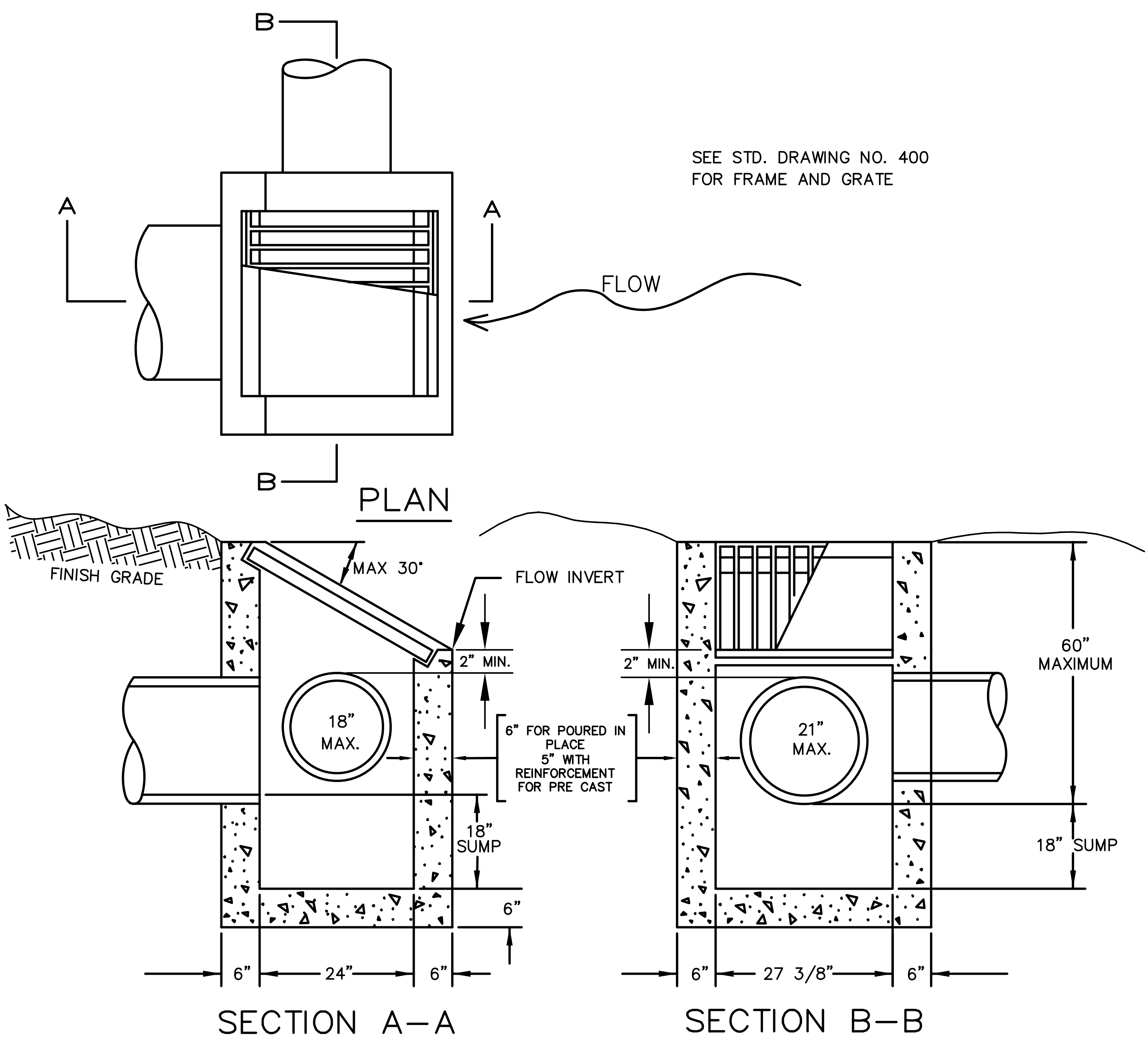
CLAMP DETAIL
(SECTION A–A)
N.T.S.

WATER QUALITY MANHOLE (MECHANICAL)

DRAWING NO. 240

REVISED 12–06

CleanWater Services
Our commitment is clear.



NOTES:

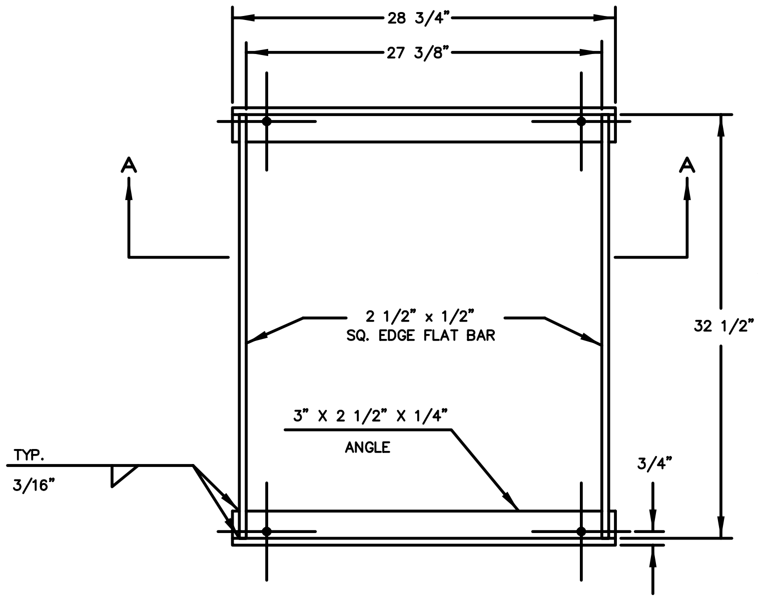
1. ALL PRE CAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
2. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" - 0" COMPACTED BASE MATERIAL.
3. PRE CAST REINFORCEMENT SHALL BE REBAR MEETING ASTM A615 GRADE 60 OR WELDED WIRE MEETING ASTM A497
4. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI AND SLUMP OF 2" TO 4".
5. PRE-CAST STRUCTURE'S CONFORMING TO O.D.O.T. TYPE G-2 CATCH BASIN DESIGN/WITH DITCH INLET TOP ARE AN ACCEPTABLE ALTERNATE. ALL GRATE MATERIALS SHALL MEET C.W.S. STANDARDS AS SHOWN ON DETAIL #400

DITCH INLET

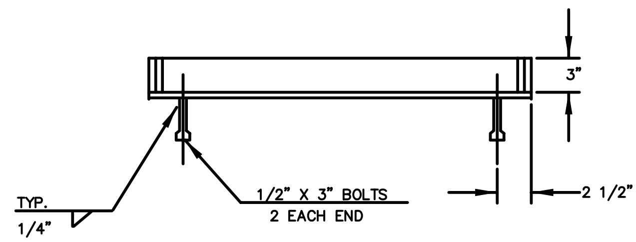
DRAWING NO. 390

REVISED 05-07

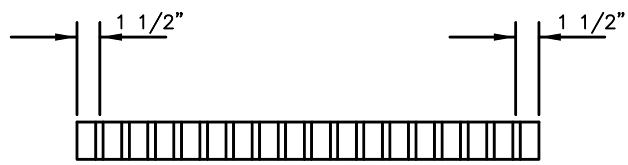
Clean Water Services
Our commitment is clear.



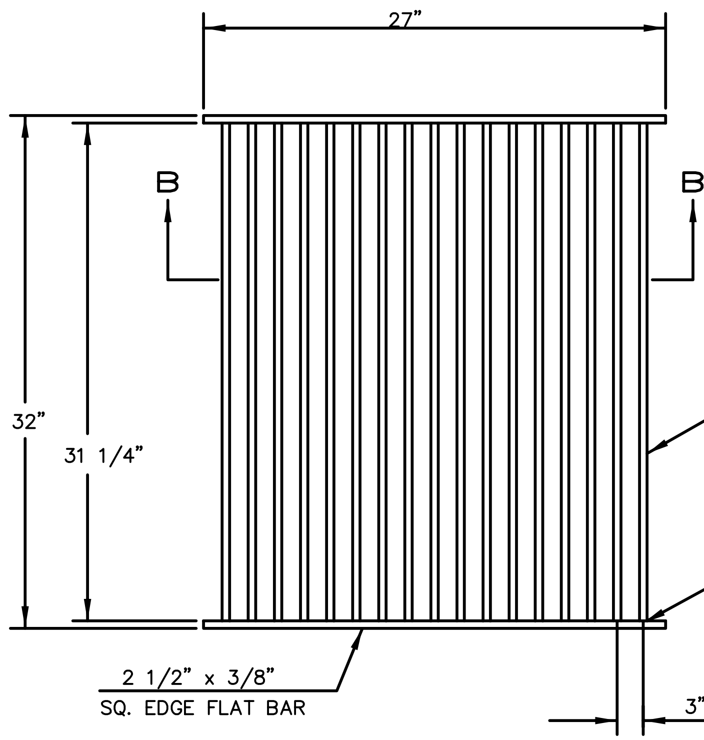
PLAN



SECTION A–A



SECTION B–B



PLAN

NOTE:
FRAME AND GRATE SHALL BE NEW STRUCTURAL ASTM A–36 FLAT BAR STEEL OR APPROVED EQUAL.

DITCH INLET FRAME AND GRATE

DRAWING NO. 400

REVISED 12–06

Clean Water Services
Our commitment is clear.

Appendix H

Summary for Subcatchment 17S: Ex Aux 5

Runoff = 1.17 cfs @ 8.13 hrs, Volume= 0.581 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25yr Rainfall=3.90"

Area (ac)	CN	Description
0.200	98	Paved roads w/curbs & sewers, HSG B
4.000	65	2 acre lots, 12% imp, HSG B
1.600	74	Farmsteads, HSG B
5.800	69	Weighted Average
5.120		88.28% Pervious Area
0.680		11.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0100	0.09		**Sheet Flow, Field** Cultivated: Residue>20% n= 0.170 P2= 2.50"
6.5	500	0.0200	1.27		**Shallow Concentrated Flow, Field** Cultivated Straight Rows Kv= 9.0 fps
0.5	100	0.0400	3.22		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.6	105	0.0400	3.00		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
16.9	755	Total			

From County Storm Drainage Report for SW Boones Ferry Road (Jan 2013), PDF Page 59 of 152.

Table LU_a. ORIGINAL Subbasin Areas with Future Land Use Conditions

Weighted Curve Numbers used in HEC-HMS Hydrologic Modeling for Varying Land Use Cases

Weighted average CN Calculations

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
4.000	65	2 acre lots, 12% imp, HSG B [At 4 acres this is two lots that are 2 acres each.]		
1.600	74	Farmsteads, HSG B	Calibration-Check Washington County (OK)	
5.8	69	Weighted Average		68.6

Ongoing Land Use (LU)

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
2.000	65	2 acre lot, 12% imp, HSG B		
2.000	92	Urban Districts: Commercial and Business		
1.600	74	Farmsteads, HSG B		LU Case CN
5.8	77.9	Weighted Average	Weighted Average CN	77.9

Full Build-out (BO)

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
2.000	85	2 acre lot, 12% imp, HSG B		
2.000	92	Urban Districts: Commercial and Business		
1.600	85	Residential Districts: 1/8 acre		BO Case CN
5.8	87.9	Weighted Average	Weighted Average CN	87.9

Global Summary Results for Run "Lucini_o_17S"

Project: BF_o_Lucini Simulation Run: Lucini_o_17S

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 11:57:36 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S	0.009048	1.17	01Jan3000, 08:06	1.20

Summary Results for Subbasin "Lucini_o_17S"

Project: BF_o_Lucini Simulation Run: Lucini_o_17S
Subbasin: Lucini_o_17S

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 11:57:36 Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

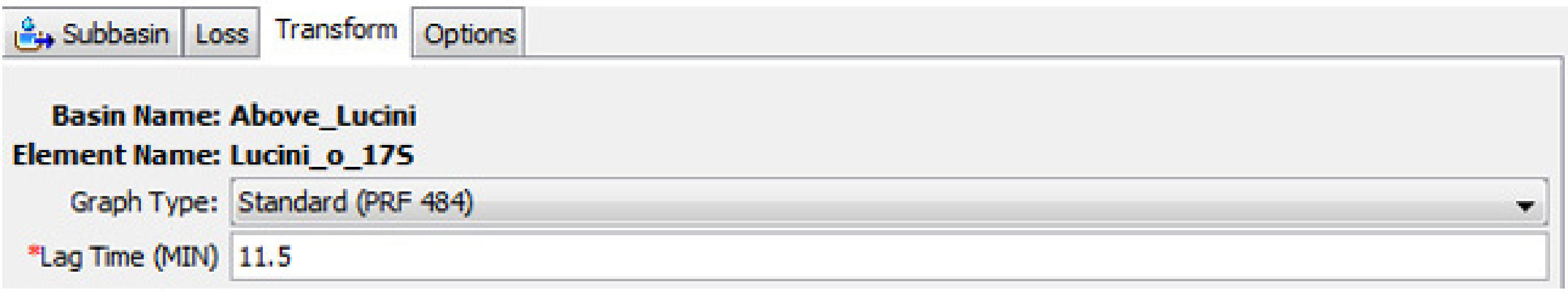
Peak Discharge:	1.17 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:06
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.20 (IN)
Loss Volume:	2.70 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.20 (IN)	Discharge Volume:	1.20 (IN)

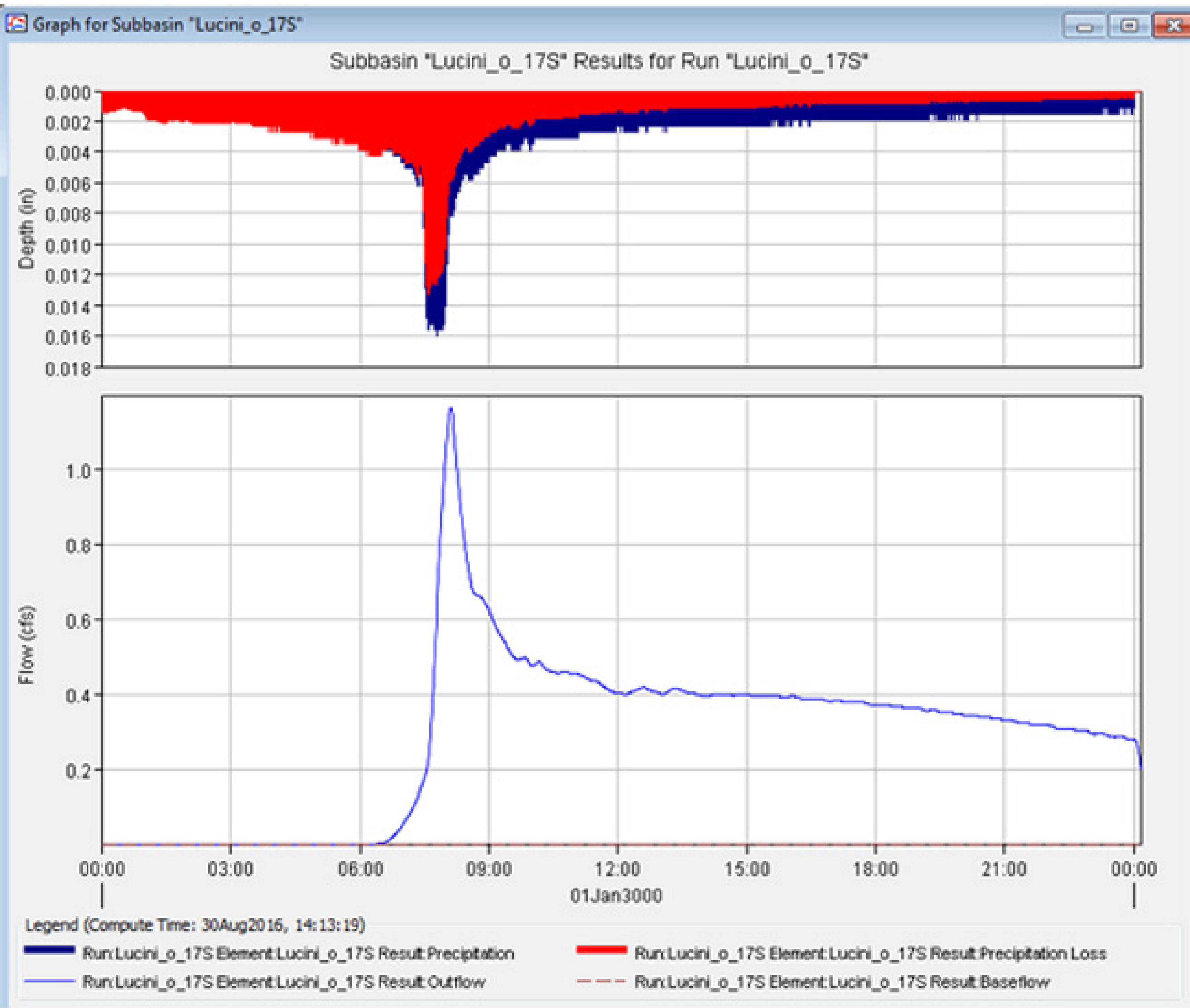
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini
Element Name: Lucini_o_17S

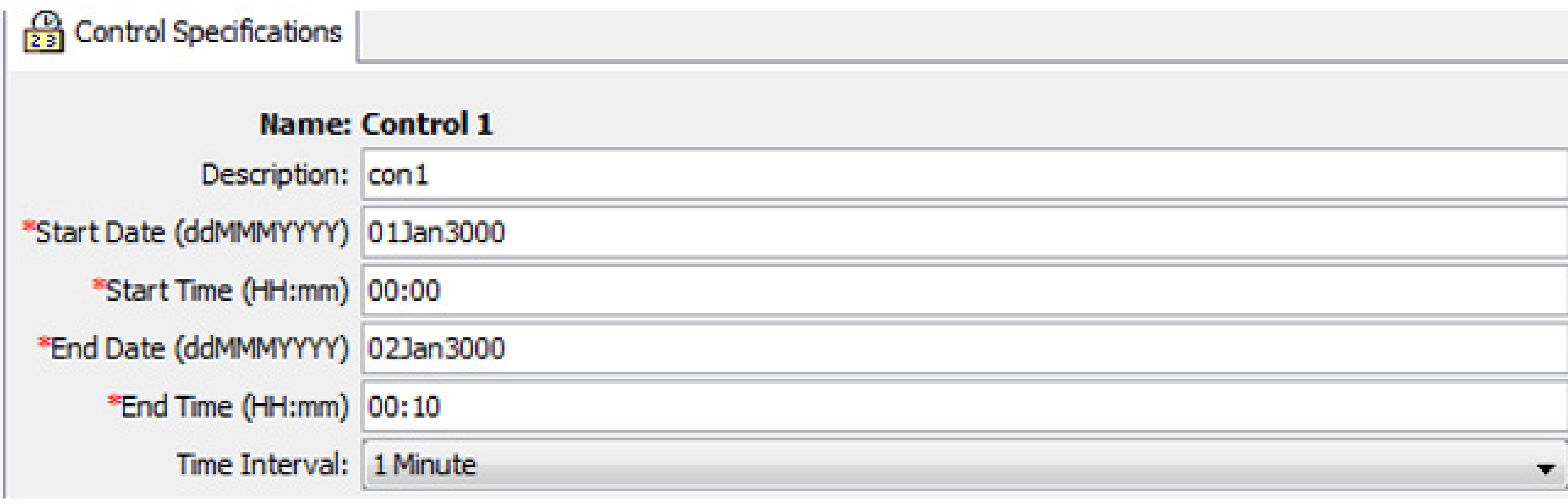
Description:	sub1
Downstream:	--None--
*Area (MI2)	0.009048
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Initial Abstraction (IN)
*Curve Number: 69
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 11.5


Graph for Subbasin "Lucini_o_17S"
Subbasin "Lucini_o_17S" Results for Run "Lucini_o_17S"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
1.0
0.8
0.6
0.4
0.2
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:13:19)
Run:Lucini_o_17S Element:Lucini_o_17S Result:Precipitation
Run:Lucini_o_17S Element:Lucini_o_17S Result:Precipitation Loss
Run:Lucini_o_17S Element:Lucini_o_17S Result:Outflow
Run:Lucini_o_17S Element:Lucini_o_17S Result:Baseflow


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:


Control Specifications
Name: Control 1
Description: con1
*Start Date (ddMMMYYYY) 01Jan3000
*Start Time (HH:mm) 00:00
*End Date (ddMMMYYYY) 02Jan3000
*End Time (HH:mm) 00:10
Time Interval: 1 Minute

Global Summary Results for Run "Lucini_o_17S_base_aa"

Project: BF_o_17S_base_aa   Simulation Run: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:30:08   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S_base_aa	0.00678	0.89	01Jan3000, 08:05	1.20

Summary Results for Subbasin "Lucini_o_17S_base_aa"

Project: BF_o_17S_base_aa   Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:30:08   Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

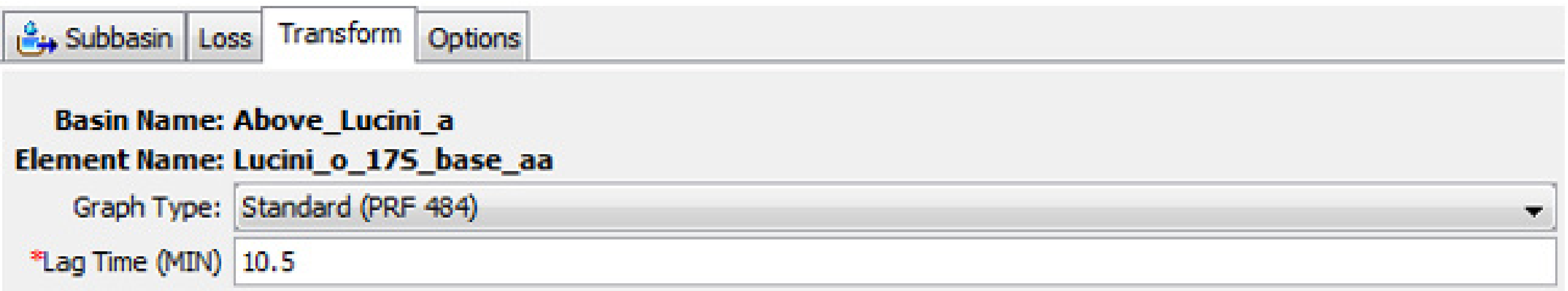
Peak Discharge:	0.89 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:05
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.20 (IN)
Loss Volume:	2.70 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.20 (IN)	Discharge Volume:	1.20 (IN)

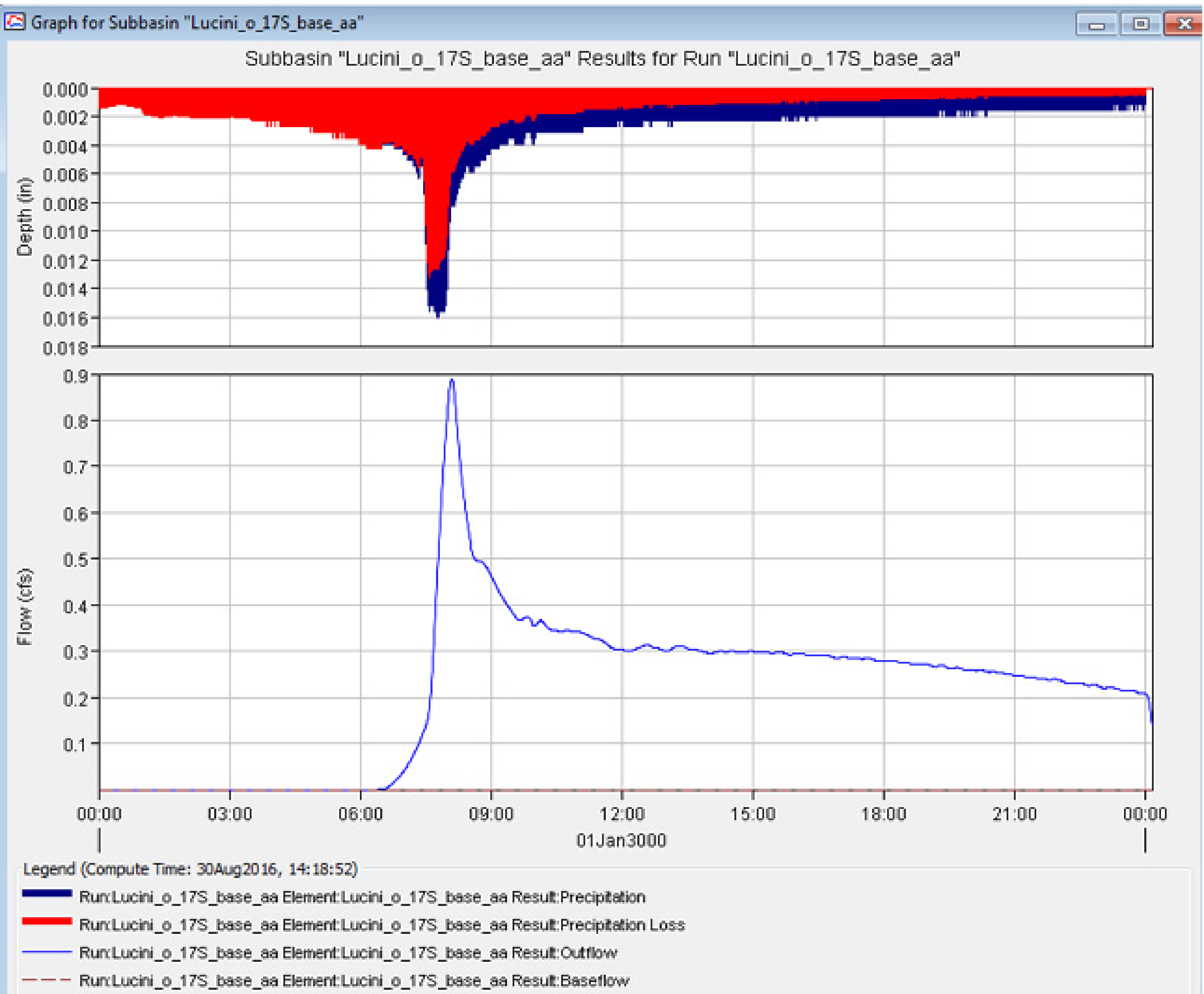
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

Description:	sub1
Downstream:	--None--
*Area (MI2)	0.00678
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Initial Abstraction (IN)
*Curve Number: 69
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "Lucini_o_17S_base_aa"
Subbasin "Lucini_o_17S_base_aa" Results for Run "Lucini_o_17S_base_aa"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:18:52)
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation Loss
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Outflow
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Baseflow

Global Summary Results for Run "Lucini_o_17S_base_aa"

Project: Lucini_o-17S_LU Simulation Run: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 12:56:51

Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S_base_aa	0.006781	1.71	01Jan3000, 08:04	1.80

Summary Results for Subbasin "Lucini_o_17S_base_aa"

Project: Lucini_o-17S_LU Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 12:56:51

Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

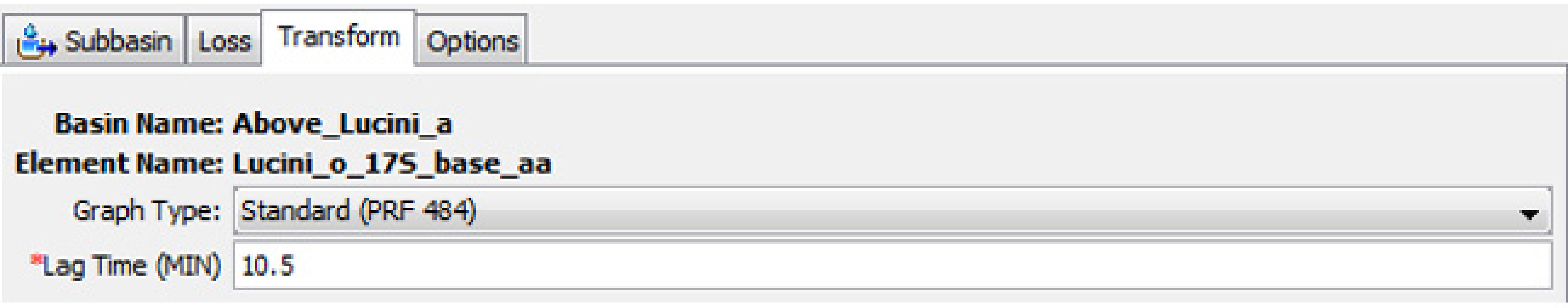
Peak Discharge:	1.71 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:04
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.80 (IN)
Loss Volume:	2.10 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.80 (IN)	Discharge Volume:	1.80 (IN)

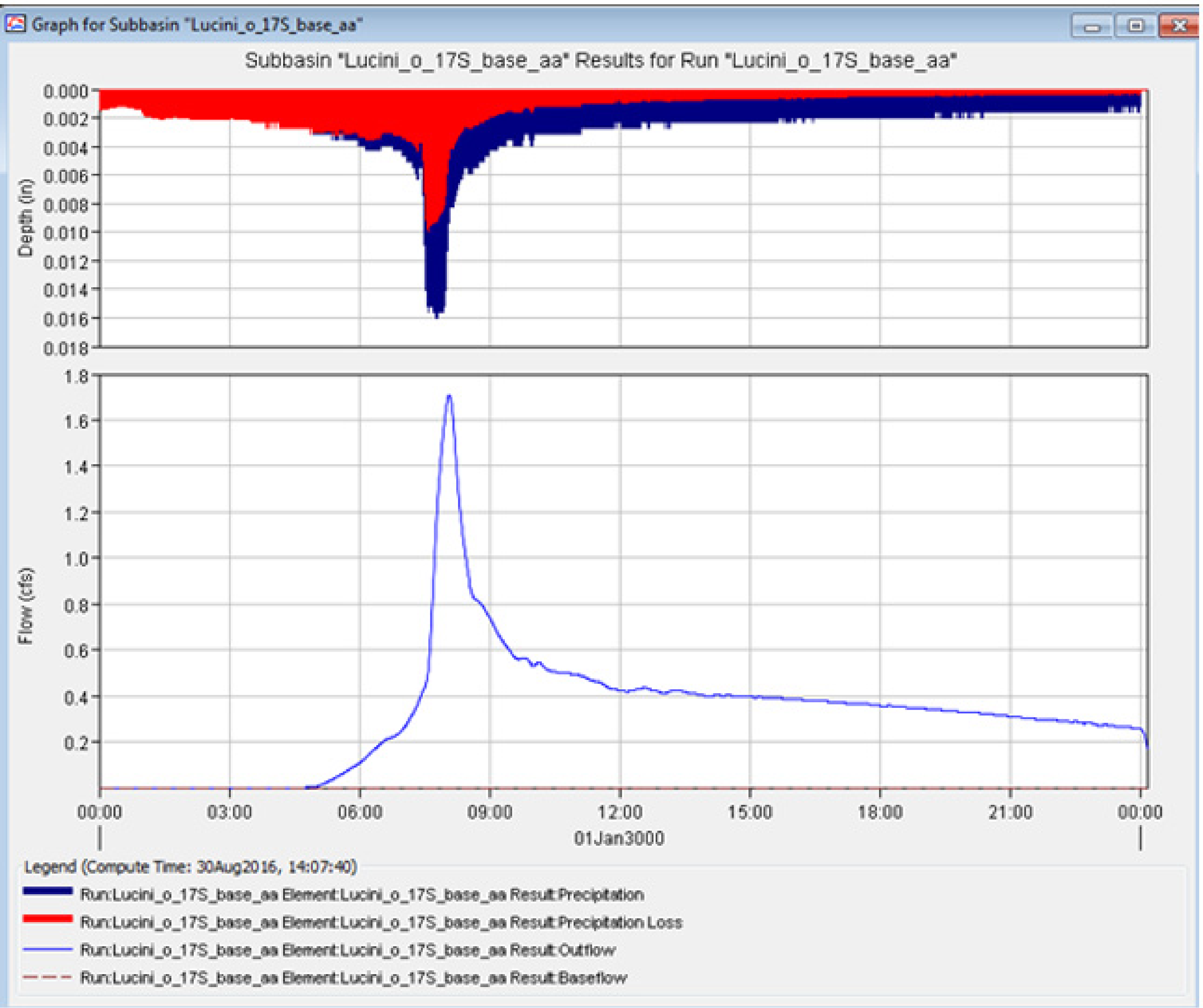
Subbasin | Loss | Transform | Options

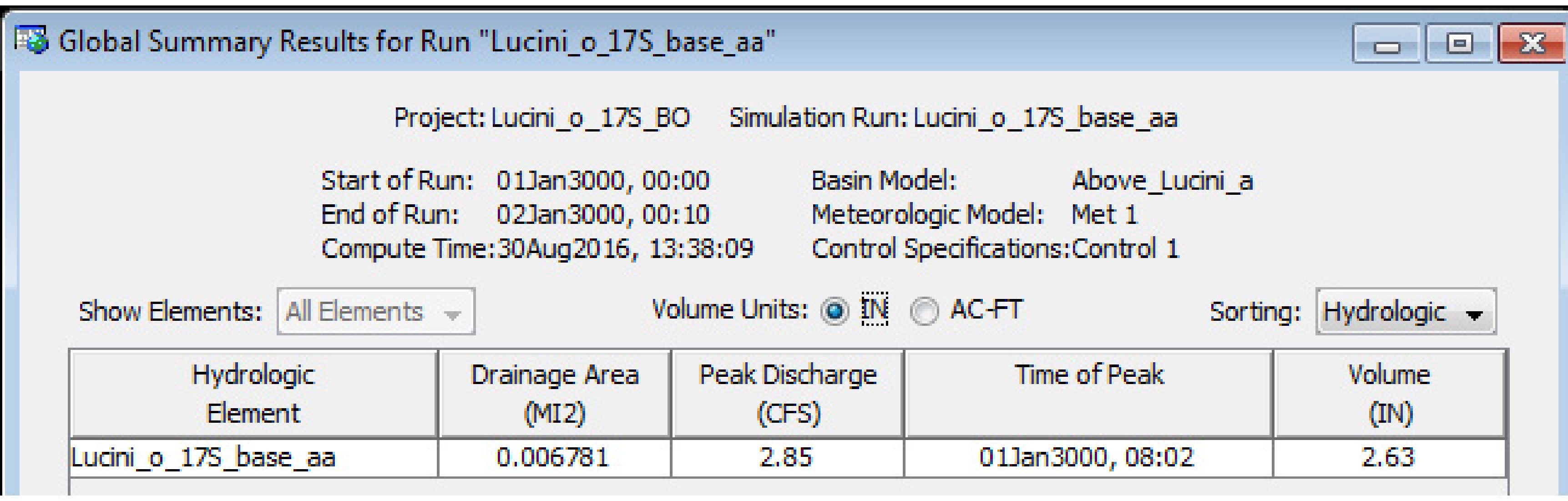
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

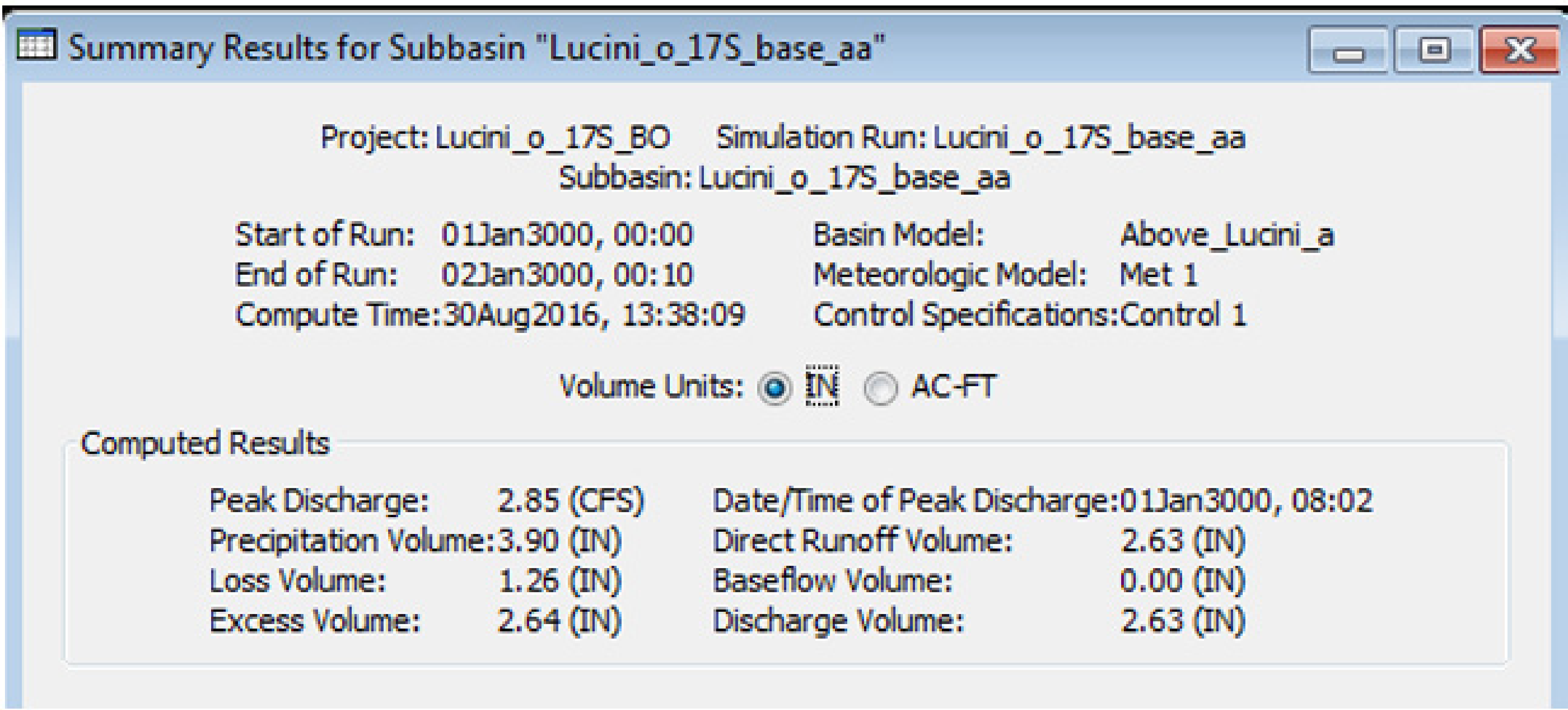
Description:	sub1
Downstream:	--None--
*Area (MI2)	0.006781
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

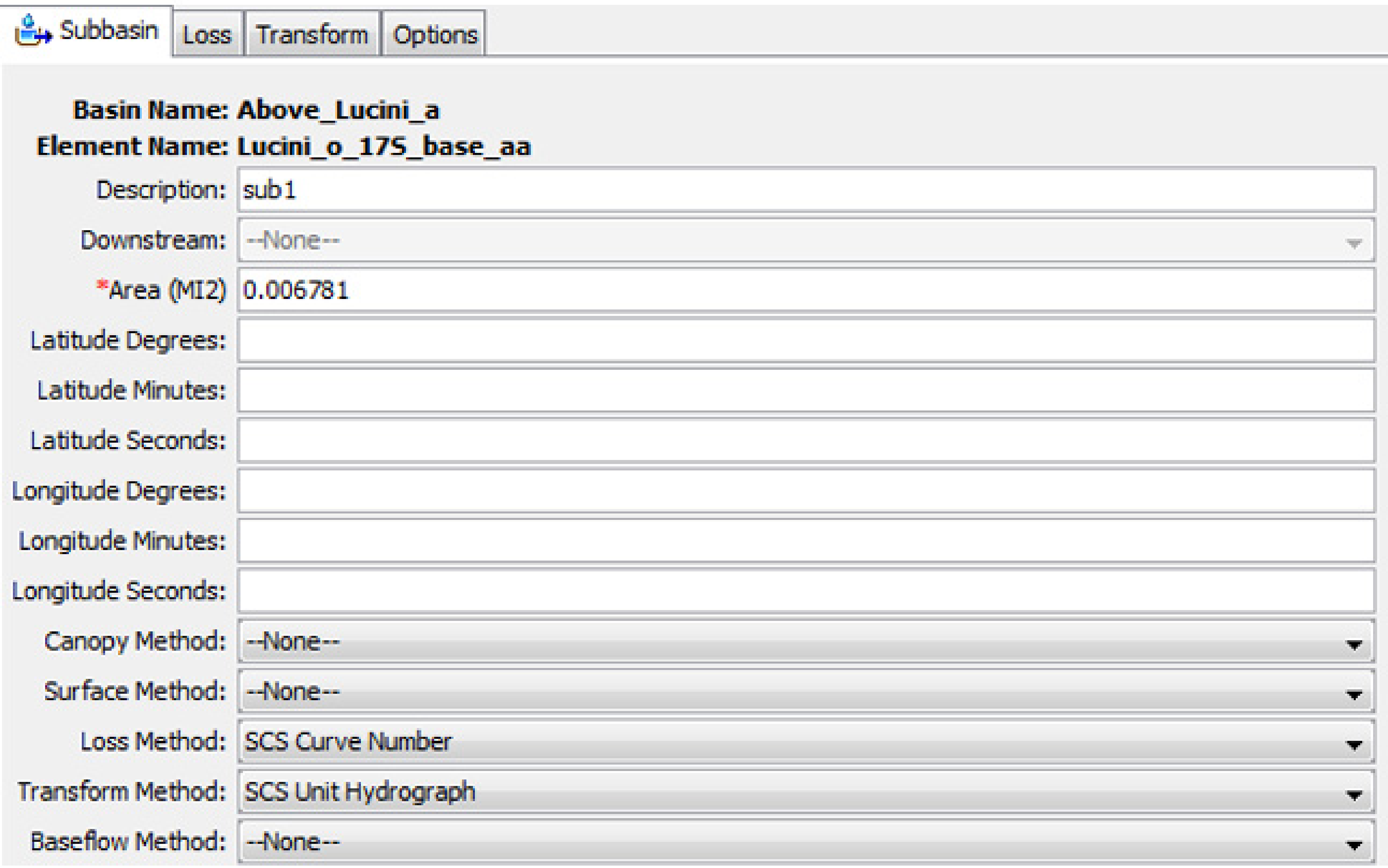

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Initial Abstraction (IN)
*Curve Number: 77.9
*Impervious (%) 0

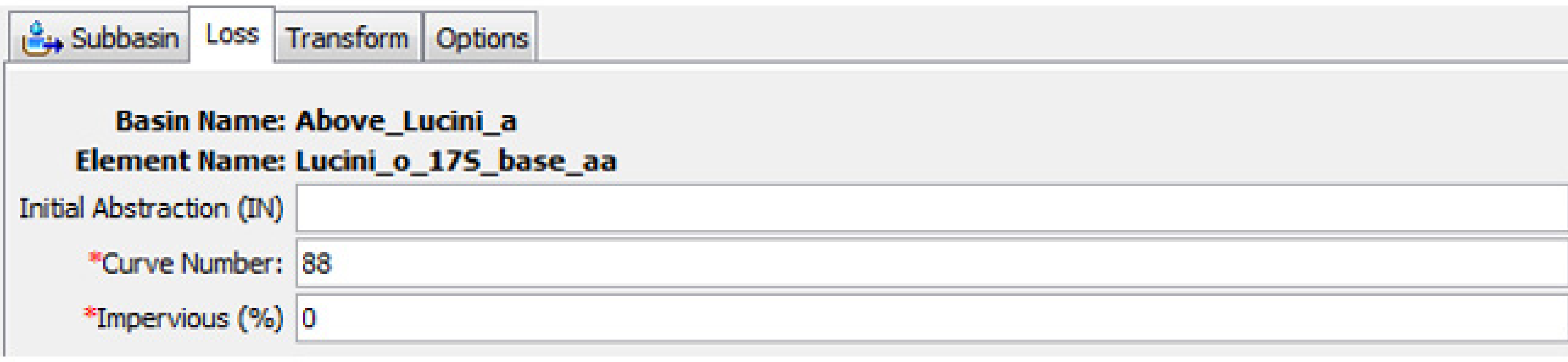

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "Lucini_o_17S_base_aa"
Subbasin "Lucini_o_17S_base_aa" Results for Run "Lucini_o_17S_base_aa"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:07:40)
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation Loss
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Outflow
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Baseflow


Global Summary Results for Run "Lucini_o_17S_base_aa"
Project: Lucini_o_17S_BO Simulation Run: Lucini_o_17S_base_aa
Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 13:38:09
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1
Show Elements: All Elements
Volume Units: IN AC-FT
Sorting: Hydrologic
Hydrologic Element
Drainage Area (MI2)
Peak Discharge (CFS)
Time of Peak
Volume (IN)
Lucini_o_17S_base_aa
0.006781
2.85
01Jan3000, 08:02
2.63


Summary Results for Subbasin "Lucini_o_17S_base_aa"
Project: Lucini_o_17S_BO Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa
Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 13:38:09
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1
Volume Units: IN AC-FT
Computed Results
Peak Discharge: 2.85 (CFS)
Precipitation Volume: 3.90 (IN)
Loss Volume: 1.26 (IN)
Excess Volume: 2.64 (IN)
Date/Time of Peak Discharge: 01Jan3000, 08:02
Direct Runoff Volume: 2.63 (IN)
Baseflow Volume: 0.00 (IN)
Discharge Volume: 2.63 (IN)

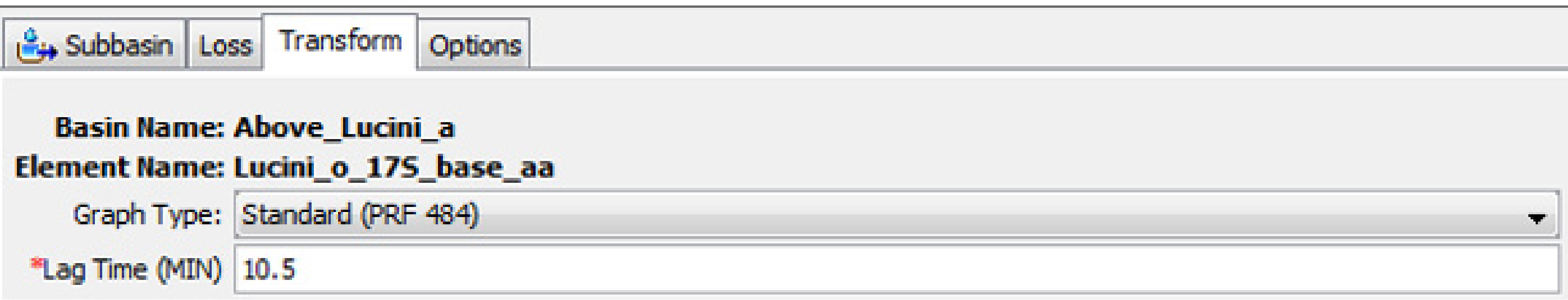

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Description: sub1
Downstream: --None--
*Area (MI2) 0.006781
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--



Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

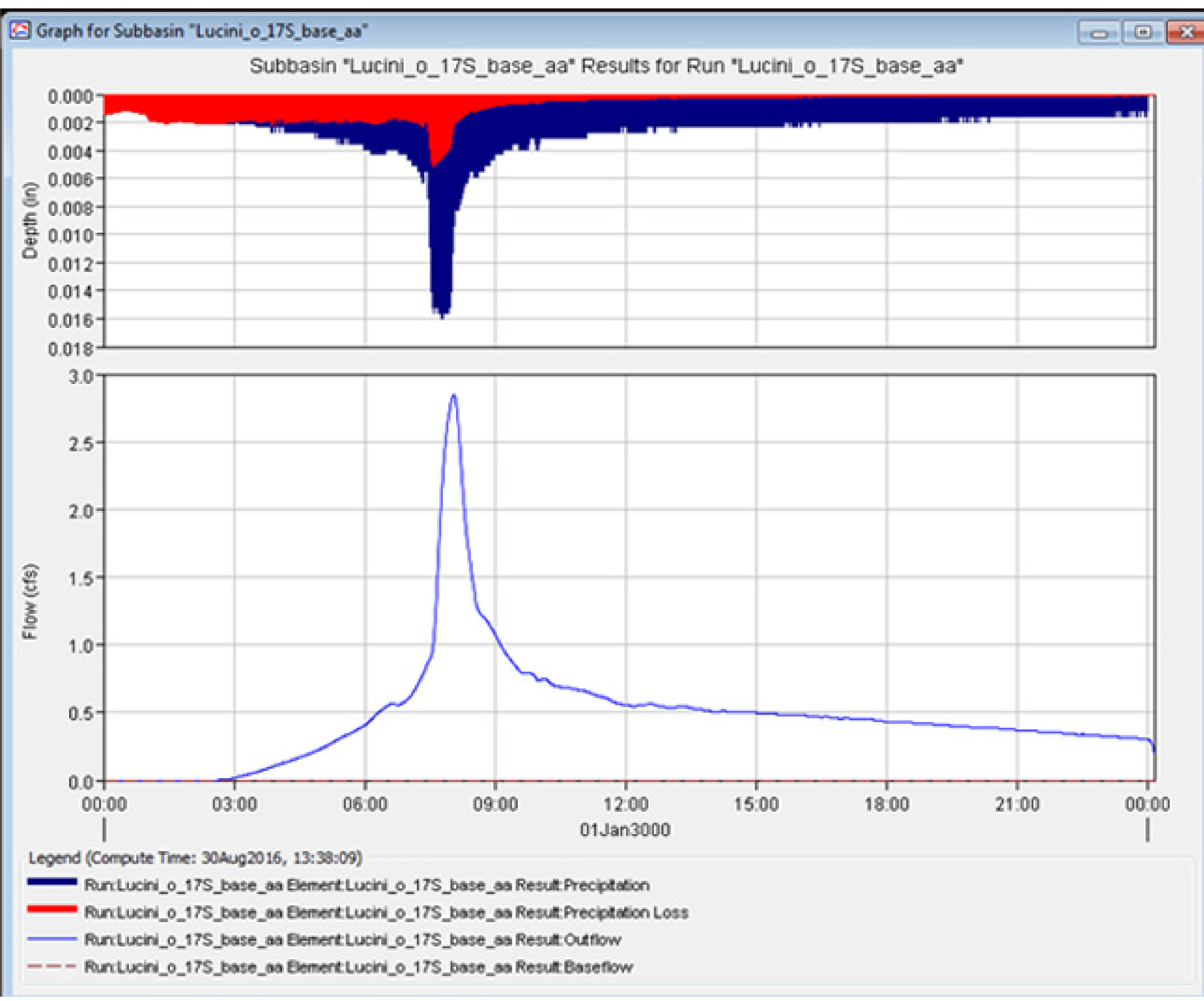
Initial Abstraction (IN):
*Curve Number: 88
*Impervious (%): 0



Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

Graph Type: Standard (PRF 484)
*Lag Time (MIN): 10.5



Summary for Subcatchment 59S: Pro Aux 5

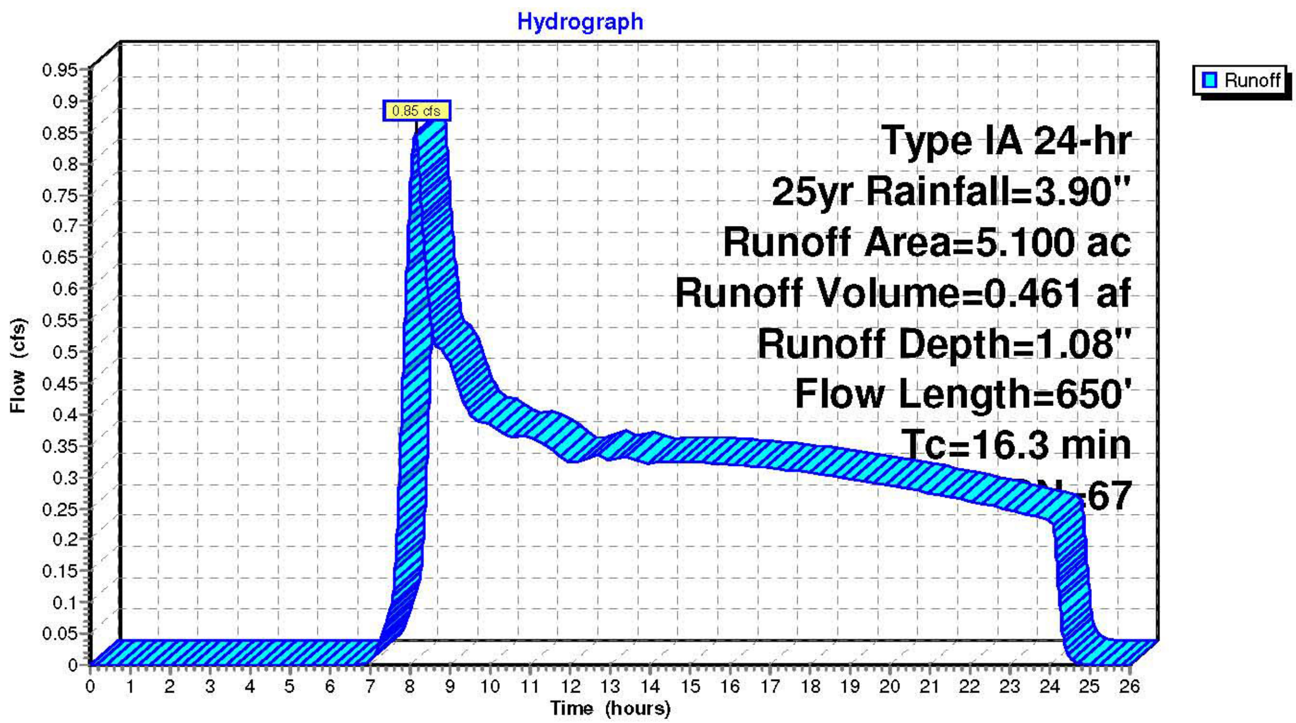
Runoff = 0.85 cfs @ 8.13 hrs, Volume= 0.461 af, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25yr Rainfall=3.90"

Area (ac)	CN	Description
3.800	65	2 acre lots, 12% imp, HSG B
1.300	74	Farmsteads, HSG B
5.100	67	Weighted Average
4.644		91.06% Pervious Area
0.456		8.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0100	0.09		**Sheet Flow, Field** Cultivated: Residue>20% n= 0.170 P2= 2.50"
6.5	500	0.0200	1.27		**Shallow Concentrated Flow, Field** Cultivated Straight Rows Kv= 9.0 fps
0.5	100	0.0400	3.22		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
16.3	650	Total			

Subcatchment 59S: Pro Aux 5



From County Storm Drainage Report for SW Boones Ferry Road (Jan 2013), PDF Page 101 of 152.

Table LU_b. IMPLEMENTED Subbasin Areas with Future Land Use Conditions
Weighted Curve Numbers used in HEC-HMS Hydrologic Modeling for Varying Land Use Cases

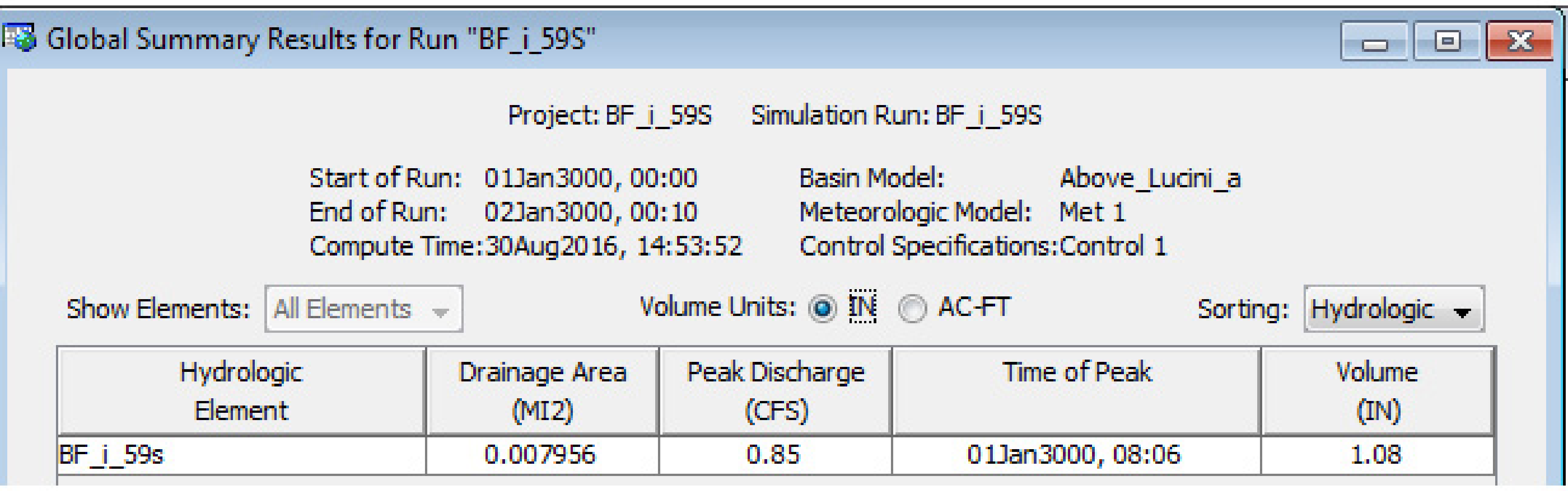
Weighted average CN Calculations

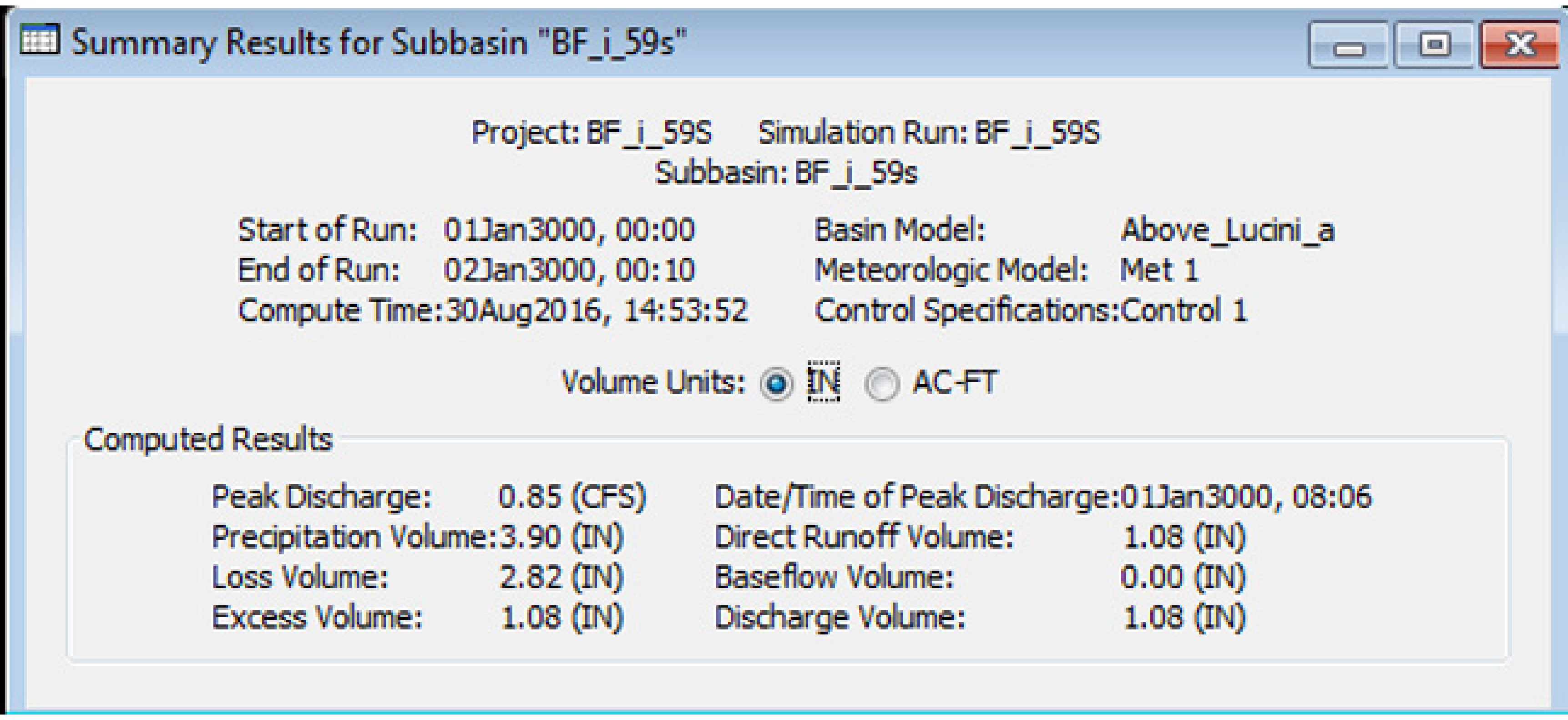
Inplemented On-going Land Use (LU)

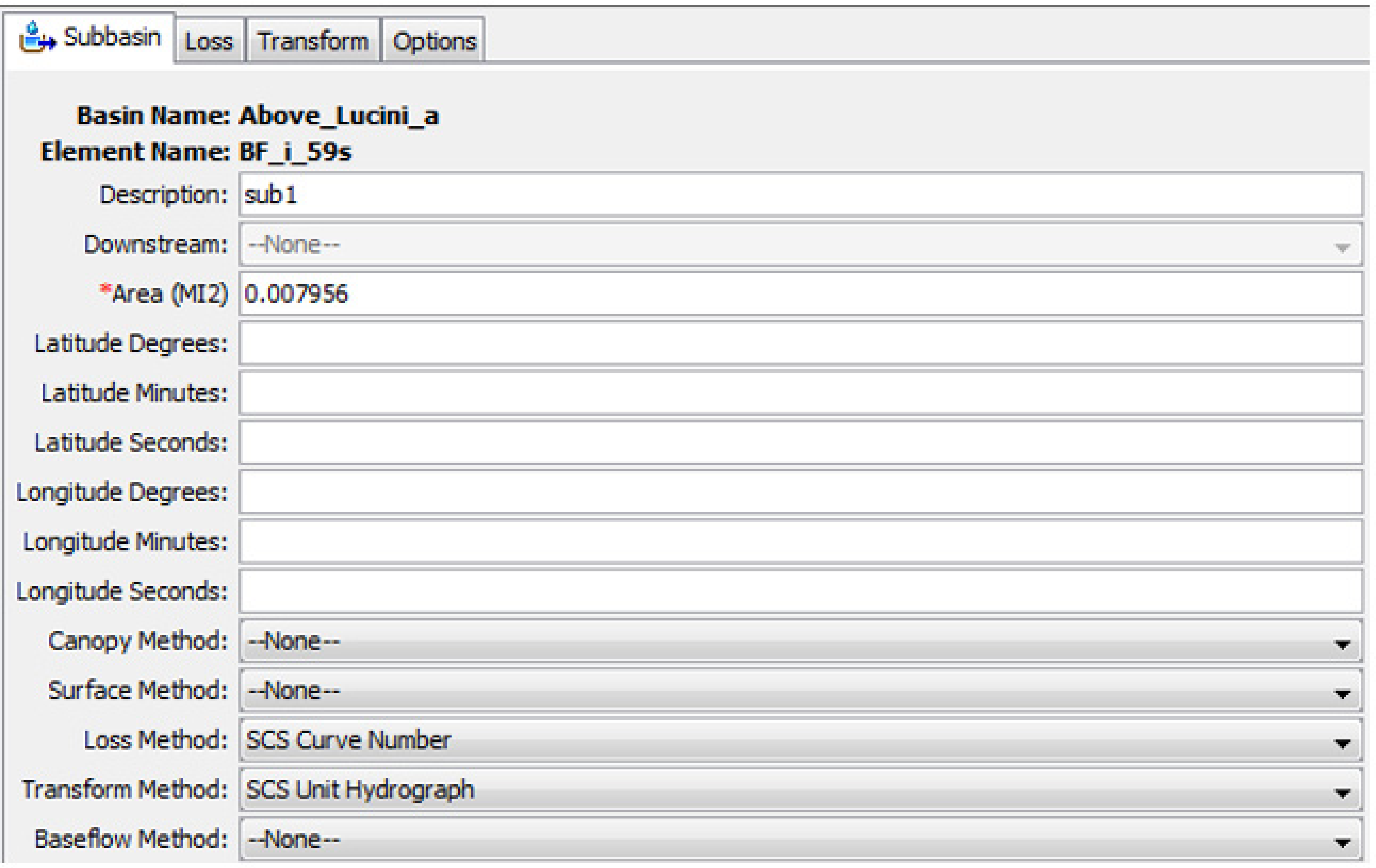
Area (ac)	CN	Description		
1.9	65	2 acre lot, 12% imp., HSG B		
1.9	92	Urban Districts: Commercial and Business		
1.3	74	Farmsteads, HSG B		LU Case CN
5.1	77.4	Weighted Average	Weighted Average CN	77.4

Implemented, Full Build-out (BO)

Area (ac)	CN	Description		
1.9	85	2 acre lot, 12% imp., HSG B		
1.9	92	Urban Districts: Commercial and Business		
1.3	85	Residential Districts: 1/8 acre		BO Case CN
5.1	87.6	Weighted Average	Weighted Average CN	87.6


Global Summary Results for Run "BF_i_59S"
Project: BF_i_59S Simulation Run: BF_i_59S
Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time:30Aug2016, 14:53:52
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications:Control 1
Show Elements: All Elements
Volume Units: IN AC-FT
Sorting: Hydrologic
Hydrologic Element
Drainage Area (MI2)
Peak Discharge (CFS)
Time of Peak
Volume (IN)
BF_i_59s
0.007956
0.85
01Jan3000, 08:06
1.08


Summary Results for Subbasin "BF_i_59s"
Project: BF_i_59S Simulation Run: BF_i_59S
Subbasin: BF_i_59s
Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time:30Aug2016, 14:53:52
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications:Control 1
Volume Units: IN AC-FT
Computed Results
Peak Discharge: 0.85 (CFS)
Precipitation Volume:3.90 (IN)
Loss Volume: 2.82 (IN)
Excess Volume: 1.08 (IN)
Date/Time of Peak Discharge:01Jan3000, 08:06
Direct Runoff Volume: 1.08 (IN)
Baseflow Volume: 0.00 (IN)
Discharge Volume: 1.08 (IN)


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Description: sub1
Downstream: --None--
*Area (MI2) 0.007956
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--

Subbasin | **Loss** | Transform | Options

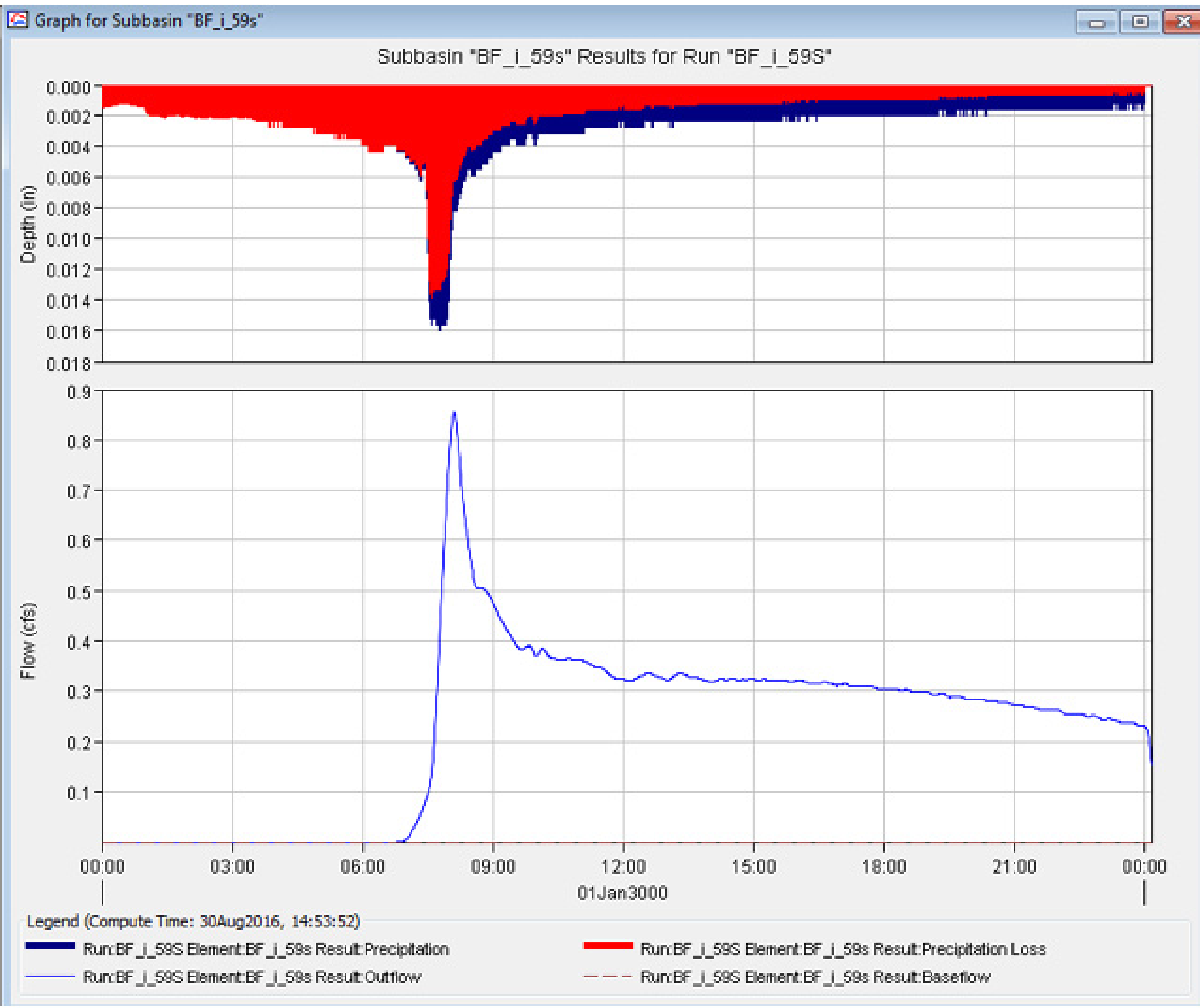
Basin Name: Above_Lucini_a
Element Name: BF_i_59s

Initial Abstraction (IN)	
*Curve Number:	67
*Impervious (%)	0

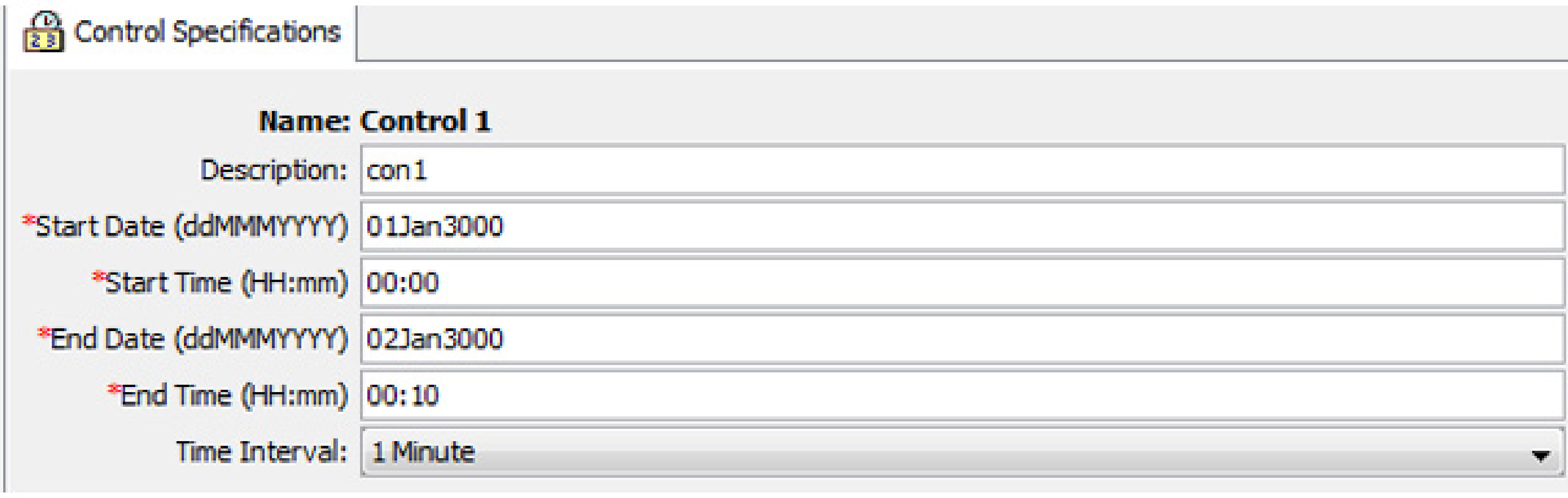
Subbasin | Loss | **Transform** | Options

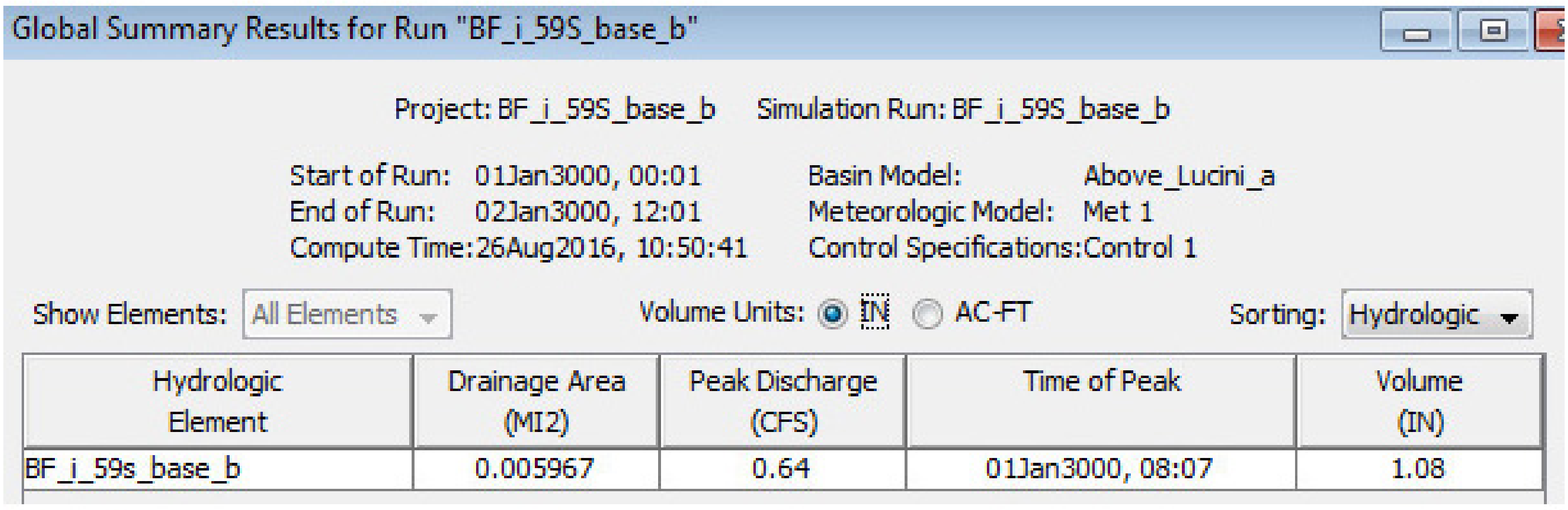
Basin Name: Above_Lucini_a
Element Name: BF_i_59s

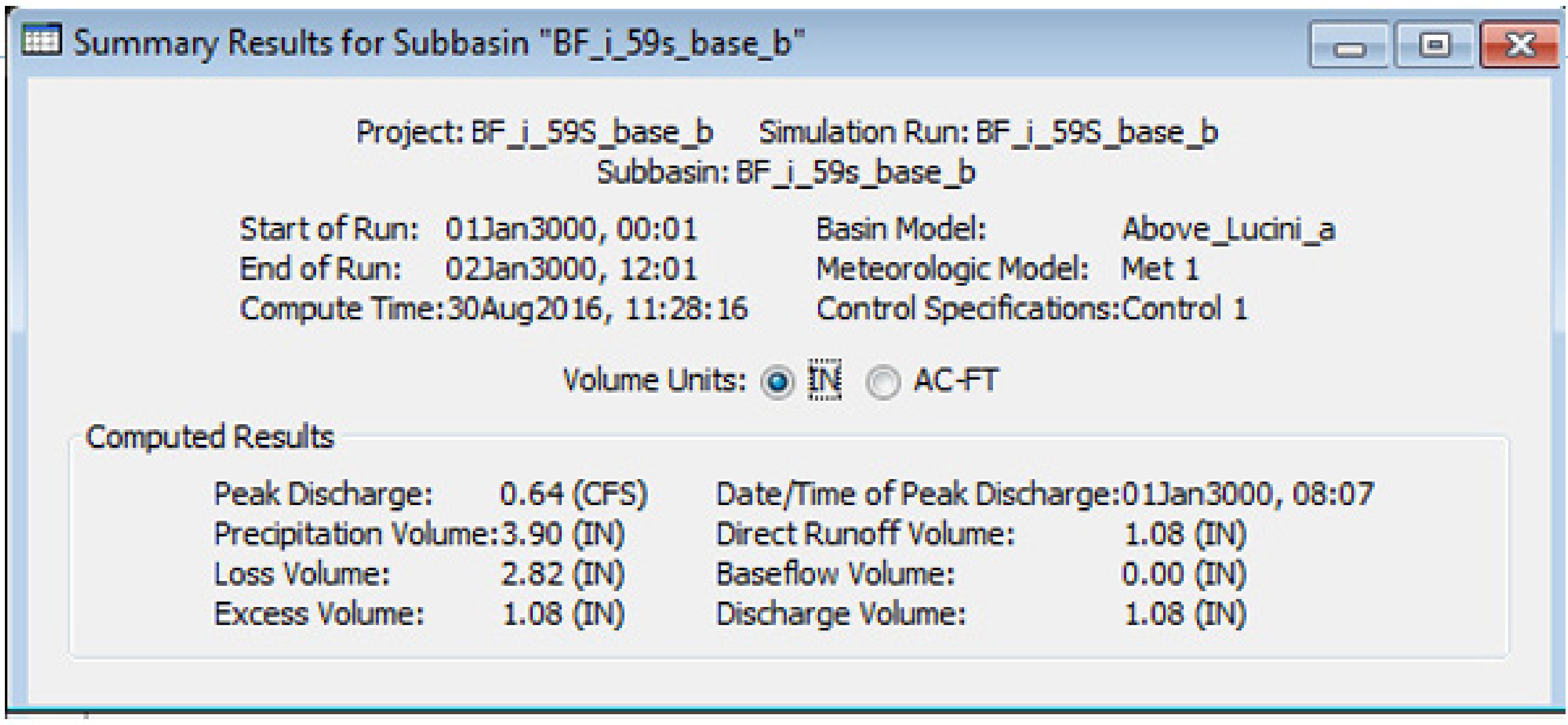
Graph Type:	Standard (PRF 484)
*Lag Time (MIN)	10.5

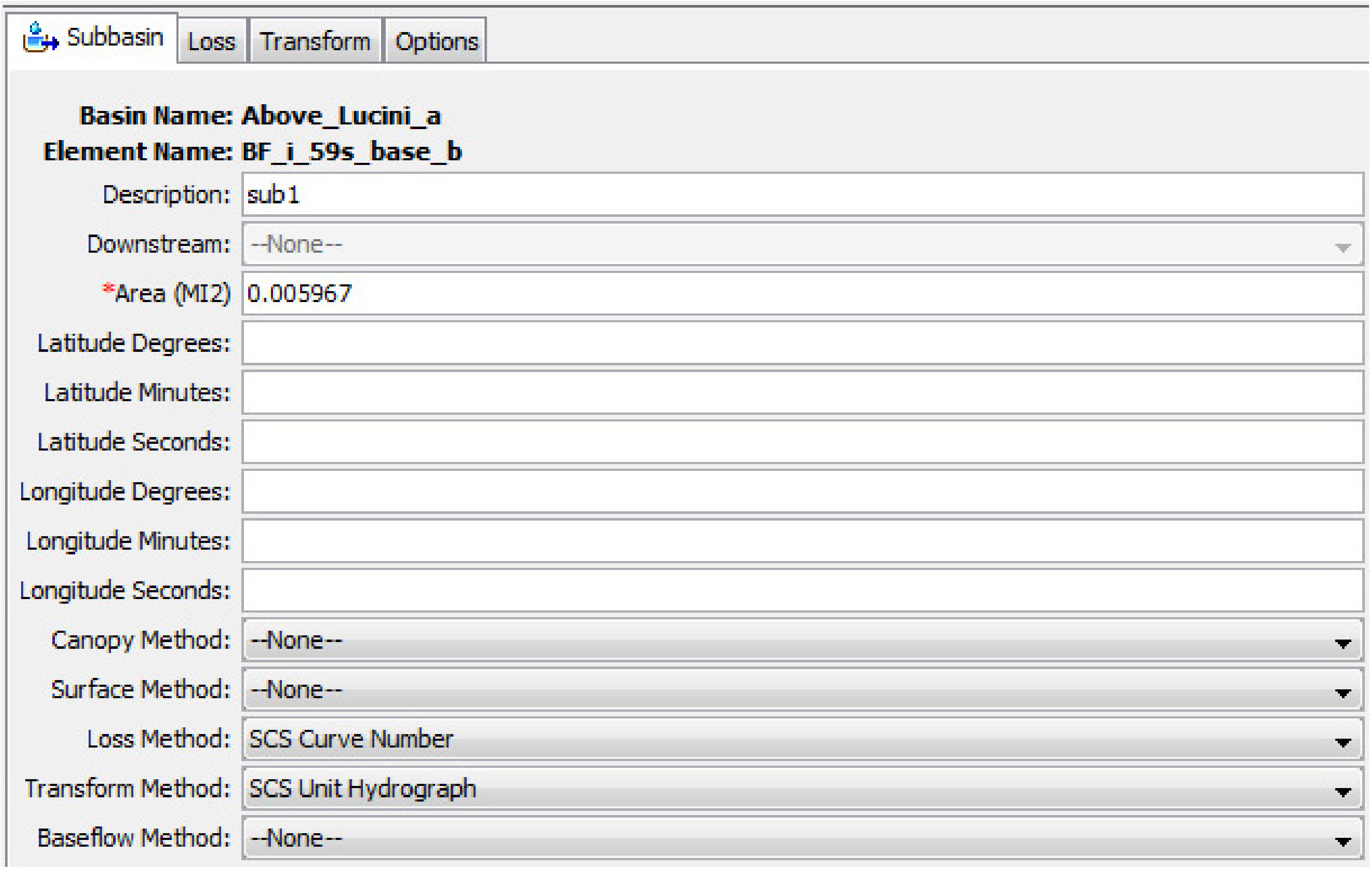



Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:

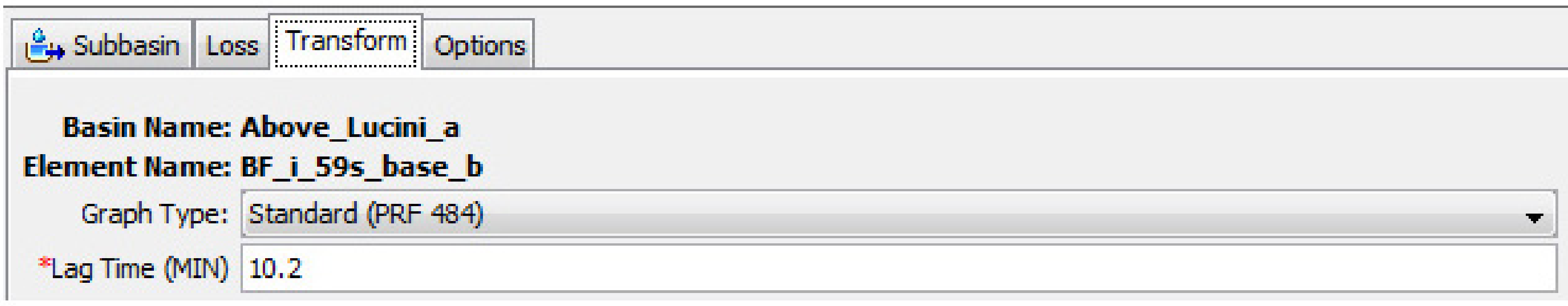

Control Specifications
Name: Control 1
Description: con1
*Start Date (ddMMMYYYY) 01Jan3000
*Start Time (HH:mm) 00:00
*End Date (ddMMMYYYY) 02Jan3000
*End Time (HH:mm) 00:10
Time Interval: 1 Minute

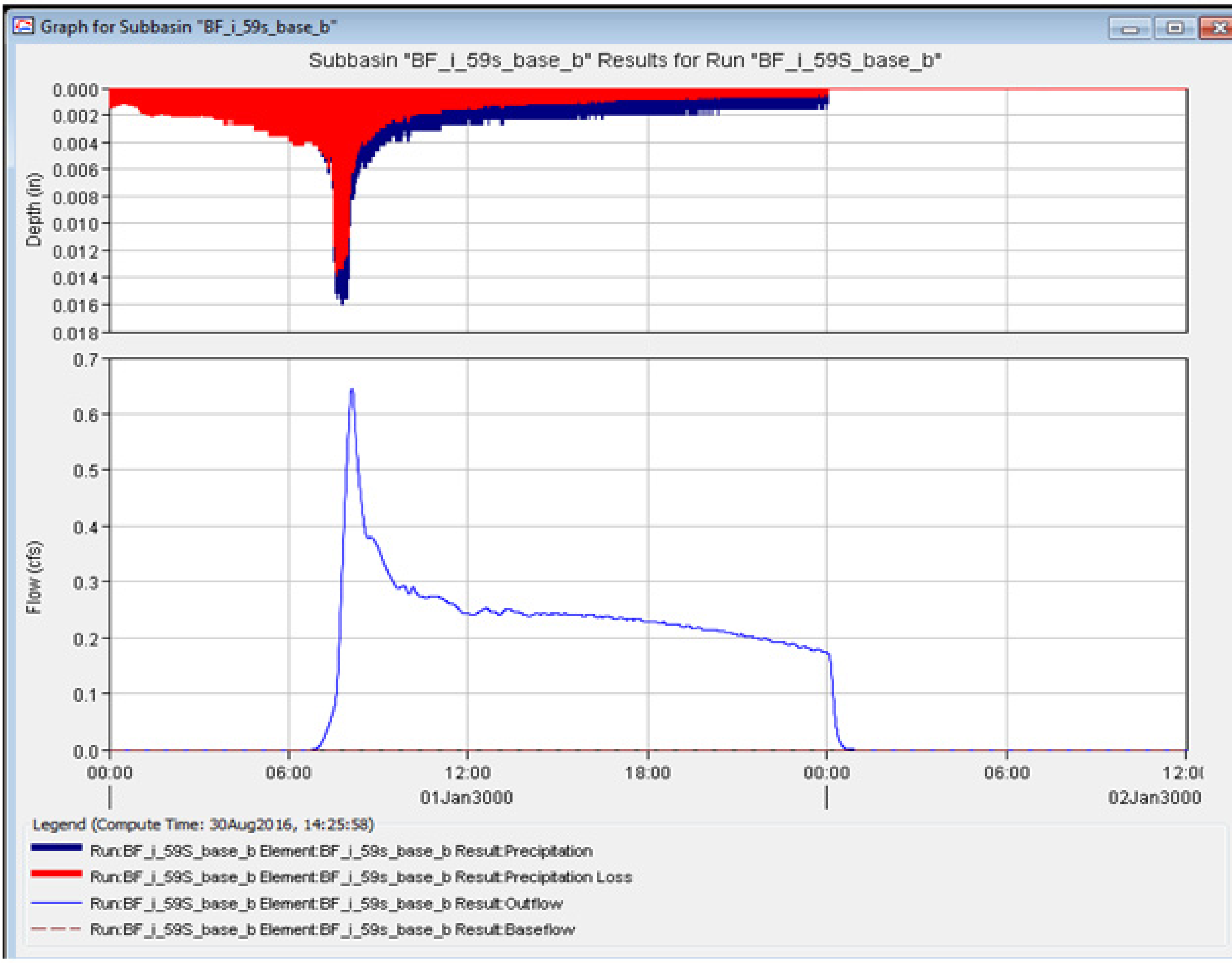

Global Summary Results for Run "BF_i_59S_base_b"
Project: BF_i_59S_base_b Simulation Run: BF_i_59S_base_b
Start of Run: 01Jan3000, 00:01
End of Run: 02Jan3000, 12:01
Compute Time:26Aug2016, 10:50:41
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications:Control 1
Show Elements: All Elements
Volume Units: IN AC-FT
Sorting: Hydrologic
Hydrologic Element
Drainage Area (MI2)
Peak Discharge (CFS)
Time of Peak
Volume (IN)
BF_i_59s_base_b
0.005967
0.64
01Jan3000, 08:07
1.08


Summary Results for Subbasin "BF_i_59s_base_b"
Project: BF_i_59S_base_b Simulation Run: BF_i_59S_base_b
Subbasin: BF_i_59s_base_b
Start of Run: 01Jan3000, 00:01
End of Run: 02Jan3000, 12:01
Compute Time:30Aug2016, 11:28:16
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications:Control 1
Volume Units: IN AC-FT
Computed Results
Peak Discharge: 0.64 (CFS)
Precipitation Volume:3.90 (IN)
Loss Volume: 2.82 (IN)
Excess Volume: 1.08 (IN)
Date/Time of Peak Discharge:01Jan3000, 08:07
Direct Runoff Volume: 1.08 (IN)
Baseflow Volume: 0.00 (IN)
Discharge Volume: 1.08 (IN)


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b
Description: sub1
Downstream: --None--
*Area (MI2) 0.005967
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b
Initial Abstraction (IN)
*Curve Number: 67
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.2


Graph for Subbasin "BF_i_59s_base_b"
Subbasin "BF_i_59s_base_b" Results for Run "BF_i_59S_base_b"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
00:00
06:00
12:00
18:00
00:00
06:00
01Jan3000
02Jan3000
Legend (Compute Time: 30Aug2016, 14:25:58)
Run:BF_i_59S_base_b Element:BF_i_59s_base_b Result:Precipitation
Run:BF_i_59S_base_b Element:BF_i_59s_base_b Result:Precipitation Loss
Run:BF_i_59S_base_b Element:BF_i_59s_base_b Result:Outflow
Run:BF_i_59S_base_b Element:BF_i_59s_base_b Result:Baseflow

Global Summary Results for Run "BF_i_59S"

Project: BF_i_59S_all_lu Simulation Run: BF_i_59S

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 15:56:48

Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
BF_i_59s	0.007956	1.95	01Jan3000, 08:04	1.76

Summary Results for Subbasin "BF_i_59s"

Project: BF_i_59S_all_lu Simulation Run: BF_i_59S
Subbasin: BF_i_59s

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 15:56:48

Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

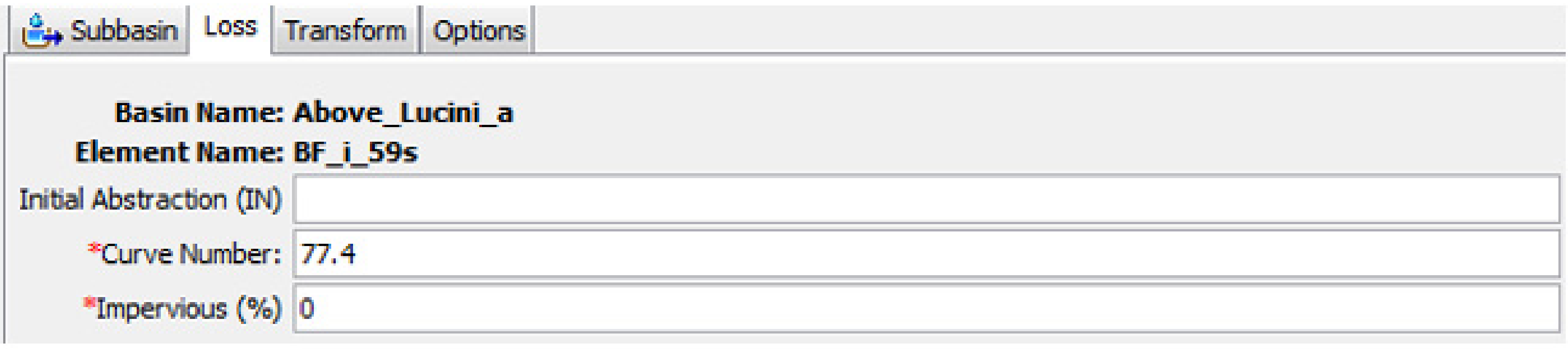
Peak Discharge: 1.95 (CFS)
Precipitation Volume: 3.90 (IN)
Loss Volume: 2.14 (IN)
Excess Volume: 1.76 (IN)

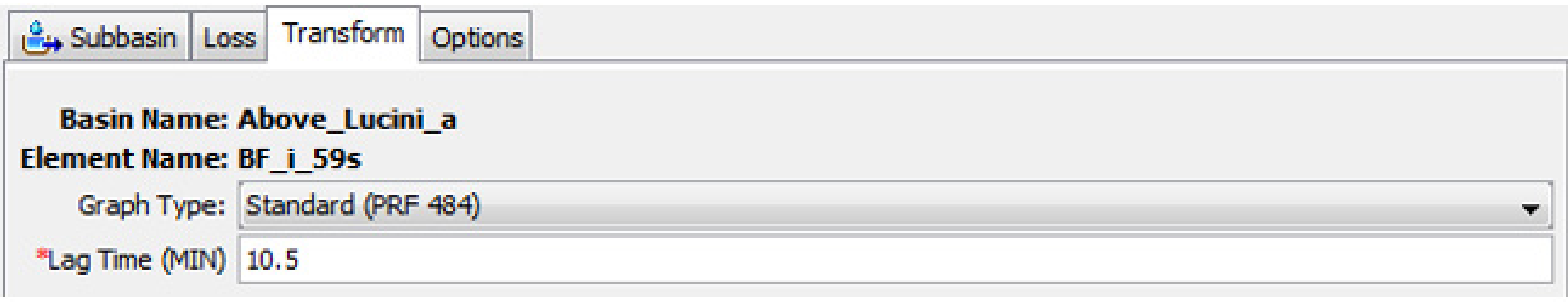
Date/Time of Peak Discharge: 01Jan3000, 08:04
Direct Runoff Volume: 1.76 (IN)
Baseflow Volume: 0.00 (IN)
Discharge Volume: 1.76 (IN)

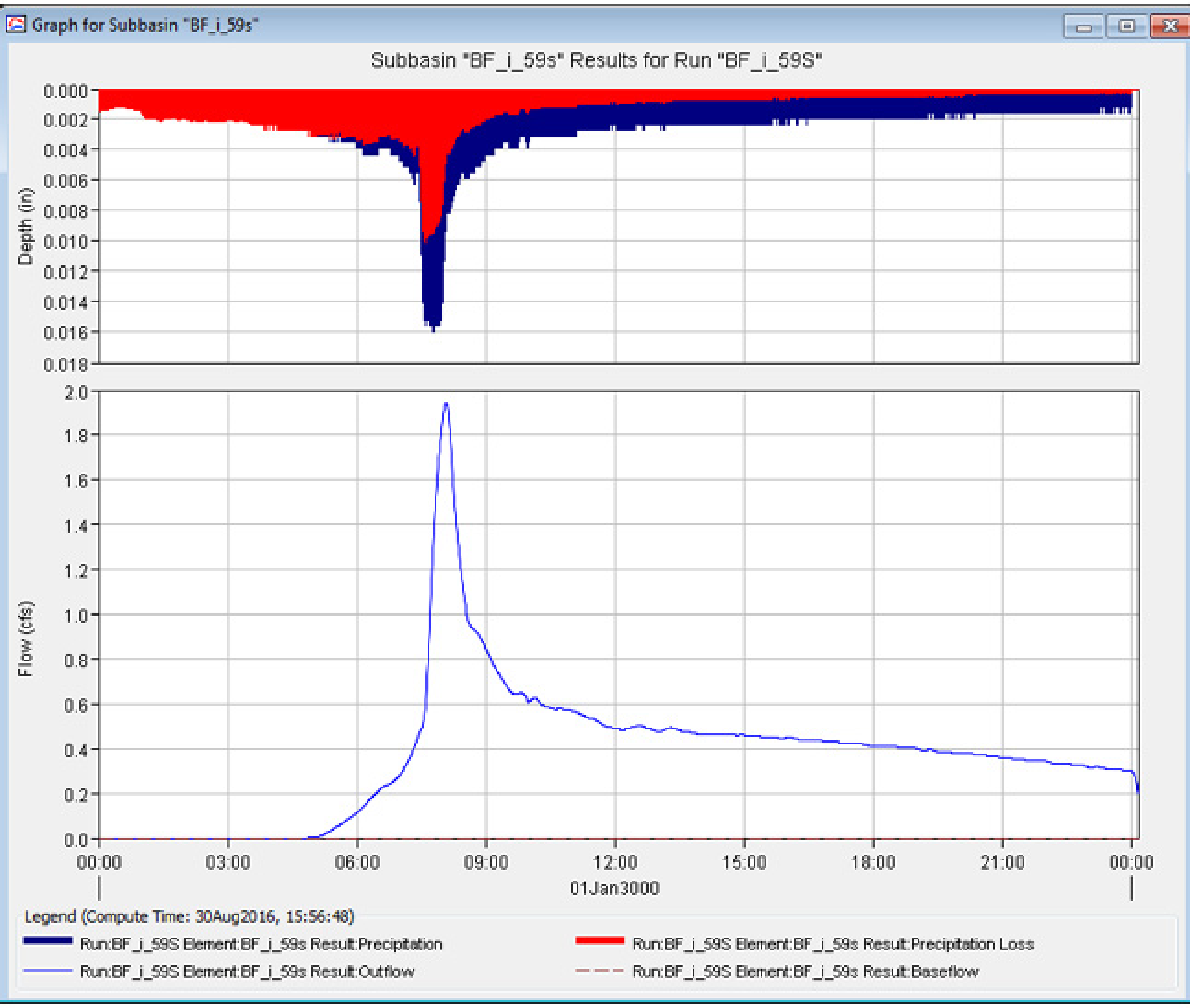
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: BF_i_59s

Description: sub1
Downstream: --None--
*Area (MI2) 0.007956
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Initial Abstraction (IN)
*Curve Number: 77.4
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "BF_i_59s"
Subbasin "BF_i_59s" Results for Run "BF_i_59S"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 15:56:48)
Run:BF_i_59S Element:BF_i_59s Result:Precipitation
Run:BF_i_59S Element:BF_i_59s Result:Precipitation Loss
Run:BF_i_59S Element:BF_i_59s Result:Outflow
Run:BF_i_59S Element:BF_i_59s Result:Baseflow

Global Summary Results for Run "BF_i_59S"

Project: BF_i_base_all_bo   Simulation Run: BF_i_59S

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 16:18:37   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
BF_i_59s	0.007956	3.29	01Jan3000, 08:03	2.59

Summary Results for Subbasin "BF_i_59s"

Project: BF_i_base_all_bo   Simulation Run: BF_i_59S
Subbasin: BF_i_59s

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 16:18:37   Control Specifications: Control 1

Volume Units: IN AC-FT

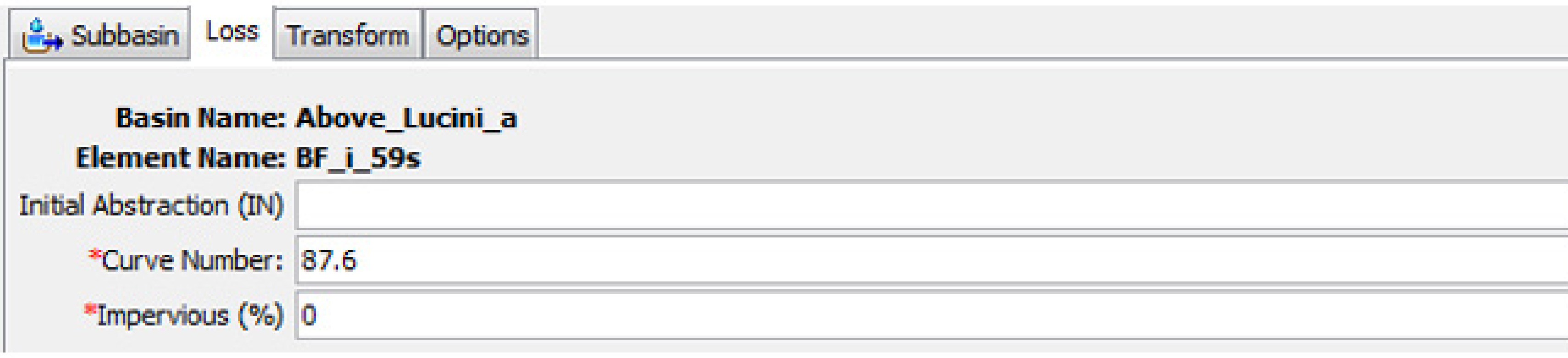
Computed Results

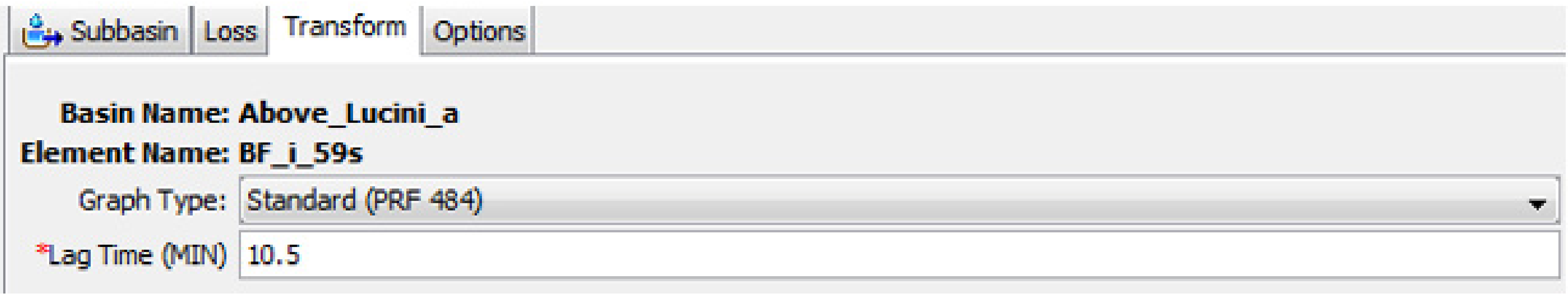
Peak Discharge:	3.29 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:03
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	2.59 (IN)
Loss Volume:	1.30 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	2.60 (IN)	Discharge Volume:	2.59 (IN)

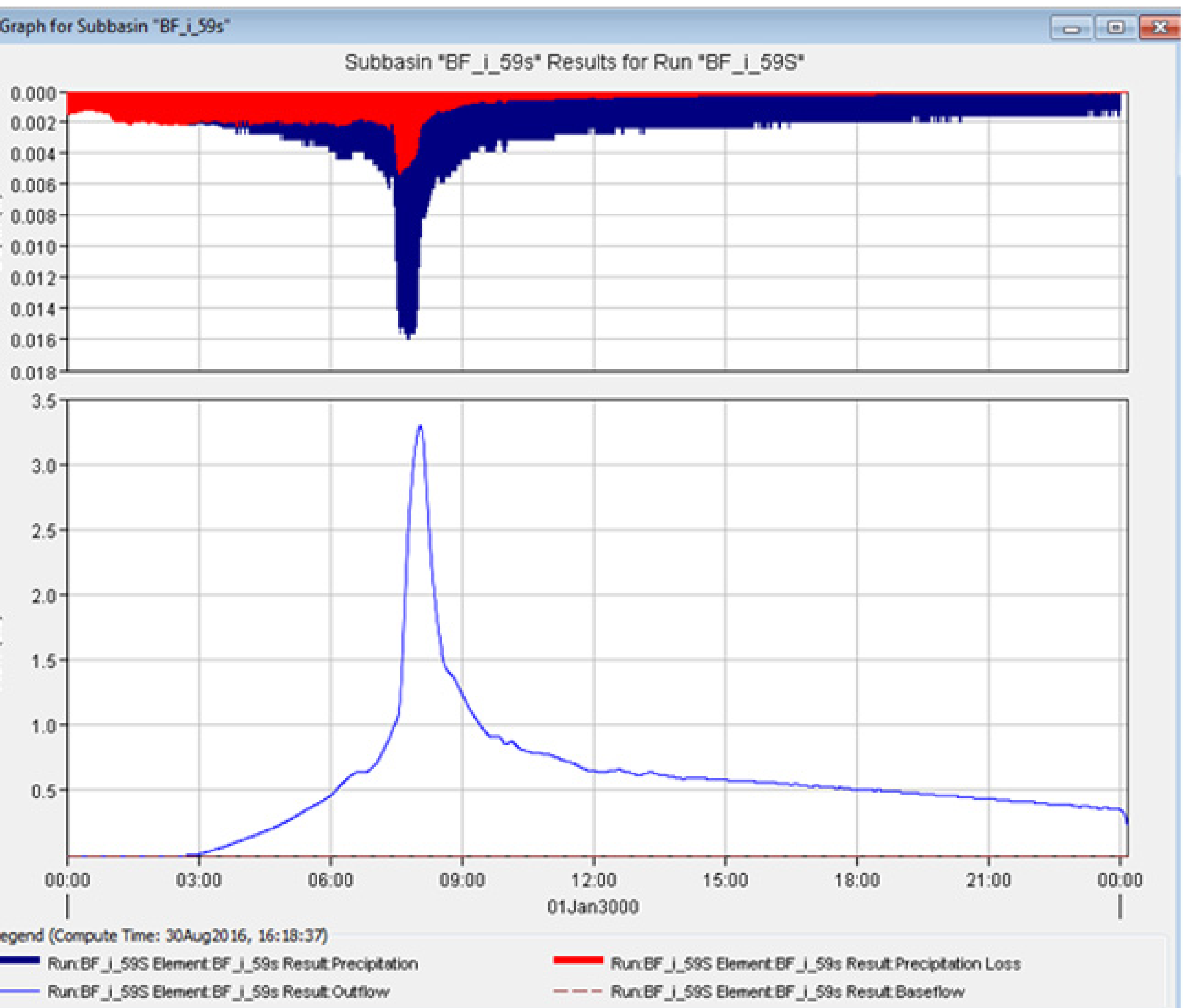
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: BF_i_59s

Description:	sub1
Downstream:	--None--
*Area (MI2)	0.007956
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

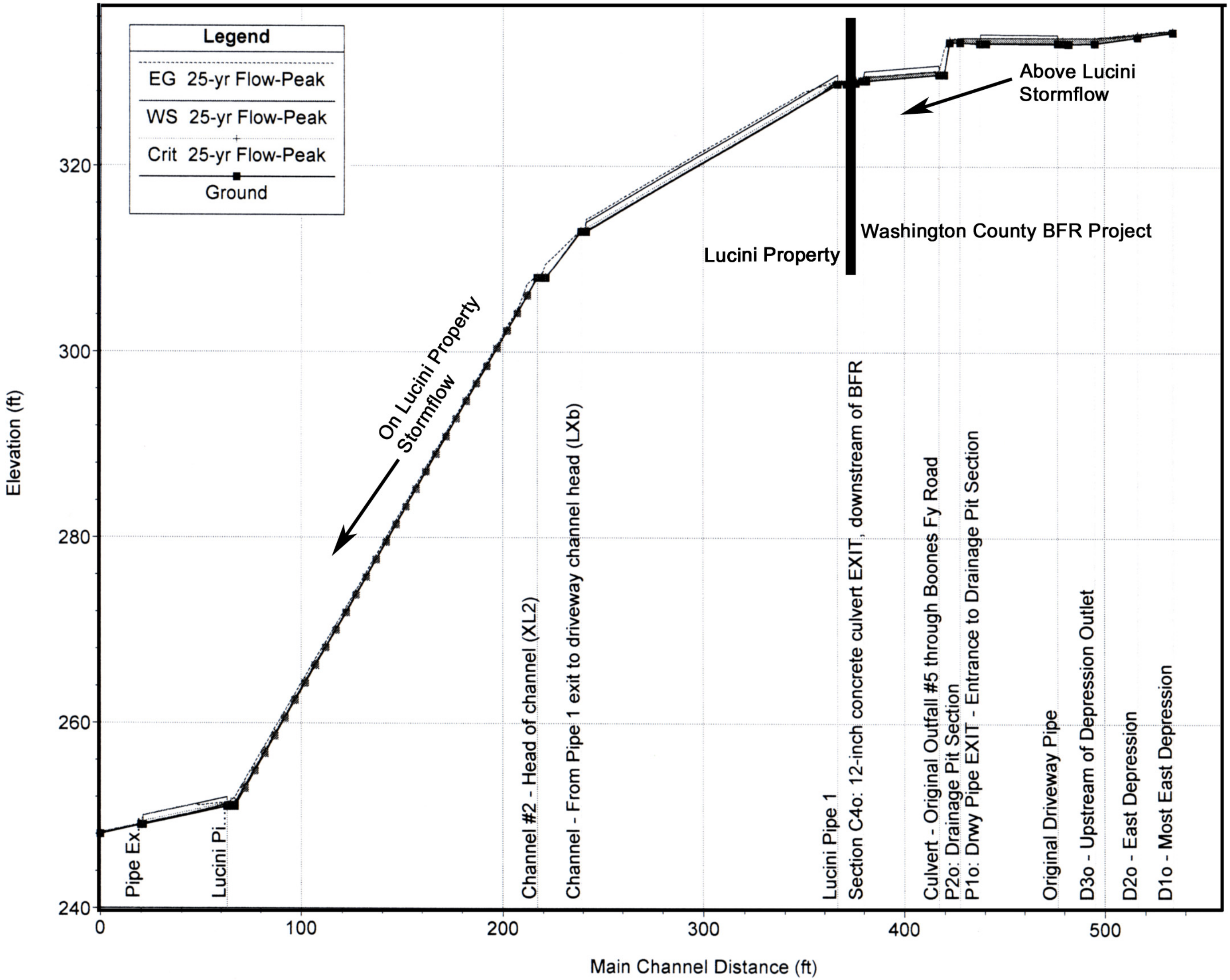

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Initial Abstraction (IN)
*Curve Number: 87.6
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "BF_i_59s"
Subbasin "BF_i_59s" Results for Run "BF_i_59S"
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
3.5
3.0
2.5
2.0
1.5
1.0
0.5
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 16:18:37)
Run:BF_i_59S Element:BF_i_59s Result:Precipitation
Run:BF_i_59S Element:BF_i_59s Result:Precipitation Loss
Run:BF_i_59S Element:BF_i_59s Result:Outflow
Run:BF_i_59S Element:BF_i_59s Result:Baseflow

Appendix I

Figure I-1. HEC-RAS Hydraulic Profile of ORIGINAL Pipe and Ditch Conditions at 0.89 cfs
Above and On the Lucini Property



Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Cor_Orig 0.89cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	0.89	334.50	334.76	334.68	334.77	0.011532	0.91	0.98	7.60	0.44
o_17S	142.4	25-yr Flow-Peak	0.89	334.00	334.30	334.30	334.38	0.056691	2.20	0.40	2.67	0.99
o_17S	121.3	25-yr Flow-Peak	0.89	333.30	333.96	333.67	333.97	0.002925	0.81	1.10	3.37	0.25
o_17S	108.4	25-yr Flow-Peak	0.89	333.24	333.93		333.93	0.001875	0.62	1.44	4.44	0.19
o_17S	105.7	25-yr Flow-Peak	0.89	333.30	333.91	333.67	333.93	0.004143	0.92	0.97	3.16	0.29
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	0.89	333.28	333.92		333.92	0.000206	0.28	3.19	6.83	0.07
o_17S	56.6	25-yr Flow-Peak	0.89	333.40	333.90		333.91	0.006810	1.04	0.85	3.44	0.37
o_17S	51.5	25-yr Flow-Peak	0.89	333.40	333.73	333.73	333.82	0.056356	2.31	0.39	2.31	1.00
o_17S	48.8	25-yr Flow-Peak	0.89	329.94	329.97	330.09	332.61	1.800609	13.05	0.07	2.70	14.46
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	0.89	329.27	329.68	329.68	329.79	0.057239	2.57	0.35	1.67	1.00
o_17S	4.8	25-yr Flow-Peak	0.89	329.00	329.42	329.37	329.47	0.027824	1.86	0.48	2.30	0.72
o_17S	0.00	25-yr Flow-Peak	0.89	328.92	329.20	329.20	329.28	0.059737	2.16	0.41	2.89	1.01
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	0.89	313.00	313.20		313.22	0.009717	1.04	0.85	4.60	0.43
o_17S	-132	25-yr Flow-Peak	0.89	313.00	313.11	313.11	313.17	0.067286	1.91	0.47	4.33	1.03
o_17S	-150	25-yr Flow-Peak	0.89	308.00	308.03	308.11	309.03	7.363283	8.05	0.11	4.08	8.63
o_17S	-152	25-yr Flow-Peak	0.89	308.00	308.22	308.13	308.24	0.009842	1.04	0.85	4.67	0.43
o_17S	-154	25-yr Flow-Peak	0.89	308.00	308.13	308.13	308.19	0.098000	1.97	0.45	3.97	1.03
o_17S	-302	25-yr Flow-Peak	0.89	251.00	251.35	251.48	251.80	0.375062	5.44	0.16	0.95	2.31
o_17S	-304	25-yr Flow-Peak	0.89	251.00	251.48	251.48	251.60	0.062529	2.78	0.32	1.33	1.00
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	0.89	249.00	249.07	249.07	249.12	0.086052	1.65	0.54	7.66	1.09
o_17S	-369	25-yr Flow-Peak	0.89	248.00	248.17	248.09	248.18	0.010007	0.92	0.97	6.51	0.42

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Err_Orig 1.17cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	1.17	334.50	334.79	334.71	334.80	0.011156	0.96	1.22	8.48	0.44
o_17S	142.4	25-yr Flow-Peak	1.17	334.00	334.34	334.34	334.42	0.054613	2.32	0.50	2.98	0.99
o_17S	121.3	25-yr Flow-Peak	1.17	333.30	334.02	333.72	334.03	0.003334	0.88	1.32	3.89	0.27
o_17S	108.4	25-yr Flow-Peak	1.17	333.24	333.99		333.99	0.002252	0.68	1.72	5.31	0.21
o_17S	105.7	25-yr Flow-Peak	1.17	333.30	333.97	333.72	333.98	0.004599	1.02	1.14	3.43	0.31
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	1.17	333.28	333.98		333.98	0.000257	0.33	3.57	7.09	0.08
o_17S	56.6	25-yr Flow-Peak	1.17	333.40	333.95		333.97	0.006985	1.13	1.04	3.79	0.38
o_17S	51.5	25-yr Flow-Peak	1.17	333.40	333.77	333.77	333.86	0.054365	2.44	0.48	2.58	1.00
o_17S	48.8	25-yr Flow-Peak	1.17	329.94	329.97	330.12	332.68	1.308928	13.20	0.09	2.70	12.83
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	1.17	329.27	329.73	329.73	329.85	0.057477	2.76	0.42	1.85	1.01
o_17S	4.8	25-yr Flow-Peak	1.17	329.00	329.36	329.41	329.53	0.105970	3.29	0.36	1.98	1.37
o_17S	0.00	25-yr Flow-Peak	1.17	328.92	329.24	329.24	329.32	0.056489	2.27	0.52	3.24	1.00
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	1.17	313.00	313.23		313.25	0.010699	1.19	0.99	4.68	0.45
o_17S	-132	25-yr Flow-Peak	1.17	313.00	313.12	313.13	313.20	0.088360	2.31	0.51	4.36	1.19
o_17S	-150	25-yr Flow-Peak	1.17	308.00	308.05	308.14	308.67	2.370216	6.36	0.18	4.14	5.31
o_17S	-152	25-yr Flow-Peak	1.17	308.00	308.07	308.15	308.45	0.831842	4.94	0.24	3.54	3.37
o_17S	-154	25-yr Flow-Peak	1.17	308.00	308.15	308.15	308.22	0.091385	2.11	0.55	4.16	1.02
o_17S	-302	25-yr Flow-Peak	1.17	251.00	251.38	251.54	251.91	0.374716	5.82	0.20	1.05	2.35
o_17S	-304	25-yr Flow-Peak	1.17	251.00	251.54	251.54	251.67	0.060366	2.93	0.40	1.48	1.00
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	1.17	249.00	249.09	249.09	249.14	0.070877	1.72	0.68	7.83	1.03
o_17S	-369	25-yr Flow-Peak	1.17	248.00	248.20	248.11	248.21	0.010001	1.01	1.16	6.77	0.43

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: LU_Orig 1.71cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

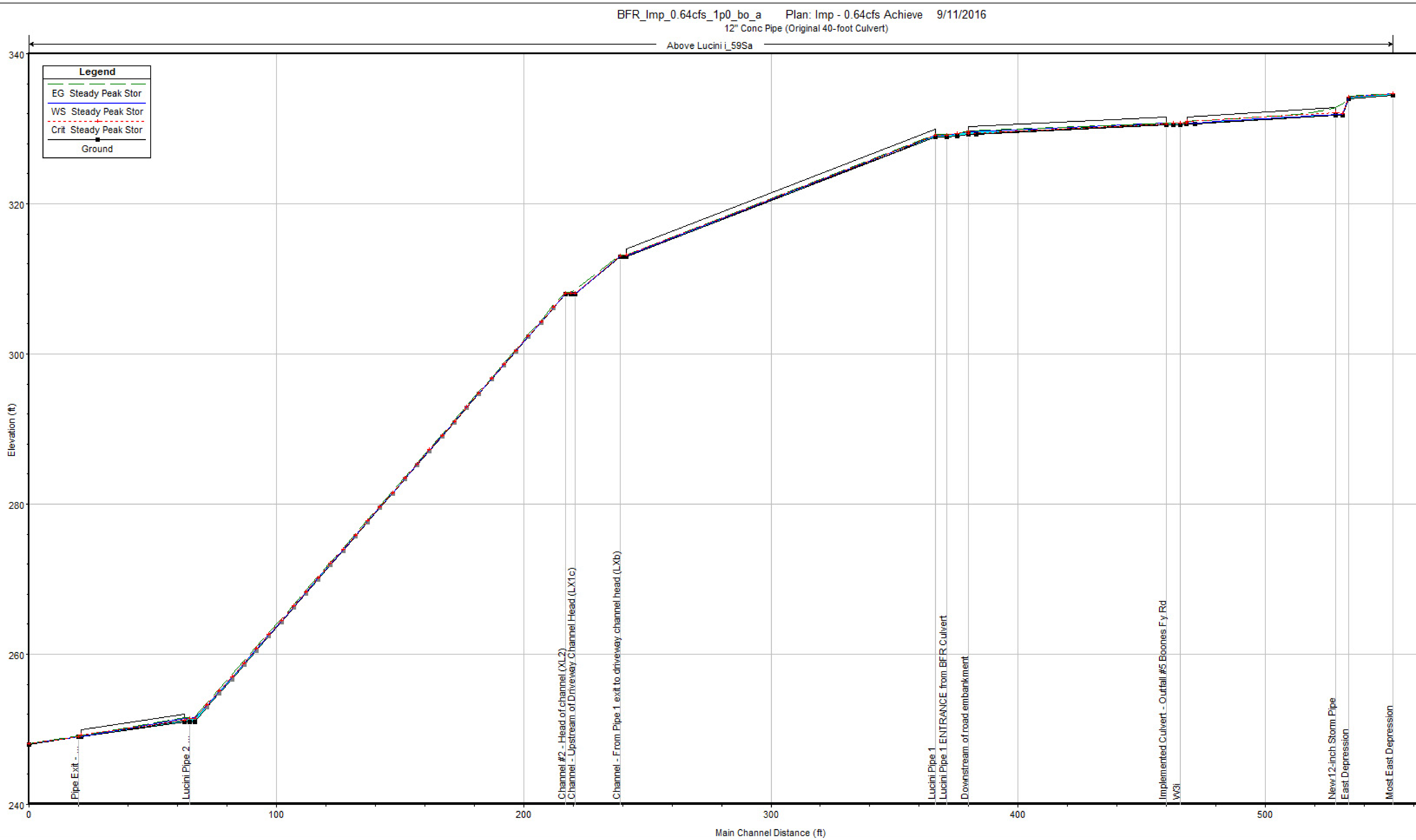
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	1.71	334.50	334.84	334.74	334.85	0.010207	1.02	1.68	9.94	0.44
o_17S	142.4	25-yr Flow-Peak	1.71	334.00	334.39	334.39	334.49	0.054093	2.54	0.67	3.44	1.01
o_17S	121.3	25-yr Flow-Peak	1.71	333.30	334.11	333.79	334.13	0.004242	0.97	1.77	5.54	0.30
o_17S	108.4	25-yr Flow-Peak	1.71	333.24	334.07		334.08	0.002629	0.76	2.24	6.65	0.23
o_17S	105.7	25-yr Flow-Peak	1.71	333.30	334.05	333.79	334.07	0.006123	1.18	1.46	4.45	0.36
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	1.71	333.28	334.06		334.06	0.000351	0.41	4.18	7.48	0.10
o_17S	56.6	25-yr Flow-Peak	1.71	333.40	334.02		334.05	0.007513	1.28	1.34	4.31	0.40
o_17S	51.5	25-yr Flow-Peak	1.71	333.40	333.83	333.83	333.94	0.051589	2.63	0.65	3.00	0.99
o_17S	48.8	25-yr Flow-Peak	1.71	329.94	329.99	330.17	332.78	0.843351	13.41	0.13	2.70	10.87
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	1.71	329.27	329.80	329.80	329.94	0.054404	2.97	0.58	2.16	1.01
o_17S	4.8	25-yr Flow-Peak	1.71	329.00	329.41	329.47	329.62	0.113652	3.71	0.46	2.25	1.44
o_17S	0.00	25-yr Flow-Peak	1.71	328.92	329.29	329.29	329.38	0.052889	2.43	0.70	3.78	1.00
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	1.71	313.00	313.28		313.31	0.011691	1.40	1.23	4.83	0.49
o_17S	-132	25-yr Flow-Peak	1.71	313.00	313.16	313.17	313.26	0.078067	2.56	0.67	4.47	1.17
o_17S	-150	25-yr Flow-Peak	1.71	308.00	308.05	308.17	309.02	2.947858	7.88	0.22	4.16	6.07
o_17S	-152	25-yr Flow-Peak	1.71	308.00	308.31	308.20	308.33	0.011372	1.34	1.27	5.30	0.48
o_17S	-154	25-yr Flow-Peak	1.71	308.00	308.20	308.20	308.28	0.081682	2.31	0.74	4.49	1.00
o_17S	-302	25-yr Flow-Peak	1.71	251.00	251.44	251.62	252.08	0.375093	6.40	0.27	1.21	2.40
o_17S	-304	25-yr Flow-Peak	1.71	251.00	251.53	251.62	251.83	0.139144	4.41	0.39	1.46	1.51
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	1.71	249.00	249.12	249.12	249.18	0.061679	1.90	0.90	8.08	1.00
o_17S	-369	25-yr Flow-Peak	1.71	248.00	248.24	248.15	248.26	0.010004	1.15	1.49	7.20	0.45

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: BO_Orig 2.85cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	2.85	334.50	334.92	334.80	334.94	0.009158	1.11	2.57	12.28	0.43
o_17S	142.4	25-yr Flow-Peak	2.85	334.00	334.48	334.48	334.60	0.049261	2.79	1.02	4.24	1.00
o_17S	121.3	25-yr Flow-Peak	2.85	333.30	334.25	333.89	334.27	0.004561	1.06	2.70	7.96	0.32
o_17S	108.4	25-yr Flow-Peak	2.85	333.24	334.21		334.22	0.002898	0.87	3.27	8.71	0.25
o_17S	105.7	25-yr Flow-Peak	2.85	333.30	334.18	333.89	334.21	0.007433	1.30	2.19	6.73	0.40
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	2.85	333.28	334.19		334.20	0.000519	0.55	5.23	8.11	0.12
o_17S	56.6	25-yr Flow-Peak	2.85	333.40	334.14		334.18	0.008075	1.49	1.91	5.15	0.43
o_17S	51.5	25-yr Flow-Peak	2.85	333.40	333.93	333.93	334.06	0.050191	2.96	0.96	3.66	1.01
o_17S	48.8	25-yr Flow-Peak	2.85	329.94	330.02	330.27	332.92	0.469839	13.68	0.21	2.70	8.68
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	2.85	329.27	329.93	329.93	330.09	0.049951	3.27	0.87	2.66	1.00
o_17S	4.8	25-yr Flow-Peak	2.85	329.00	329.50	329.58	329.77	0.111470	4.18	0.68	2.74	1.48
o_17S	0.00	25-yr Flow-Peak	2.85	328.92	329.38	329.38	329.49	0.049294	2.69	1.06	4.64	0.99
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	2.85	313.00	313.36		313.41	0.013243	1.74	1.64	5.08	0.54
o_17S	-132	25-yr Flow-Peak	2.85	313.00	313.23	313.24	313.36	0.064030	2.89	0.98	4.68	1.11
o_17S	-150	25-yr Flow-Peak	2.85	308.00	308.07	308.24	309.65	3.452740	10.07	0.28	4.21	6.85
o_17S	-152	25-yr Flow-Peak	2.85	308.00	308.39	308.27	308.43	0.012447	1.62	1.76	5.95	0.52
o_17S	-154	25-yr Flow-Peak	2.85	308.00	308.27	308.27	308.38	0.076003	2.64	1.08	5.02	1.01
o_17S	-302	25-yr Flow-Peak	2.85	251.00	251.53	251.77	252.36	0.375560	7.28	0.39	1.47	2.48
o_17S	-304	25-yr Flow-Peak	2.85	251.00	251.74	251.77	251.96	0.064544	3.76	0.76	2.04	1.09
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	2.85	249.00	249.17	249.17	249.24	0.055550	2.21	1.29	8.50	1.00
o_17S	-369	25-yr Flow-Peak	2.85	248.00	248.33	248.20	248.35	0.010003	1.35	2.10	7.93	0.46



BFR_Imp_0.64cfs_1p0_bo_a Plan: Imp - 0.64cfs Achieve 9/11/2016
12" Conc Pipe (Original 40-foot Culvert)
Above Lucini i_59Sa
Legend
EG Steady Peak Stor
WS Steady Peak Stor
Crit Steady Peak Stor
Ground
Elevation (ft)
Main Channel Distance (ft)
Pipe Exit - ...
Lucini Pipe 2 ...
Channel #2 - Head of channel (XL2)
Channel - Upstream of Driveway Channel Head (LX1c)
Channel - From Pipe 1 exit to driveway channel head (LXb)
Lucini Pipe 1
Lucini Pipe 1 ENTRANCE from BFR Culvert
Downstream of road embankment
Implemented Culvert - Outfall #5 Boones Fy Rd
W3i
New12-inch Storm Pipe
East Depression
Most East Depression

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 0.64cfs Ach River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	0.64	334.50	334.73	334.66	334.74	0.011869	0.84	0.76	6.68	0.44
i_59Sa	157.5	Steady Peak Stor	0.64	334.00	334.27	334.27	334.33	0.059196	2.06	0.31	2.34	0.99
i_59Sa	154.8	Steady Peak Stor	0.64	331.80	331.87	332.03	333.24	0.289235	9.41	0.07	1.00	6.36
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	0.64	330.60	330.75	330.75	330.82	0.005384	2.15	0.30	2.00	0.98
i_59Sa	91.8	Steady Peak Stor	0.64	330.55	330.75	330.70	330.79	0.002079	1.59	0.40	2.00	0.62
i_59Sa	89.1	Steady Peak Stor	0.64	330.55	330.70	330.70	330.77	0.005576	2.17	0.29	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	0.64	329.27	329.63	329.63	329.72	0.059744	2.40	0.27	1.47	0.99
i_59Sa	4.3	Steady Peak Stor	0.64	329.00	329.36	329.32	329.41	0.030271	1.77	0.36	2.00	0.73
i_59Sa	0.00	Steady Peak Stor	0.64	328.92	329.17	329.17	329.23	0.060142	2.00	0.32	2.55	0.99
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	0.64	313.00	313.18		313.19	0.006681	0.82	0.78	4.55	0.35
i_59Sa	-132	Steady Peak Stor	0.64	313.00	313.09	313.09	313.14	0.078006	1.77	0.36	4.26	1.07
i_59Sa	-150	Steady Peak Stor	0.64	308.00	308.03	308.10	308.55	3.864839	5.82	0.11	4.08	6.25
i_59Sa	-152	Steady Peak Stor	0.64	308.00	308.20	308.11	308.21	0.006900	0.83	0.77	4.53	0.36
i_59Sa	-154	Steady Peak Stor	0.64	308.00	308.11	308.11	308.16	0.098240	1.76	0.36	3.80	1.00
i_59Sa	-302	Steady Peak Stor	0.64	251.00	251.59	251.42	251.62	0.010996	1.33	0.48	1.63	0.43
i_59Sa	-304	Steady Peak Stor	0.64	251.00	251.42	251.42	251.53	0.065191	2.60	0.25	1.16	0.99
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	0.64	249.00	249.06	249.06	249.09	0.075315	1.40	0.46	7.57	1.00
i_59Sa	-369	Steady Peak Stor	0.64	248.00	248.14	248.07	248.15	0.010003	0.82	0.78	6.25	0.41

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 0.85cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	0.85	334.50	334.76	334.68	334.77	0.010967	0.88	0.97	7.54	0.43
i_59Sa	157.5	Steady Peak Stor	0.85	334.00	334.30	334.30	334.37	0.059039	2.21	0.39	2.60	1.01
i_59Sa	154.8	Steady Peak Stor	0.85	331.80	331.89	332.08	333.29	0.215416	9.51	0.09	1.00	5.60
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	0.85	330.60	330.78	330.78	330.87	0.004860	2.31	0.37	2.00	0.95
i_59Sa	91.8	Steady Peak Stor	0.85	330.55	330.79	330.73	330.84	0.002135	1.77	0.48	2.00	0.64
i_59Sa	89.1	Steady Peak Stor	0.85	330.55	330.73	330.73	330.82	0.005435	2.39	0.36	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	0.85	329.27	329.68	329.68	329.78	0.057611	2.55	0.33	1.64	1.00
i_59Sa	4.3	Steady Peak Stor	0.85	329.00	329.33	329.36	329.46	0.093919	2.90	0.29	1.80	1.26
i_59Sa	0.00	Steady Peak Stor	0.85	328.92	329.21	329.21	329.27	0.044824	1.92	0.44	3.00	0.88
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	0.85	313.00	313.21		313.22	0.007623	0.95	0.90	4.62	0.38
i_59Sa	-132	Steady Peak Stor	0.85	313.00	313.11	313.11	313.16	0.075371	1.95	0.44	4.31	1.08
i_59Sa	-150	Steady Peak Stor	0.85	308.00	308.03	308.11	308.67	3.636185	6.39	0.13	4.10	6.25
i_59Sa	-152	Steady Peak Stor	0.85	308.00	308.05	308.13	308.51	1.668853	5.47	0.16	3.37	4.49
i_59Sa	-154	Steady Peak Stor	0.85	308.00	308.13	308.13	308.18	0.092597	1.91	0.45	3.96	1.00
i_59Sa	-302	Steady Peak Stor	0.85	251.00	251.66	251.47	251.69	0.010986	1.43	0.59	1.81	0.44
i_59Sa	-304	Steady Peak Stor	0.85	251.00	251.47	251.47	251.59	0.065314	2.79	0.30	1.29	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	0.85	249.00	249.07	249.07	249.11	0.084703	1.61	0.53	7.65	1.08
i_59Sa	-369	Steady Peak Stor	0.85	248.00	248.16	248.10	248.18	0.010013	0.91	0.94	6.47	0.42

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 1.95cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

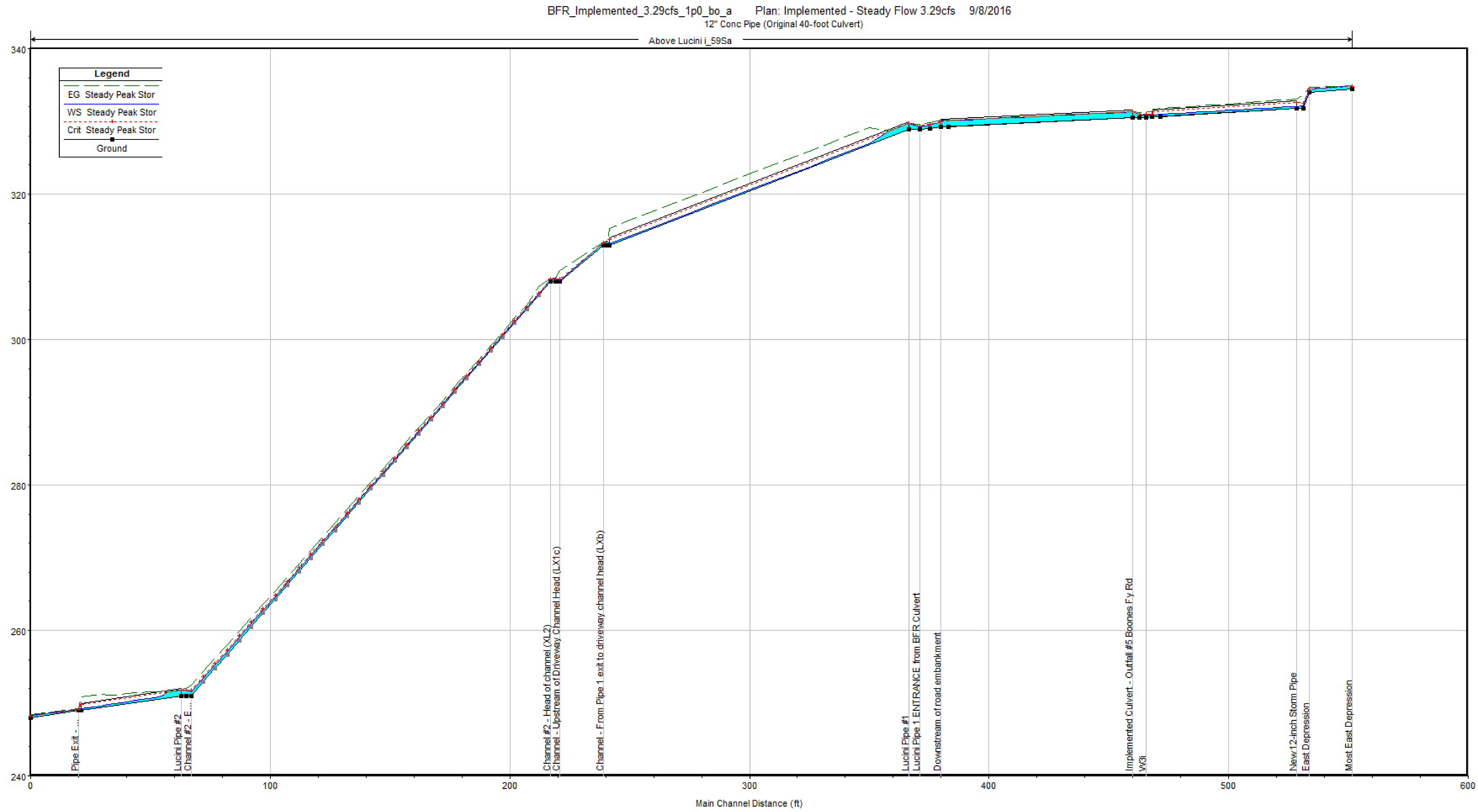
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	1.95	334.50	334.85	334.75	334.87	0.010335	1.06	1.84	10.41	0.44
i_59Sa	157.5	Steady Peak Stor	1.95	334.00	334.41	334.41	334.52	0.051301	2.58	0.76	3.65	1.00
i_59Sa	154.8	Steady Peak Stor	1.95	331.80	332.00	332.29	333.49	0.098788	9.80	0.20	1.00	3.87
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	1.95	330.60	330.94	330.91	331.07	0.003944	2.87	0.68	2.00	0.87
i_59Sa	91.8	Steady Peak Stor	1.95	330.55	330.96	330.86	331.05	0.002295	2.40	0.81	2.00	0.66
i_59Sa	89.1	Steady Peak Stor	1.95	330.55	330.86	330.86	331.01	0.005240	3.16	0.62	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	1.95	329.27	329.84	329.84	329.98	0.052108	3.02	0.65	2.29	1.00
i_59Sa	4.3	Steady Peak Stor	1.95	329.00	329.44	329.50	329.65	0.105045	3.72	0.52	2.40	1.40
i_59Sa	0.00	Steady Peak Stor	1.95	328.92	329.31	329.31	329.41	0.053963	2.54	0.77	3.96	1.01
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	1.95	313.00	313.32		313.35	0.009015	1.34	1.45	4.97	0.44
i_59Sa	-132	Steady Peak Stor	1.95	313.00	313.18	313.19	313.28	0.061572	2.49	0.78	4.55	1.06
i_59Sa	-150	Steady Peak Stor	1.95	308.00	308.06	308.19	309.21	3.355479	8.62	0.23	4.17	6.52
i_59Sa	-152	Steady Peak Stor	1.95	308.00	308.36	308.21	308.38	0.008566	1.27	1.54	5.66	0.43
i_59Sa	-154	Steady Peak Stor	1.95	308.00	308.21	308.21	308.30	0.080059	2.39	0.82	4.61	1.00
i_59Sa	-302	Steady Peak Stor	1.95	251.00	251.46	251.66	252.14	0.375315	6.62	0.29	1.27	2.42
i_59Sa	-304	Steady Peak Stor	1.95	251.00	251.66	251.66	251.82	0.058525	3.30	0.59	1.80	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	1.95	249.00	249.13	249.13	249.19	0.064594	2.02	0.97	8.15	1.03
i_59Sa	-369	Steady Peak Stor	1.95	248.00	248.26	248.16	248.29	0.010003	1.20	1.63	7.37	0.45

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 3.29cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	3.29	334.50	334.94	334.82	334.96	0.009048	1.15	2.87	12.99	0.43
i_59Sa	157.5	Steady Peak Stor	3.29	334.00	334.51	334.51	334.64	0.049598	2.90	1.13	4.47	1.01
i_59Sa	154.8	Steady Peak Stor	3.29	331.80	332.13	332.49	333.66	0.064421	9.91	0.33	1.00	3.03
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	3.29	330.60	330.90	331.04	331.37	0.016296	5.49	0.60	2.00	1.77
i_59Sa	91.8	Steady Peak Stor	3.29	330.55	330.85	330.99	331.32	0.016296	5.49	0.60	2.00	1.77
i_59Sa	89.1	Steady Peak Stor	3.29	330.55	330.90	330.99	331.24	0.010077	4.68	0.70	2.00	1.39
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	3.29	329.27	329.96	329.96	330.14	0.050085	3.39	0.97	2.80	1.01
i_59Sa	4.3	Steady Peak Stor	3.29	329.00	329.53	329.61	329.81	0.102500	4.20	0.78	2.93	1.43
i_59Sa	0.00	Steady Peak Stor	3.29	328.92	329.30	329.40	329.60	0.164469	4.39	0.75	3.91	1.77
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	3.29	313.00	313.43		313.47	0.009499	1.63	2.02	5.30	0.47
i_59Sa	-132	Steady Peak Stor	3.29	313.00	313.26	313.27	313.39	0.057058	2.94	1.12	4.77	1.07
i_59Sa	-150	Steady Peak Stor	3.29	308.00	308.08	308.27	309.51	2.468790	9.60	0.34	4.25	5.96
i_59Sa	-152	Steady Peak Stor	3.29	308.00	308.46	308.29	308.50	0.009105	1.51	2.18	6.46	0.46
i_59Sa	-154	Steady Peak Stor	3.29	308.00	308.29	308.29	308.41	0.073053	2.73	1.21	5.21	1.00
i_59Sa	-302	Steady Peak Stor	3.29	251.00	251.56	251.81	252.44	0.373059	7.52	0.44	1.55	2.50
i_59Sa	-304	Steady Peak Stor	3.29	251.00	251.81	251.81	252.02	0.054487	3.66	0.90	2.22	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	3.29	249.00	249.18	249.18	249.27	0.056065	2.33	1.41	8.63	1.01
i_59Sa	-369	Steady Peak Stor	3.29	248.00	248.35	248.22	248.38	0.010012	1.42	2.32	8.17	0.47


BFR_Implemented_3.29cfs_1p0_bo_a   Plan: Implemented - Steady Flow 3.29cfs   9/8/2016
12" Conc Pipe (Original 40-foot Culvert)
Above Lucini i_59Sa
Legend
EG Steady Peak Stor
WS Steady Peak Stor
Crit Steady Peak Stor
Ground
Pipe Exit - ...
Lucini Pipe #2
Channel #2 - E...
Channel #2 - Head of channel (XL2)
Channel - Upstream of Driveway Channel Head (LX1c)
Channel - From Pipe 1 exit to driveway channel head (LXb)
Lucini Pipe #1
Lucini Pipe 1 ENTRANCE from BFR Culvert
Downstream of road embankment
Implemented Culvert - Outfall #5 Boones Fy Rd
W3i
New 12-inch Storm Pipe
East Depression
Most East Depression
340
320
300
280
260
240
0
100
200
300
400
500
600
Main Channel Distance (ft)

LEA Comments
On the Draft Tualatin Stormwater Master Plan
(Dated April 2019)

Prepared for
John and Grace Lucini
23677 SW Boones Ferry Road
Tualatin, Oregon
97140

Prepared by
Dave LaLiberte
Principal Engineer
Liberte Environmental Associates, Inc.
Wilsonville, Oregon

December 14, 2020

Draft Comments on the Tualatin Stormwater Master Plan (Draft, April 2019)

Due December 15, 2020, by Dave LaLiberte, P.E., Liberte Environmental Associates (LEA)

Summary Comments

These comments are based on the Draft Tualatin Stormwater Master Plan (SWMP) dated April 2019. Comments highlight issues in the Plan concerning Southwest Boones Ferry Road (BFR) south of Norwood Road, referred to as "BFR south".

Significant problems in the Plan for the BFR south area are: lack of identified stormwater facilities[1] omission of hydrologic and hydraulic modeling analysis[2], potential for mis-application of design alternatives[3], absence of stormwater problem acknowledgement and evaluation[4], no assessment of stormflows on steep slopes[5], effect of stormflows on the Basalt Creek Concept Plan are neglected[6], no existing and future development stormwater flows are compared[7], protection of natural resources is unclear[8], no designation of Capital Improvement Projects (CIPs[9]) in the BFR south area, and other Plan related problems.

Supplement documents collected by Liberte Environmental Associates (LEA) for these comments are identified as:

Supplement A - LEA Request for Tualatin SWMP Appendices

Supplement B - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016).
This report is included in two parts: Supplement B Part 1 (Report) and Part 2 (Appendices) under separate cover because of their size.

Supplement C –David M. LaLiberte, P.E., Cumuli Vitae (CV)

David M. LaLiberte, P.E., Civil and Environmental Engineer licensed in the State of Oregon, has compiled these comments under contract with John and Grace Lucini (see Comment LEA2 below). Dave has over 30 years of experience in stormwater, water quality and design solution analysis. His education and experience are attached as Supplement C – Cumuli Vitae (CV).

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[1] See Specific Comment LEA6.

[2] See Specific Comment LEA5.

[3] See Specific Comment LEA9.

[4] See Specific Comments LEA9, 11 and 14 as they pertain to the SWMP Table 3-1 and Figure 7-1.

[5] See Specific Comments LEA5, 7 and 8.

[6] See Specific Comments LEA6, 7, 8, 12 and 15.

[7] See Specific Comment LEA5.

[8] See Specific Comment LEA6.

[9] See Specific Comment LEA4, 9, 10 and 11.

Specific Comments

Comment LEA1. Many of the questions raised in these Tualatin SWMP comments focus on the area along BFR south. The BFR south area is shown within the city limits in all of the corresponding master plan figures. That is: Figures ES-1, 2-2 through 2-6 and 7-1.

Comment LEA2. Many of these comments refer to *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016), contracted by John and Grace Lucini, 23677 SW Boones Ferry Road, Washington County, Oregon, Tualatin, Oregon, 97140. This report is referred to as the "Stormflow Analysis" and is attached to these comments as Supplement B Part 1 (Report) and Part 2 (Appendices).

Comment LEA3. The Tualatin SWMP Appendices were obtained (Dec 10, 2020) from the City of Tualatin as part of this comment period ending December 15, 2020. A description of the SWMP Appendix request is contained in LEA Supplement A.

Comment LEA4. Some of the comments reference procedures in other areas of Tualatin. For example, Project Opportunity Area 6 – Alsea, aka Capital Improvement Project #17 (CIP17), calls for infiltration/retention that could be erroneously applied to the BFR south area. These procedures will potentially be applied to the hydrologic and hydraulic modeling in BFR south, and possibly any resulting CIP and stormwater design considerations.

Comment LEA5. The Tualatin SWMP does not include any hydrologic or hydraulic (H/H) modeling for stormwater flows in BFR south. The SWMP must include H/H modeling of the BFR south and affected areas such as the Basalt Creek corridor. Stormwater piping, channels, inlets, outfalls and other stormwater related facilities exist in BFR south (see LEA Supplement B Part 2: Appendices B through E) but are undocumented and un-analyzed in the SWMP. A perusal of the Tualatin SWMP Appendices A through C demonstrates that engineering data and analyses have all been omitted for the BFR south area. The SWMP must include stormwater facilities in Figure 2-6 – Stormwater System Overview for the BFR south and affected areas such as the Basalt Creek corridor. Comparison existing and developed future stormwater flow conditions are not performed. Evaluation of stormflows on hazardous steep slopes is omitted. Assessment of downstream conveyances below Tualatin outfalls is not conducted for the BFR south impacted areas.

Comment LEA6. The Tualatin SWMP does not include any wetlands in BFR south although they do exist. The SWMP Figure 2-5 - Stream Ownership omits the majority of stormwater impacted wetlands in Tualatin. Metro's Title 13 – Nature in Neighborhoods is intended to protect natural resources in urban areas but none of these opportunities are identified in the Plan for BFR south. The SWMP calls for protecting natural resources in subsections 1.1 Stormwater Master Plan Objectives and 2.2 Future Planning Areas. None of these opportunities are evaluated in the Plan for BFR south especially for the Basalt Creek Concept Plan area.

Comment LEA7. SWMP Figure 2-3 - Topography and Soils map contains too many TEXT overlays in the vicinity of Boones Ferry Road South of Norwood Road and the Lucini Property.

The sensitive steep slope topography in this vicinity can't be read. The "Boones Ferry" and "Basalt Creek" labels need to be moved from this visually important area of this map.

Comment LEA8. SWMP Table 2-1 (Page 2-3) in combination with Figure 2-3 - Topography and Soils suggests that infiltration is not a likely future runoff design solution in the BFR south. This is particularly important since this area is perched above steep slopes draining to Basalt Creek. This area is also above drinking water wells in the area including the Lucini property.

Comment LEA9. When the SWMP Appendix A - CIP Fact Sheets documentation is accessed for the Siuslaw Water Quality Retrofit, which includes the Alsea Road area (CIP17), there is no mention of infiltration in the design. But Table 3-1, Opportunity Area 6, aka CIP17, plainly refers to infiltration. The potential application of infiltration at the CIP17 site is of concern because it is inappropriate based on poorly draining soils (see next comment). As it relates to the BFR south area, applying the same inappropriate infiltration design approach will potentially cause significant problems (see next comment).

Comment LEA10. The BFR south area needs to exclude infiltration facilities as an alternative to reducing surface flow. Figure 7-1 (Page 3-2) does not show any CIP in the vicinity of BFR south although potential problems exist (see LEA Supplement B Part 2: Appendix A.2).

Comment LEA11. SWMP Figure 7-1 does show the location of CIP17, which is additionally described in Table 3-1 - City of Tualatin Stormwater Project Opportunities Number 6 as Alsea/BF Rd and 99th/Siuslaw Greenway. This CIP17 would drain to Hedges Creek and is comprised of "C" type soils as identified by Hydrologic Soil Group (see Section 2.4 -Soils, Table 3-1 and Figure 2-3). "C" type soils poorly drain and do not support functional infiltration facilities. The concern is that the "C" type soils above the Lucini property may be subjected to the same contradictory conclusion as the CIP17 site. This problem of misapplying design solutions may also exist for other conditions because BFR south has not been evaluated by Tualatin for hydrology and hydraulics as well as CIP.

Comment LEA12. SWMP Figure 2-6 - Stormwater System Overview omits the stormwater inlets, piping and other stormwater facilities in and around BFR south. The Stormwater Outfalls to the Basalt Creek Management Area and Greenhill Lane are not indicated (see LEA Supplement B Part 2: Appendix A.2). Downstream channels below the outfalls are not shown.

Comment LEA13. The SWMP Section 9 has incomplete References to Clean Water Services (CWS). The CWS document date and title are not current. For consistence in citing standards, the CWS reference must read "Design and Construction Standards" dated December 2019.

Comment LEA14. Nowhere in the Tualatin SWMP is a Stormwater Field Monitoring or Sampling program identified or proposed. This is despite the fact that Table 3-1 indicates numerous flooding and water quality problems resulting from stormwater flows. Table ES-1 – Capital Project Summary is being proposed without monitoring and sampling program basis.

Comment LEA15. There is no assessment of peak and average stormflows on the steep slopes, which constitute the west flank of the BFR south area. These Tualatin stormflows discharge to the Basalt Creek Concept Plan area and their existence is not established in the SWMP. Stormflows on these steep slopes have excessive peak and average flow velocities, which cause erosion (see Supplement B Part 1 Analysis Report Section 4. Stormflow Hydraulics and Part 2 Appendices A2 and I).

Comment LEA16. The Tualatin SWMP makes no provisions for temporary stormwater storage and discharge facilities when phasing-in large developments such as the Root property in BFR south. The concern is that arbitrary storage and discharge locations could occur in the interim, before the final stormwater facility is operable. It needs to be specified in the Tualatin SWMP that new construction developments must use stormwater facilities and outfalls consistent only with its final specifications and drawings.

Supplements

Supplements Contents

Supplement A

LEA Request for Tualatin SWMP Appendices

Subject:
Re: Review of Draft Tualatin SWMP by LEA
From:
Dave LaLiberte <dave@ee83.com>
Date:
12/10/2020 10:33 AM
To:
Hayden Ausland <hausland@tualatin.gov>
CC:
"grluci@gmail.com" <grluci@gmail.com>

Thanks Hayden.

The files downloaded just fine.

Dave

On 12/10/2020 10:05 AM, Hayden Ausland wrote:
> Good morning Dave,
>
> Due to large files sizes, I've had to upload the appendices to an online file sharing system. The appendices come in two separate files and I'm hoping both hyperlinks below will work for you. Please let me know if you have any issues or problems with accessing these files.
>
> - Appendices A-D: https://cityoftualatin-my.sharepoint.com/:b:/g/personal/hausland_tualatin_gov/EYCg3fA-dVpMrk_014xs9KwB0o-idA1Eo1MdnnKw6fufZw?e=u0CnNH
>
> - Appendices E-I: https://cityoftualatin-my.sharepoint.com/:b:/g/personal/hausland_tualatin_gov/ESQumWDmfCdGrAIq_nTWEgQBNGIFcmZuGrb670B-KzxMow?e=jwjpn9
>
> Regards,
>
> Hayden Ausland, EIT, CPSWQ
> Engineering Associate - Water Quality
> City of Tualatin
> P 503.691.3037 | C 971.978.8217
>
> -----Original Message-----
> From: Dave LaLiberte <dave@ee83.com>
> Sent: Thursday, December 10, 2020 8:55 AM
> To: Hayden Ausland <hausland@tualatin.gov>
> Subject: Review of Draft Tualatin SWMP by LEA
>
> Hi Hayden,
>
> I am an Engineer working with John and Grace Lucini reviewing the Draft Tualatin Stormwater Master Plan (April 2019). I need to obtain the Appendices that are referenced in the report but not included by the City in the report. These are:
>

>
> Please let me know at your earliest convenience when I may receive
these documents for my review.
>
> Thanks,
> David (Dave) LaLiberte, P.E.
> LIberte Environmental Associates, Inc. (LEA) WIlsonville, Oregon
> 503.582.1558
>

Supplement B: Part 1 – Analysis Report

Included under separate cover because of size.

Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property (LEA, November 2016)

Contracted by John and Grace Lucini, 23677 SW Boones Ferry Road, Washington County, Oregon, Tualatin, Oregon, 97140.
This report is referred to as the “Stormflow Analysis” throughout these comments.

Supplement B: Part 2 – Rpt Appendices

Included under separate cover because of size.

Appendices - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016)

Supplement C

CV for David M. LaLiberte, P.E.

David M. LaLiberte, P.E.
Principal Engineer

Summary:

Mr. LaLiberte's qualifications comprise over 30 years of experience in surface water quality analysis and evaluation, hydrology and hydraulics, stormwater system analysis, biological criteria for water and sediments, environmental quality control, sewage and industrial pollution abatement, effluent treatment alternatives and design, discharge requirements for NPDES wastewater and stormwater permits, mixing zone assessment, water intake and thermal discharges and environmental design. He has managed and performed on many environmental project teams assisting state and federal agencies, as well as municipal and industrial facilities, and non-governmental organizations in Oregon, California, Washington, Alaska and throughout the USA.

Education:	M.S., Civil Engineering, Portland State University, 1990 B.S., Civil Engineering, Portland State University, 1988
Registration:	Professional Engineer, Oregon (Civil and Environmental)

Liberte Environmental Associates, Inc. Experience:

Water Quality Evaluation of the Stormwater Management Plan (SWMP) Proposed for The Dalles, Oregon Wal-Mart Super Center for Karl Anuta, Attorney representing the plaintiff Citizens for Responsible Development in The Dalles. The effect on receiving water quality from stormwater discharges from a large retail facility was assessed in a report submitted to the Circuit Court of the State of Oregon. The detailed Expert Report was developed identifying the discharge conditions, storm flows based on local precipitation, storm flow mapping and routes, potential treatment levels using mechanical filtration and swales and other WQ issues. Water quality effects on receiving wetlands and tributaries of the Columbia River were investigated because of increased solids, toxics and bacterial loadings to be released from the proposed facility. Expert Testimony was provided in court supporting the evaluation report. This project was conducted in 2012 and 2013.

NPDES Mixing Zone and Water Quality Evaluations for Trident Seafoods Corporation, Alaska – Effluent characterization, discharge system configuration, receiving waterbody consideration, biological criteria and mixing zone evaluations were performed. Acting as subconsultant for Steigers Corporation. Facility operations generating wastewater discharges include: stormwater runoff inflow, seafood-processing wastewater, non-contact cooling water, treated sanitary effluent and other sources of industrial effluents. The MZ evaluations conformed to NPDES permit requirements and mixing zone guidelines for Trident facilities in Alaska at Akutan and Sandpoint. This project was performed from 2010 through 2012.

NPDES Water Quality Technical Assistance and Alternative Design Evaluations for North Slope Borough, Alaska – Evaluation of US Environmental Protection agency NPDES permit for discharges from oil and gas facilities including discharges from: stormwater system, drilling operations, cooling water intake and discharge, storage facilities, pipelines, gravel pits, treated sewage discharges, maintenance requirements, and other types of discharges. These discharges include stormwater affected deck drainage, cooling water intake and thermal discharges, treated sewage discharges and drill cuttings disposal to marine sediments. Water quality evaluation of the Camden Bay Exploration Plan for the Beaufort Sea of the Arctic Ocean was conducted for discharge impacts on the marine aquatic environment and relative to BOEMRE/MMS EIS. Analysis of the Chukchi Sea Exploration Plan of the Arctic Ocean was conducted for discharge impacts on the marine aquatic environment and relative to BOEMRE/MMS EIS. These evaluations were based on water quality and treatment alternatives assessment, and comparison to biological criteria. This project was conducted in 2010 through 2011.

Aurora STP NPDES Assessment for CRAG Law Center - Review of documents related to the design, operation and monitoring of the Aurora, Oregon Sewage Treatment Plant. Documents include: NPDES permit; stormwater inflow and infiltration, design related plans and specifications including recent headworks unit design; discharge monitoring reports, irrigation using effluent reuse, biosolids monitoring reports; effluent reuse plan and additional information relating to the design and operation of the Aurora STP. The review provided a basis for assessing potential causes of facility underperformance and discharge violations. An STP site visit was performed during this project to investigate facility aeration treatment, reuse equipment and capacities. This project was conducted from 2008 through 2010.

Review of the Medford STP Nutrient Related Discharges, for CRAG Law Center in Portland, Oregon. Evaluation of treatment facility and nutrient discharges from the Medford Sewage Treatment Plant (STP) into the Rogue River in Jackson County, Oregon. Existing discharges were evaluated for nutrient concentrations based on the discharger's CORMIX mixing zone analysis. Facility costs to upgrade for nutrient removal, including nitrogen and phosphorus, were developed. This project was performed in 2015 through 2017.

Evaluation of Sewage Treatment Plant Discharges to the Illinois River, Oregon, for the City of Cave Junction. Mixing zone analysis using EPA CORMIX was performed to determine the effects of temperature and other discharge parameters on river quality. Hydraulic analysis of river flow conditions was conducted to support the MZ analysis particularly for critical summertime conditions. This project was performed in 2013 through 2014.

Draper Valley Farms, Inc. Chicken Processing Industrial Discharge to Municipal Sewage System, for Smith and Lowney, PLLC representing the plaintiff Waste Action Project Citizens Suit. The effects on sewage treatment processes were evaluated relative to high biochemical oxygen demand (BOD) from Draper Valley Farms (DVF). A key focus of this analysis was the operational consequences of excess BOD on treatment in the aeration basins of the Mt. Vernon, WA municipal facility. The pass-through impact on the Skagit River was assessed for increased BOD from the industrial discharge. This project was conducted in 2014 and 2015.

Coal Discharge Investigation for the Columbia River and Selected Tributaries, for the Sierra Club supported by the Columbia Riverkeepers. Prospective coal samples were collected from sediments along 18 miles of the Columbia River located at the confluences of selected tributaries from Rock Creek (RM 150.0) to the White Salmon River (RM 168.3). Sampling locations corresponded to Burlington Northern Santa Fe (BNSF) railroad crossings at or near tributaries. The distribution of coal discharges into the Columbia River were mapped. Samples were analyzed by a third-party laboratory. Sample parameters were: moisture content, fixed carbon, volatile matter, ash and total sulfur. This was based on ASTM Proximate Analysis plus sulfur. Coal identification, to determine potential sources of coal, was completed for this investigation with the support of supplemental analysis advised by the laboratory. Supplemental analysis included ASTM D-388 requirements for heating value, sulfur in ash, free swelling index (carbonization physical characteristic) and classification of coal by rank. A deposition was provided in 2016 to defend the results of coal report. This project was performed in 2012 through 2013 and 2016.

Oregon Department of Environmental Quality - WQ Technical Assistance: Industrial discharge effluent evaluation of the Port of St. Helens, Oregon ethanol and power generating plants. Outfall mixing zone analysis with design assessment was developed. Provided water quality evaluation and environmental engineering assistance to the Oregon DEQ. Work included receiving WQ analysis, operations review, thermal discharge evaluation, biological criteria comparison and mixing zone analysis. NPDES requirements were based on EPA *Quality Criteria for Water*, EPA *Technical Support Document for Water-based Toxics Control* (TSD) and State Administrative Rules. The mixing zone models CORMIX and PLUMES were evaluated relative to the cases at hand. Potential discharge chlorine residual and temperature requirements were evaluated. The effect of potential temperature Total Maximum Daily Loads (TMDLs) in the Columbia River was also evaluated. This project was performed in 2003 through 2004.

Wauna Pulp and Paper Mill Outfall 003 and Columbia River Field Survey Locations and Sampling Results for Columbia Riverkeeper including sampling. In coordination with staff and volunteers, water samples were collected in the vicinity of the paper mill outfall for laboratory analysis. The physical outfall mixing zone was mapped using in-situ Hydrolab water quality measurements taken with depth for temperature, dissolved oxygen, pH, conductivity and turbidity. Laboratory samples were analyzed for potentially toxic concentrations of dioxins, total residual chlorine (TRC) and metals including aluminum, arsenic, copper, iron, lead, mercury and zinc. Additional information sources were investigated using the Oregon DEQ permit file and including the mill's NPDES permit and the mutual agreement and order (MAO) compliance schedule. This project was conducted in 2004.

Review of Draft and Final NPDES General Permit Cook Inlet, Alaska Oil and Gas Operators for Cook Inletkeeper - Evaluation of the draft National Pollutant Discharge Elimination System (NPDES) permit proposed by the U.S. Environmental Protection Agency (EPA) authorizing wastewater discharges from oil and gas exploration, development, and production facilities into Cook Inlet, Alaska. There are 18 existing facilities discharging into Cook Inlet with new facilities capable of being brought on line under the draft permit. Technical analysis of these discharges, which can contain toxic and bioaccumulating contaminants, was performed relative to the potential to adversely affect Cook Inlet water quality and sediments. This project was conducted from 2007 through 2009.

Water Quality Evaluations and NPDES Permit Requirements for the four (4) WES publicly owned treatment works (POTW) discharges (2000-2004, 1999) performed for Water Environment Services, Clackamas County, Oregon. These included evaluation of discharge effects on the Willamette River (2 outfalls), Sandy River and a tributary of the Clackamas River. Field water quality sampling including detailed outfall mixing zone investigations. Water quality assessment was conducted relative to effluent temperature, disinfection and ammonia requirements to protect fish and aquatic organisms. Effluent mixing zone simulation and analysis was performed. Treatment alternatives analysis and costing were undertaken to ensure existing and future discharge conditions were protective of river WQ. River outfall piping alignment and diffuser design was provided including construction management of river installation.

Expert Analysis of Surimi and Seafood Industrial Wastewater Discharge into the Skipanon and Columbia Rivers, Oregon (2003-2006) was conducted for the National Environmental Law Center. Water quality analysis evaluating the effects of seafood and surimi wastewater discharges on the Skipanon and Columbia Rivers, Oregon. Field data collection was performed to support water quality technical analysis. Investigation included mixing zone analysis of historic seafood and surimi wastewater discharges into the Skipanon River, and new discharges to the Columbia River. Evaluations were performed for various discharge scenarios, monitoring and sampling requirements, potential treatment options, and alternative outfall pipeline alignments. Effluent and instream dissolved oxygen (DO), biochemical oxygen demand (BOD), ammonia, hydrogen sulfide, nutrients nitrogen and phosphorus, oil and grease, and total suspended solids (TSS) were evaluated in detail. Expert witness analysis and reporting was provided.

Westport Sewer Service District, Clatsop County, Oregon - MZ Evaluation with Alternative Disinfection (2003-2004). This project assessed water quality and mixing zone effects of disinfected treated wastewater discharged to Westport Slough, a segment of the Columbia River. Chlorine residual reduction or elimination was a key evaluation concern to satisfy Oregon DEQ requirements. Comparisons of alternative disinfection treatment scenarios and costs were performed that would allow the discharger to continue to meet WQ requirements. Ultraviolet disinfection, chlorination-dechlorination, and outfall diffuser feasibility were all investigated with comparison costs. In particular, the existing chlorination system was evaluated relative to how easily it could be retrofitted to function with dechlorination. The alternatives analysis aided the discharger in making a determination as to course of action.

Public Employees for Environmental Responsibility preparation of report Effect On Puget Sound Chinook Salmon of NPDES Authorized Toxic Discharges as Permitted by Washington Department of Ecology (2005-2006). Industrial, municipal, stormwater and general facility NPDES permits were reviewed and analyzed relative to the presence of toxic contaminants in Puget Sound. Toxic contaminants evaluated included metals, hydrocarbons, and chlorinated hydrocarbons.

Citizens for Responsibility v. Izaak Walton League, Circuit Court of the State of Oregon for Lane County, Expert Analysis for Plaintiff evaluating the effects of lead contamination from shooting range into South Fork Spencer Creek (2004-2005). Sediment sampling was conducted for metals including lead, arsenic, copper and polynuclear aromatic hydrocarbons (PAH). This information was evaluated for pollutant distribution and transport from the contaminated site and relative to upstream and downstream properties. Expert testimony was given at trial in 2004. Expert analysis and testimony was also provided in the subsequent equitable relief phase. Participation in the settlement conference was also provided.

Canby Utility Board - Industrial Discharge from Water Treatment Plant Study and Predesign (1999-2000) addressing Molalla River water quality issues with Oregon DEQ including treatment alternatives: filter backwash sedimentation basin, disinfected effluent de-chlorination, river infiltration gallery design, intake piping system, and sediment and riparian effects mitigation.

Water Environment Services of Clackamas County Hoodland WWTP Outfall Project Descriptions and Costs (2000); FEMA engineering, budgeting and negotiations is intended to reimburse Clackamas County for flood damage to their wastewater treatment plant outfall on the Sandy River. Numerous regulatory issues affected costs including an ACE 404 permit for instream construction work, NMFS ESA Section 7 Consultation, and NEPA documentation including environmental and biological assessments.

City of Bremerton, CSO Projects --A comprehensive review of the City of Bremerton, Washington collection system model was performed (2000). Hydraulic modeling was used to update information for the main sewer lines, combined sewer overflows and discharge conditions. Selected CSO reduction alternatives were evaluated and implemented. The purpose of the CSO reduction alternatives was accomplished and potential early action projects were identified. These projects yielded substantial CSO reductions while being quickly implemented at reasonable cost. Revised CSO baselines were produced conforming to Washington Department of Ecology requirments for Bremerton's 17 CSO outfalls. Expert witness testimony supporting the findings of the CSO baselines was provided in a hearing at the Federal Court in Seattle.

Previous Experience (Montgomery Watson Americas)
In addition, I have performed as project manager and/or project engineer on the following undertakings:

- Project Manager/Engineer evaluating stormwater hydrologic, hydraulic and quality conditions in Balch Creek Basin for the City of Portland, Bureau of Environmental Services, Oregon. The Army Corps of Engineers (COE) hydrographic model, (HEC-1) and hydraulic model (HEC-2) were applied to establish design criteria for flood magnitude, stormwater detention, water quality facility hydraulics and fish passage culvert hydraulics.

- Project Engineer evaluating stormwater hydrologic, hydraulic and quality conditions in Clackamas County for the CCSD#1. The graphically enhanced model, XP-SWMM, was used to develop the hydrology and hydraulics for the Kellogg and Mt. Scott Creeks basins in CCSD#1.

- *City of Portland, Bureau of Environmental Services* included Water Quality Evaluations and Diffuser Designs (2000-2001, 1997,1994) for wet and dry weather flows with chlorine residual discharges, and wet weather stormwater runoff for suspended solids and metals with potentially affected agencies including US Corps of Engineers, Oregon Division of State Lands, NOAA Fisheries, Oregon Dept. of Fish and Wildlife and US Fish and Wildlife.

- Project Manager/Engineer for the Kensington Mine in Alaska. PLUMES mixing zone modeling was used to evaluate the conditions affecting this industrial outfall. Sedimentation basin design for removal of mine tailings prior to discharge to Lynn Canal.

- City of Bremerton Corrosion and Fluoridation Facility detention facility design. An on-site detention facility was designed pursuant to Washington Department of Ecology's requirements as specified in the *Puget Sound Stormwater Management Manual*.

- Project Engineer for Water Environment Services of Clackamas County Kellogg Creek WWTP Odor Control Project. Participated as team engineer to design malodorous air collection system for headworks, primary clarifiers, secondary clarifiers, and dissolved air floatation thickening (DAFT) building. Malodorous air was passed through a biofilter for treatment.

- Project Engineer for Crescent City, California WWTP outfall mixing zone analysis. A major consideration of this project was developing alternative outfall pipeline alignments and an effective discharge location to optimize mixing.

- Project Manager/Engineer for the Hoodland WWTP Outfall project, which includes outfall diffuser design and construction (1998) in a sensitive Sandy River corridor.

- Project Task Manager—Jefferson County (Birmingham, Alabama) stream water quality analysis was performed relating to recommended NPDES permit limits for dry and wet weather conditions. Collection system analysis and treatment plant design constraints are also considerations in this potentially very large project.

- Project Engineer using Pizer's HYDRA, data compatible with the City of Portland, Oregon's XP-SWMM format, to evaluate gravity flow conditions in the proposed dual outfall system consisting of two connected parallel outfall systems over one mile each and including wet weather (CSO) hydraulic structures such as flow control structures, mix boxes and outfall diffusers.

- *City of Madison, Wisconsin* - stream water quality modeling analysis of POTW discharge relative to NPDES permitting requirements (1995-1996). A key objective of this study was restoration of base flows to the Sugar River Basin using high quality POTW effluent. An EPA QUAL2E model was developed for Badger Mill Creek and the Sugar River. Physical, chemical and biological simulation included temperature, algae, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS) and ammonia. Particular attention was focused on the inter-relationships between temperature, climatological conditions, stream shading and channel conditions, DO, BOD and algal activity. Temperature and discharge point design alternatives were investigated using the model. It was demonstrated that, with minimal WWTP facility upgrading and cost, the City could beneficially discharge high quality effluent to surface streams. This assurance was primarily accomplished through detailed modeling analysis and model approach consensus building with regulators (WDNR). Some keys to the success of this project were in identifying important NPDES permitting issues, evaluating them with the model, recommending permit effluent limits and negotiating with regulators.

- *Washington Beef, Incorporated* in Toppenish, Washington – Development of an NPDES permit under the direction of the EPA (1993-94). The project objective was development of receiving water based permit effluent limits for this food-products industry discharger using dissolved air floatation (DAF) treatment. Important project elements were: interfacing with regulatory (EPA Region 10 and Washington Ecology) and public agencies; evaluation of the effect of effluent parameters on receiving water using modeling analysis (EPA QUAL2E and EPA CORMIX); and providing long-term treatment system design recommendations. Fishery issues were of key concern for this project. Receiving water modeling was used to analyze the discharge effects of on stream dissolved oxygen and temperature on the aquatic environment. The inter-relationship between temperature, climatological conditions, stream shading and channel conditions, DO and algal activity were thoroughly investigated. Temperature and discharge design alternatives were evaluated using the water quality model.

Previous Experience (Other Firm)

- *Oregon Department of Environmental Quality and Oregon Department of State Land Conservation and Development* - Non-point Source Pollution Control Guidebook for Local Government (1994) evaluation of non-point runoff pollution and control measures including detention facilities, sedimentation basins, water quality ponds and marshes; City of Portland, Bureau of Environmental Services (1989-90) - evaluated effects of combined sewer overflows and stormwater discharges on the Columbia Slough of the Columbia River. Hydrologic and water quality modeling support was provided including sampling.

- Project Engineer for NPDES waste discharge permit review and support related to permit effluent limits for the City of Vancouver, Washington. Two tracer dye studies were performed at their two municipal WTP outfalls. The key project objective was to determine actual outfall dilution and provide a physical, receiving water basis for setting permit effluent limits. The mixing zone evaluations showed that actual dilution was greater than estimated by the regulatory agency (Washington Department of Ecology) and higher permit effluent limits were recommended.

- Project Task Manager and Engineer for a comprehensive hydraulic and water quality compliance evaluation and recommendations. The City of Portland's Columbia Boulevard WTP, the largest municipal discharger in Oregon (300 MGD), required assistance in meeting their water quality compliance needs. A highly detailed Columbia River tidal flow evaluation was performed in the outfall vicinity to serve as the basis for the mixing zone simulation and diffuser design. EPA CORMIX, and the EPA supported PLUME model family (including UDKHDEN), were used in the modeling analysis. A thorough investigation of water quality compliance options led to regulatory (ODEQ) approval of the multi-port diffuser design, the lowest cost compliance option.

- Project Engineer for Kehei, Hawaii Water Reuse Facility (1992). Participated as team engineer to design upgrades to the facility’s aeration basin including aeration blower design and aeration basin air piping with small bubble diffusion.

- Project Engineer for the Columbia Slough flow augmentation project for the City of Portland Bureau of Environmental Services, Oregon. Dynamic water quality modeling (COE CE-QUAL-W2), water quality sampling, and hydrodynamic sampling were performed for this dynamic “freshwater” estuary. This project was driven by the City’s need to evaluate the impact of water quality limited conditions on the Columbia Slough and was coupled to the City’s EPA SWMM model. The objective was to propose best management practices (BMP) and evaluate design alternatives. The effect of temperature on the aquatic environment was examined in detail. The sophisticated two-dimensional (vertical and longitudinal) dynamic model evaluated temperature regimes and their effect on in-stream water quality. In-stream temperature design alternatives were investigated via simulation of climatological conditions, stream shading and channel conditions, algal processes and kinetics, and instream DO.

- Project Engineer conducting stormwater hydrologic and hydraulic simulation to evaluate flood effects for the City of Beaverton, Oregon. HEC-1 hydrographic modeling was conducted to generate peak flow values from surface runoff for existing and future conditions. HEC-1 model results for 2, 5, 10, 25, 50 and 100-year storm events were supplied to the HEC-2 model for detailed hydraulic analysis. The HEC-2 modeling was required as part of a cost assessment that included potential flood damage of key storms.

- Project Manager and Engineer for a mixing zone evaluation and diffuser design for the City of Albany, Oregon. An outfall pipeline and 40 MGD capacity multi-port diffuser was designed for this municipal discharger using EPA CORMIX. Simulation was performed to optimize the diffuser design. The DEQ approved design will meet water quality compliance needs for chlorine and ammonia.

- Project Engineer mixing zone modeling and design for the City of Gresham, Oregon. Alternative disinfection and multiport diffuser design were evaluated. Modeling (EPA CORMIX) was utilized to optimize multiport diffuser design for this WWTP outfall. Simulation offered the flexibility to test numerous design conditions.

- Project Manager and Engineer for a mixing zone evaluation and diffuser design for the Unified Sewerage Agency, Washington County, Oregon. Analysis of four municipal treatment facility outfalls was conducted according to DEQ NPDES requirements. Model simulation was performed to determine revised wet weather chlorine residual effluent limits. The models were calibrated to dye study results. Wet weather stream surveys were also performed at two sites, Hillsboro and Forest Grove. Alternative disinfection was evaluated and diffuser design recommendations were also made.

- Project Manager and Engineer for outfall mixing zone simulation and water quality compliance evaluation for the Oak Lodge Sanitary District, Oregon. As part of NPDES permit requirements, model simulation was performed to characterize the municipal discharge-mixing zone. Available dilution values and recommended permit effluent limits for chlorine, ammonia and metals were derived from the study.

- Project Manager for a mixing zone evaluation and diffuser recommendations for Electronic Controls Devices, Incorporated. A mixing zone field evaluation of this circuit board manufacturer's discharge was performed. Very low amounts of organics and metals from the facility discharge needed to be discharged to a small stream in a responsible manner. This study illustrated that the discharge was well within compliance requirements.

Previous Experience (Portland State University Research Assistant)
City of Portland, Bureau of Environmental Services (1989-90) - evaluated effects of combined sewer overflows and stormwater discharges on the Columbia Slough of the Columbia River. Hydrologic and water quality modeling support was provided including field sampling.

- Project Engineer for evaluation of fish screen approach velocities and hydraulic design analysis for the Eugene Water and Electric Board, Leaburg, Oregon. The effects of downstream baffles on velocities through fish screens at the Leaburg Power Canal Facility were evaluated for fish passage.

- Project Engineer evaluating combined sewer overflows (CSO) and stormwater discharges on the Columbia Slough. Hydrologic and water quality modeling, using the City's EPA SWMM model data, of urban runoff from sub-basins discharging to the Columbia Slough was supplied as input to the Army Corps of Engineers in-stream surface water model, CE-QUAL-W2. This study was performed for the City of Portland, Bureau of Environmental Services in Oregon.

- Project Engineer for the South Slough National Estuarine Reserve Hydrodynamic and Water Quality Study, State of Oregon, Division of State Lands, Charleston, Oregon. Dynamic water quality modeling, water quality sampling, and hydrodynamic sampling were performed for this southern section of the Coos Bay estuary. Tracer (rhodamine) dye study results were used to calibrate the Army Corps of Engineers CE-QUAL-W2 model.

- Project Engineer for design of stream flow measurement structures on two tributaries of the South Slough National Estuarine Reserve (State of Oregon, Division of State Lands) in Charleston, Oregon. Analysis and design of stream flow measurement structures was required as part of a study assessing the hydrology and hydraulics of this pristine estuary.

- Project Engineer for a hydrologic, hydraulic and water quality assessment of Smith and Bybee Lakes in Portland, Oregon. Lake sampling and modeling was performed. The objective of the study was to evaluate the potential for water quality impairment due to the close proximity of St. John's municipal landfill and Columbia (North) Slough inflow. A hydraulic model of possible flow control structures was incorporated into the Army Corps of Engineers CE-QUAL-W2 hydrodynamic and water quality model. Recommended actions were advanced for improving lake water quality based on simulation scenarios. This study was conducted as part of a larger study for the Port of Portland, Metropolitan Service District, and City of Portland, Bureau of Environmental Services, Portland, OR.

- Project Manager and Engineer assessing the water quality impact of urban runoff from the Leadbetter storm outfall discharge to Bybee Lake. This study was conducted for the Port of Portland, Portland, Oregon.

- Project Engineer assisting in initial field work and model development for assessing impact of landfill leachate on surrounding surface waters. Conducted for the Metropolitan Service District (METRO) as part of the St. Johns Landfill closure.

Publications and Presentations

Stream Temperature Trading, Presented at the Pacific Northwest Pollution Control Annual Conference, 2001, Bend, Oregon.

Winter Temperature Gradients in Circular Clarifiers (January 1999), *Water Environment Research*, **70**, 1274.

Wet Weather River Diffuser Port Velocities: The Energetic Debate, Presented at the Pacific Northwest Pollution Control Annual Conference 1998, Portland, Oregon.

Near Field Mixing and Regulatory Compliance Implications Presented at Portland State University, February, 1998.

Whither the Wet Weather Flow, Presented at the Pacific Northwest Pollution Control Annual Conference 1997, Seattle, Washington.

Supplement B: Part 1 – Analysis Report

Included under separate cover because of size.

Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property (LEA, November 2016)

Contracted by John and Grace Lucini, 23677 SW Boones Ferry Road, Washington County, Oregon, Tualatin, Oregon, 97140.
This report is referred to as the "Stormflow Analysis" throughout these comments.

Effects of SW Boones Ferry Road Construction (2013-2015)
Stormflow Analysis for the Lucini Property
Washington County, Oregon

Prepared for
John and Grace Lucini
23677 SW Boones Ferry Road
Tualatin, Oregon
97140

REGISTERED PROFESSIONAL ENGINEER
18,645
OREGON
JULY 20 1993
DAVID M La LIBERTE

Prepared by
Dave LaLiberte
Principal Engineer
Liberte Environmental Associates, Inc.
Wilsonville, Oregon

LEA

November 1, 2016

1. Summary

Beginning in about 2015, Washington County, Oregon re-routed and increased the portion of stormwater flows passing through its road culvert (Outfall #5). These increased stormflows are associated with the County's SW Boones Ferry Road (BFR) Improvement Project. A location map is presented in Figure 1 showing the Lucini property relative to the County's road project. The re-routed portion and increased stormwater ultimately discharge onto the Lucini property[1]. Figures 2 and 3 show the stormwater conveyance through the steeply sloped Lucini property, which is composed of pipes and ditches. The photos in Appendix A document drainage condition problems on the Lucini property associated with the road project.

Increased portions of stormflows are now routed to the Lucini property but the County did not acknowledge this condition in its planning document, which is identified throughout this report as the *Drainage Report* (2013).[2] Figure 4 shows the erroneous subbasin boundaries used by the County in its Drainage Report. Figure 5 shows the necessary corrections to the faulty subbasin boundaries. These corrected subbasin boundaries demarcate a smaller actual subbasin acreage draining to the Lucini property, which results in lower stormflows than those projected by the County for ORIGINAL conditions prior to 2013. Appendix B provides the Drainage Report figures pertaining to overall subbasin boundaries for "Existing Conditions Hydrology", called throughout this report as the ORIGINAL conditions; and the "Proposed Conditions Hydrology", i.e., IMPLEMENTED conditions.

Photos and Drawings Documentation
The County claims in the Drainage Report that the ORIGINAL Boones Ferry Road above the Lucini property prior to 2013 was curbed and included storm sewers. However, the photos in Appendix A1 show that there are no curbs or storm sewer inlets. The County's mischaracterization of stormflow conditions, and depriving the public of accurate land contour information, allowed the County to shift a portion of flows from the adjacent and sensitive Greenhill Lane subbasin and into the subbasin above the Lucini property generating significant problems with erosion and flooding.

Appendix C contains the "Existing Conditions Plan" (June 2012) from the County's 70 percent drawings submittal related to the subbasin above the Lucini property. The drawings contain no elevation labeling nor do the unlabeled contour lines support the County's claim that the majority of stormflows in this area originally ended up passing onto the Lucini property.

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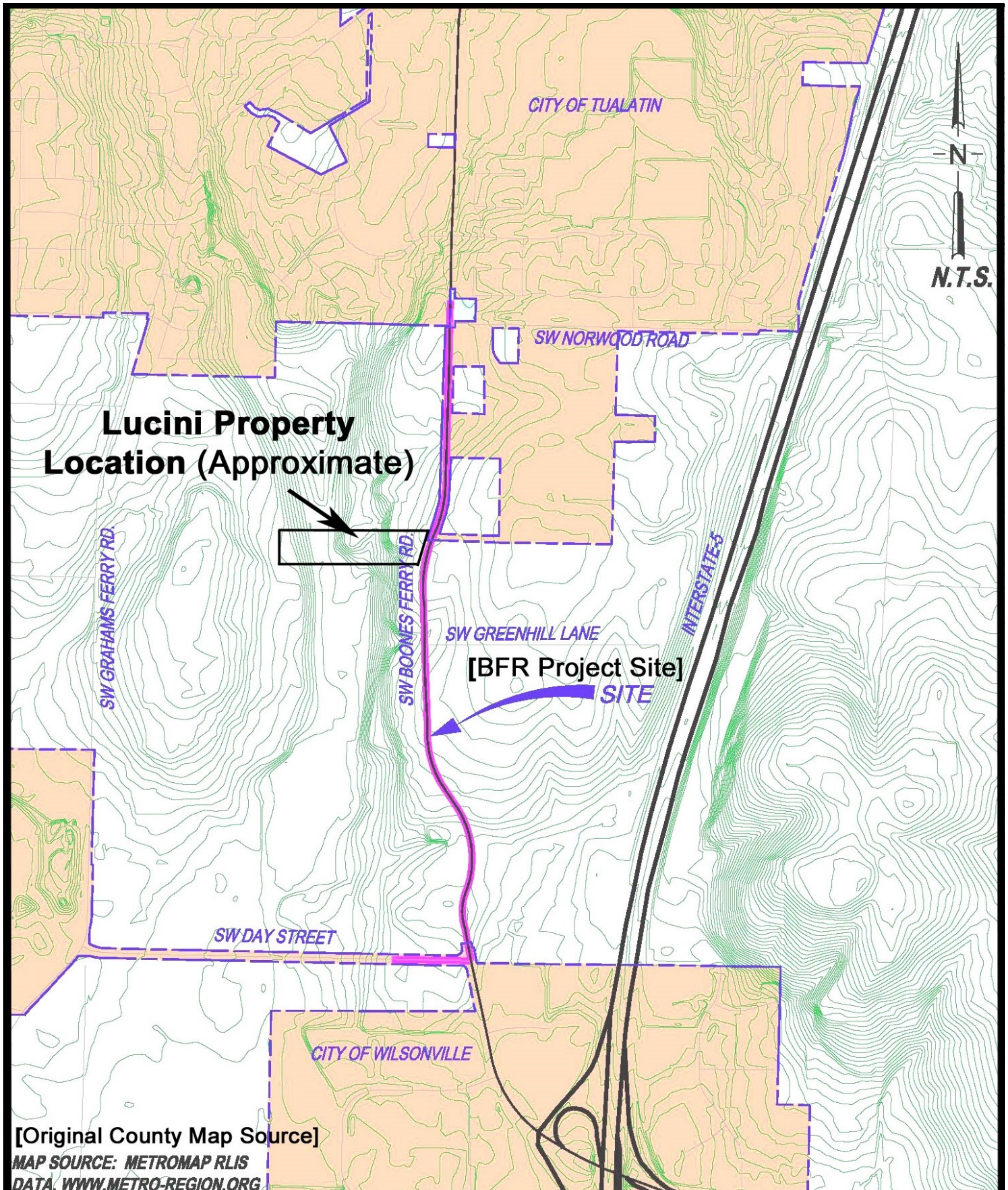
[1] John and Grace Lucini property is located at: 23677 SW Boones Ferry Road, Tualatin, Oregon, 97140.

[2] Drainage Report (2013), Storm Drainage Report – SW Boones Ferry Road (SW Day Road to SW Norwood Road, by MacKay Sposito for Washington County, Capital Project Management (CPM), Final January 31, 2013.



Background Image from Washington County's *Storm Drainage Report for SW Boones Ferry Road* Appendix A2 - Site Map figure on PDF page 27 of 152 (January 31, 2013).

Figure 1. Location Map Showing Lucini Property Overlay and Proximity to the SW Boones Ferry Road Improvement Project

These problems were not corrected in the construction plans for the project related to the subbasin above the Lucini property as shown in the final as-built drawings (November 2014) available in Appendix D. The County's "Erosion and Sediment Control Plan" from the as-built drawings as it relates to the subbasin draining to the Lucini property are contained in Appendix E. These drawings show that the original contours allowed stormflow to enter the road right-of-way and then flow south into the adjacent Greenhill Lane subbasin, not the subbasin draining into the Lucini property.

The storm flow increases overwhelmed the existing downstream conveyance system causing substantial erosion and flood damage to the property in May 18, 2015. Photos of flood damage are presented in Appendix A2. Still more flood damage is threatened in future years as the County has not protected the Lucini property from increased flows in an area that is rapidly urbanizing. Appendix A3 contains photos of erosion damage on the Lucini property resulting from increased stormflows that erode soil, widen the conveyance ditch into the adjacent embankment and expose tree roots.

In its Drainage Report, the County has departed from its stated stormwater guidance identified in Clean Water Services (CWS).[3] In particular, the County did not carry-out a Downstream System[4] evaluation for the Lucini property as necessitated in its guidance. This evaluation process is used to determine the potential effects of increased storm flows on the property. The effects of ongoing and future development in the drainage above the Lucini property are neglected in the County's Drainage Report for the ORIGINAL (pre-2013) and IMPLEMENTED (2015) subbasin conditions.

The County disregarded increased stormflow effects, above the Lucini property, resulting from more intense ongoing and future urbanization in the subbasin. Near-term increases in land use intensity were also neglected as the Drainage Report did not acknowledge the County's own construction impact on the subbasin above the property. Increased stormflows, generated from the more intensely urban "Institutional" category associated with the City of Tualatin, are entirely overlooked by the County.

Purpose of this Stormflow Analysis

This Stormflow Analysis report is performed in lieu of Washington County carrying-out an accurate assessment of ORIGINAL (prior to 2013) and IMPLEMENTED (2015) drainage conditions upstream and through the Lucini property.

The U.S. Army Corps of Engineers (Corps) model, HEC-HMS[5], is used in this analysis to evaluate rainfall hydrology. Model inputs include precipitation time distributions and amounts, drainage area sizes, land use and soil conditions, runoff time-of concentration,

[3] CWS (2007), *Design and Construction Standards for Sanitary Sewer and Surface Water Management*, for Clean Water Services (CWS), Hillsboro, Oregon, June 2007.

[4] Ibid, see Chapter 2, Page 12 under the 2.04.2 subsection heading "3. Review of Downstream System", i.e., this is subsection 2.04.2.3.

[5] HEC refers to the U.S. Army Corps of Engineers Hydrologic Engineering Center; and the HMS refers to the Hydrologic Model System.

stormwater routing and other parameters are considered for evaluating storm flows onto and through the Lucini property.

The hydrologic analysis performed in this report was first adjusted to the Washington County hydrologic results presented in its Drainage Report for the corresponding Soil Conservation Service (SCS) Type IA 25-year design storm. Then the corrected subbasin areas and land use conditions were supplied to the HEC-HMS hydrologic model so that realistic storm flow conditions could be simulated.

The County's Drainage Report did not perform a hydraulic analysis to assess the effects of stormflows above and through the Lucini property. The Corps hydraulic model, HEC-RAS[6], is used in this analysis to overcome the lack of hydraulic information. Peak flows from 25-year rainfall runoff, generated by the hydrologic model HEC-HMS, are supplied as inputs to the HEC-RAS hydraulic model. HEC-RAS is run in steady state mode, i.e., peak stormflows are held constant for each run. This process allows for the consideration of the impact of stormflows on piping, ditches and other features of the drainage system. Specifically, the hydraulic effects resulting from stormflows passing through the drainage system subbasins, stormflow routing, ditches, culverts (piping), land use conditions, ditch and piping materials, and other parameters can be assessed.

Hydrologic Modeling Results

The hydrologic simulation inputs and stormflow results generated by HEC-HMS for the subbasin above the Lucini property are contained in Appendix H.

The hydrologic modeling considered a number of probable realistic cases unexamined in the Drainage Report for the 25-year design storm. The ORIGINAL subbasin configuration as depicted in Figure 4, which is corrected as shown in Figure 5. The hydrologic model was then run with the more accurate drainage area as the ORIGINAL subbasin configuration. This comparison demonstrates that the realistic (actual) peak flow value of 0.89 cubic-feet-second (cfs) discharging to the Lucini property is 31.5 percent less (see the Figure 6 column chart) than peak flow of 1.17 cfs claimed in the County's Drainage Report. This is critically important because the County is inflating the ORIGINAL stormflows and makes it seem like the ORIGINAL condition had higher flows. This is an adverse condition for the Lucini's because the Drainage Report analysis later claims to reduce the ORIGINAL stormflow amount that it previously inflated as part of the IMPLEMENTED project.

Stormflow values are graphically compared in the Figure 6 through Figure 8 column charts. Figures 9 and 10 show the subbasin boundaries for IMPLEMENTED conditions, which permanently re-rout stormflows from a portion of the Greenhill Lane subbasin ultimately onto the Lucini property

Still greater stormflow inaccuracies are introduced by the County because it did not consider fundamental increases in impervious land areas resulting from ongoing and future land use. This is a basic necessity identified in the CWS (2007) guidance, which

[6] HEC-RAS refers to the River Analysis System hydraulic model developed by the Corps.

the County is claiming it is relying upon. It can be seen that ongoing land use and future full build-out development conditions result in much larger stormflows being discharged to the Lucini property.

Ongoing land use considerations include road construction activities and large facility support conditions necessitated by the Horizon Community Church. These land use conditions can be seen in the aerial view presented in Figures 13 and 14. Appendix F also displays additional land use characteristics in the subbasin above the Lucini property. Road construction activities result in soil compaction from heavy equipment movement and parking as well as materials staging and other provisions necessitated by road construction. Figures 13 and 14 also show the sprawling Horizon Community Church complex that relies in part on the subbasin draining to the Lucini property. The church facilities include a driveway, service roads, vehicle parking, facility support buildings and other impervious features affecting runoff.

When realistic ongoing land use is considered, stormflows discharged to the Lucini property are projected to inflate to 92.1 percent of the ORIGINAL conditions (see middle column in Figure 7). When stormflows from ongoing land use are compared to IMPLEMENTED conditions, the Lucini property is projected to receive 204.7 percent of the realistic (actual) original stormflows based on implemented conditions (see middle column in Figure 8).

The majority of the subbasin above the Lucini property is slated for intense future development allowed within the 20-year future development (FD20) planning. The County disregarded this condition in its Drainage Report and is subjecting the Lucini property to significant burdens from future erosion and flooding. When realistic future full build-out development is considered, stormflows discharged to the Lucini property are projected to inflate to 220.2 percent of the ORIGINAL conditions (see right column in Figure 7). When stormflows from full build-out conditions are compared to IMPLEMENTED conditions, the Lucini property is projected to receive 414.1 percent of the realistic (actual) original stormflows based on implemented conditions (see right column in Figure 8).

Hydraulic Modeling Results

The hydraulic modeling presented in this analysis evaluates the ORIGINAL and IMPLEMENTED piping and ditches on the Lucini property (see Figures 2 and 3) as well as the County's system above the Lucini property (see Figures 11 and 12).

Figure 11 shows the hydraulic conditions for connecting piping and the original road culvert locations for the ORIGINAL configuration. Figure 12 illustrates the IMPLEMENTED hydraulic conditions consisting of connecting piping and the new culvert comprising the County's Outfall #5. Figure 12 also shows the juxtaposition of the old and new Boones Ferry Road that hydraulically affects flows to the Lucini property.

The hydraulic simulation inputs and results, including stormflow water surface profiles and velocities, generated by HEC-RAS are available in Appendix I. The hydraulic modeling assessing pipe and ditch flow conditions shows that excessive stormflow velocities are created on the steep slopes of the Lucini property. The estimated land profiles of the storm water conveyance is illustrated in Figure 15 and Appendix I).

Stormflow velocities shown in Figure 16, for a range of land use conditions and the ORIGINAL subbasin configuration, demonstrate many instances where values exceed velocities that cause erosion on the Lucini property. These velocities exceed 4.0 feet-per-second (fps) and cannot be maintained. This deleterious situation requires measures to reduce peak flows coming through the County's culvert (Outfall #5) and onto the Lucini property. The physical conditions of excessive and increased streamflow on steep slopes existing on the Lucini property, and compared to the ORIGINAL conditions, were not evaluated by the County in its Drainage Report.

Stormflow velocities shown in Figure 17, for a range of land use conditions and the IMPLEMENTED subbasin configuration, demonstrate that values exceed velocities that cause erosion on the Lucini property for the ongoing land use and full build-out development conditions. These velocities exceed 4.0 feet-per-second (fps) and cannot be maintained. This harmful condition requires methods to reduce peak flows, including sediment and debris transport, passing through the County's culvert and onto the Lucini property. The physical conditions of excessive and increased streamflow on steep slopes existing on the Lucini property, and compared to IMPLEMENTED conditions, were not evaluated by the County in its Drainage Report.

Planning Level Costs
Three levels of estimated capital costs are related to remedying problems on the Lucini property resulting from the County's SW Boones Ferry Road widening project:

1) Immediate Shorter Term Remedy using Orifice Plate ($4,500 to $6,500 installed)
2) Ongoing Flow and Water Quality Control Facilities ($12,157 to $17,560 installed)
3) Longer Term Detention/Retention Facilities (to several hundred thousand dollars)

These capital costs include equipment, materials, labor, and construction contractor overhead and profit. Design, engineering and construction management costs are separately considered. An estimate of 20 percent of the final construction capital cost for this relatively small scale project is considered. For the high range estimates above, the design cost estimates are $1,300 for number 1 and $3,572 for number 2.

Notes:
[1] Background aerial image source from 2012-04-02 Map Boones Fry Rd FINAL_ EXHIBIT_AERIAL WA County.pdf. Five (5)-foot contours overlaid from 2013 Boones Ferry Road Wetlands and Contours from Metro Data Resource Center.
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).
[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlay from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

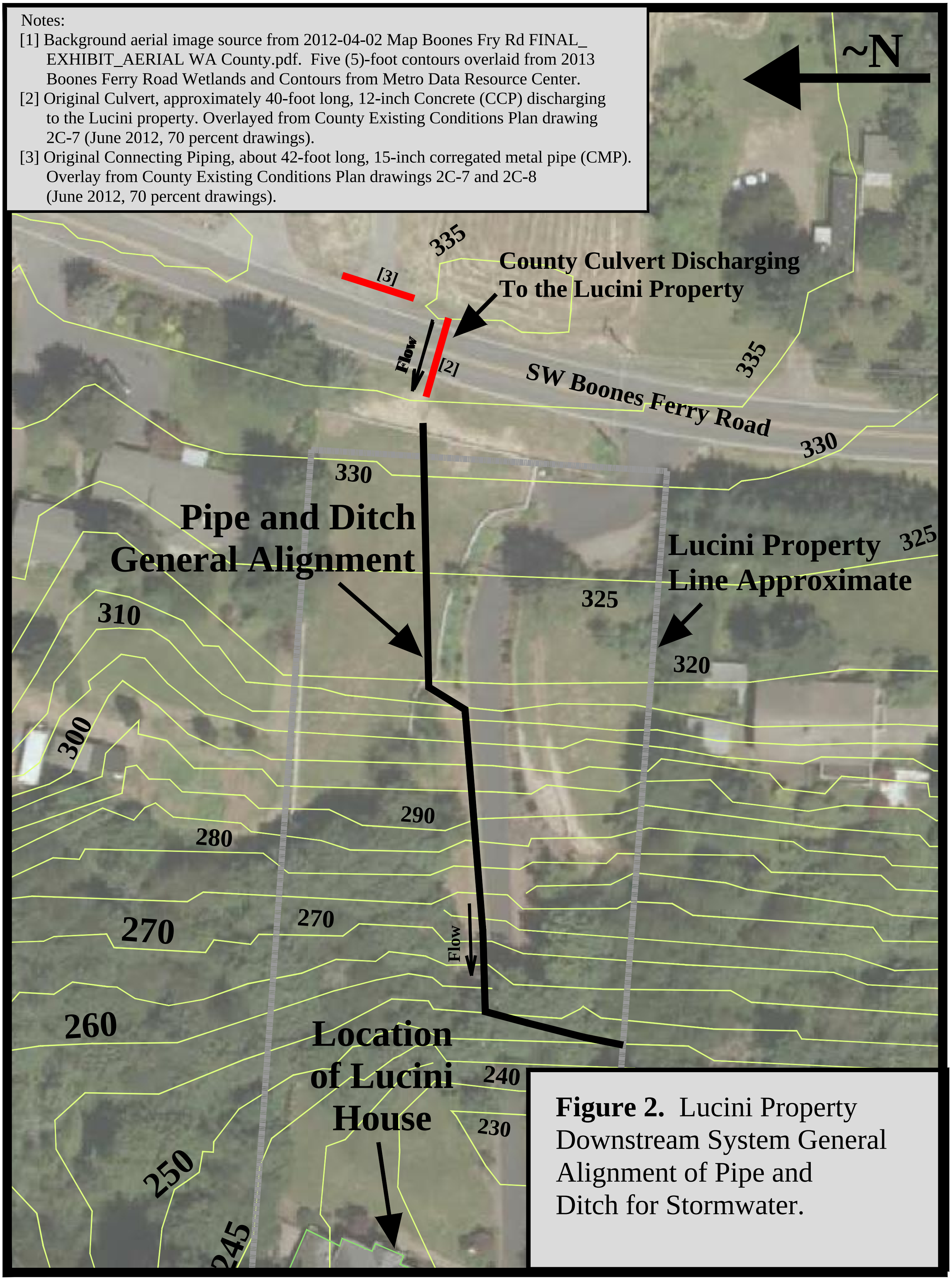


Figure 2. Lucini Property Downstream System General Alignment of Pipe and Ditch for Stormwater.

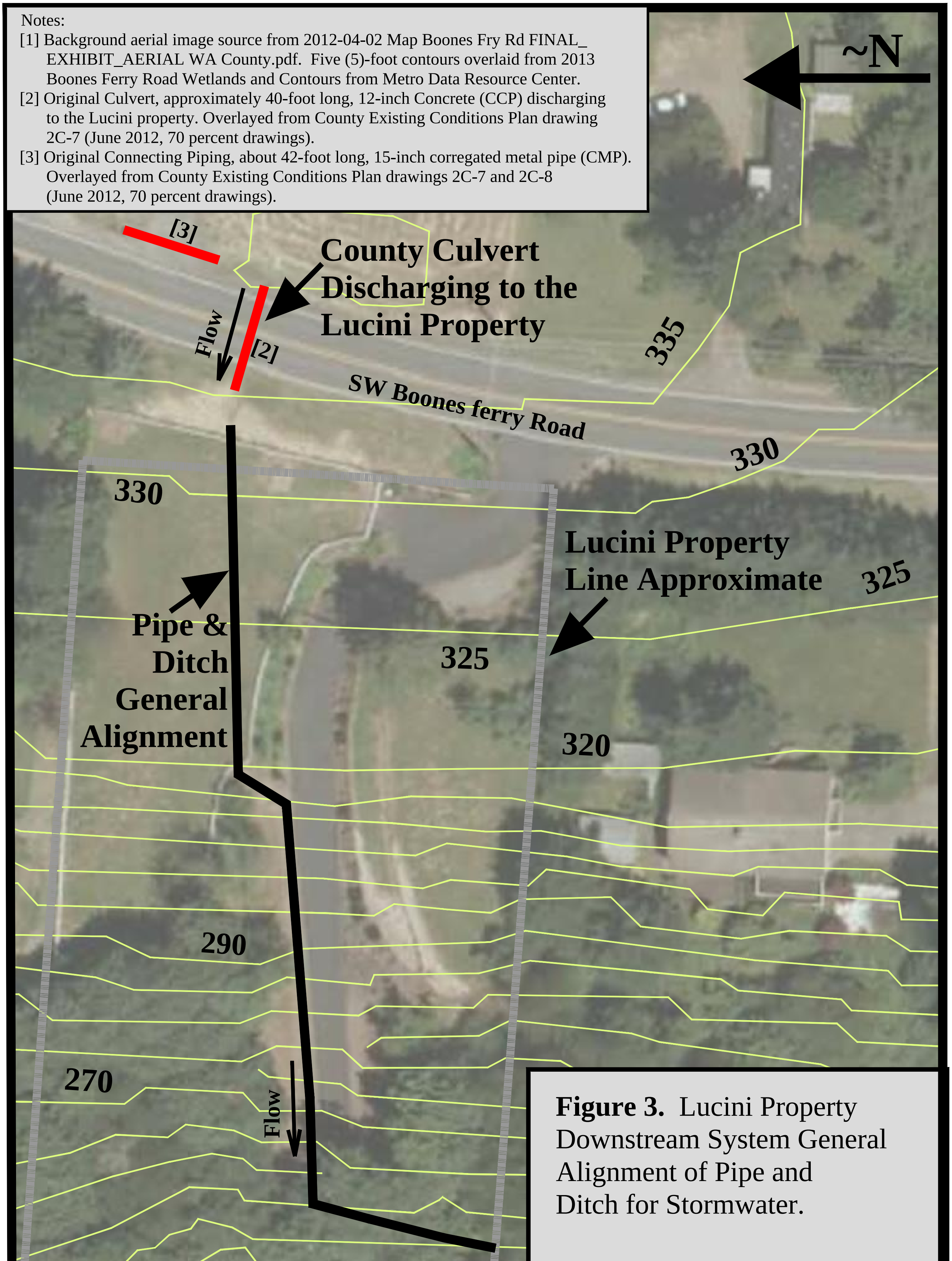


Figure 3. Lucini Property Downstream System General Alignment of Pipe and Ditch for Stormwater.

2. Background

This investigation begins with the ORIGINAL subbasin (Figures 4 and 5) stormflow conditions affecting the Lucini property and resulting from the SW Boones Ferry Road improvements project (approximately years 2013-2015). Unlike the County's Drainage Report (2013) that only considered very limited runoff hydrology, this study includes comprehensive stormflow hydrology and hydraulics comprised of the pipes and ditches upstream of, and on, the Lucini property.

Hydrology and Hydraulics

The hydrologic analysis performed in this report employs the U.S. Army Corps of Engineers (Corps) model called HEC-HMS.[7] The LEA model analysis was adjusted to the Washington County results for the initial corresponding design storm. The same Soil Conservation Service (SCS) design storm event[8] was used for both the Washington County and the LEA hydrologic analysis presented in this report.

The Washington County storm flow results affecting the Lucini property are compared in Tables 2 and 3, and are based on the SCS 25-year design storm event for ORIGINAL and IMPLEMENTED stormflow conditions, respectively.

For Original conditions, the County stated a peak storm flow of 1.17 cubic-feet-per-second (cfs) for the design storm event. The LEA hydrologic model analysis employing HEC-HMS produced the same storm flow results as the County. This LEA-County results calibration used the same model inputs as the County[9], for the supposed ORIGINAL drainage area, runoff curve numbers, and other corresponding parameters.

For IMPLEMENTED conditions, the County projected a peak storm flow of 0.85 cfs for the design storm event. The LEA hydrologic model analysis, employing HEC-HMS, produced the same storm flow results as the County. This LEA-County results calibration used the same inputs for the Implemented drainage area, runoff curve numbers, and other corresponding parameters.

Photos of the Lucini Property taken during the May 18, 2015 storm event are shown in Appendix A2. These photos demonstrate the excessive flow velocities generated at the site for storms even less than the 25-year event.

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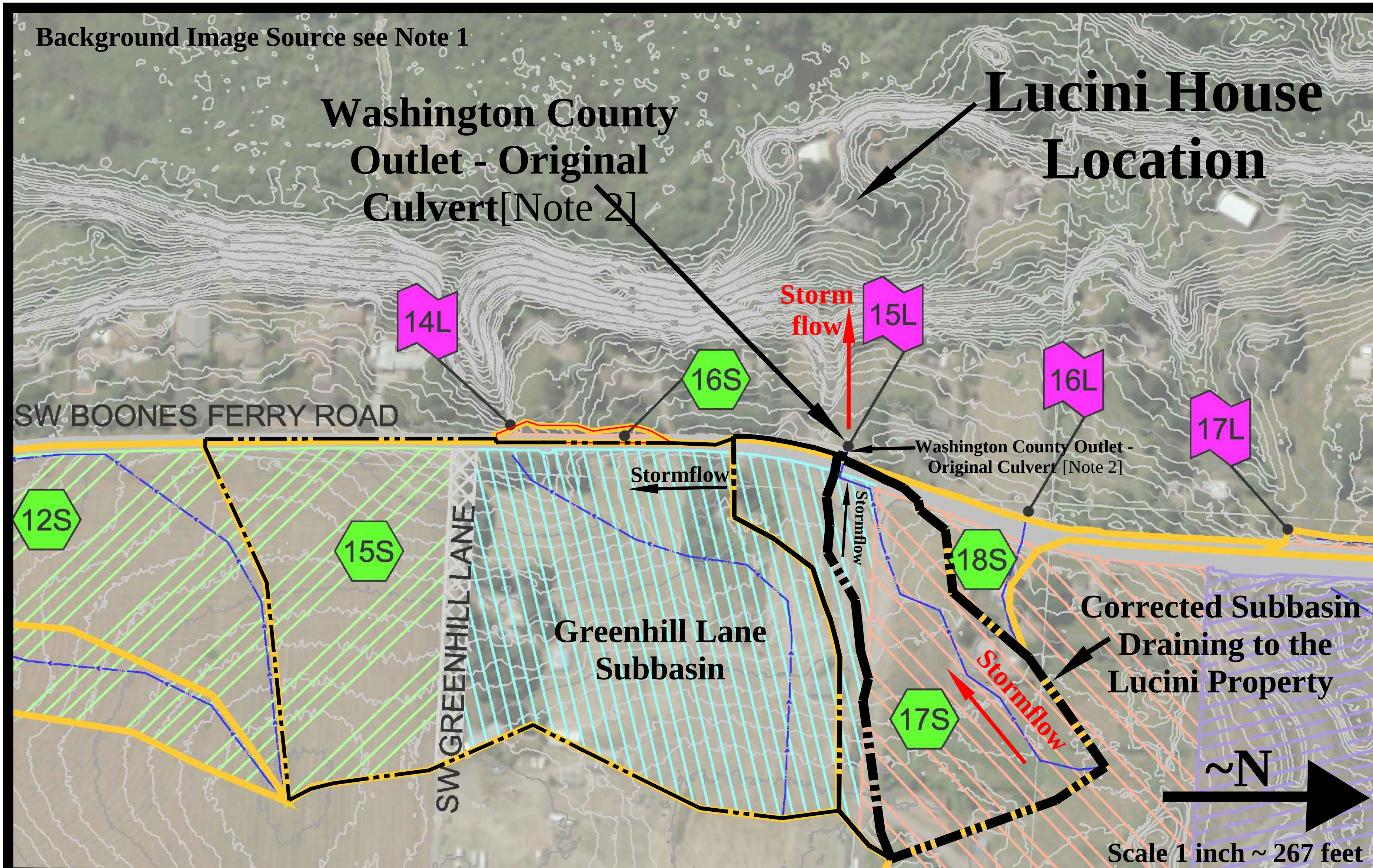
[7] HEC refers to the U.S. Army Corps of Engineers Hydrologic Engineering Center. HMS refers to the Hydrologic Model System.

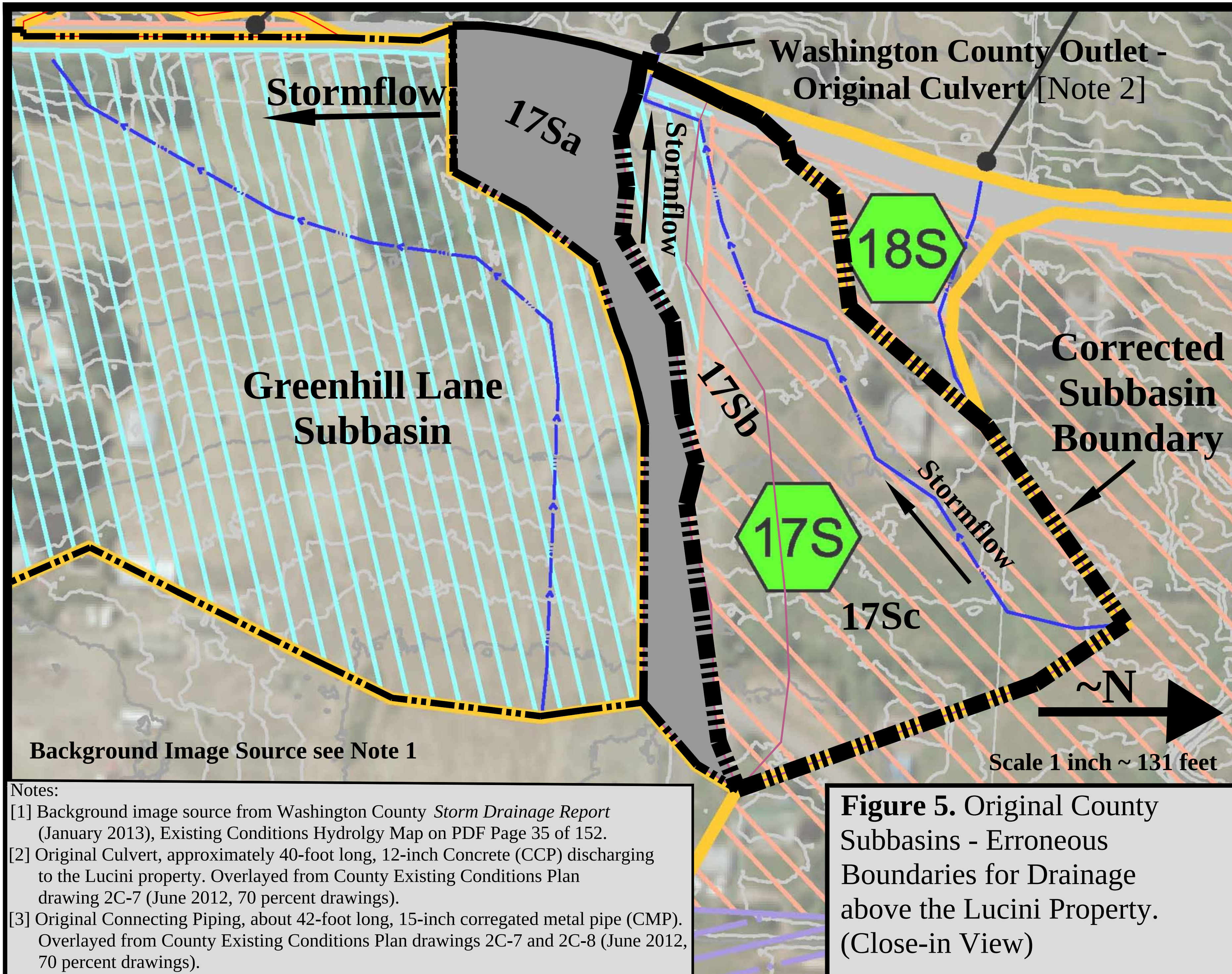
[8] The design storm is defined herein as the 24-hour, 25-year Type IA developed by the Soil Conservation Service (SCS). This the same design storm event as used by Washington County in its Drainage Report.

[9] The County employed the commercially available HydroCAD software program to carry out the hydrologic calculations using the SCS design storm method.



Notes:
[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).
[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 4. Original County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property.



Notes:

[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrolgy Map on PDF Page 35 of 152.

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 5. Original County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property. (Close-in View)

The County's Drainage Report (2013) indicates it is relying upon CWS 2007 for storm flow evaluation methodology, which requires a "Review of Downstream System"[10], especially when flow increases are likely under present and future conditions. No Downstream System review exists in the Drainage Report for the storm water culvert flow draining to the Lucini property.

Despite supposed lower stormflows based on erroneous sub-basin delineation and land use conditions being reported in the Drainage Report[11], the storm inlet capacity for the culvert has been substantially increased. Stormflows are now conveyed to the storm inlets, and hence onto the property, much more rapidly than prior to the Boones Ferry Road widening project. This problem will worsen in the future because the Drainage Report and construction design did not take into account the future effects of full build-out conditions.

Flooding problems at the Lucini property are additionally aggravated because existing and future development conditions were disregarded in the Drainage Report. As CWS 2007 standards require:[12]

> 5.05 Storm Conveyance Design Considerations
>
> 5.05.1 Design for Full Build Out
>
> Storm drainage facilities shall be designed and constructed to accommodate all future full build-out flows generated from upstream property.

The Drainage Report did not evaluate the full build out stormflow conditions that will affect the property. Increased discharges from future development, routed through the County's road culvert, will result in worse flooding than presently exists.

[10] CWS 2007, see Chapter 2, Page 12 under the 2.04.2 subsection heading "3. Review of Downstream System", i.e., this is subsection 2.04.2.3.

[11] See Drainage Report on Page 11, Table under heading 5.5 - Hydrologic Analysis Results. Specifically, see the table results for Discharge Location 15L that indicates a reduction in stormflows.

[12] CWS 2007, Chapter 5, Page7, see 1st paragraph in section 5.05.

3. Drainage Boundaries and Hydrologic Modeling

An evaluation of the stormflow drainage above the Lucini property establishes that the County's delineation of subbasin boundaries is crucially inaccurate. As broken down numerically in Table 1 for ORIGINAL conditions, the south section area of the County's Subbasin 17S is erroneously depicted as draining to the Lucini property. The south section is labeled Subbasin 17Sa in Table 1 below.

The faulty subbasin delineations in the County's Drainage Report (2013) are illustrated in Figures 4 and 5. The ORIGINAL drawings in the County's report were digitized by LEA into the computer aided design software, AutoCAD. This allowed for the making of the scale model to evaluate the subbasins affecting the Lucini property. Conversion of subbasin area into HEC-HMS compatible units in square-miles (mi^2) was also performed. The County's errors in its stated original runoff areas, draining to the Lucini property, overestimate the original stormflows that the property can convey.

Table 1. Land Area Inputs for Subbasins above the Lucini Property
For ORIGINAL and IMPLEMENTED Subbasin Boundaries

		Original Drainage Areas			
	Washington County Subbasin ID	Scale Model AutoCAD in^2	HEC-HMS Input mi^2	Subbasin Size ft^2	Subbasin Size acres
Corrected South Section	17Sa	9117253	0.002267	63314	1.45
Corrected North Section	17Sb+c	27264059	0.006781	189334	4.35
Original County Total	17S	36381312	0.009048	252648	**5.8**
Corrected South Section	17Sa	9117253	0.002267	63314	1.45
Central-Section	17Sb	7464200	0.001856	51835	1.19
North-Section	17Sc	19799859	0.004924	137499	3.16
Original County Total (OK, check on total above)	17S	36381312	0.009048	252648	**5.8**
		Implemented Drainage Areas			
	Washington County Subbasin ID	Scale Model AutoCAD in^2	HEC-HMS Input mi^2	Subbasin Size ft^2	Subbasin Size acres
South-Section	59Sa	7999004	0.001989	55549	1.28
North-Section	59Sb	23991460	0.005967	166607	3.82
Implemented County Total	59S	31990464	0.007956	222156	**5.1**

This resulted in erroneously concluding that the Boones Ferry Road right-of-way to the south of the original culvert[13] flowed into the Lucini property. The actual Original subbasin excluded all of the rainfall runoff from the southern strip of the County's wrongly depicted subbasin. This condition is illustrated in Figure 5, which more accurately shows the ORIGINAL stormflow from the southern strip as being routed to the Greenhill Lane subbasin.[14]

Original and Implemented Stormflows

Table 2 compares realistic ORIGINAL stormflows, as determined in this analysis, to the County's erroneous stormflows based on faulty subbasin drainage boundaries. For Original peak storm flows, it is estimated that the increased drainage area depicted in the County's Drainage Report results in a storm flow increase of about 31.5 percent that is discharged to the Lucini property. The hydrologic model inputs and results for HEC-HMS realistic Original conditions are contained in Appendix H.

Table 2. ORIGINAL Peak Stormflows
County Values Compared to HEC-HMS

Percent Increases for Projected County versus Actual Drainage Area Conditions

	Washington County Flows Based on Boones Fy. Road Drainage Analysis (cfs)	**HEC-HMS Flows Based on Actua1 BFR Drainage Areas** (cfs)	**Increase of Storm Flows to Lucini Property** (Percent)
Original Washington County - Pre-construction (prior to 2013)	1.17	0.89	31.5% [15]
Original Wash. CO Land Area - Ongoing Land Use (LU)	*County did Not Consider*	1.71	92.1%
Original Wash. CO Land Area - Projected Full Build-out (BO)	*County did Not Consider*	2.85	220.2%

The County's Drainage Report did not consider on-going land use changes other than the existing farming and single dwelling 2-acre lots. When actual ongoing urbanization and more intense land use are considered, the increased stormflows to the Lucini property are projected to increase by about 92.1 percent.

[13] This is the original 12-inch diameter concrete cylinder pipe (CCP) culvert, which is about 40-foot long, and identified as the County's Outfall #5.

[14] This is identified in the County's Drainage Report (2013) as Subbasin "17s". See the background image of Figure 4, which uses HexBox labels to identify subbasins.

[15] The calculation is: [(0.1.17 – 0.89) / 0.89] equals 0.315 or 31.5 percent.

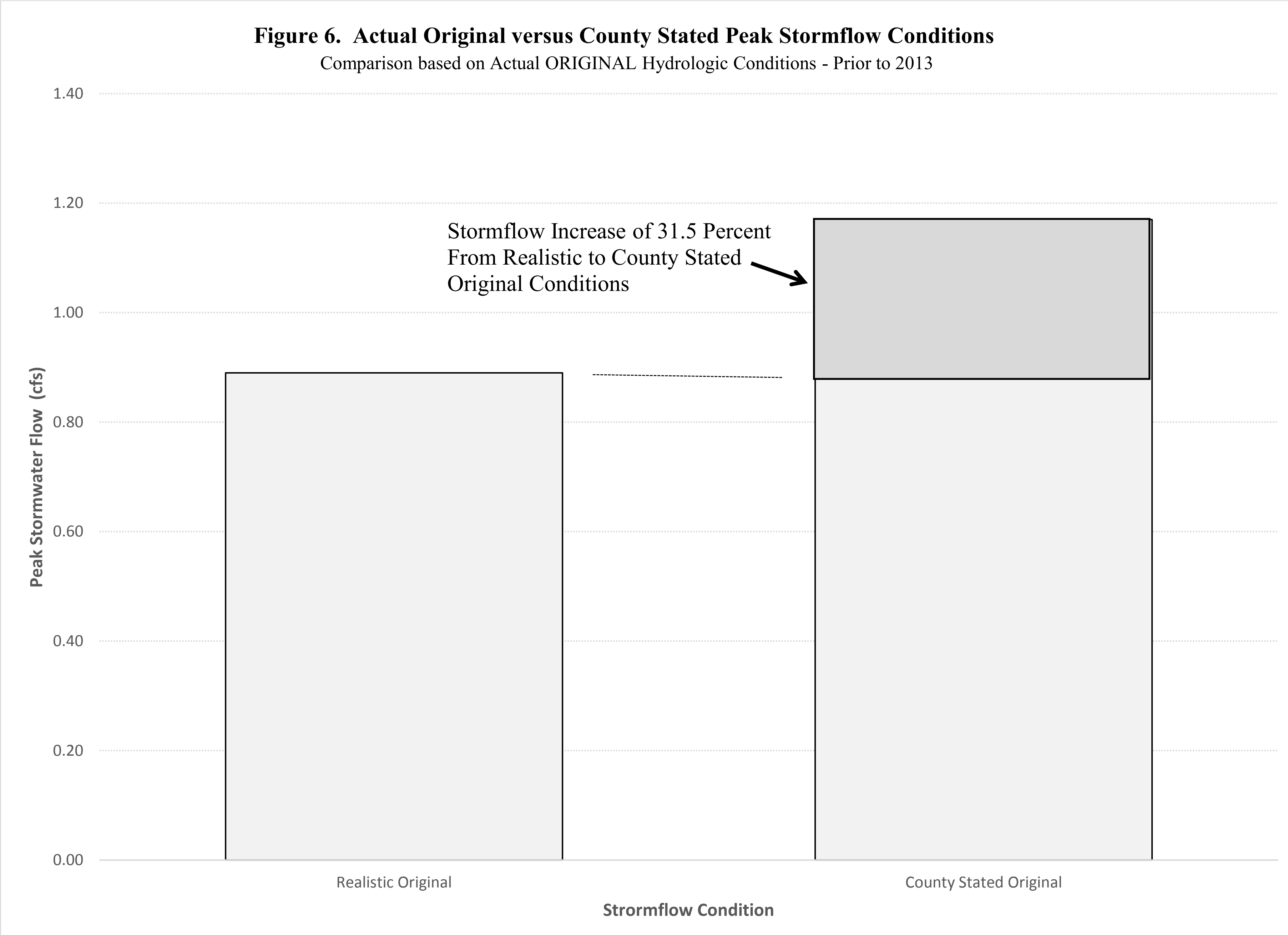


Figure 6. Actual Original versus County Stated Peak Stormflow Conditions
Comparison based on Actual ORIGINAL Hydrologic Conditions - Prior to 2013
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Peak Stormwater Flow (cfs)
Stormflow Increase of 31.5 Percent
From Realistic to County Stated
Original Conditions
Realistic Original
County Stated Original
Stormflow Condition

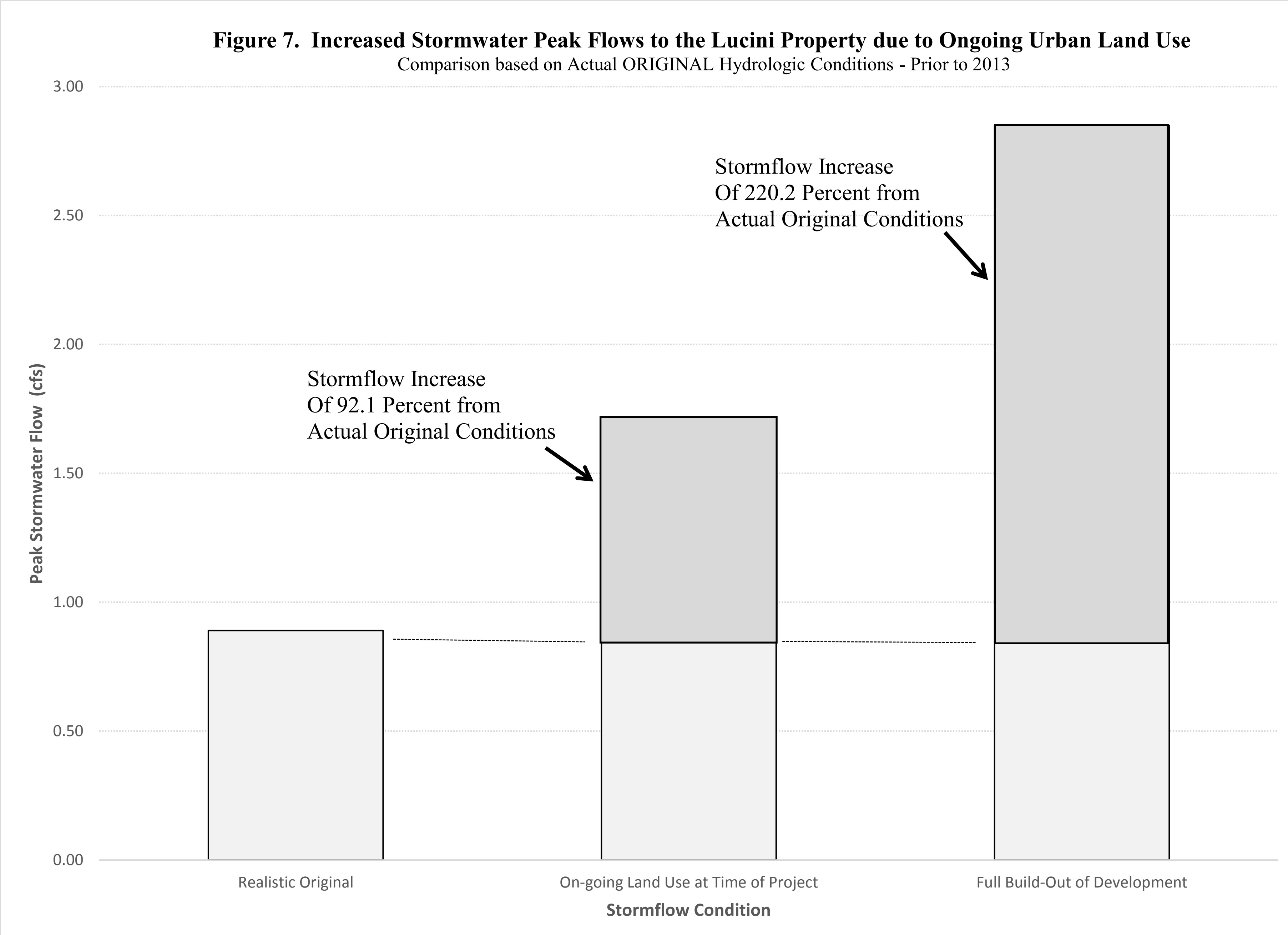


Figure 7. Increased Stormwater Peak Flows to the Lucini Property due to Ongoing Urban Land Use
Comparison based on Actual ORIGINAL Hydrologic Conditions - Prior to 2013
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Peak Stormwater Flow (cfs)
Stormflow Increase
Of 220.2 Percent from
Actual Original Conditions
Stormflow Increase
Of 92.1 Percent from
Actual Original Conditions
Realistic Original
On-going Land Use at Time of Project
Full Build-Out of Development
Stormflow Condition

The County did not consider future full build-out construction conditions slated for the drainage above the Lucini property. When this necessary evaluation based on the CWS guidance is considered, the County will be increasing storm flows to the Lucini property by about 220.2 percent.

Table 3 compares IMPLEMENTED stormflows, as determined in this analysis, to the County's stormflows based on faulty subbasin drainage boundaries (see Figures 9 and 10). For the Implemented condition under previous land use, the LEA analysis and the County's analysis of peak flows are equal and no increase in flows is reported.

Table 3. IMPLEMENTED Peak Stormflows
County Values Compared to HEC-HMS

Percent Increases of Projected versus Actual Conditions

	Peak Storm Flow from HEC-HMS		
	Washington County Flows Based on Boones Fy. Road Drainage Analysis (cfs)	**HEC-HMS Flows Based on Actua1 BFR Drainage Areas** (cfs)	**Increase of Storm Flows to Lucini Property** (Percent)
Implemented Washington County - Post-construction (after about early 2015)	*County did not Consider* [16, 17]	0.64	32.8% [18]
Implemented Wash. CO Land Area - Ongoing Land Use (LU)	*County did Not Consider*	1.95	204.7%
Implemented Wash. CO Land Area - Projected Full Build-out (BO)	*County did Not Consider*	3.29	414.1%

The County's Drainage Report did not consider on-going land use changes. Only farming was evaluated. For Implemented peak storm flows, when on-going urbanization and more intense land use are considered, the increased storm flows to the Lucini property increase by about 204.7 percent.

The County did not consider future full build-out conditions construction scheduled for the drainage above the Lucini property. When this necessary evaluation based on the CWS guidance is considered, the County will be increasing storm flows to the Lucini property by about 414.1 percent.

[16] The County simulated Implemented conditions that resulted in a stormflow of 0.85 cfs. The LEA hydrologic model was adjusted to the County's implemented conditions and stormflow of 0.85 cfs.

[17] Stormflows less than Original conditions were not considered by the County. The County claimed in its Drainage Report (2013) that it was reducing Original stormflows by about 10 percent.

[18] The calculation is (0.85 – 0.64) / 0.64 equals 0.328 or 32.8 percent. Where 0.85 cfs is the lowest velocity considered by Washington County.

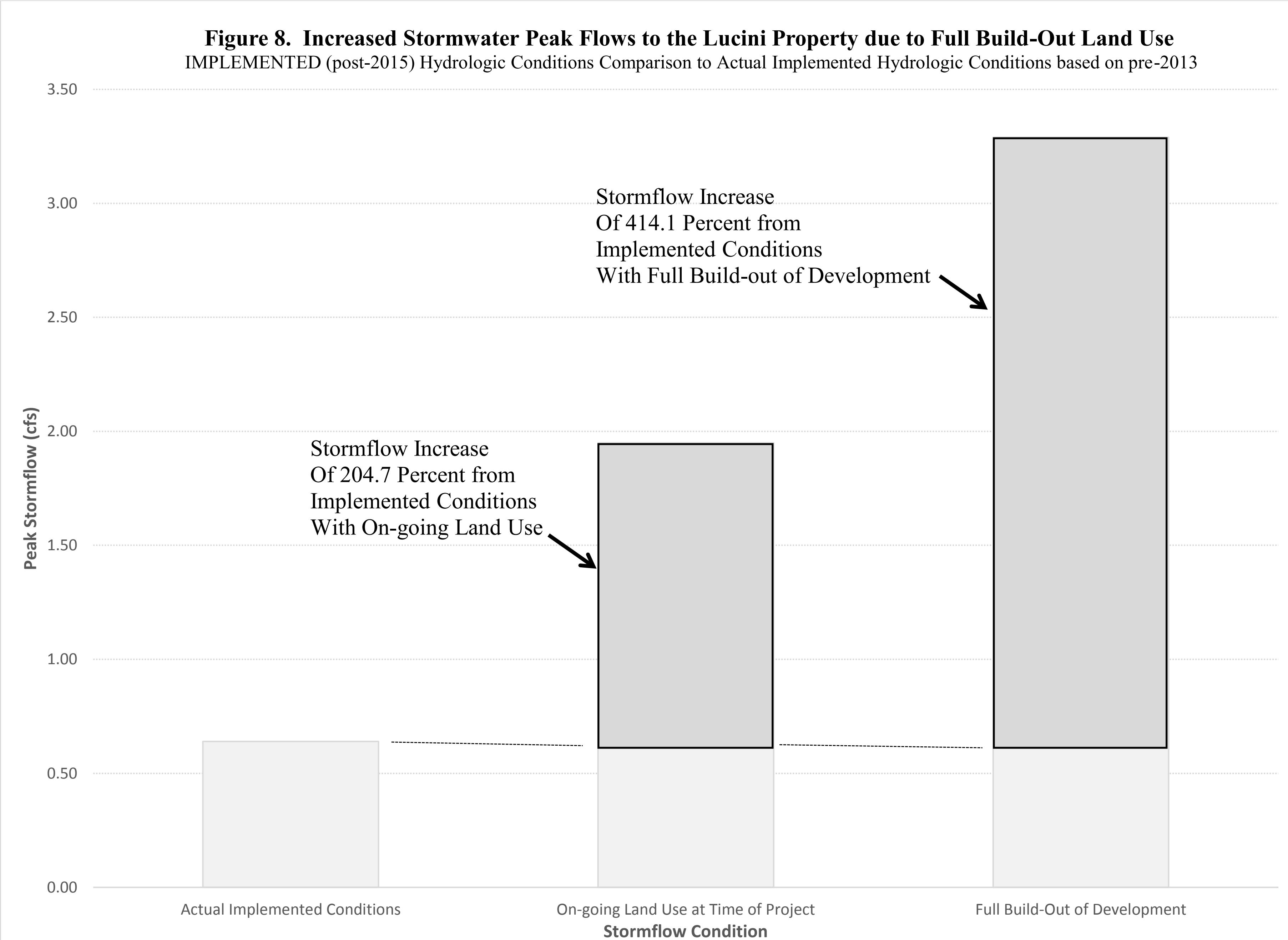
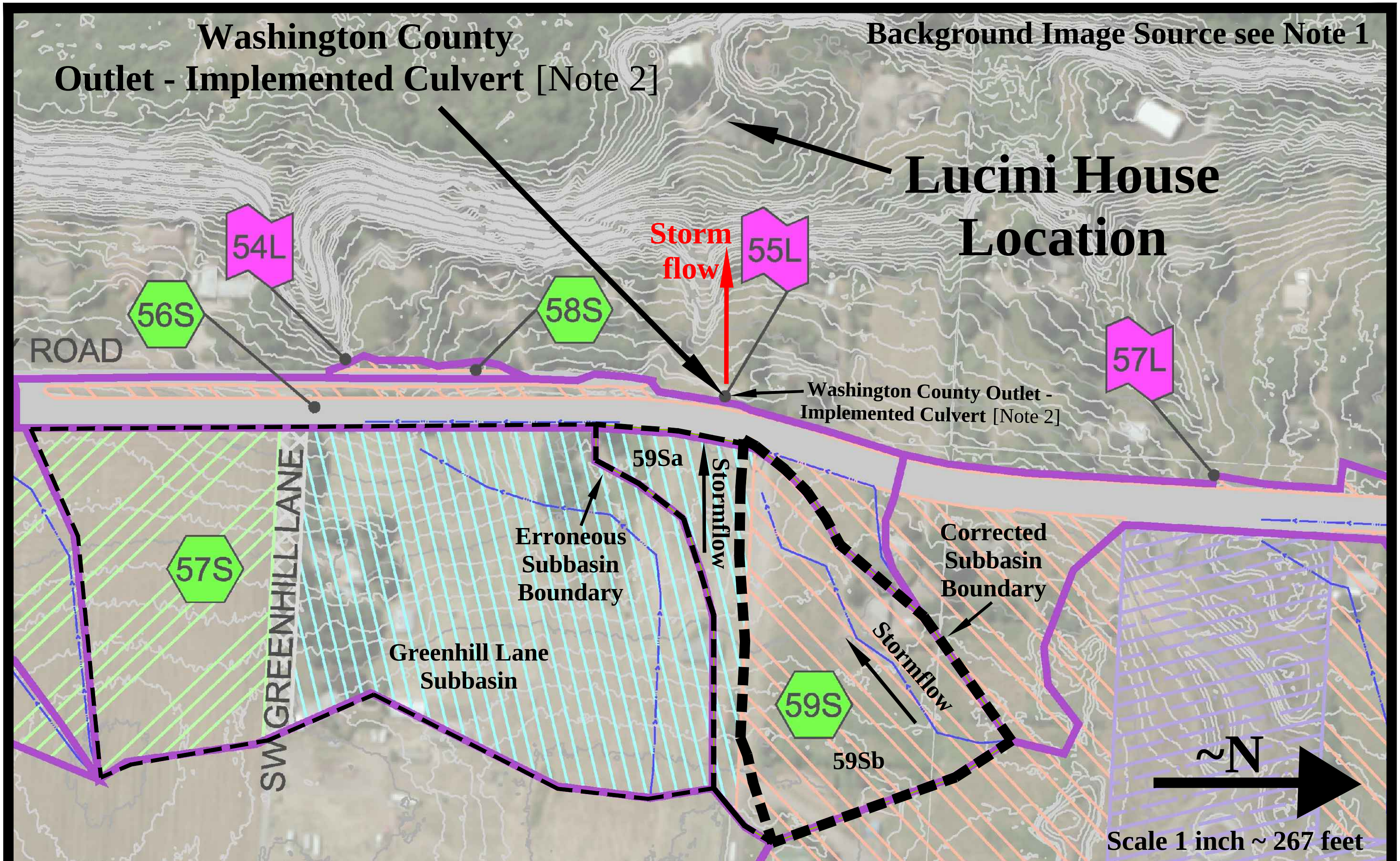
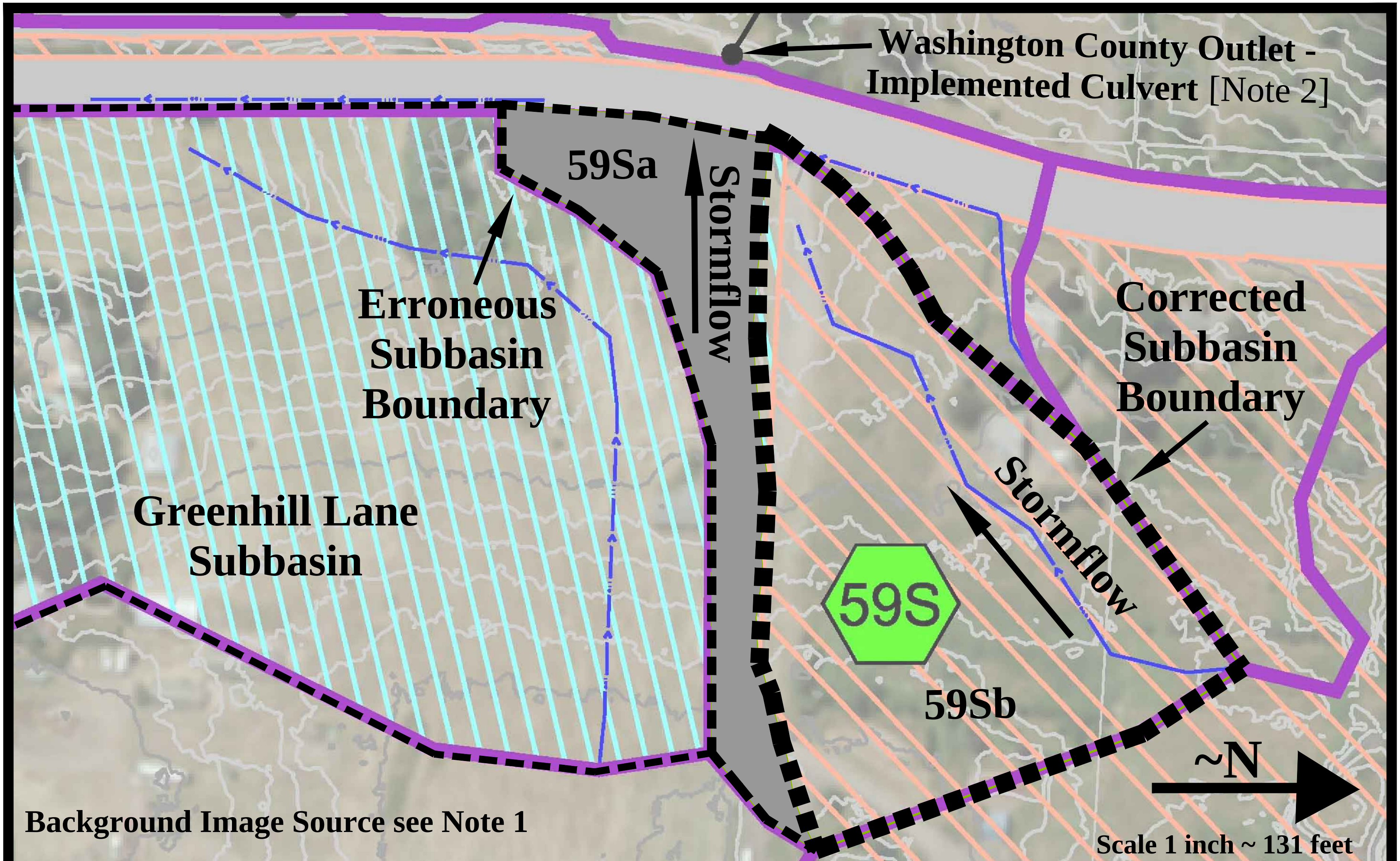


Figure 8. Increased Stormwater Peak Flows to the Lucini Property due to Full Build-Out Land Use
IMPLEMENTED (post-2015) Hydrologic Conditions Comparison to Actual Implemented Hydrologic Conditions based on pre-2013
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Peak Stormflow (cfs)
Stormflow Increase
Of 414.1 Percent from
Implemented Conditions
With Full Build-out of Development
Stormflow Increase
Of 204.7 Percent from
Implemented Conditions
With On-going Land Use
Actual Implemented Conditions
On-going Land Use at Time of Project
Full Build-Out of Development
Stormflow Condition



Notes:
[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 36 of 152.
[2] Implemented Culvert, approximately 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Overlayed from As-built construction plan drawings 232-233 of 385.

Figure 9. IMPLEMENTED County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property.



Notes:

[1] Background image source from Washington County *Storm Drainage Report* (January 2013), Existing Conditions Hydrology Map on PDF Page 36 of 152.

[2] Implemented Culvert, approximately 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Overlayed from As-built construction plan drawings 232-233 of 385.

Figure 10. IMPLEMENTED County Subbasins - Erroneous Boundaries for Drainage above the Lucini Property. (Close-in View)

Defective County Topography and Inaccurate Original Curb and Storm Sewer Claims
Stormflows originally directed south into the Greenhill Lane subbasin, through the road right-of-way, were re-routed by the road improvement project onto the Lucini property via the County's Storm Outfall #5. As shown in Figures 4 and 5, the subbasin drainage drawings for the ORIGINAL conditions[19] do not show the actual topography affecting drainage conditions. The IMPLEMENTED drainage basin conditions then re-route increased storm flows to the Lucini property.[20]

The County's Drainage Report says that the original road had curbs and storm sewers routing flows.[21] This is incorrect as there were no curbs or storm sewers for SW Boones Ferry Road above the Lucini property. Drawings 2C-7 and 2C-8 excerpted in Appendix C demonstrate there were no curbs and storm sewers upstream of the Lucini property.[22] Additionally, the photos in Appendix A1 taken by as part of the County's Wetland Delineation Report[23] and by the Lucini's also reveal the lack of curbs and storm sewers above the Lucini property. This is a crucial detail because it determines whether a portion of stormflows go south into the Greenhill Lane subbasin, or north into the subbasin above the Lucini property. In its Drainage Report the County erroneously claims that a portion of the Greenhill Lane subbasin stormwater drains into the Lucini property.

The photos contained in Appendix A1 show the ORIGINAL Drainage of Storm Water from SW Boones Ferry Road. Photo A1a was taken by Washington County September 28, 2012; and Photo A1b was taken by John & Grace Lucini on Dec. 20, 2012. Portions of the subbasins to the east (on the left) historically drained into the Road Alignment and then south away from the Lucini property. This is contrary to the analysis contained in the County's Drainage Report (2013), which wrongly states this road section is curbed including storm sewers, with portions of stormflows being directed into the Lucini property.

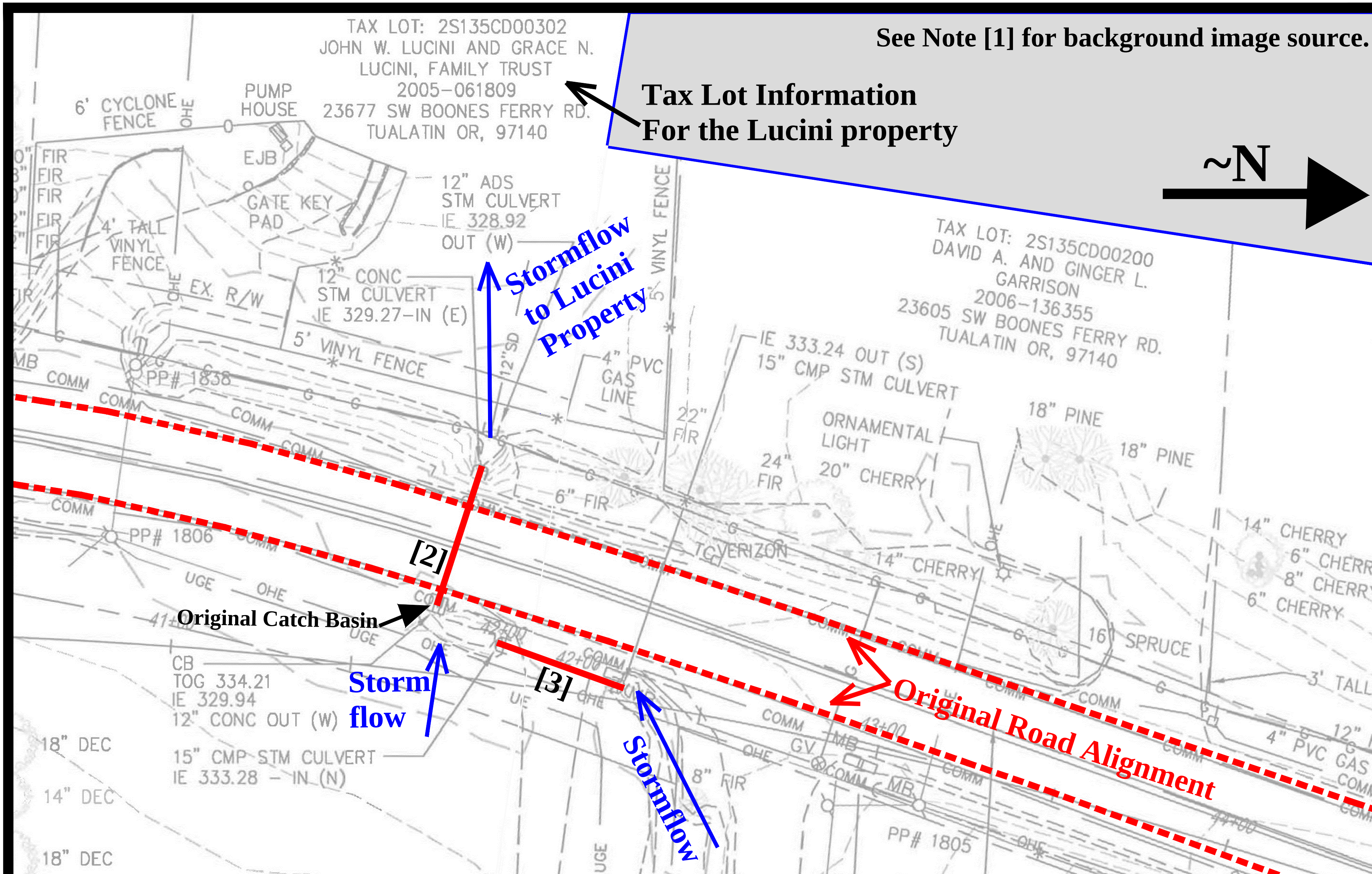
[19] Drainage Report (2013), Sheet No. 1 of 3 labeled "Existing Conditions Hydrology Map" on PDF page 35 of 152.

[20] Ibid, see Sheet No. 2 of 3 labeled "Proposed Conditions Hydrology Map" on PDF page 36 of 152.

[21] Drainage Report (2013), Storm Drainage Report – SW Boones Ferry Road (SW Day Road to SW Norwood Road, by MacKay Sposito for Washington County, Capital Project Management (CPM), Final January 31, 2013. See PDF page 59 of 152 under Summary of Subcatchment 17S, which is the drainage above the Lucini property. The Drainage Report erroneously states that the drainage is "w/curbs & sewers" which did not exist above the Lucini property. This faulty information and its implications were used in the County's hydrologic analysis.

[22] County 2012a, Drawings from MacKay Sposito submittal to the County contained in file: 2012 June Existing Conditions 70% Plans.pdf.

[23] County 2012b, See PDF page 81 of 90 in file: 2012 Dec Wetland Delineation Report-Boones Ferry Rd Improvement Project WD2013-0002.pdf.



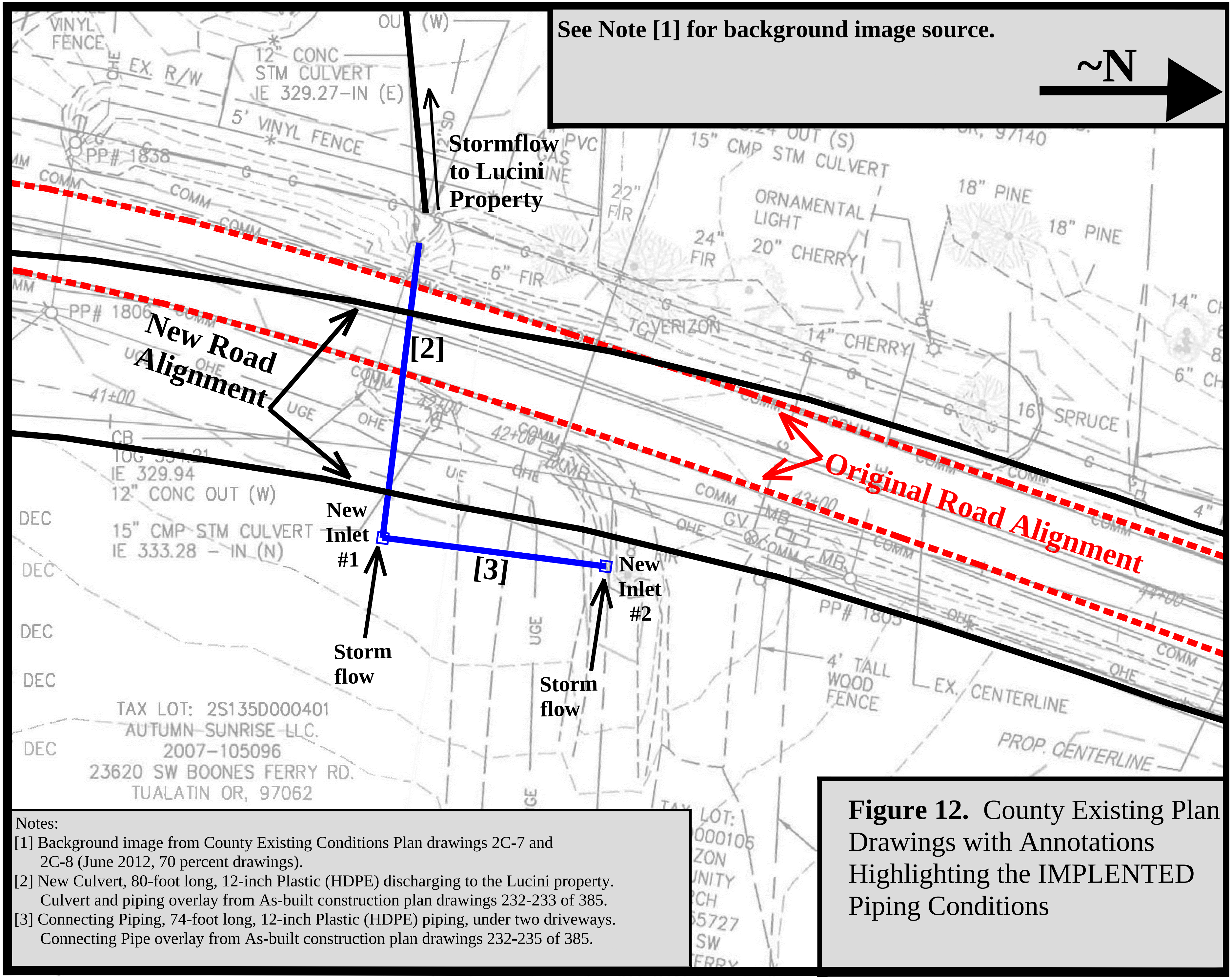
Notes:

[1] Background image from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

[3] Original Connecting Piping, about 42-foot long, 15-inch corregated metal pipe (CMP). Overlayed from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).

Figure 11. County Existing Plan Drawings with Annotations Highlighting the ORIGINAL Conditions and Piping



Notes:
[1] Background image from County Existing Conditions Plan drawings 2C-7 and 2C-8 (June 2012, 70 percent drawings).
[2] New Culvert, 80-foot long, 12-inch Plastic (HDPE) discharging to the Lucini property. Culvert and piping overlay from As-built construction plan drawings 232-233 of 385.
[3] Connecting Piping, 74-foot long, 12-inch Plastic (HDPE) piping, under two driveways. Connecting Pipe overlay from As-built construction plan drawings 232-235 of 385.

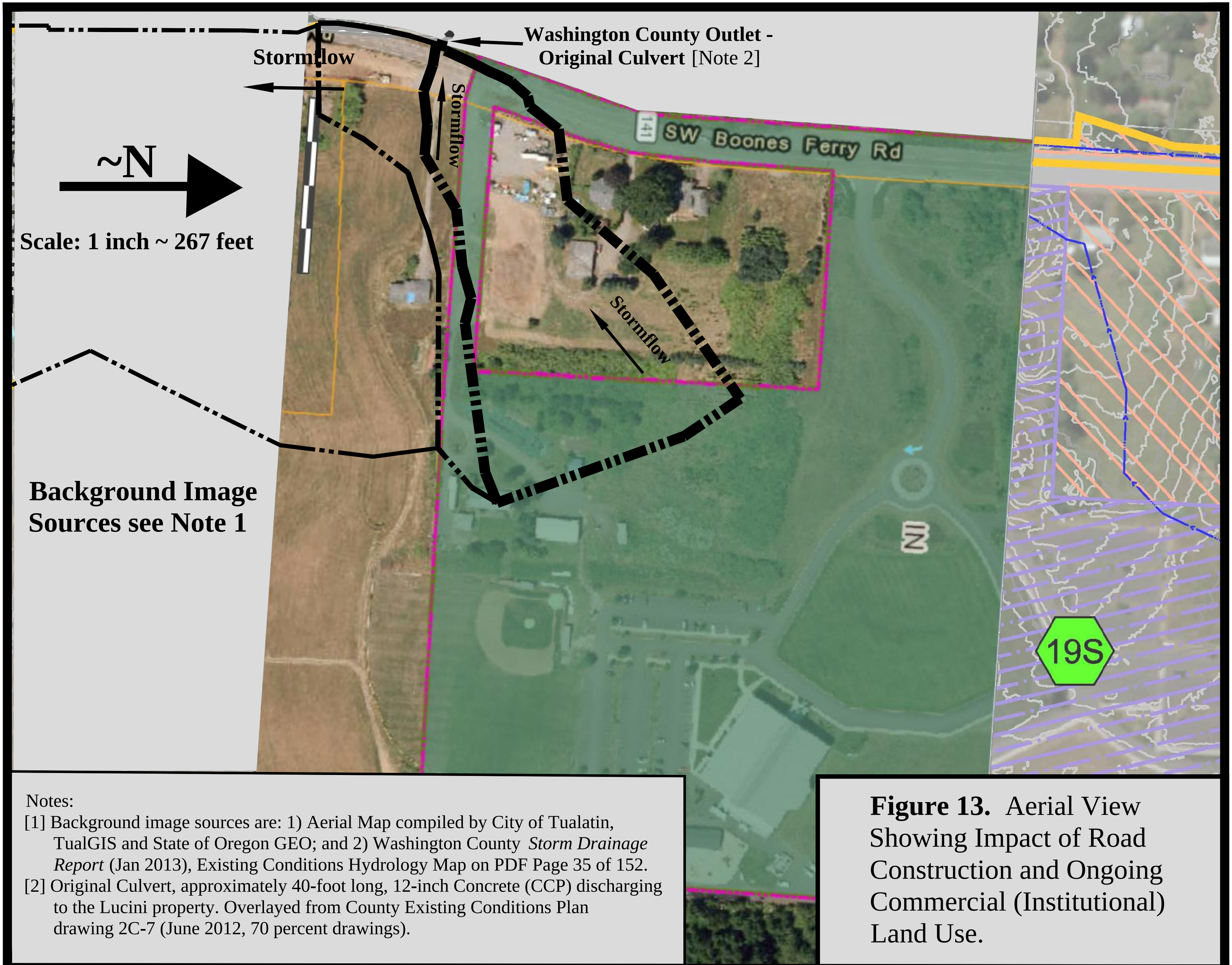
Figure 12. County Existing Plan Drawings with Annotations Highlighting the IMPLENTED Piping Conditions

Hydrologic Modeling and Construction Development

The County's Drainage Report disregarded construction development that increases run-off in the drainage upstream of the Lucini property. The County's hydrologic modeling of the upstream subbasin was characterized as "Farmstead" and single dwelling 2-acre lots. However, the actual additional use of a majority of the subbasin is to support heavy road construction and on-going use as commercial (Institutional), a more intense land-use from a stormwater generation standpoint. This relationship between the subbasin boundary delineation and active road construction (in 2012), equipment parking and material staging can be plainly seen in the aerial view presented in Figures 13 and 14.

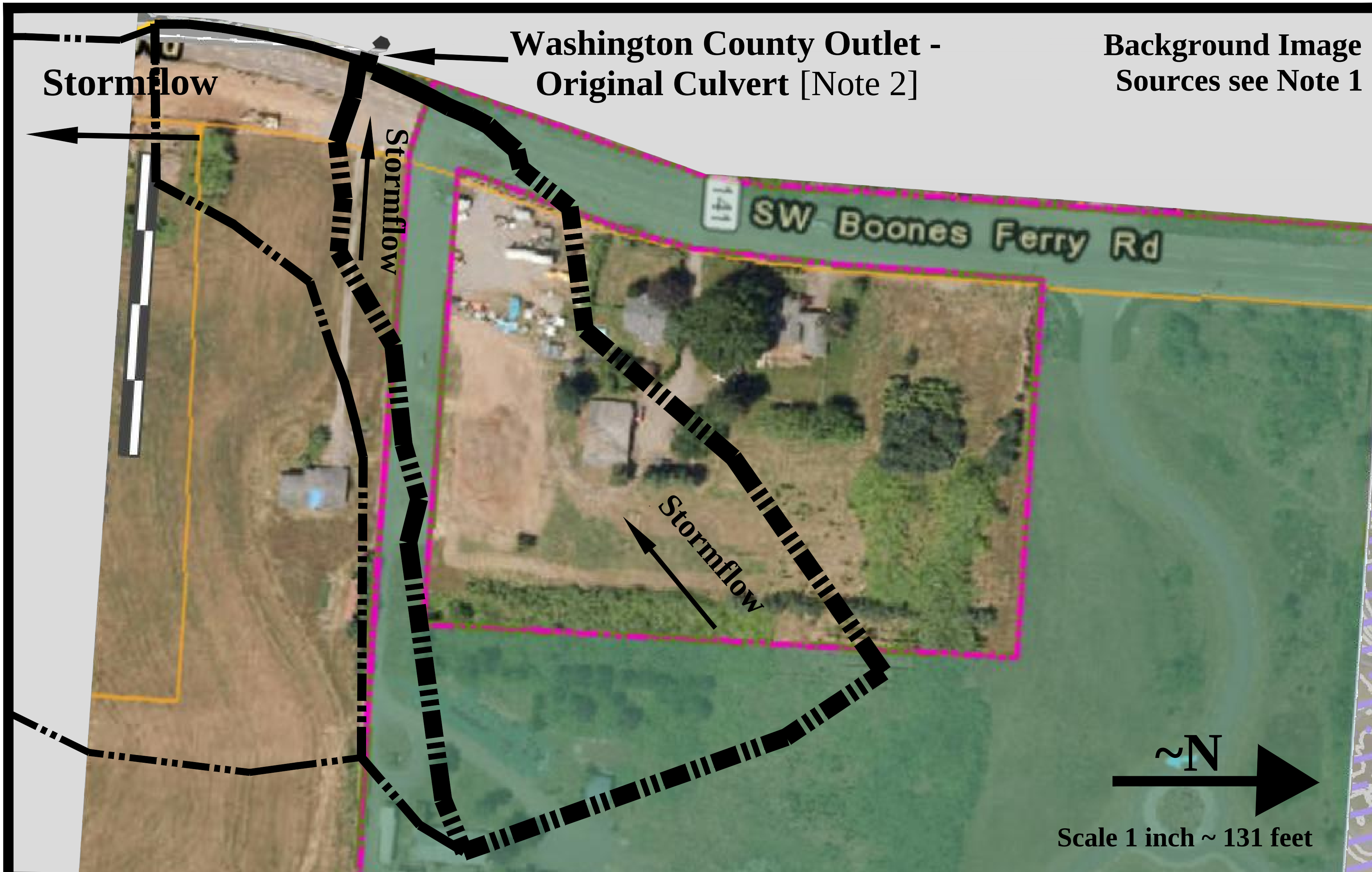
The Natural Resources Conservation Service (NRCS) has commented on this problem of disturbed soil effectively raising runoff flows and has stated:

> **630.0702 Disturbed soils**
>
> As a result of **construction and other disturbances**, the soil profile can be altered from its natural state and the listed group assignments generally no longer apply, nor can any supposition based on the natural soil be made that will accurately describe the **hydrologic properties of the disturbed soil**. In these circumstances, an onsite investigation should be made to determine the hydrologic soil group. A general set of guidelines for estimating **saturated hydraulic conductivity** from field observable characteristics is presented in the Soil Survey Manual (Soil Survey Staff 1993).
>
> [Bold by LEA except subsection title.]



Notes:
[1] Background image sources are: 1) Aerial Map compiled by City of Tualatin, TualGIS and State of Oregon GEO; and 2) Washington County *Storm Drainage Report* (Jan 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.
[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

Figure 13. Aerial View Showing Impact of Road Construction and Ongoing Commercial (Institutional) Land Use.



Notes:

[1] Background image sources are: 1) Aerial Map compiled by City of Tualatin, TualGIS and State of Oregon GEO; and 2) Washington County *Storm Drainage Report* (Jan 2013), Existing Conditions Hydrology Map on PDF Page 35 of 152.

[2] Original Culvert, approximately 40-foot long, 12-inch Concrete (CCP) discharging to the Lucini property. Overlayed from County Existing Conditions Plan drawing 2C-7 (June 2012, 70 percent drawings).

Figure 14. Aerial View Showing Impact of Road Construction and Ongoing Commercial (Institutional) Land Use. (Close-in View)

4. Stormflow Hydraulics

The County's Drainage Report did not perform a hydraulic analysis to assess the effects of its stormflow above and through the Lucini property. The Corps hydraulic model, HEC-RAS[24], is used in this analysis to partly[25] fill-in this crucial lack of stormflow hydraulic information.

Rainfall runoff flows generated by the hydrologic model HEC-HMS are supplied as inputs to the HEC-RAS hydraulic model to consider the impact on drainage channels, piping, and other features of the drainage system. Specifically, the hydraulic effects resulting from stormflows passing through the drainage system subbasins, stormflow routing, channels, culverts (piping), land use conditions, channel and piping materials, and other parameters can be assessed.

Cross-sections and Other Hydraulic Information

The HEC-RAS hydraulic model requires the input of cross-sectional information that demarcate the channel with elevation versus distance from the bank. Additional information supplied to the model includes distance between cross-sections, hydraulic losses and other stormflow parameters.

The County has not provided the public with complete topography of the subbasin draining to the Lucini property, and other properties, below its Boones Ferry Road project site. Accordingly, channel and pipe cross-section information are estimated for input into the HEC-RAS hydraulic model. Summary input and output hydraulic information for the HEC-RAS simulation is contained in Appendix I.

The County did not consider the hydraulic effects of increased stormflow conditions on the Lucini property resulting from its Boones Ferry Road Improvement construction project. As discussed previously, increased stormflows onto the Lucini project are likely because of inaccurate subbasin delineation by the County. The County also failed to consider the effects of ongoing and future development, with increasingly intense land use and full-build-out conditions, contributing to increased stormflows.

Hydraulic Analysis Results

The County did not consider stormflow cases that take into account greater land use conditions and future development above the Lucini property. For example, the County disregarded the impact of its own road construction efforts, plainly visible in the aerial views in Figures 13 and 14 as well as Appendix F, on lands draining to the Lucini property. The County characterizes these activities as "farming" or single dwelling 2-acre lots.

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[24] HEC-RAS refers to the River Analysis System hydraulic model developed by the Corps.

[25] This hydraulic analysis using HEC-RAS performs a steady-state evaluation for a range of peak stormflow conditions inputted from the HEC-HMS hydrologic model. A more detailed time-varying analysis employing unsteady stormflow conditions, with stormflow storage, may be warranted in future evaluation with additional planning information but is beyond the timing and scope of this report.

The analysis presented herein does take into account actual land use intensity and development circumstances as previously discussed in the Hydrologic Modeling section. This analysis evaluates conditions for both ORIGINAL and IMPLEMENTED hydraulic configurations for the range of runoff conditions presented in Tables 2 and 3, respectively. Appendix I contains the results of the hydraulic analysis.

Figure 15 depicts the hydraulic profile generated by HEC-RAS for the ORIGINAL configuration using runoff stormflows based on future full build-out development conditions at 2.85 cfs. Stormflow existing prior to the County's road project[26] (0.89 cfs) and additional profiles are also contained in Appendix I.

A key consideration in reviewing these figures is that the ground slope goes from moderate above (east) the Lucini property to very steep (west) on the Lucini property. The County's Drainage Report (2013) analysis did not consider this substantial change of slope and its likely effect, which is to cause high stormflow velocities and extremely erosive conditions, on the Lucini property.

Comparing velocities with likely stormflows demonstrates the value of reducing runoff flow peaks. High stormwater flows cause erosion and clog ditch and pipe locations. In this HEC-RAS analysis, 25-yr design storm events were varied by correcting for actual subbasin areas and using genuine land use conditions as described in the hydrologic Tables 2 and 3 of this report for the ORIGINAL and IMPLEMENTED configurations, respectively.

Figure 16 for the ORIGINAL configuration illustrates velocities for the upstream and downstream stations along the Lucini property approximate 150-foot ditch[27]. This figure shows that as stormflows increase from 0.89 cfs to 2.85 cfs, highly erosive storm velocities occur.

As charted in Figure 16, flow velocities in excess of 4.0 feet-per-second (fps) produce adverse conditions that erode soil.[28] This is consistent with the stormwater damage to the ditches, and pipe blockage, on the Lucini property (see photos in Appendix A2).

Figure 17 for the IMPLEMENTED configuration illustrates velocities for the upstream and downstream stations along the Lucini property approximate 150-foot ditch. This figure shows that as stormflows increase from 0.85 cfs to 3.29 cfs, highly erosive storm velocities will occur into the future.

The two lower flow conditions at 0.64 cfs and 0.85 cfs do not produce excessive storm velocities. The 0.64 cfs value is what the peak 25-year storm event should be if the County was actually reducing stormflows onto the Lucini property consistent with what it

---

[26] Prior to early 2013.

[27] This ditch is alongside the Lucini driveway and runs generally from east to west. See Figures 2 and 3 for the alignment of this drainage ditch relative to the County's road construction and the Lucini property.

[28] Linsley, Ray K. and Franzini, Joseph B., Water-Resources Engineering, published by McGraw-Hill, 1979.

is saying in its Drainage Report. The 0.85 cfs value simulated by the County is for farmland only and does not include actual urbanization and increased runoff in the subbasin above the Lucini property. When actual ongoing land use is considered, stormflow of 1.95 cfs more accurately reflects actual runoff being discharged from the County's culvert (Outfall #5) onto the Lucini property.

An orifice plate can be used to reduce storm pipe flow diameter and flow area during peak flow events. This physical measure decreases peak stormflows and lowers storm flow velocities on the Lucini property. The location of the proposed orifice plate is shown in Figure 12 as indicated in the IMPLEMENTED new storm inlet #1.

The construction and installation plans for the orifice plate is shown in the guidance document relied upon by the County (CWS 2007). For convenience, the orifice plate drawings are presented in Appendix G (see CWA Drawings Nos. 720 and 730).

Figure 15. HEC_RAS Hydraulic Profile of ORIGINAL Pipe and Ditch Conditions at 2.85 cfs
Above and On the Lucini Property

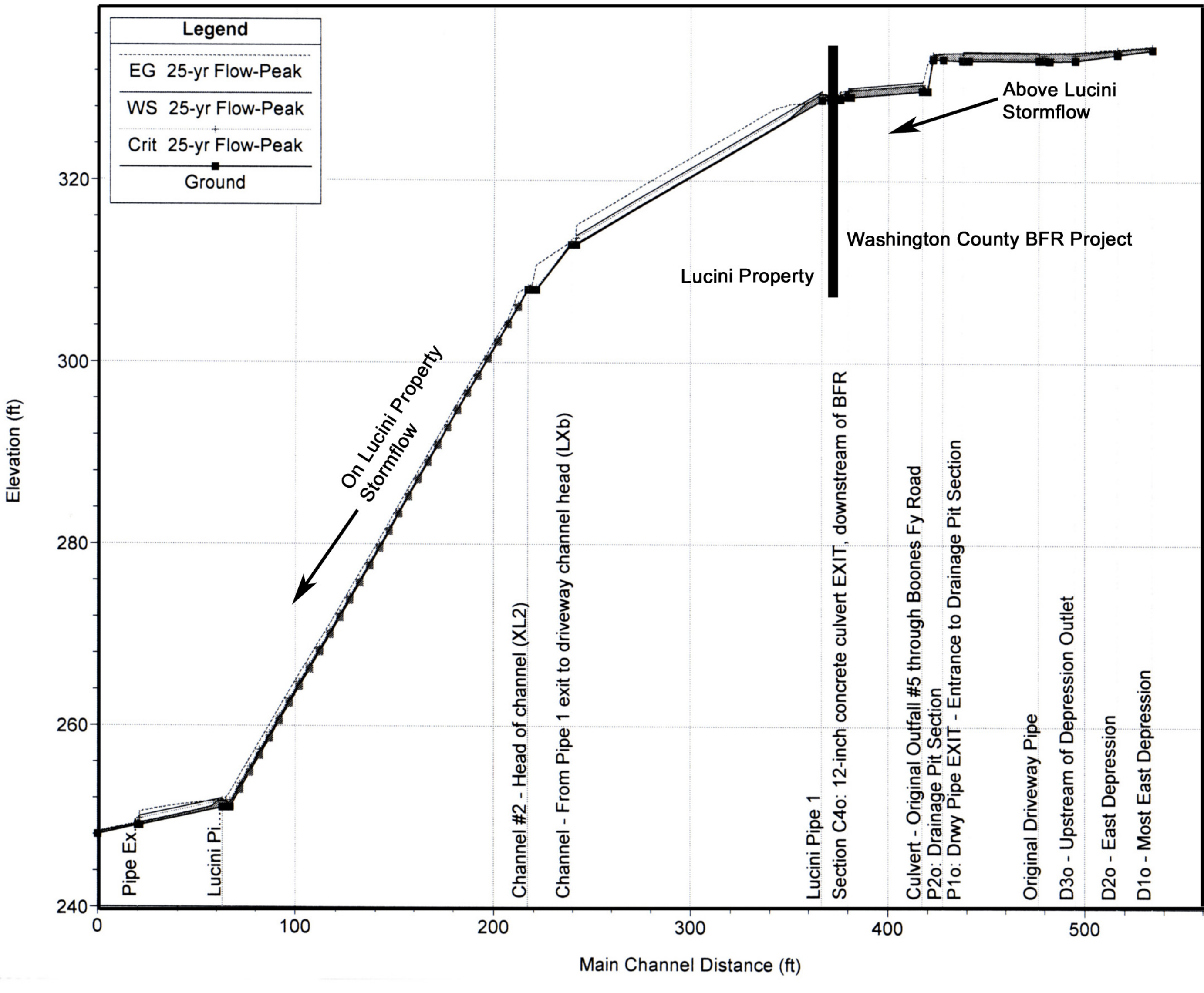
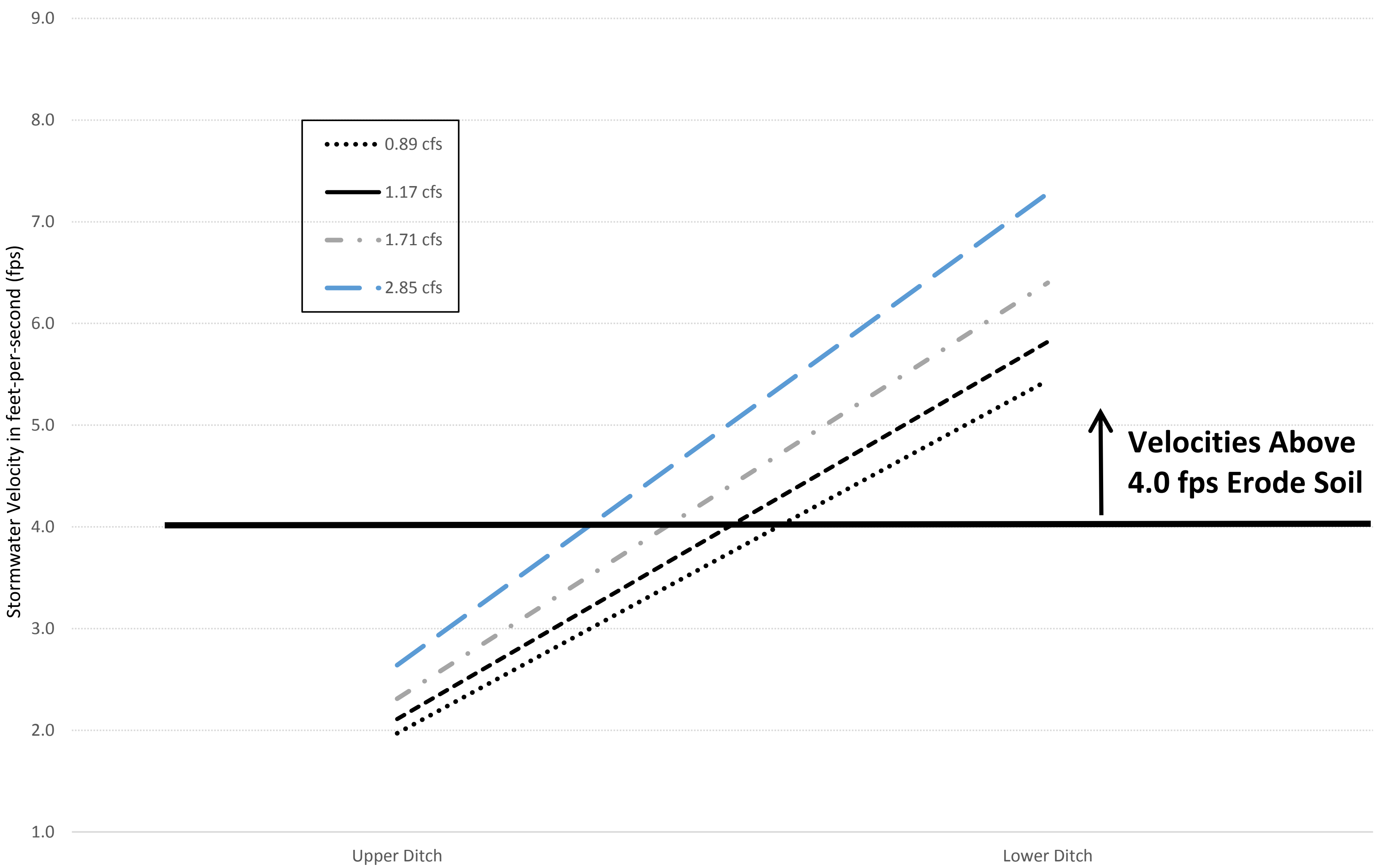


Figure 16. ORIGINAL Configuration - Velocities at Likely Flows 25-yr Design Storm Event

Upstream and Downstream Stations along the Lucini property approximate 150-foot Ditch



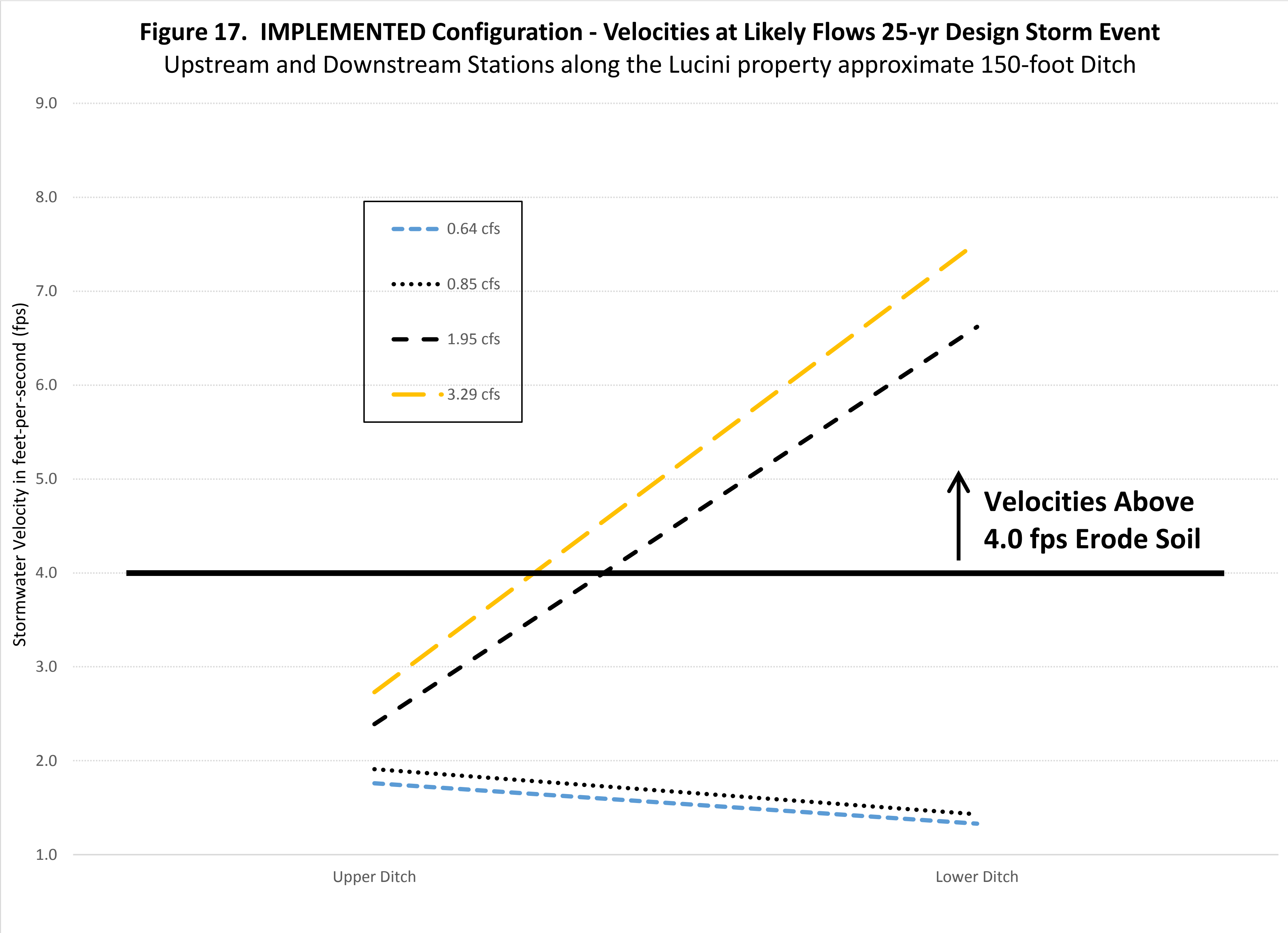


Figure 17. IMPLEMENTED Configuration - Velocities at Likely Flows 25-yr Design Storm Event
Upstream and Downstream Stations along the Lucini property approximate 150-foot Ditch
Stormwater Velocity in feet-per-second (fps)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.64 cfs
0.85 cfs
1.95 cfs
3.29 cfs
Velocities Above
4.0 fps Erode Soil
Upper Ditch
Lower Ditch

5. Planning Level Costs

There are three levels of estimated capital costs associated with fixing problems on the Lucini property resulting from the County's SW Boones Ferry Road project:

1) Immediate Shorter Term Remedy using Orifice Plate ($4,500 to $6,500 installed)
2) Ongoing Flow and Water Quality Control Facilities ($12,157 to $17,560 installed)
3) Longer Term Detention/Retention Facilities (to several hundred thousand dollars)

These capital costs include equipment, materials, labor, and construction contractor overhead and profit. Design, engineering and construction management costs are separately considered. An estimate of 20 percent of the final construction capital cost for this relatively small scale project is considered. For the high range estimates above, the design cost estimates are $1,300 for number 1 and $3,572 for number 2.

These are planning level capital costs and are presented in a range between the lower cost that is 10 percent below the estimated base cost; and the high cost that is 30 percent above the estimated base cost. Presenting only a single estimated base cost is not adequate for planning purposes and providing costs as a range is more convenient. Planning level costs for construction are presented using this cost range method because direct bid costs are not part of this study. While actual bid costs may come in lower (e.g., 10 percent), if actual potential bid costs are higher (e.g., up to 30 percent) then the outcome is undesirable if unaccounted for.

1) Immediate Shorter Term Remedy

This remedy alleviates the immediate problem on a short-term basis by reducing peak stormflows and consequent erosion on the Lucini property. This can be accomplished by using an orifice plate at the County's New Inlet #1 (this is the south inlet). The proposed orifice location is shown in Figure 12 at the New Inlet #1. The orifice would be installed at the upstream end of the implemented 80-foot long, 12-inch diameter culvert comprising the County's Outfall #5.

The County has indicated it is using CWS 2007 for guidance, which contains the Drawing No. 730 "Orifice Plate and Guide" that can be installed in New Inlet #1. For convenience, the CWS Drawing No. 730 is contained in Appendix G of this report. Orifice plate openings of 6, 8 and 10 inches can be fabricated and each used separately until it is determined which size best reduces peak flows and most efficiently uses storage in the IMPLEMENTED pipes, ditches and depressions.

The installed orifice fits into the new inlet without structural changes to the inlet. Construction materials are not extensive or expensive. Accordingly, the cost of installation of this immediate remedy is estimated in the range of $4,500 to $6,500.

2) Ongoing Flow and Water Quality Control Facilities

Estimated costs of the intermediate remedy facilities are listed in Table 4.[29] Both flow and water quality (WQ) control are needed because high stormflow velocities cause erosion upstream as well as on the Lucini property. Debris and sediment transport are a significant threat to the Lucini property because it clogs downstream piping and causes flooding. The County did not evaluate stormwater conveyance from its road project through the Lucini property. Increased amounts of runoff directed to the Lucini property, and its effects, were disregarded in the County's drainage assessment.

Table 4. Capital Costs of Ongoing Flow and Water Quality Control Facilities

Control Unit	**Base Cost**
Flow Control Manhole Installed to the East of BFR at the south New Inlet #1 location.	$8,046
Water Quality Manhole Installed to the West of BFR just above the Lucini property.	$5,462
Total Estimated Base Costs	**$13,800**
Estimation Range Between (-10% and +30%)	**$12,157** to **$17,560**

The County provided storm grates on its two new stormwater inlets in the subbasin above the Lucini property as shown in Figure 12. The County neglected to provide a storm grate for the pipe entrance to the Lucini property (see Figure 12). The Lucini property drainage receives stormwater passing through SW Boones Ferry Road culvert (Outfall #5). The County supposed that its generated stormflow will be conveyed successfully through the Lucini property. The Corps HEC-HMS and HEC-RAS demonstrate that this is not the case for the 25-year design storm cases presented in this analysis.

It is important to note that the Greenhill Lane subbasin, to the south of the Lucini property, has received flow and water quality control. The Greenhill Lane subbasin and the Lucini property both drain to the Basalt Creek wetlands. For the Greenhill Lane subbasin, which has dual outfalls the County used at least three (3) manholes to control

[29] Costs are based on *RS Means Building Construction Cost Data* (2010). Costs are adjusted for inflation based on the cost index as published by the Engineering News Review (ENR). In this case the index is set at 8800.66 for 2010 and 10337.05 for 2016. This is calculated as an inflation ratio of 1.175, i.e., an inflation rate of 17.5 percent from 2010 to 2016.

flow and a water quality manhole to control pollution. The subbasin draining to the Lucini property has no manholes to control flow nor a water quality manhole to control pollution including eroded sediment and debris.

While the Greenhill Lane subbasin typically will have greater stormflows, the necessity of controlling excess stormflows to the Lucini property is no less significant. This is especially true because the County performed no downstream system evaluation for hydraulic conditions on the Lucini property and has no basis for discharging excess flows to the Lucini property.

The County has indicated it is using CWS 2007 for guidance, which contains: Drawing No. 270 “Flow Control Structure Detail” that can be installed at the New Inlet #1 location; and Drawing No. 240 “Water Quality Manhole (Mechanical)” that can be installed just upstream of the Lucini property pipe entrance. For convenience, CWS Drawing Nos. 270 and 240 are contained in Appendix G of this report. See Figure 12 for the locations of these proposed flow and water quality control facilities.

3) Longer Term Detention/Retention Facility
Future full build-out development in the subbasin draining to the Lucini property was not considered by the County’s Drainage Report (2013). This is surprising because the subbasin is zoned for future development (FD-20)[30] and includes Tualatin’s Institutional (IN) development as characterized by the Horizon Community Church with its large buildings, extensive driveways, parking lots, and numerous support facilities. Ongoing development in the subbasin above the Lucini’s, including the construction of the BFR widening project itself, demonstrate that the trend of more intense urban development is already underway and having an effect on the Lucini property.

As shown in the hydrologic and hydraulic evaluations in this report, ongoing urban development is already producing stormflows that exceed ORIGINAL conditions, by about 220 percent, that the Lucini property has historically been subjected to (see Figure 7). Urban development above the Lucini property, under full build-out conditions, pose a still greater threat. These stormflow projections exceed, by about 414 percent, the ORIGINAL stormflow conditions that the Lucini property has historically been subject to as depicted in Figure 8.

Stormflows with ongoing development and full build-out conditions draining to the Lucini property require substantial detention (flow control) and retention (WQ control) measures. These stormwater control units are absent from the Drainage Report (2013) and have not been considered by the County.

The design and detailed costing of detention/retention facilities is beyond the scope of this report but construction and land costs could be as high as several hundred thousand dollars.

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[30] Washington County 20-year Future Development (FD-20), see PDF Page 33 of 152

Supplement B: Part 2 – Rpt Appendices

Included under separate cover because of size.

Appendices - *Effects of SW Boones Ferry Road Construction (2013-2015): Stormflow Analysis for the Lucini Property* (LEA, November 2016)

Appendices

Appendix A

Appendix A1

Photos of ORIGINAL SW Boones Ferry Road
Above and just south of the Lucini Property

Photos taken prior to BFR Road Widening Project of 2013. The County's photo was taken on September 28, 2012 and the Lucini's photo was taken on December 20, 2012.

Photo A1a. This photo is from the County's Wetland Delineation Report (December 2010, PDF Page 81 of 90), which indicates the view is: "Looking south at the north - central portion of the study area." The County identifies this photo as "Photo K" taken on September 28, 2012. The mailbox on the right (to the west) identifies the Lucini property at 23677 SW Boones Ferry Road. The approach sign indicates the Greenhill Lane entrance is ahead but it is not visible because of the vertical curve in the road. There are no curbs or storm sewers in this section of the Boones Ferry Road contrary to the County's Drainage Report (2013).

Photo A1b. Drainage from the ORIGINAL Boones Ferry Road (December 2012). Looking northerly with ponding on the eastern (right) portion of the road. The white fence line of the Lucini property can be seen in the distance in the upper left of the photo, i.e., looking to the northwest. There are no curbs or storm sewers in this section of the ORIGINAL Boones Ferry Road contrary to the claim made in the County's Drainage Report (January 2013).

Appendix A2

Photos taken by John and Grace Lucini on May 18, 2015.
Showing the Downstream System conveying stormflows from
the SW Boones Ferry Road widening project

Excessive storm flows on May 18, 2015 overwhelmed the Lucini property.

Photo A2a. Storm flood waters directed to the Lucini property from Boones Ferry Road (5-18-15).

Photo A2b. Channel conveying Boones Ferry Road drainage across the Lucini property (5-18-15).

Photo A2c. The junction for the ditch and driveway pipe are overwhelmed and flood waters drain into the front yard toward the house (5-18-15).

Photo A2d. Flooding storm water ultimately found its way onto the porch and steps of the house and into the lower driveway area (5-18-15).

Photo A2e. The front lawn drained its flood waters into the walkway and porch in front of the house.

Photo A2f. The front walkway steps drain into the lower driveway and garage area.

Photo A2g.
Flooding stormwater ultimately found its way into the lower driveway and garage area.

Appendix A3

Photos of Ongoing Erosion on Lucini Property (taken August 19, 2016)

Photo A3a. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally northeast up the slope to the pipe end exiting from the County's road project. This photo shows the continuing effects of erosion with the ditch spreading east and west into the embankment where bare soil and tree roots are exposed. To slow flows the owner has placed riprap and concrete block in the ditch to reduce stormwater flow velocities that continue to erode the channel requiring ongoing repairs. This photo corresponds to the flood location in photo A2a of the previous Appendix A2, which shows high velocity storm flows into the Lucini property.

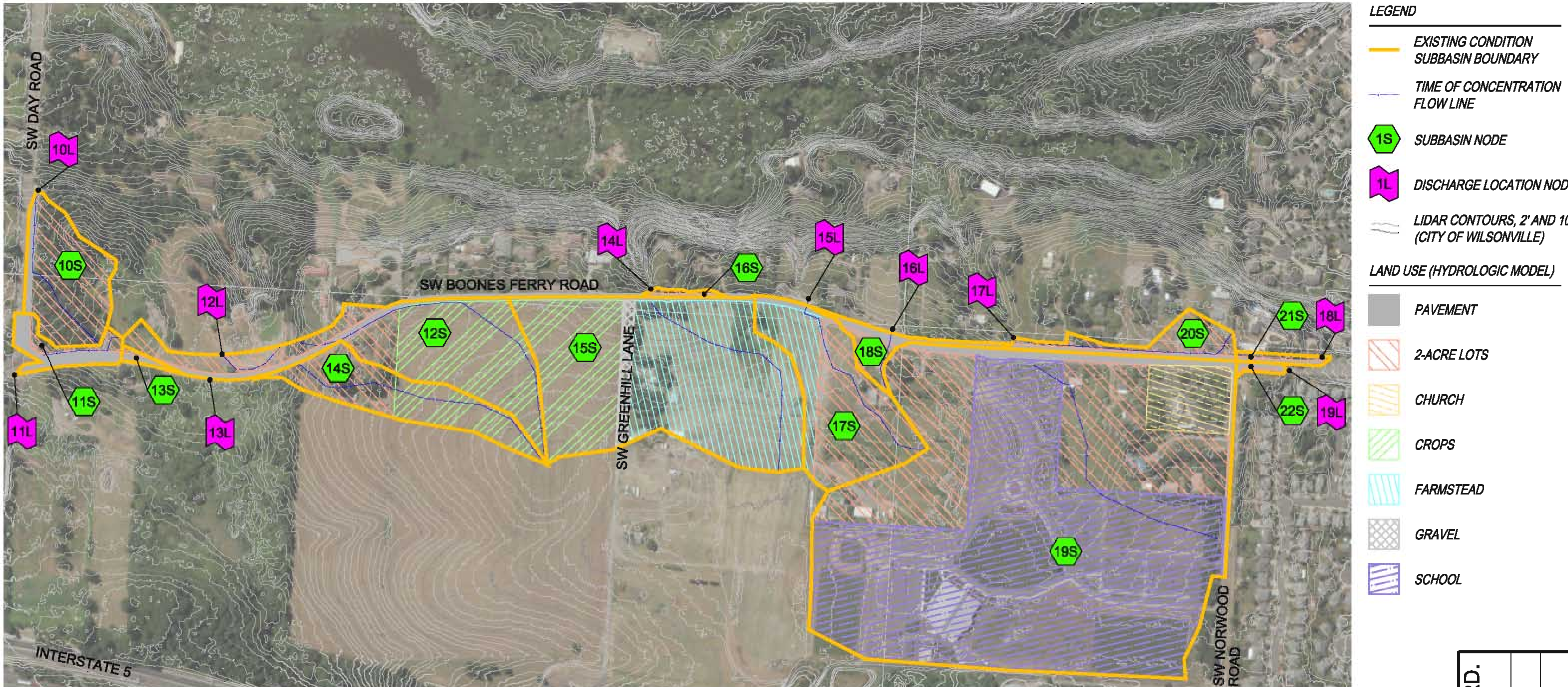
Photo A3b. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally east up the slope of the driveway. This photo shows the continuing effects of erosion with the ditch spreading south toward the driveway, and north into the embankment where bare soil and tree roots are exposed. To slow flows and reduce erosion, the owner has placed riprap in the ditch and gravel next to the driveway. However, very high stormwater velocities continue to erode the channel requiring ongoing repairs.

Photo A3c. This photo of the Lucini property ditch was taken on August 19, 2016 and looks generally northeast up the slope. This photo shows the continuing effects of erosion with the ditch spreading north into the embankment where bare soil and tree roots are exposed. To slow flows the owner has placed riprap in the ditch to reduce stormwater flow velocities that continue to erode the channel requiring ongoing repairs. This photo corresponds to the flood location in Photo A2c of the previous Appendix A2. The entrance to the 12-inch driveway culvert, which carries stormflows to the right (to the south), is hidden from view by the large rock at the bottom of the photo. See the next photo (A3d) for a view of the entrance to the driveway culvert).

Photo A3d. This photo of the westernmost base of the ditch was taken on August 19, 2016 and looks generally west toward the Lucini house. Shown the basin where stormwater collects and is routed into the entrance of the 12-inch corrugated plastic pipe (CPP), which is visible in the center of the photo. This pipe entrance allows flows to go south into the driveway culvert. Although a reversed view, this photo corresponds to the flood location in Photo A2c of the previous Appendix A2.

Appendix B

EXISTING CONDITIONS HYDROLOGY MAP



EXISTING CONDITIONS HYDROLOGY

DISCHARGE LOCATION	PRIMARY SITE CONVEYANCE	DOWNSTREAM RECEIVING ENTITY	CONTRIBUTING SUBBASINS
10L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	10S
11L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	11S
12L	MISC SURFACE FLOW	EXISTING DRAW, WEST	12S
13L	MISC SURFACE FLOW	EXISTING DRAW, SOUTHEAST	13S,14S
14L	CULVERT(S)	EXISTING RAVINE, WEST	15S, 16S
15L	CULVERT(S)	EXISTING PIPE CONVEYANCE, WEST	17S
16L	PAVEMENT RUNOFF	NON-POINT SHEET FLOW	18S
17L	CULVERT(S)	EXISTING CHANNEL, SOUTHWEST	19S, 20S
18L	MISC SURFACE FLOW	EXISTING ROADSIDE LOWPOINT, WEST	21S
19L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	22S

N

0 400 800

SCALE: 1" = 400'

SW BOONES FERRY RD.
SW DAY ST. TO SW NORWOOD RD.
WASHINGTON COUNTY

HYDROLOGY MAPS

PLOT STAMP: 01/31/13 4:53A BTHAYNE
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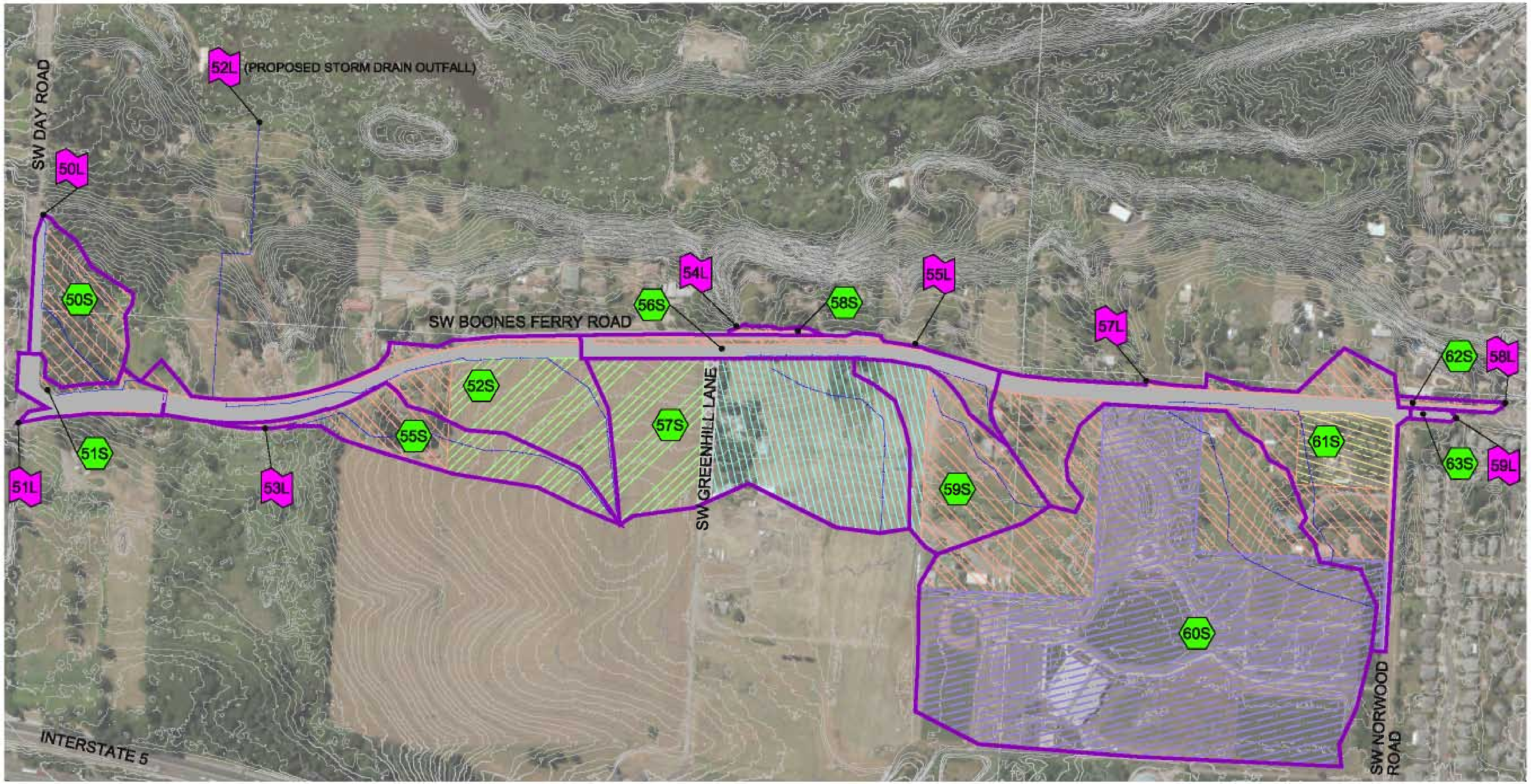
PROJECT NUMBER
100096

SHEET NO.
1 OF 3

SHEET TITLE
HYD1

PROPOSED CONDITIONS HYDROLOGY MAP



LEGEND

- *PROPOSED CONDITION SUBBASIN BOUNDARY*
- *TIME OF CONCENTRATION FLOW LINE*
- 1S *SUBBASIN NODE*
- 1L *DISCHARGE LOCATION NODE*
- *LIDAR CONTOURS, 2' AND 10' (CITY OF WILSONVILLE)*

LAND USE (HYDROLOGIC MODEL)

- *PAVEMENT*
- *2-ACRE LOTS*
- *CHURCH*
- *CROPS*
- *FARMSTEAD*
- *GRAVEL*
- *SCHOOL*

PROPOSED CONDITIONS HYDROLOGY

DISCHARGE LOCATION	PRIMARY SITE CONVEYANCE	DOWNSTREAM CONVEYANCE DESCRIPTION	CONTRIBUTING SUBBASINS
50L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	50S
51L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF WILSONVILLE)	51S
52L	PROPOSED STORM DRAIN	BASALT CREEK MARSH	52S
53L	MISC SURFACE FLOW	EXISTING DRAW, SOUTHEAST	55S
54L	PROPOSED STORM DRAIN	EXISTING RAVINE, WEST	56S, 57S, 58S
55L	CULVERT(S)	EXISTING PIPE CONVEYANCE, WEST	59S
56L	NOT USED	NON-POINT SHEET FLOW	NOT USED
57L	PROPOSED STORM DRAIN	EXISTING CHANNEL, SOUTHWEST	60S, 61S
58L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	62S
59L	GUTTER FLOW	EXISTING STORM DRAIN (CITY OF TUALATIN)	63S

N

0 400 800

SCALE: 1" = 400'

SW BOONES FERRY RD.
SW DAY ST. TO SW NORWOOD RD.
WASHINGTON COUNTY

HYDROLOGY MAPS

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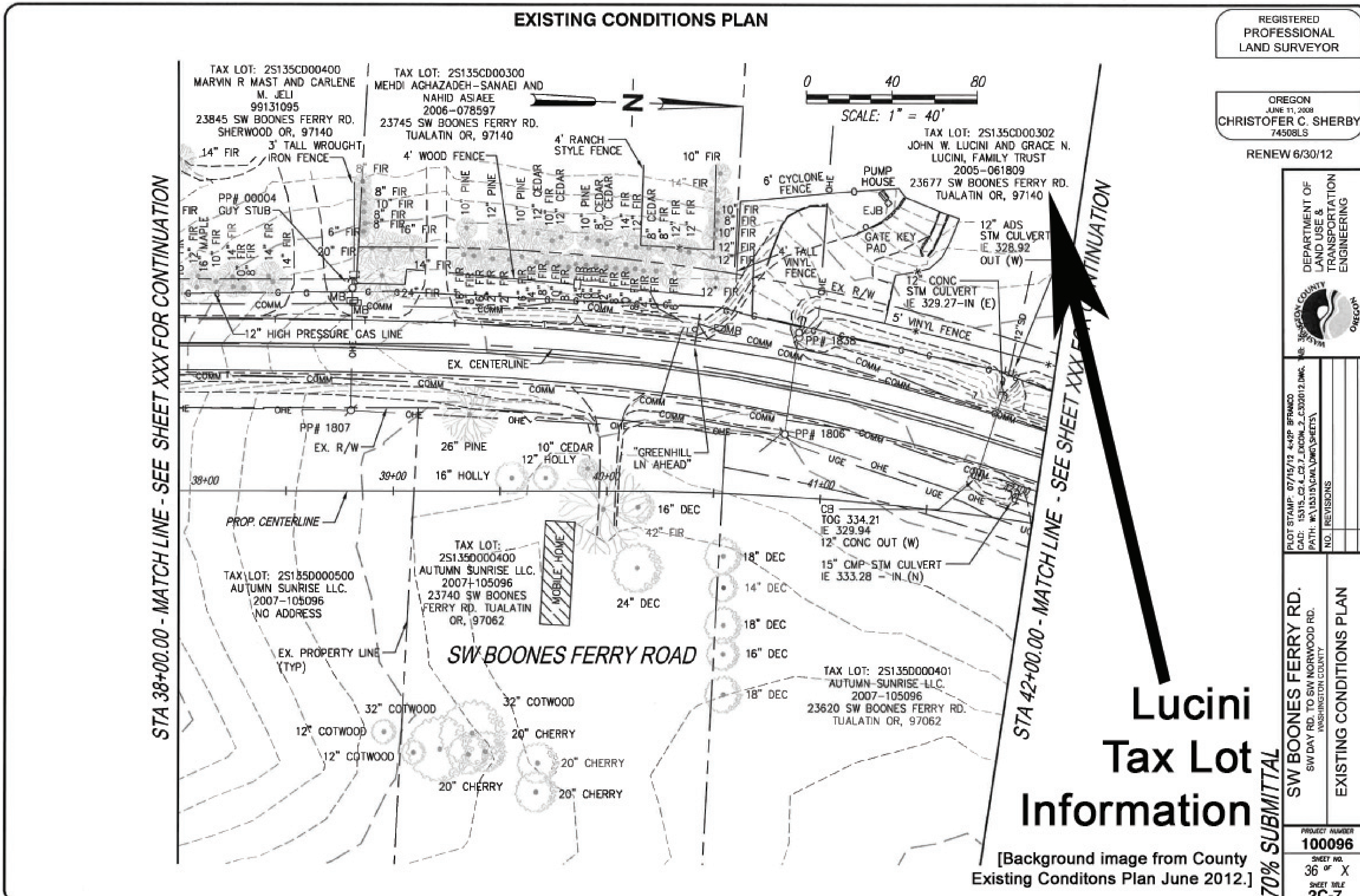
PROJECT NUMBER 100096

SHEET NO. 2 OF 3

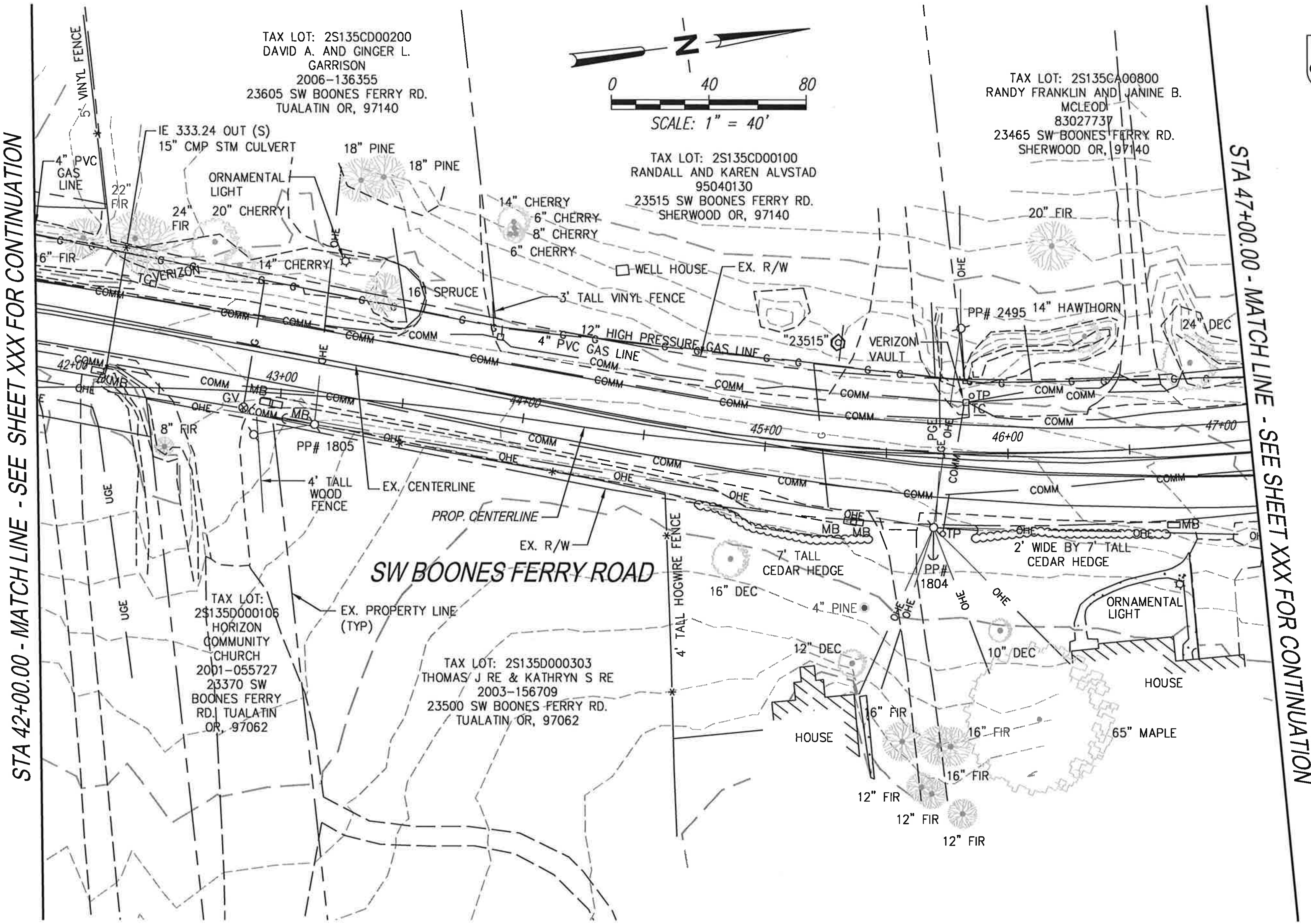
SHEET TITLE HYD2

Appendix C



[Background image from County Existing Conditons Plan June 2012.]

EXISTING CONDITIONS PLAN



REGISTERED PROFESSIONAL LAND SURVEYOR

OREGON
JUNE 11, 2008
CHRISTOFER C. SHERBY
74508LS

RENEW 6/30/12

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING

WASHINGTON COUNTY OREGON

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NO.	REVISIONS

70% SUBMITTAL

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EXISTING CONDITIONS PLAN

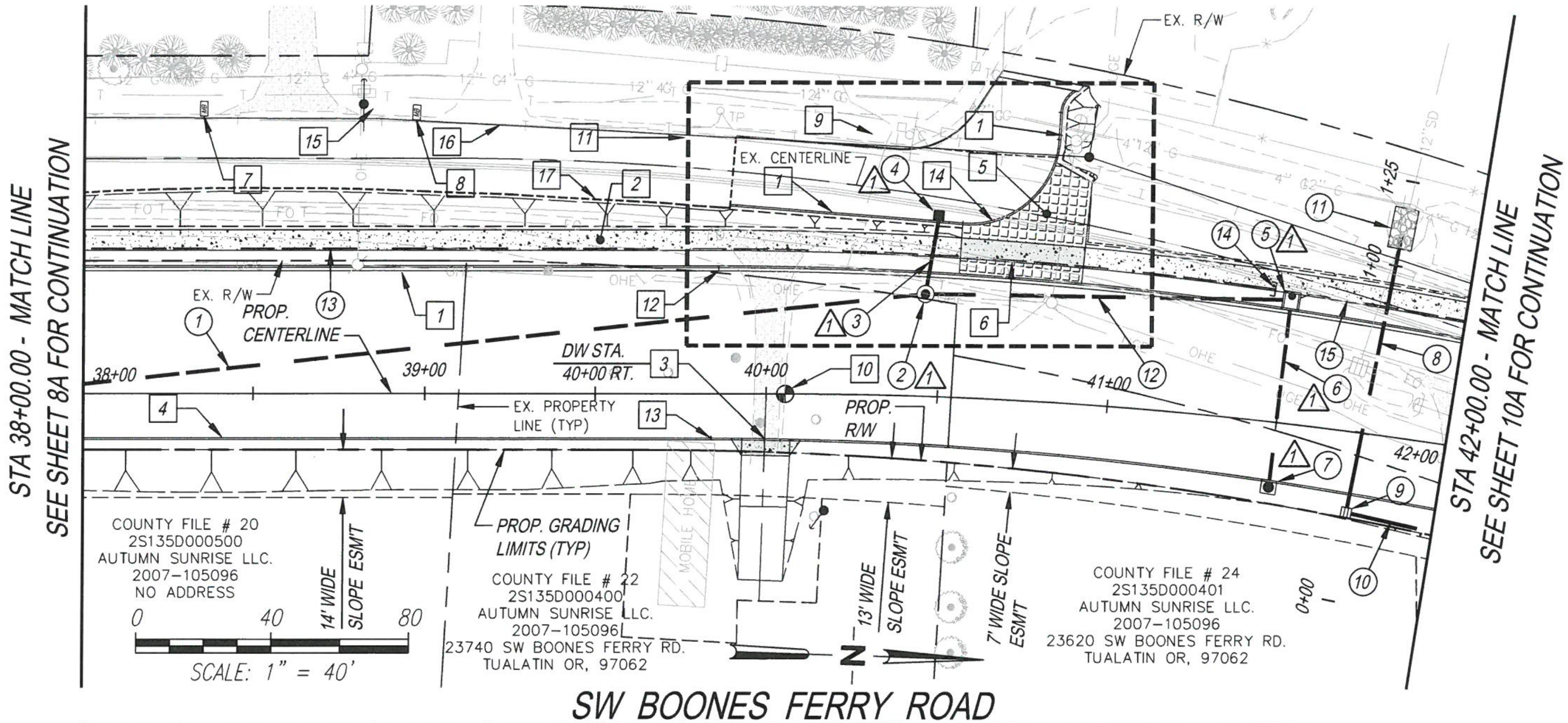
PROJECT NUMBER 100096

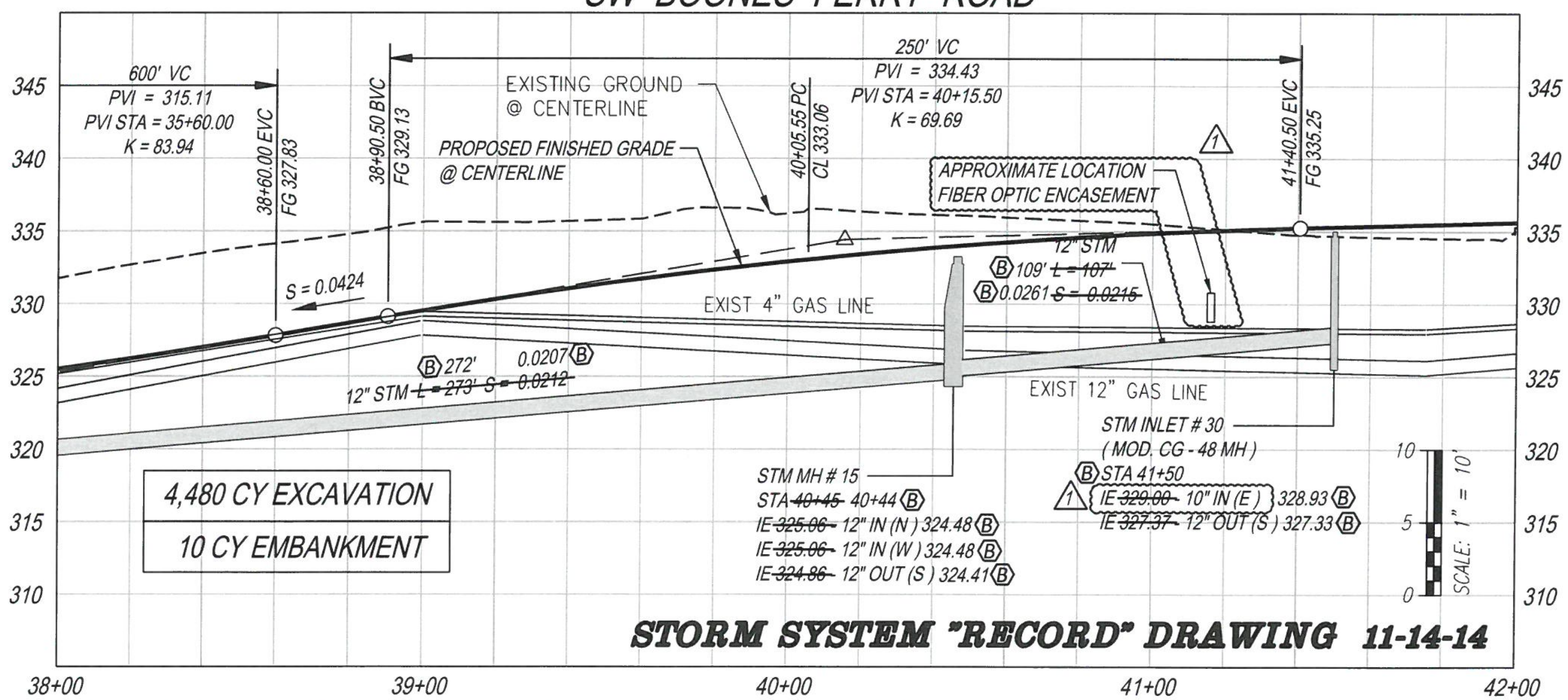
SHEET NO. 37 OF X

SHEET TITLE 2C-8

Appendix D

CONSTRUCTION PLAN AND PROFILE





STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1994
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING

WASHINGTON COUNTY OREGON

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NO.	REVISIONS	
1	REVISION NO. 3	5-20-2013 RRM
B	STORM SYSTEM "RECORD" DATA 11-14-14	

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

CONSTRUCTION PLAN AND PROFILE

PROJECT NUMBER 100096

SHEET NO. 145 OF 274

SHEET TITLE 9A

CONSTRUCTION NOTES

THIS SHEET TO FACE SHT. 9A

1. CONST. P.C. CONC. CURB & GUTTER
   SEE SHEET 2B-4 FOR DETAILS
2. CONST. POROUS P.C. CONC. WALK
   SEE SHEET 2B-6 FOR DETAILS
3. CONST. P.C. RESIDENTIAL DRIVEWAY
   SEE SHEET 2B-1 & 2B-2 FOR DETAILS
4. CONST. P.C. CONC. MOUNTABLE VERTICAL CURB
   SEE SHEET 2B-4.1 FOR DETAILS
5. INSTALL UNIT PAVERS AS SPECIFIED IN BOOK 2
6. CONST. CONC. COMMERCIAL DRIVEWAY
   SEE SHEET 2B-6 FOR DETAILS
7. CONST. SINGLE MAILBOX
   STATION 38+35
   MB ADDRESS " 23845 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
8. CONST. SINGLE MAILBOX
   STATION 38+97
   MB ADDRESS " 23745 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
9. CONST. SINGLE MAILBOX
   STATION 40+30
   MB ADDRESS " 23677 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
10. INSTALL CENTERLINE SURVEY MONUMENT
    WITH FRAME AND COVER
    @ STA 40+05.55 - CL PC
    SEE SHEET NO 2B-7 FOR DETAIL
11. SEE SHEET 17A FOR DETAIL
    OF THIS AREA.
12. 39+85.89 PC (37.00' LT)
    TC 332.05
13. 39+65.87 PC (13.00' RT)
    TC 332.62
14. CONST LOW PROFILE MOUNTABLE CURB
    SEE SHEET 2B-6 FOR DETAILS
15. POWER POLE BY PGE (TYP)
16. OVERHEAD POWER BY PGE (TYP)
17. SAWCUT EXIST AC PAVEMENT
    AND REMOVE (N)

(1) 12" STM SEWER ~~L = 273' S = 0.0212~~ B 272' 0.0207 B

1 (2) STM MH # 15
@ STA ~~40+45~~ (30' LT) 40+44 B
RIM = ~~333.22~~ 333.16 B
IE ~~325.06~~ 12" IN (N) 324.48 B
IE ~~325.06~~ ~~12" IN (W)~~ 324.48 B
10" IN (W) 1
IE 324.86 - 12" OUT (S) 324.41 B

1 (3) ~~10" STM SEWER L = 23' S = 0.1270~~
1 10" STM SEWER L = 23' ~~S = 0.2626~~
B 0.2535 B

1 (4) STM CB # 29 (AREA DRAIN TYPE II)
@ STA ~~40+50~~ (53' LT) 40+47 B
~~TC 334.27~~ TOG 333.71 B
~~IE 330.00~~ - 10" OUT (E)
1 IE ~~331.15~~ 330.31 B

1 (5) STM CB # 30 (MOD. CG - 48 MH)
B @ STA 41+50 (36' LT)
RIM = ~~334.98~~ 334.95 B
~~IE 327.54 - 10" IN (E)~~ IE ~~329.00~~ 10" IN (E) 1 328.93 B
IE ~~327.37~~ 12" OUT (S) 327.33 B

1 (6) 10" STM SEWER ~~L = 58' S = 0.0483~~ L = 54' ~~S = 0.0100~~ 1
B 0.0081 B

1 (7) STM CB # 31 (CG-30)
B @ STA 41+50 (22' RT)
TC ~~335.32~~ 335.38 B
~~IE 330.32 - 10" OUT (W)~~ IE ~~329.54~~ - 10" OUT (W) 1 329.37 B

(8) 12" STM CULVERT ~~L = 83' S = 0.0162~~
STM OUTFALL #5 B 80' 0.0148 B

(9) STM INLET # 32 (DITCH INLET)
B @ STA 41+74 (24' RT)
~~TC 335.45~~ RIM 334.66 (BOTTOM OF GRATE) B
IE ~~330.81~~ - 12" IN (N) 331.11 B
IE ~~330.61~~ - 12" OUT (W) 330.55 B

(10) 12" STM SEWER ~~L = 77'~~ S = 0.0101
B 74' B

(11) RIP RAP PAD
CLASS 50 RIP RAP
8' LONG x 7' WIDE x 1.5' DEEP
PLACE 1' ABOVE PIPE CROWN

(12) 12" STM SEWER ~~L = 107' S = 0.0215~~
B 109' 0.0261 B

(13) 4" PP STM SEWER L = 373'

(14) STA 41+45 (39' LT)
PLUG 4" PP

(15) 4" PP STM SEWER L = 349'

STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1991
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 11/17/14 7:46A ASTAICH
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NO.	REVISIONS	
1	REVISION NO. 3	5-20-2013 RRM
B	STORM SYSTEM "RECORD" DATA 11-14-14	

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY
CONSTRUCTION NOTES

PROJECT NUMBER
100096
SHEET NO.
144 OF 274
SHEET TITLE
9

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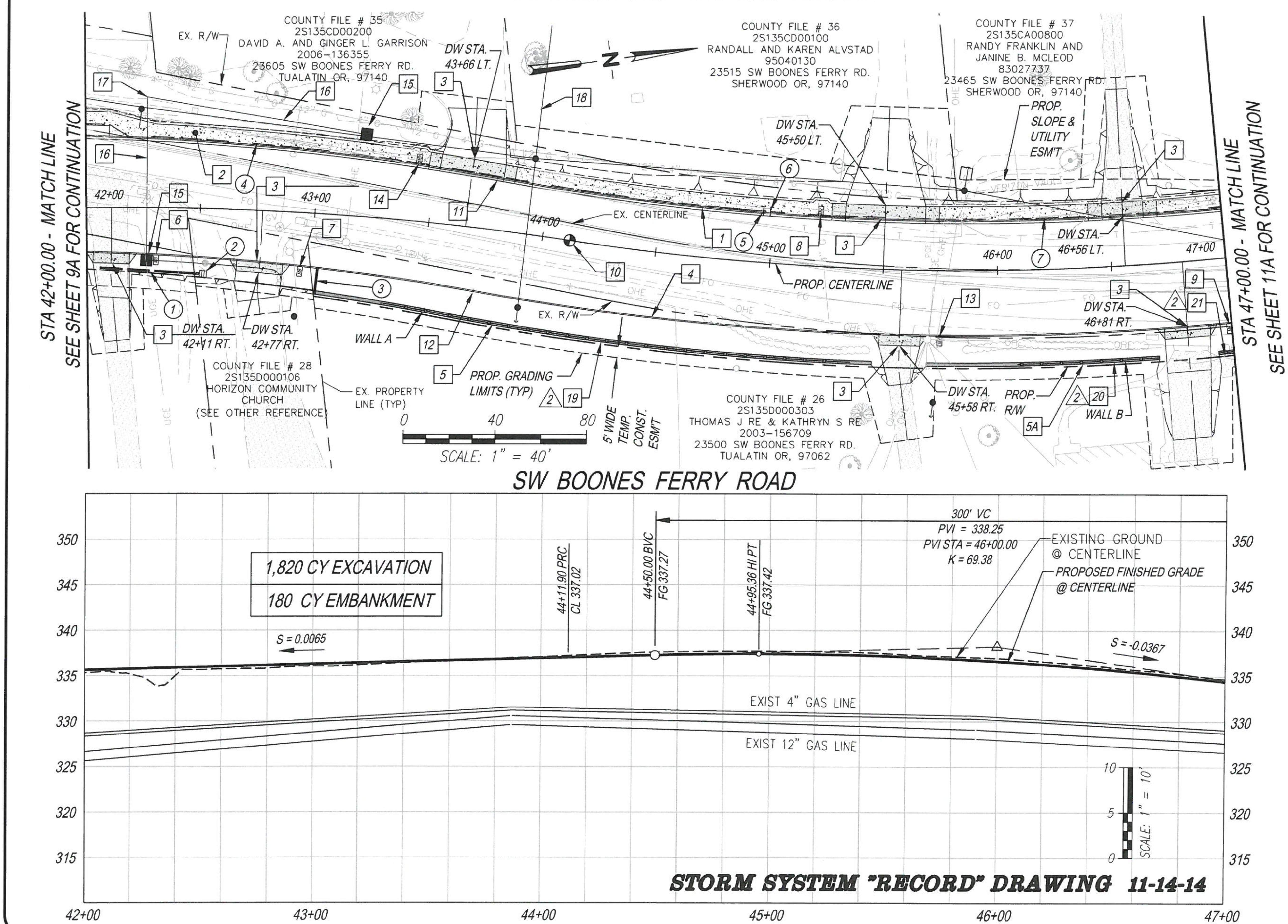
CONSTRUCTION PLAN AND PROFILE



REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1986
RAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

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NO.	REVISIONS		
2	ADDENDUM NO. 2	RRM	4-16-2013
B	STORM SYSTEM "RECORD" DATA 11-14-14		

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SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY
CONSTRUCTION PLAN AND PROFILE

PROJECT NUMBER 100096
SHEET NO. 147 OF 274
SHEET TITLE 10A

CONSTRUCTION NOTES

THIS SHEET TO FACE SHT. 10A

1. CONST. P.C. CONC. CURB & GUTTER
   SEE SHEET 2B-4 FOR DETAILS
2. CONST. POROUS P.C. CONC. WALK
   SEE SHEET 2B-6 FOR DETAILS
3. CONST. P.C. RESIDENTIAL DRIVEWAY
   SEE SHEET 2B-1 & 2B-2 FOR DETAILS
4. CONST. P.C. CONC. MOUNTABLE VERTICAL CURB
   SEE SHEET 2B-4.1 FOR DETAILS
5. CONST. PREFAB. MODULAR RETAINING WALL A
   SEE SHEET 28A FOR DETAILS

5A. CONST. PREFAB. MODULAR RETAINING WALL B
   SEE SHEET 28A FOR DETAILS

6. CONST. SINGLE MAILBOX
   STATION 42+31
   MB ADDRESS " 23620 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
7. CONST. DOUBLE MAILBOX
   STATION 42+95
   MB ADDRESS " 23560 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
8. CONST. SINGLE MAILBOX
   STATION 45+21
   MB ADDRESS " 23515 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
9. CONST. SINGLE MAILBOX
   STATION 46+99
   MB ADDRESS " 23500 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
10. INSTALL CENTERLINE SURVEY MONUMENT
   WITH FRAME AND COVER
   @ STA 44+11.90 - CL PRC
   SEE SHEET NO 2B-7 FOR DETAIL
11. 43+77.26 PRC (22.52' LT)
   TC 336.58
12. 43+58.83 PRC (34.82' LT)
   TC 336.30
13. CONST. SINGLE MAILBOX
   STATION 45+75
   MB ADDRESS " 23550 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
14. CONST. SINGLE MAILBOX
   STATION 43+43
   MB ADDRESS " 23605 "
   SEE SHEETS 2B-7, 2B-8, AND 2B-9 FOR DETAILS
15. PROPOSED POWER VAULT BY PGE
16. PROPOSED POWER CONDUIT BY PGE
17. POWER POLE BY PGE (TYP)
18. OVERHEAD POWER BY PGE (TYP)
19. BLACK VINYL COATED CHAINLINK FENCE
   WALL A: STA. 0+30 TO STA. 2+37
   2 ~~3" FROM BACK OF WALL~~
   REFER TO ODOT STD DRAWING
   RD815. INSTALL FENCE ON WALL.
20. BLACK VINYL COATED CHAINLINK FENCE
   WALL B: STA. 0+40 TO STA. 1+12
   2 ~~3" FROM BACK OF WALL~~
   REFER TO ODOT STD DRAWING
   RD815. INSTALL FENCE ON WALL.
21. BLACK VINYL COATED CHAINLINK FENCE
   WALL C: STA. 0+00 TO STA. 0+36
   2 ~~3" FROM BACK OF WALL~~
   REFER TO ODOT STD DRAWING
   RD815. INSTALL FENCE ON WALL.

(1) 12" STM SEWER ~~L = 77'~~ S = 0.0101
B 74' B

(2) STM INLET # 33 (DITCH INLET)
@ STA ~~42+52~~ (29' RT) 42+50 B
~~TC 335.83~~ RIM 334.68 (BOTTOM OF GRATE) B
IE ~~331.58~~ - 12" OUT (S) 331.86 B

(3) 4" D.I.P. FOOTING DRAIN CONNECTION
THRU CURB FACE - L = 12' UNABLE TO VERIFY

(4) 4" PP STM SEWER L = 349'

(5) STA 44+95 (23' LT)
PLUG 4" PP

(6) STA 44+98 (23' LT)
PLUG 4" PP

(7) 4" PP STM SEWER L = 335'

STORM SYSTEM "RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER
15552PE
OREGON
JULY 25, 1991
DAMON C. WEBSTER
11/18/14
EXPIRES: 6/30/16

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 11/17/14 7:48A ASTAICH
CAD: 15315_9_11A_ST_PL_PR.DWG, TAB: 10
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NO.	REVISIONS	
2	ADDENDUM NO 2	RRM 4-16-2013
B	STORM SYSTEM "RECORD" DATA 11-14-14	

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

CONSTRUCTION NOTES

PROJECT NUMBER 100096
SHEET NO. 146 OF 274
SHEET TITLE 10

MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

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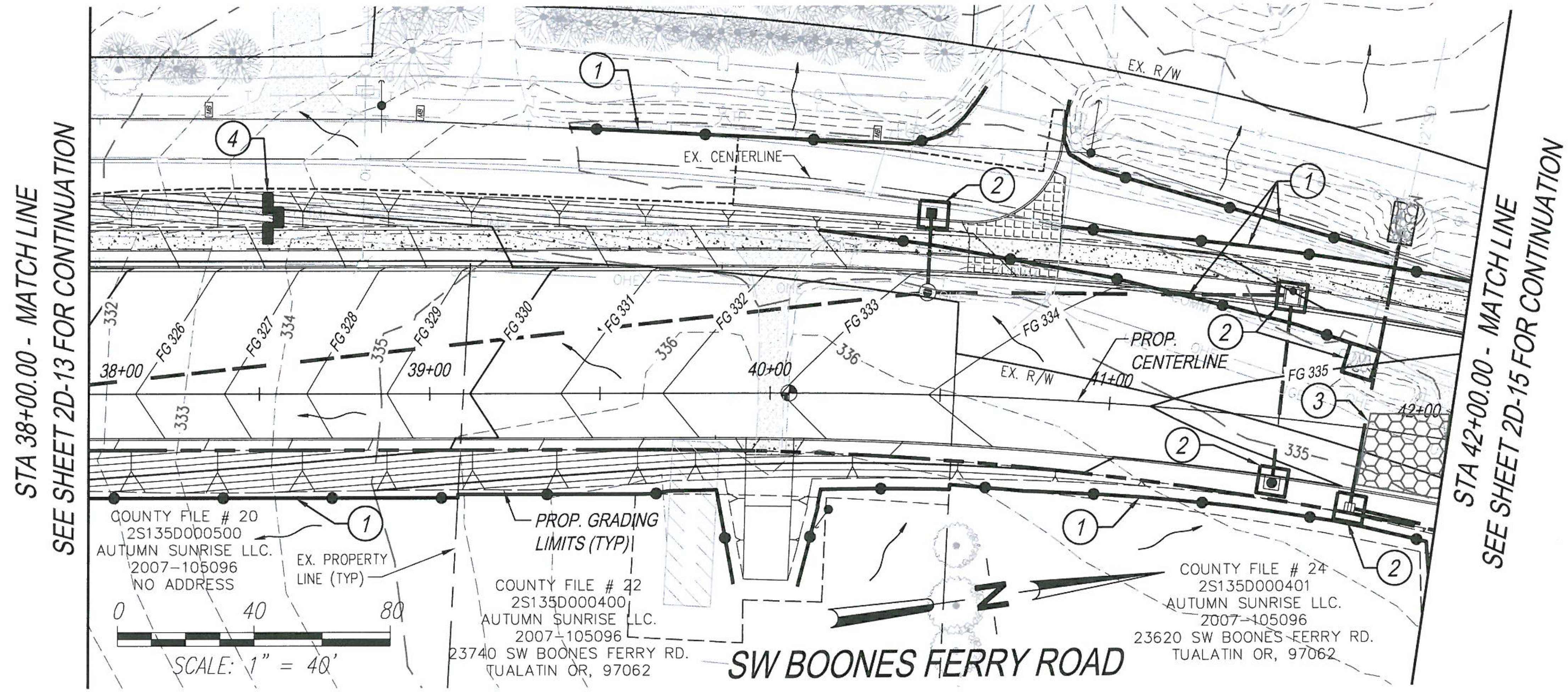
Appendix E

EROSION & SEDIMENT CONTROL PLAN



LEGEND

---280---	EXISTING CONTOUR
FG 281	FINISHED CONTOURS (MINOR)
FG 280	FINISHED CONTOURS (MAJOR)
	SILT FENCE
	CHECK DAM BIO-FILTER BAG
	DIRECTION OF FLOW
	TEMPORARY STORM INLET PROTECTION
	GRAVEL CONSTRUCTION ENTRANCE

EROSION & SEDIMENT CONTROL NOTES

1. CONSTRUCT SEDIMENT FENCE
SEE SHEET 2D-3 & 2D-4 FOR DETAILS
2. CONSTRUCT INLET PROTECTION
SEE SHEET 2D-4 FOR DETAILS
3. CONSTRUCT GRAVEL CONSTRUCTION ENTRANCE
SEE SHEET 2D-3 FOR DETAILS
4. CONSTRUCT CHECK DAM BIO-FILTER BAG
SEE SHEET 2D-3 FOR DETAILS

NOTE:
EROSION AND SEDIMENT CONTROLS SELECTION AND PLACEMENT MUST BE CONSISTENT AND APPROPRIATE FOR CONSTRUCTION PHASING AT ALL TIMES. CONTROLS SHOWN ON PLANS MAY NOT APPLY TO ALL CONSTRUCTION PHASES.

"RECORD" DRAWING 11-14-14

REGISTERED PROFESSIONAL ENGINEER 15552PE OREGON JULY 25, 1991 DAMON C. WEBSTER
EXPIRES: 6/30/14
1/31/13

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 01/31/13 10:12A BFRANCO
CAD: 15315_2D-15_2D-17_ESC_3.DWG, TAB: 2D-14
PATH: W:\15315\CIVIL\DWG\SHEETS\

NO.	REVISIONS

SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EROSION & SEDIMENT CONTROL PLAN

MacKay Sposito
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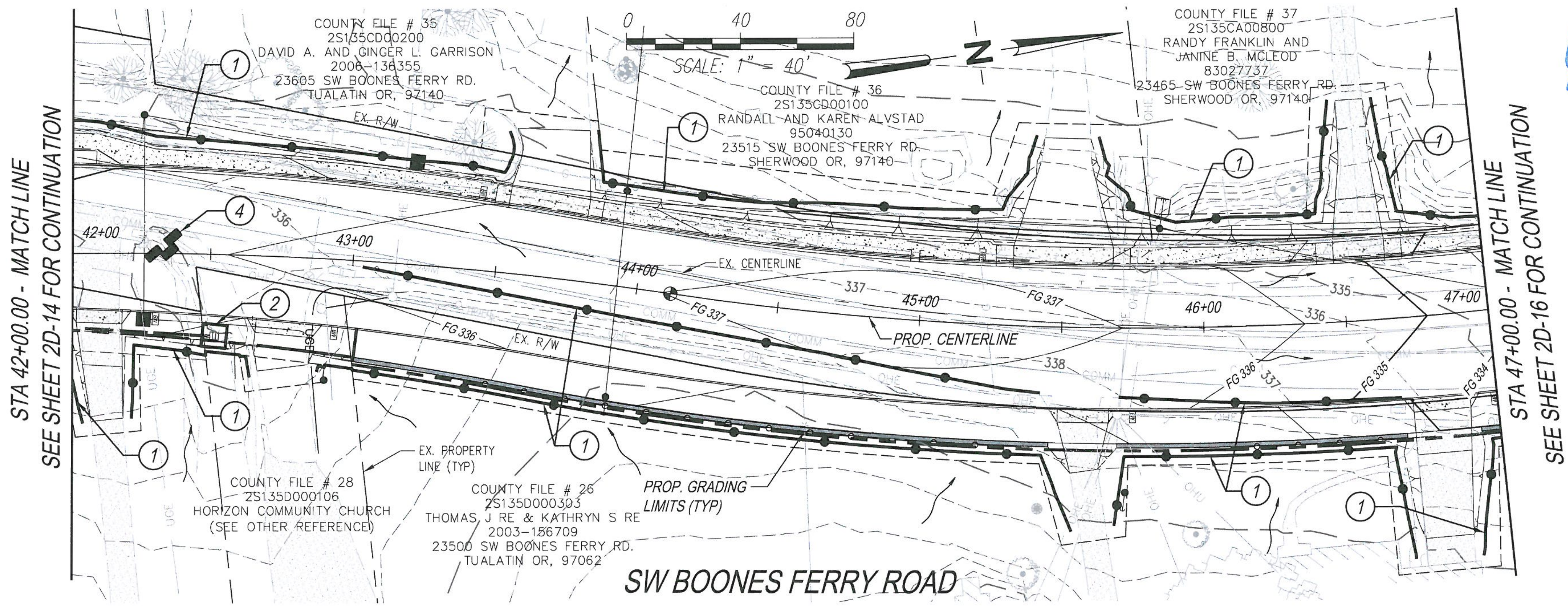
PROJECT NUMBER 100096
SHEET NO. 80 OF 274
SHEET TITLE 2D-14

EROSION & SEDIMENT CONTROL PLAN



LEGEND

——280——	EXISTING CONTOUR
——FG 281——	FINISHED CONTOURS (MINOR)
——FG 280——	FINISHED CONTOURS (MAJOR)
	SILT FENCE
	CHECK DAM BIO-FILTER BAG
	DIRECTION OF FLOW
	TEMPORARY STORM INLET PROTECTION
	GRAVEL CONSTRUCTION ENTRANCE

EROSION & SEDIMENT CONTROL NOTES

1. CONSTRUCT SEDIMENT FENCE
SEE SHEET 2D-3 & 2D-4 FOR DETAILS
2. CONSTRUCT INLET PROTECTION
SEE SHEET 2D-4 FOR DETAILS
3. CONSTRUCT GRAVEL CONSTRUCTION ENTRANCE
SEE SHEET 2D-3 FOR DETAILS
4. CONSTRUCT CHECK DAM BIO-FILTER BAG
SEE SHEET 2D-3 FOR DETAILS

"RECORD" DRAWING 11-14-14

NOTE:
EROSION AND SEDIMENT CONTROLS SELECTION AND PLACEMENT MUST BE CONSISTENT AND APPROPRIATE FOR CONSTRUCTION PHASING AT ALL TIMES. CONTROLS SHOWN ON PLANS MAY NOT APPLY TO ALL CONSTRUCTION PHASES.

REGISTERED PROFESSIONAL ENGINEER 15552PE OREGON JULY 25, 1997 DAMON C. WEBSTER
1/31/13
EXPIRES: 6/30/14

DEPARTMENT OF LAND USE & TRANSPORTATION ENGINEERING
WASHINGTON COUNTY OREGON

PLOT STAMP: 01/31/13 10:12A BFRANCO
CAD: 15315_2D-15_2D-17_ESC_3.DWG, TAB: 2D-15
PATH: W:\15315\CIVIL\DWG\SHEETS\

NO.	REVISIONS

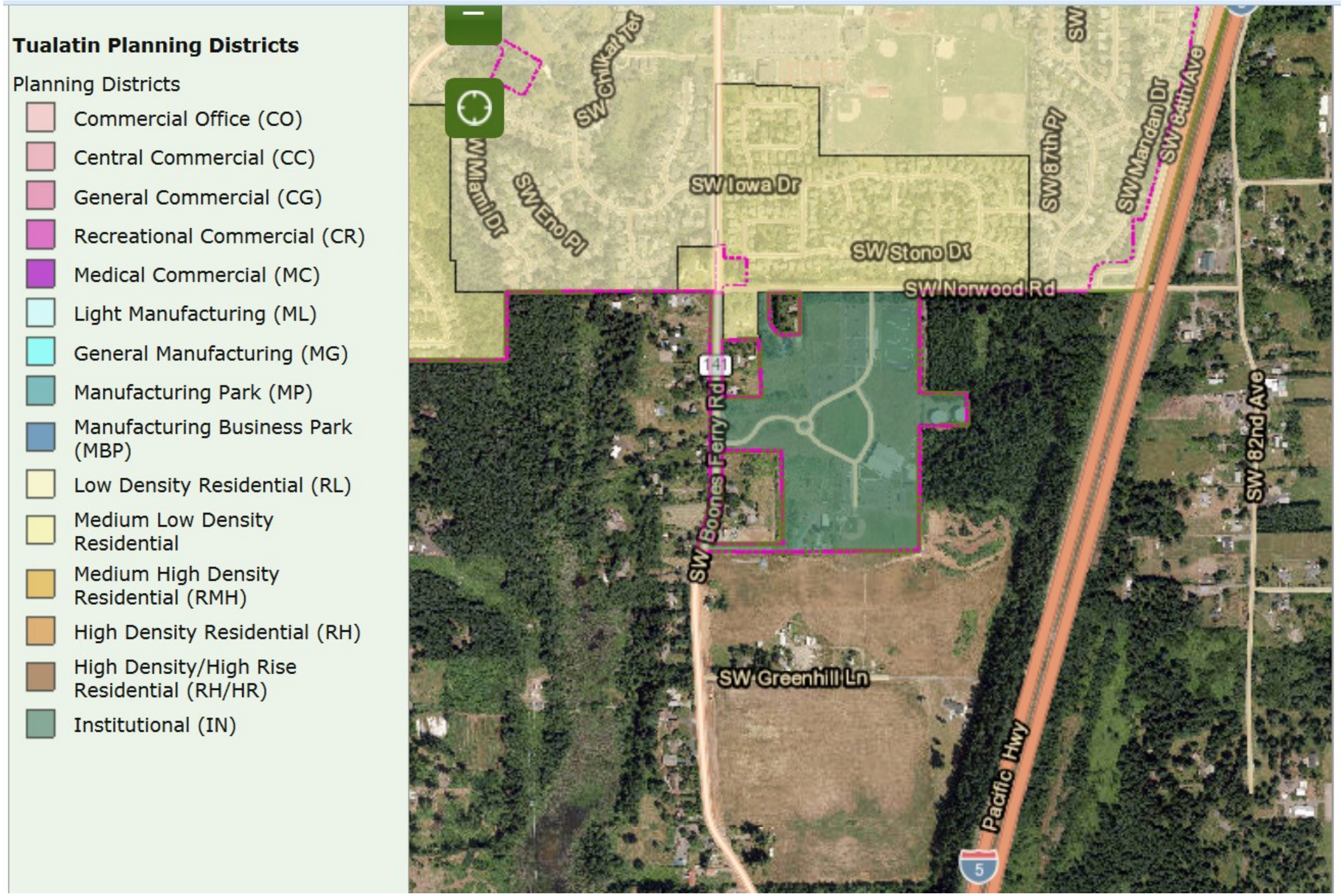
MacKay Sposito
ENERGY PUBLIC WORKS LAND DEVELOPMENT
www.mackaysposito.com

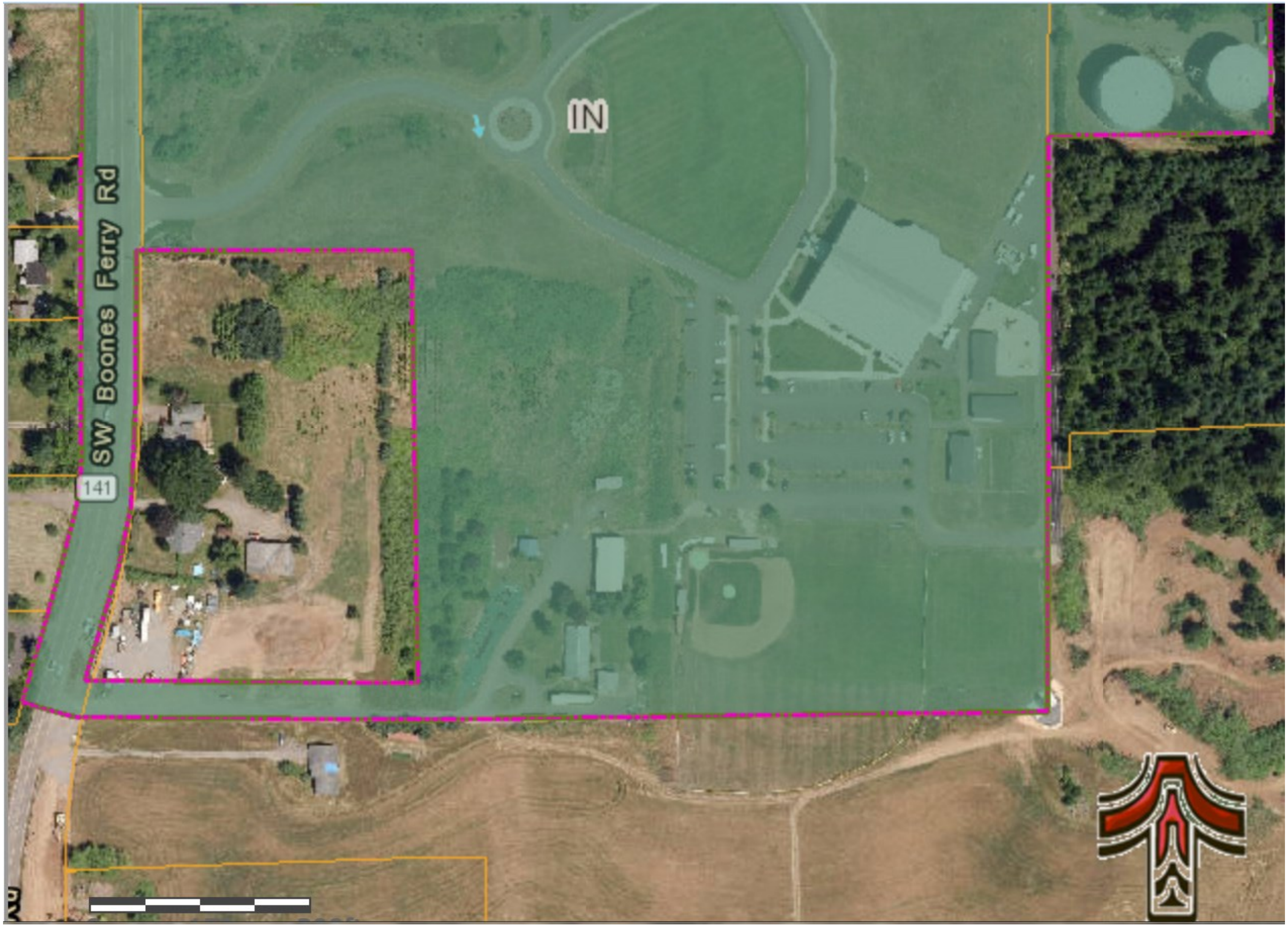
SW BOONES FERRY RD.
SW DAY RD. TO SW NORWOOD RD.
WASHINGTON COUNTY

EROSION & SEDIMENT CONTROL PLAN

PROJECT NUMBER 100096
SHEET NO. 81 OF 274
SHEET TITLE 2D-15

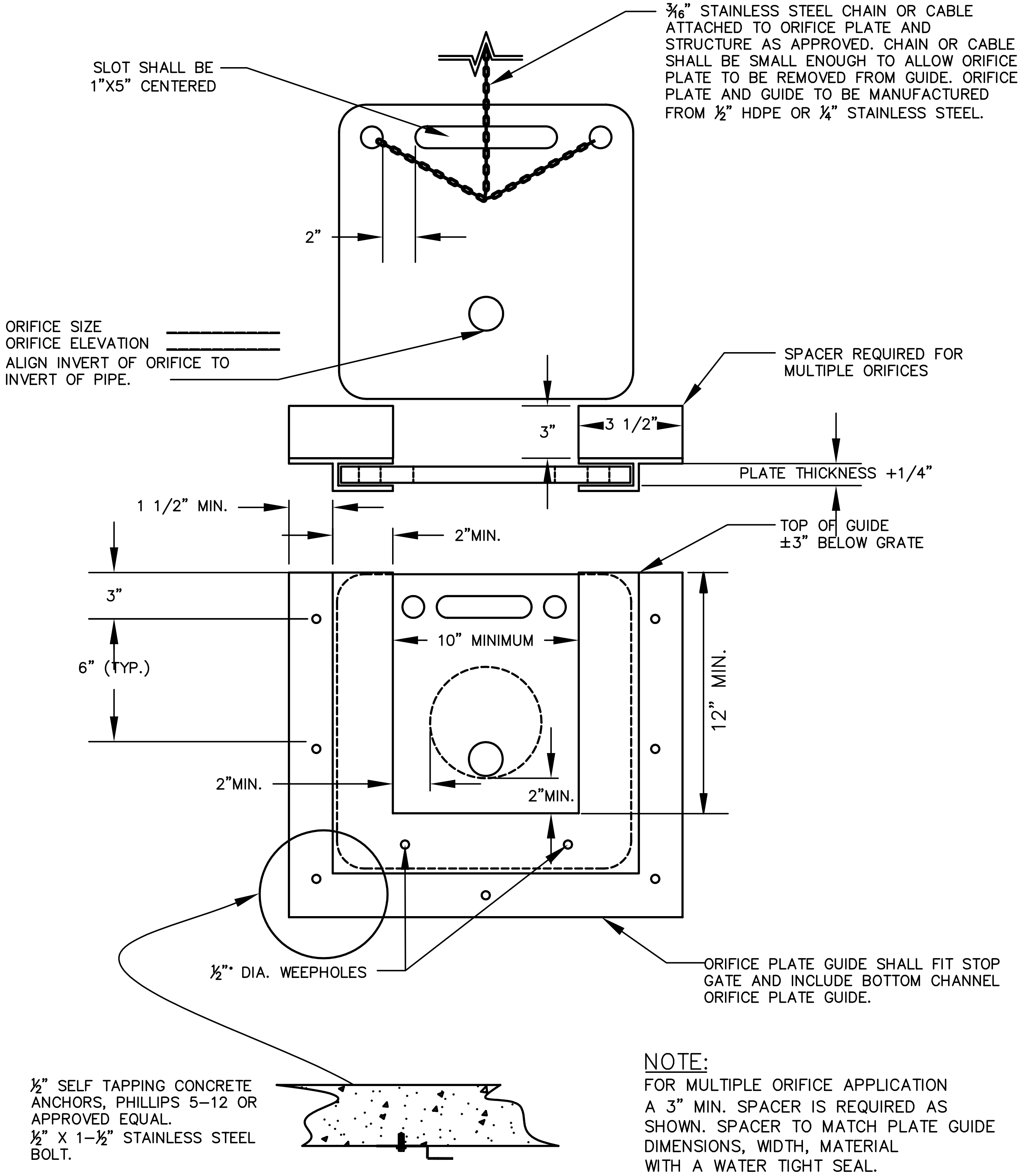
Appendix F


Tualatin Planning Districts
Planning Districts
Commercial Office (CO)
Central Commercial (CC)
General Commercial (CG)
Recreational Commercial (CR)
Medical Commercial (MC)
Light Manufacturing (ML)
General Manufacturing (MG)
Manufacturing Park (MP)
Manufacturing Business Park (MBP)
Low Density Residential (RL)
Medium Low Density Residential
Medium High Density Residential (RMH)
High Density Residential (RH)
High Density/High Rise Residential (RH/HR)
Institutional (IN)
SW Chilkat Ter
W Miami Dr
SW Eno Pl
SW Iowa Dr
SW Stono Dr
SW 87th Pl
SW Mandan Dr
SW 84th Ave
SW Norwood Rd
141
SW Boones Ferry Rd
SW Greenhill Ln
Pacific Hwy
5
SW 82nd Ave


IN
SW Boones Ferry Rd
141

141
SW Boones Ferry Rd
23643

Appendix G



NOTE:
FOR MULTIPLE ORIFICE APPLICATION A 3" MIN. SPACER IS REQUIRED AS SHOWN. SPACER TO MATCH PLATE GUIDE DIMENSIONS, WIDTH, MATERIAL WITH A WATER TIGHT SEAL.

ORIFICE PLATE AND GUIDE

DRAWING NO. 730

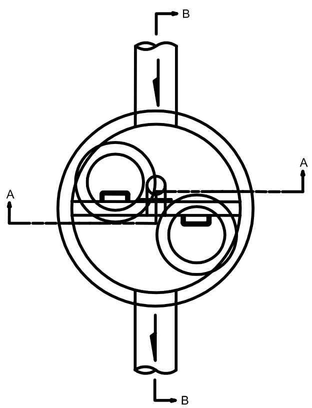
REVISED 12-06

Clean Water Services
Our commitment is clear.

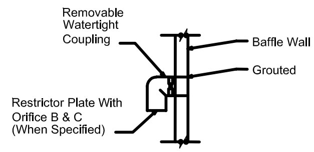
FLOW CONTROL STRUCTURE DETAIL

DRAWING NO. 270

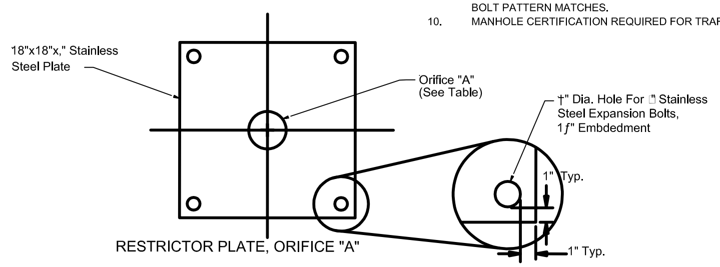
REVISED 12-06



PLAN



ELBOW DETAIL



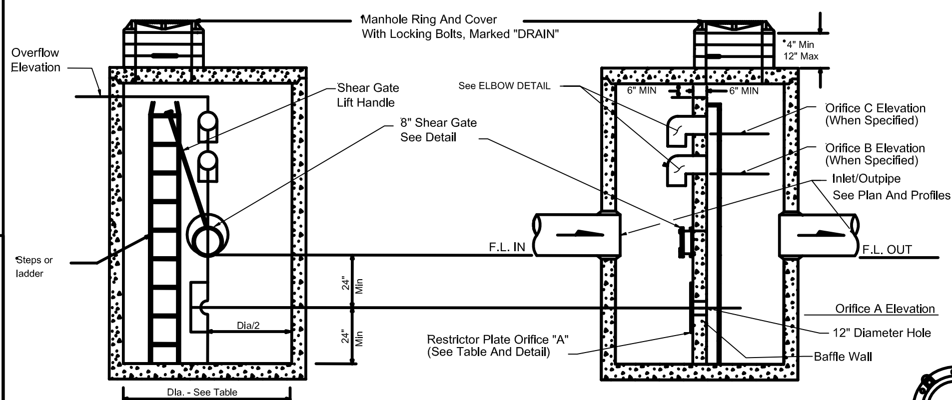
RESTRICTOR PLATE, ORIFICE "A"

NOTES:

1. BAFFLE WALL SHALL HAVE #4 BAR AT 12" SPACING EACH WAY.
2. PRECAST BAFFLE SHALL BE KEYED AND GROUTED IN PLACE. JOINT BETWEEN CONCRETE BAFFLE AND MANHOLE WALL SHALL BE WATERTIGHT.
3. UPPER FLOW ORIFICE SHALL BE ALUMINUM, ALUMINIZED STEEL OR GALVANIZED STEEL. GALVANIZED STEEL SHALL HAVE TREATMENT 1.
4. FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT: SHEAR GATE IS VISIBLE FROM THE TOP; CLIMB-DOWN SPACE IS CLEAR OF RISER AND GATE; FRAME IS CLEAR OF CURB.
5. MULTI-ORIFICE ELBOWS SHALL BE PREINSTALLED TO INSURE LADDER CLEARANCE.
6. RESTRICTOR PLATE WITH ORIFICE AS SPECIFIED IN THE CONTRACT. OPENING IS TO BE CUT ROUND AND SMOOTH. NEOPRENE GASKET SHALL BE INSTALLED BETWEEN THE ORIFICE PLATE AND CONCRETE BAFFLE TO PROVIDE A WATERTIGHT SEAL.
7. SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCRDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION Zg32A 0R CAST IRON IN ACCORDANCE WITHASTM A 48, CLASS 30B. LIFT HANDLE MAY BE SOLID ROD OR HOLLOW TUBING WITH ADJUSTABLE HOOK AS REQUIRED. NEOPRENE RUBBER GASKET RERQUIRED BETWEEN RISER MOUNTING FLANGE AND GATE FLANGE. MATING SURFACES OF LID AND BODY SHALL BE MACHINED FOR PROPER FIT. FLANGE MOUNTING BOLTS SHALL BE....."DIAMETER STAINLESS STEEL.
8. SHEAR GATE MAXIMUM OPENING SHALL BE CONTROLLED BY LIMITED HINGE MOVEMENT, STOP TAB OR SOME OTHER DEVISE.
9. ALTERNATE SHEAR GATES DESIGNS AREACCEPTABLE, IF MATERIAL SPECIFICATIONS ARE MET AND FLANGE BOLT PATTERN MATCHES.
10. MANHOLE CERTIFICATION REQUIRED FOR TRAFFIC LOADING.

FLOW CONTROL STRUCTURE TABLE

Diameter Of Manhole (In.)	
F.L. (In)	
F.L. (Out)	
Outlet Pipe Diameter (In.)	
Number Of Orifice	
Orifice A Elevation	
Diameter Of Orifice A (In.)	
Orifice B Elevation	
Diameter Of Orifice B (In.)	
Orifice C Elevation	
Diameter Of Orifice C (In)	
Overflow Elevation	
Rim Elevation	
Riser Diameter (In.)	

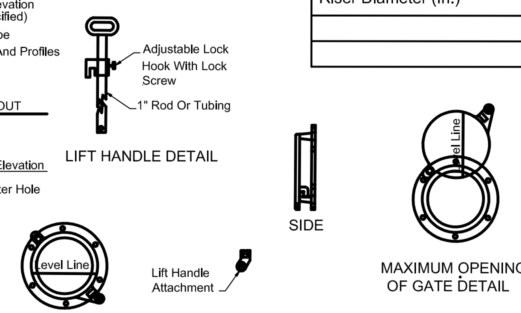


SECTION A-A

ELEVATION

SECTION B-B

FLOW CONTROL STRUCTURE DETAIL
NTS

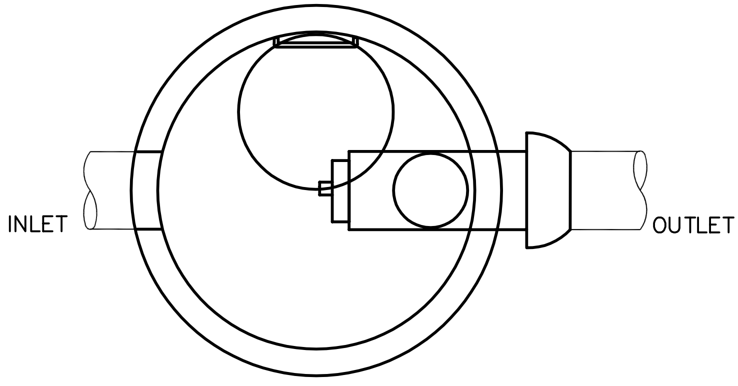


SHEAR GATE
AS MANUFACTURED BY KENNEDY VALVE OR EQUAL

DRAINAGE DETAILS

2B-2

NOTES:
1. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STD. MANHOLE DRAWING NO. 010
2. INLET AND OUTLET PIPE NOT TO EXCEED 18"DIA.
3. PROVIDE SPECIAL DETAIL FOR OUTLET FLOW CONTROL EXCEEDING 18" DIA.
4. ALL OUTLETS SHALL HAVE FLOW CONTROL DEVICE.



PLAN

SUMP VOLUME AVAILABLE

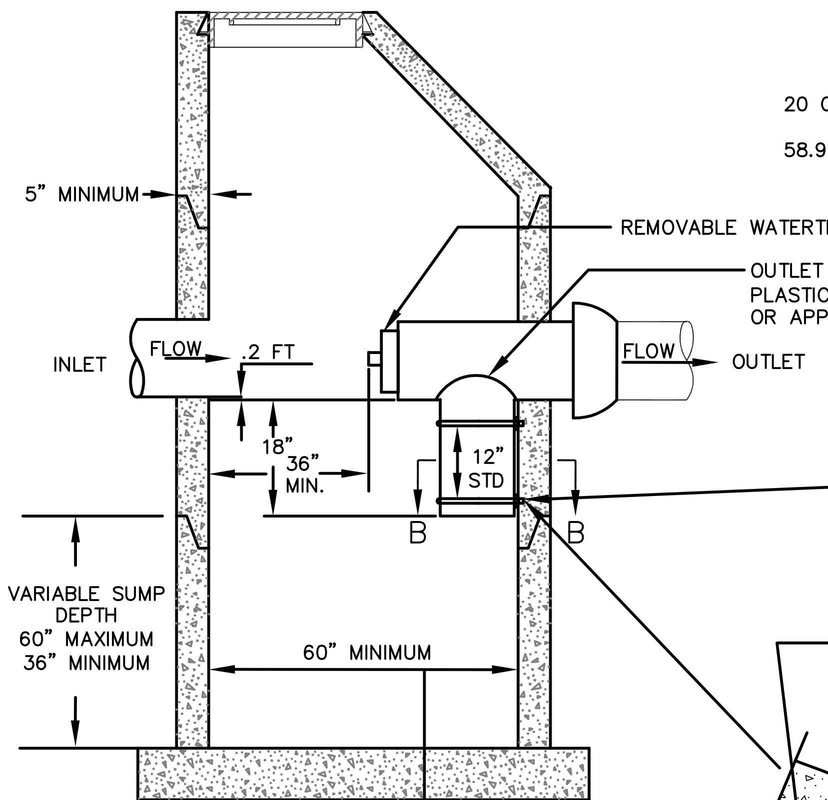
	MINIMUM	MAXIMUM
60" M.H.=	58.9 CF	98.1 CF
72" M.H.=	84.8 CF	141.3 CF
84" M.H.=	115.4 CF	192.3 CF

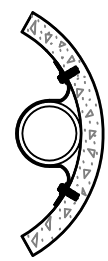
PROVIDE SPECIAL DETAIL FOR VOLUME REQUIREMENTS EXCEEDING 192.3 CF

SUMP VOLUME REQUIREMENTS

20 CF/1.0 CFS OF INFLOW

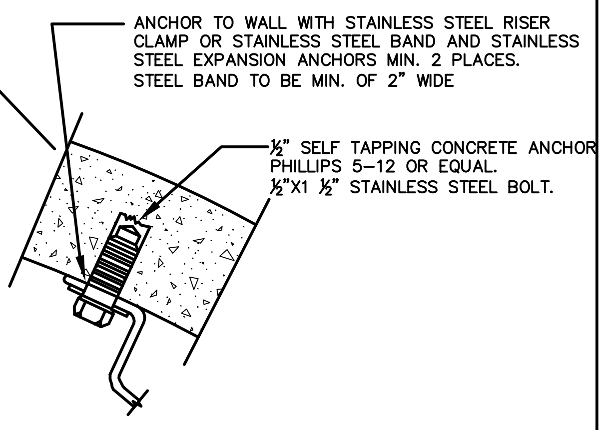
58.9 CF MINIMUM REQUIRED





SECTION B–B

MANHOLE DIAMETER TO BE DETERMINED BY:
1. SUMP VOLUME REQUIREMENTS.
2 NUMBER AND SIZE OF INLETS & OUTLETS.



CLAMP DETAIL
(SECTION A–A)
N.T.S.

WATER QUALITY MANHOLE (MECHANICAL)

DRAWING NO. 240

REVISED 12–06

CleanWater Services
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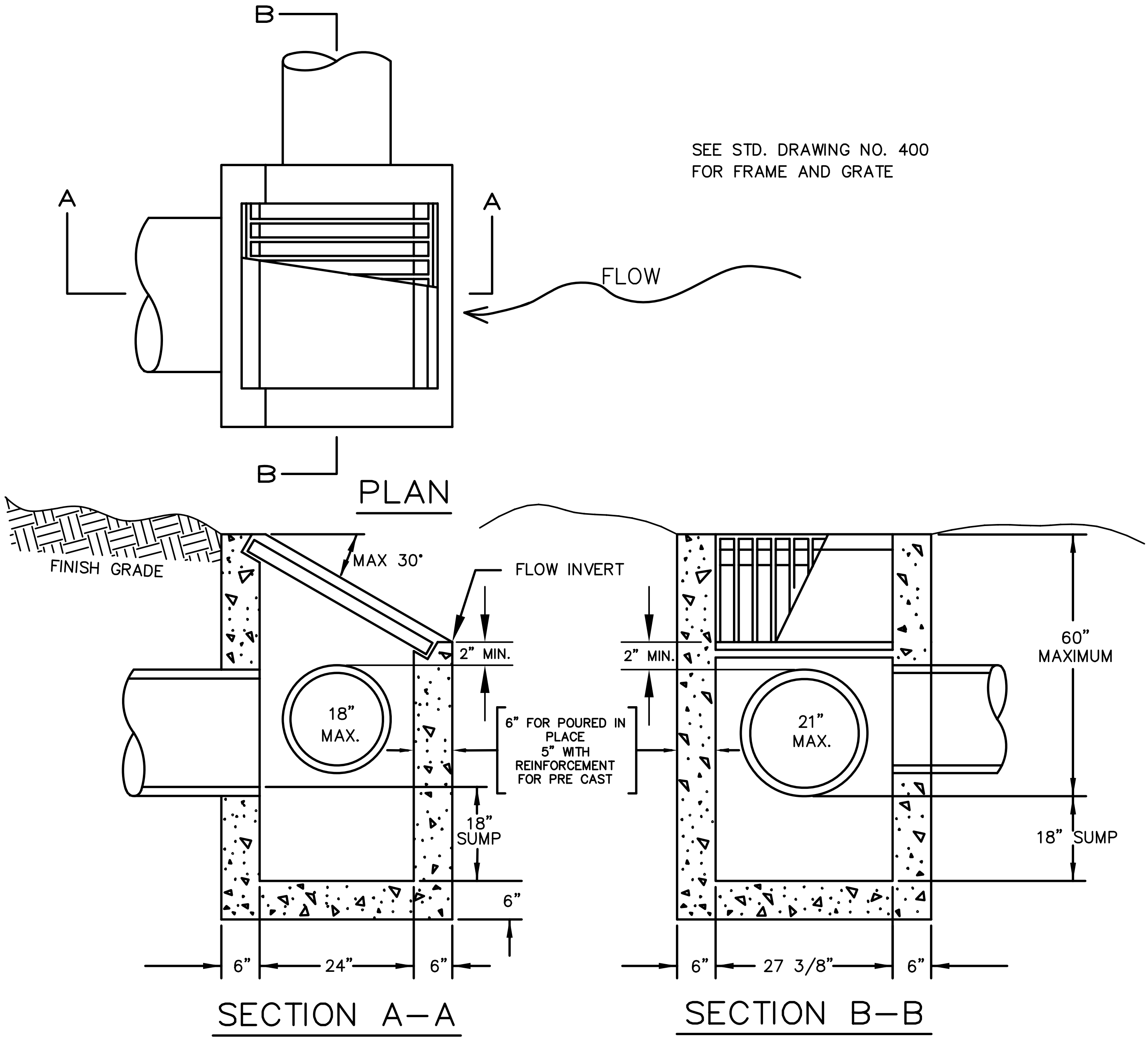

NOTES:
1. ALL PRE CAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C–478.
2. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" – 0" COMPACTED BASE MATERIAL.
3. PRE CAST REINFORCEMENT SHALL BE REBAR MEETING ASTM A615 GRADE 60 OR WELDED WIRE MEETING ASTM A497
4. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI AND SLUMP OF 2" TO 4".
5. PRE–CAST STRUCTURE'S CONFORMING TO O.D.O.T. TYPE G–2 CATCH BASIN DESIGN/WITH DITCH INLET TOP ARE AN ACCEPTABLE ALTERNATE. ALL GRATE MATERIALS SHALL MEET C.W.S. STANDARDS AS SHOWN ON DETAIL #400

DITCH INLET

DRAWING NO. 390

REVISED 05–07

CleanWater Services
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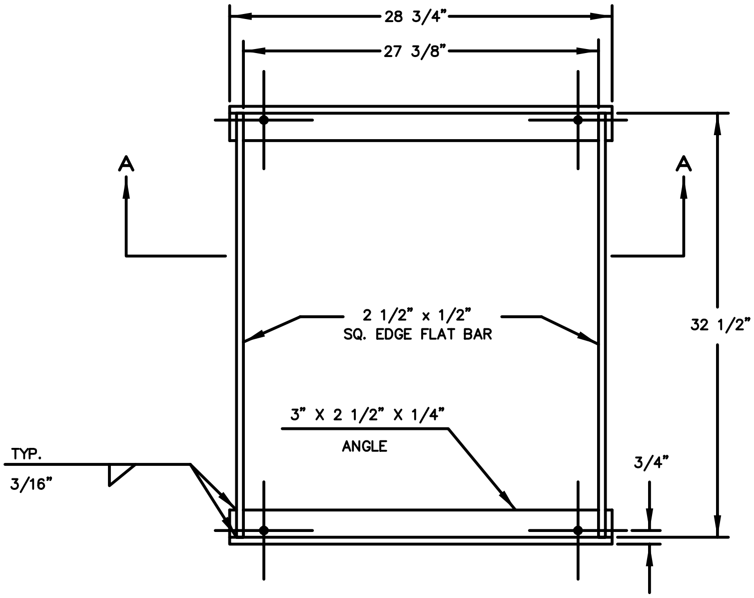
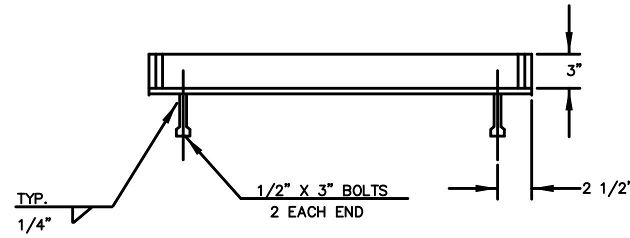
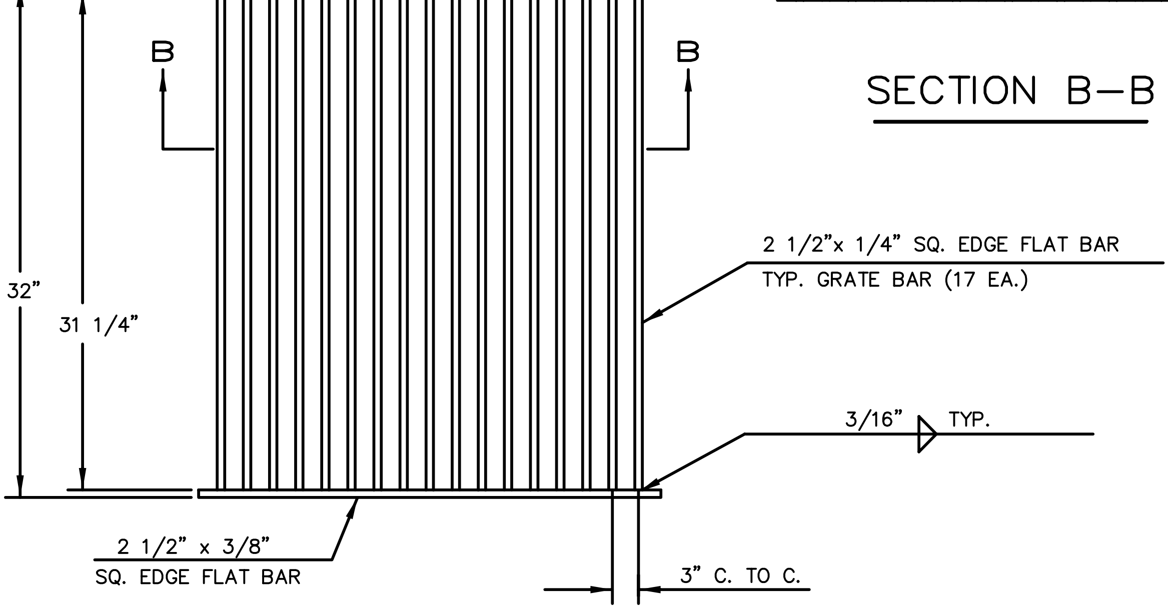


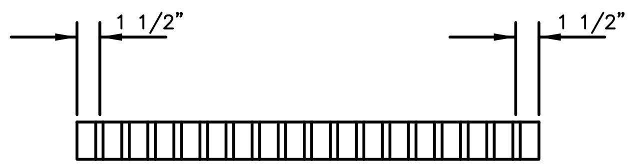
PLAN



SECTION A–A



PLAN



SECTION B–B

NOTE:
FRAME AND GRATE SHALL BE NEW STRUCTURAL ASTM A–36 FLAT BAR STEEL OR APPROVED EQUAL.

DITCH INLET FRAME AND GRATE

DRAWING NO. 400

REVISED 12–06

Clean Water Services
Our commitment is clear.

Appendix H

Summary for Subcatchment 17S: Ex Aux 5

Runoff = 1.17 cfs @ 8.13 hrs, Volume= 0.581 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25yr Rainfall=3.90"

Area (ac)	CN	Description
0.200	98	Paved roads w/curbs & sewers, HSG B
4.000	65	2 acre lots, 12% imp, HSG B
1.600	74	Farmsteads, HSG B
5.800	69	Weighted Average
5.120		88.28% Pervious Area
0.680		11.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0100	0.09		**Sheet Flow, Field** Cultivated: Residue>20% n= 0.170 P2= 2.50"
6.5	500	0.0200	1.27		**Shallow Concentrated Flow, Field** Cultivated Straight Rows Kv= 9.0 fps
0.5	100	0.0400	3.22		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.6	105	0.0400	3.00		**Shallow Concentrated Flow, Grass** Grassed Waterway Kv= 15.0 fps
16.9	755	Total			

From County Storm Drainage Report for SW Boones Ferry Road (Jan 2013),
PDF Page 59 of 152.

Table LU_a. ORIGINAL Subbasin Areas with Future Land Use Conditions
Weighted Curve Numbers used in HEC-HMS Hydrologic Modeling for Varying Land Use Cases

Weighted average CN Calculations

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
4.000	65	2 acre lots, 12% imp, HSG B [At 4 acres this is two lots that are 2 acres each.]		
1.600	74	Farmsteads, HSG B	Calibration-Check Washington County (OK)	
5.8	69	Weighted Average		68.6

Ongoing Land Use (LU)

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
2.000	65	2 acre lot, 12% imp, HSG B		
2.000	92	Urban Districts: Commercial and Business		
1.600	74	Farmsteads, HSG B		LU Case CN
5.8	77.9	Weighted Average	Weighted Average CN	77.9

Full Build-out (BO)

Area (ac)	CN	Description		
0.200	98	Paved roads w/curbs & sewers, HSG B		
2.000	85	2 acre lot, 12% imp, HSG B		
2.000	92	Urban Districts: Commercial and Business		
1.600	85	Residential Districts: 1/8 acre		BO Case CN
5.8	87.9	Weighted Average	Weighted Average CN	87.9

Global Summary Results for Run "Lucini_o_17S"

Project: BF_o_Lucini Simulation Run: Lucini_o_17S

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 11:57:36 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S	0.009048	1.17	01Jan3000, 08:06	1.20

Summary Results for Subbasin "Lucini_o_17S"

Project: BF_o_Lucini Simulation Run: Lucini_o_17S
Subbasin: Lucini_o_17S

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 11:57:36 Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

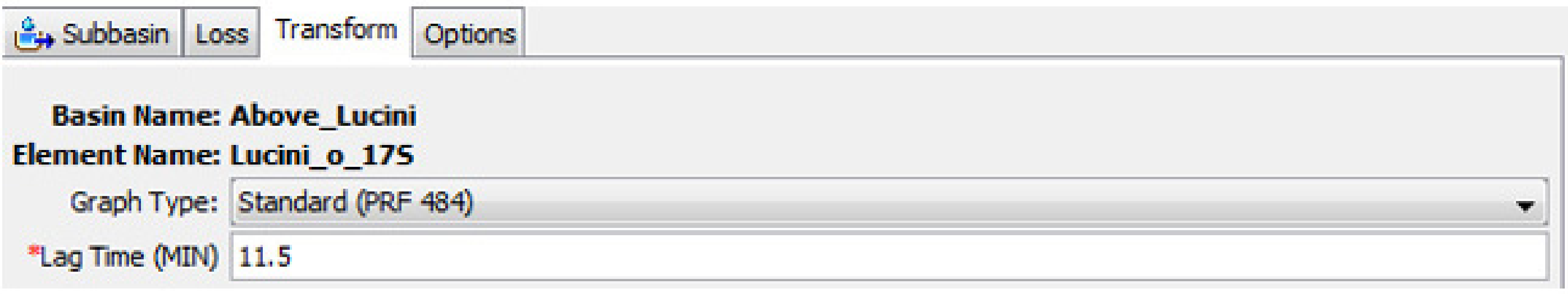
Peak Discharge:	1.17 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:06
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.20 (IN)
Loss Volume:	2.70 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.20 (IN)	Discharge Volume:	1.20 (IN)

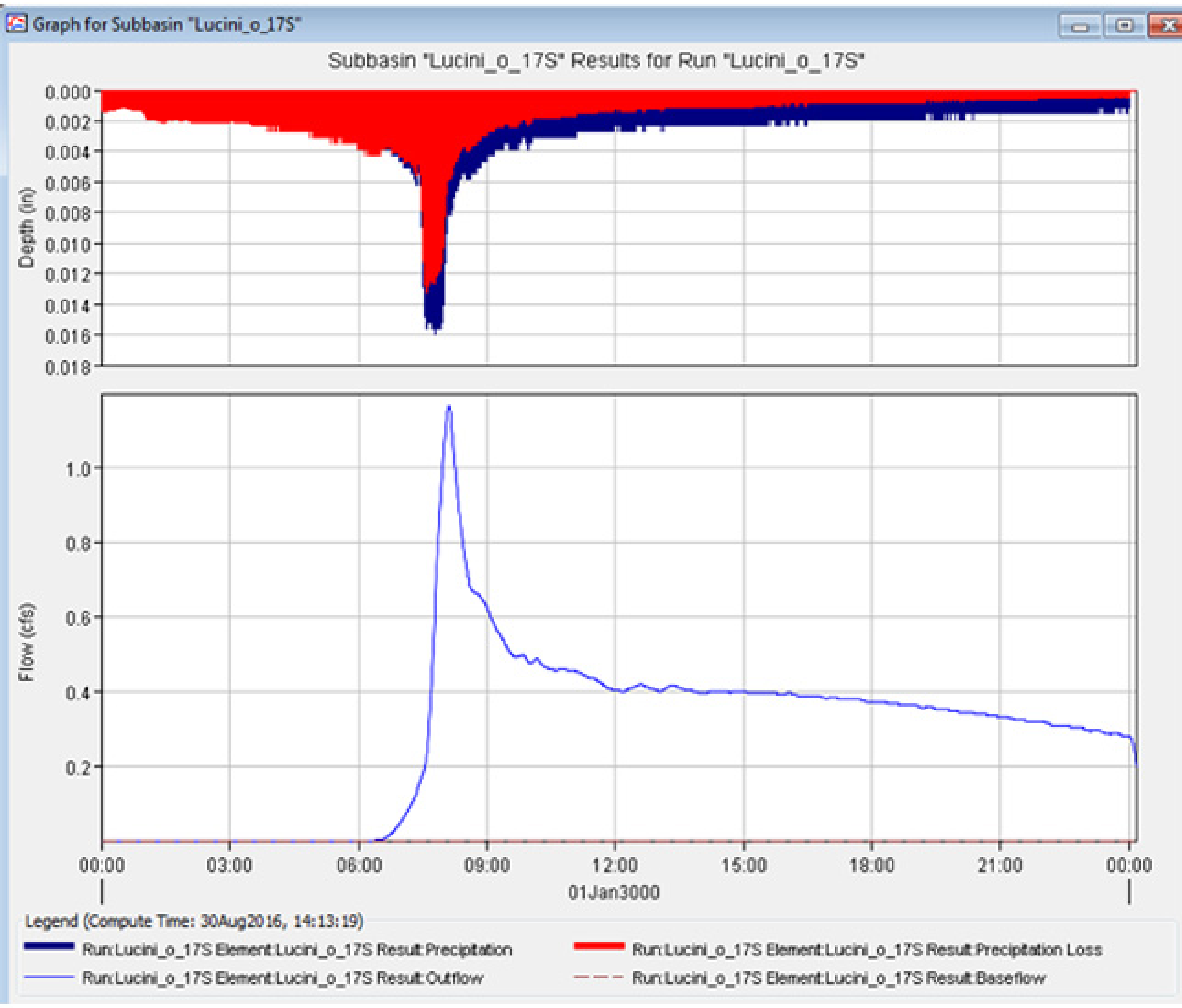
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini
Element Name: Lucini_o_17S

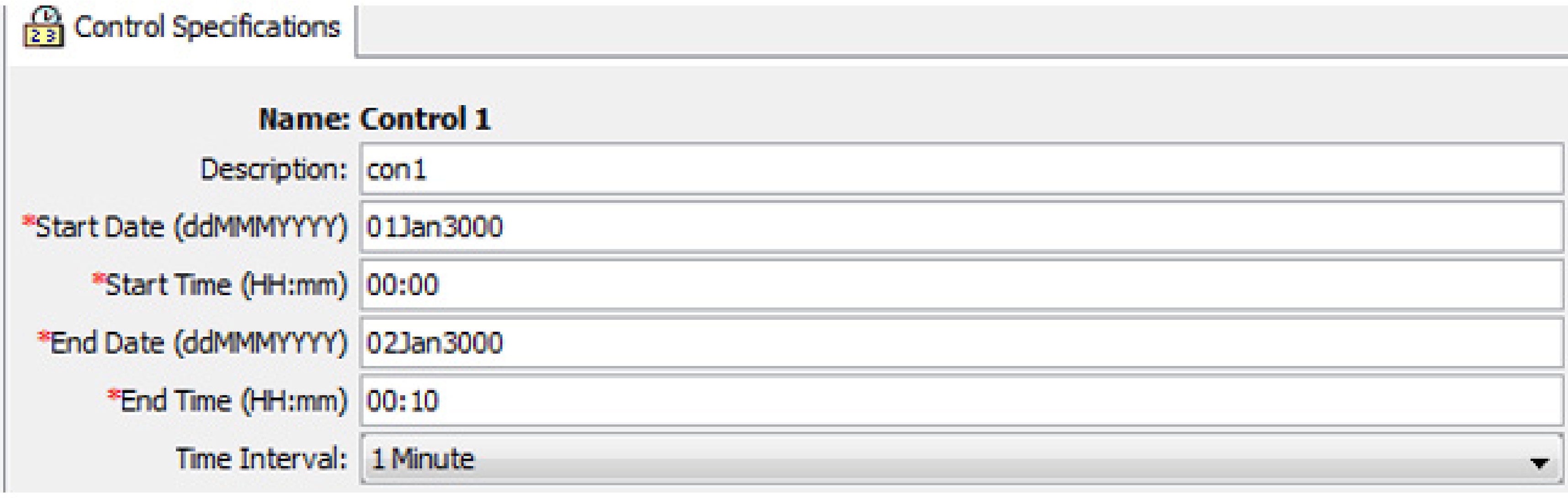
Description:	sub1
Downstream:	--None--
*Area (MI2)	0.009048
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Initial Abstraction (IN)
*Curve Number: 69
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 11.5


Graph for Subbasin "Lucini_o_17S"
Subbasin "Lucini_o_17S" Results for Run "Lucini_o_17S"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
1.0
0.8
0.6
0.4
0.2
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:13:19)
Run:Lucini_o_17S Element:Lucini_o_17S Result:Precipitation
Run:Lucini_o_17S Element:Lucini_o_17S Result:Precipitation Loss
Run:Lucini_o_17S Element:Lucini_o_17S Result:Outflow
Run:Lucini_o_17S Element:Lucini_o_17S Result:Baseflow


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini
Element Name: Lucini_o_17S
Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:


Control Specifications
Name: Control 1
Description: con1
*Start Date (ddMMMYYYY) 01Jan3000
*Start Time (HH:mm) 00:00
*End Date (ddMMMYYYY) 02Jan3000
*End Time (HH:mm) 00:10
Time Interval: 1 Minute

Global Summary Results for Run "Lucini_o_17S_base_aa"

Project: BF_o_17S_base_aa   Simulation Run: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:30:08   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S_base_aa	0.00678	0.89	01Jan3000, 08:05	1.20

Summary Results for Subbasin "Lucini_o_17S_base_aa"

Project: BF_o_17S_base_aa   Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:30:08   Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	0.89 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:05
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.20 (IN)
Loss Volume:	2.70 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.20 (IN)	Discharge Volume:	1.20 (IN)

Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

Description:	sub1
Downstream:	--None--
*Area (MI2)	0.00678
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a

Element Name: Lucini_o_17S_base_aa

Initial Abstraction (IN)

*Curve Number: 69

*Impervious (%) 0

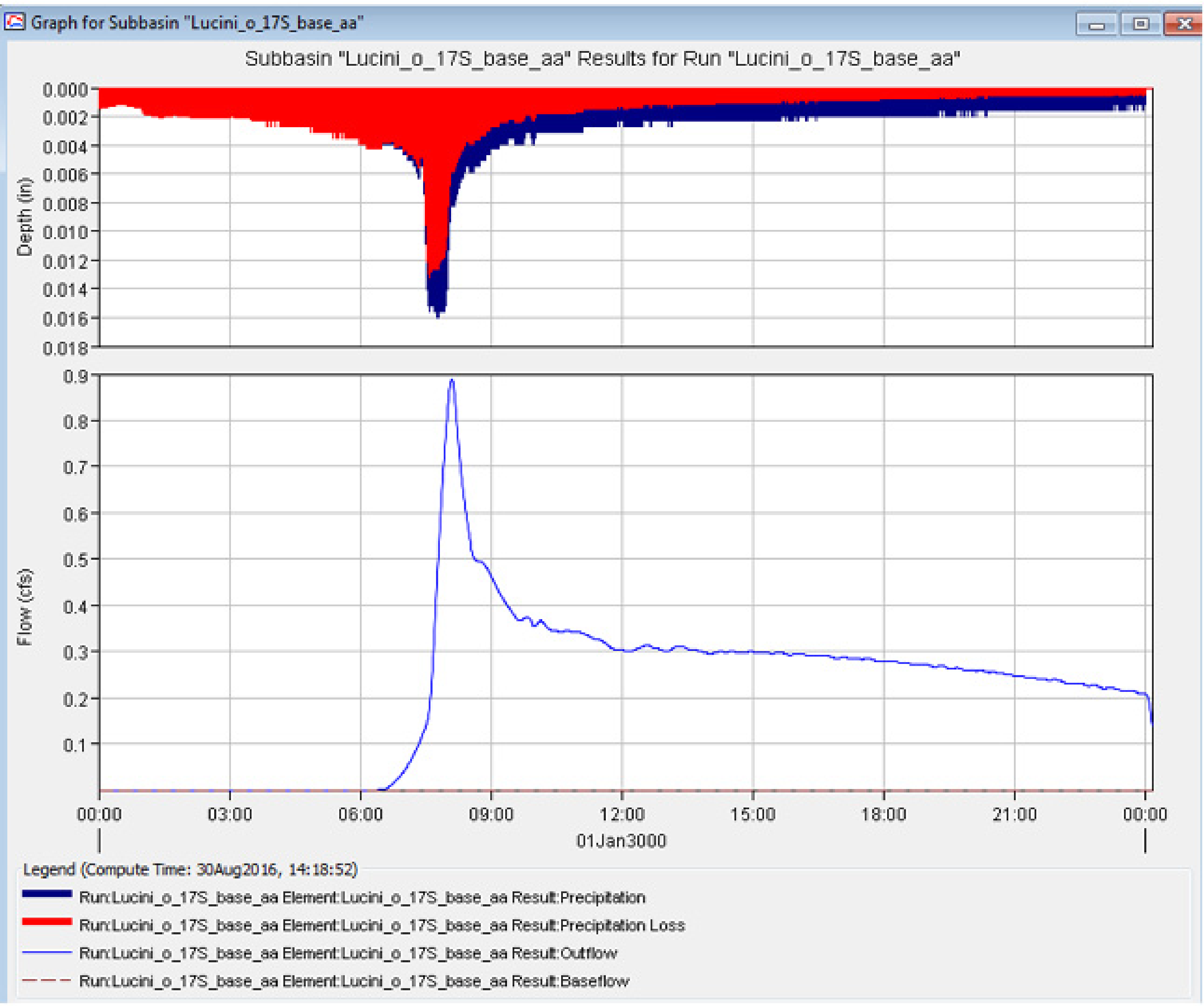
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a

Element Name: Lucini_o_17S_base_aa

Graph Type: Standard (PRF 484)

*Lag Time (MIN) 10.5



Global Summary Results for Run "Lucini_o_17S_base_aa"

Project: Lucini_o-17S_LU Simulation Run: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:56:51 Control Specifications: Control 1

Show Elements: All Elements Volume Units: (•) IN ( ) AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S_base_aa	0.006781	1.71	01Jan3000, 08:04	1.80

Summary Results for Subbasin "Lucini_o_17S_base_aa"

Project: Lucini_o-17S_LU Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 12:56:51 Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

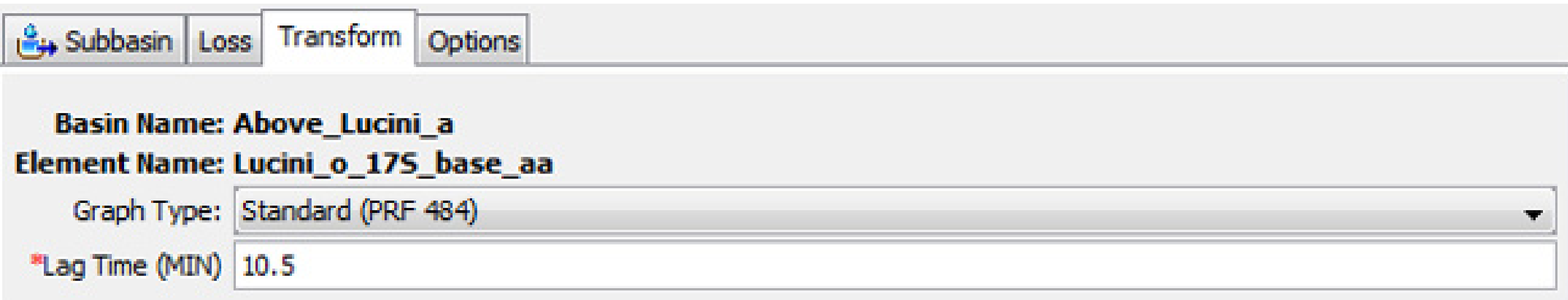
Peak Discharge:	1.71 (CFS)	Date/Time of Peak Discharge:	01Jan3000, 08:04
Precipitation Volume:	3.90 (IN)	Direct Runoff Volume:	1.80 (IN)
Loss Volume:	2.10 (IN)	Baseflow Volume:	0.00 (IN)
Excess Volume:	1.80 (IN)	Discharge Volume:	1.80 (IN)

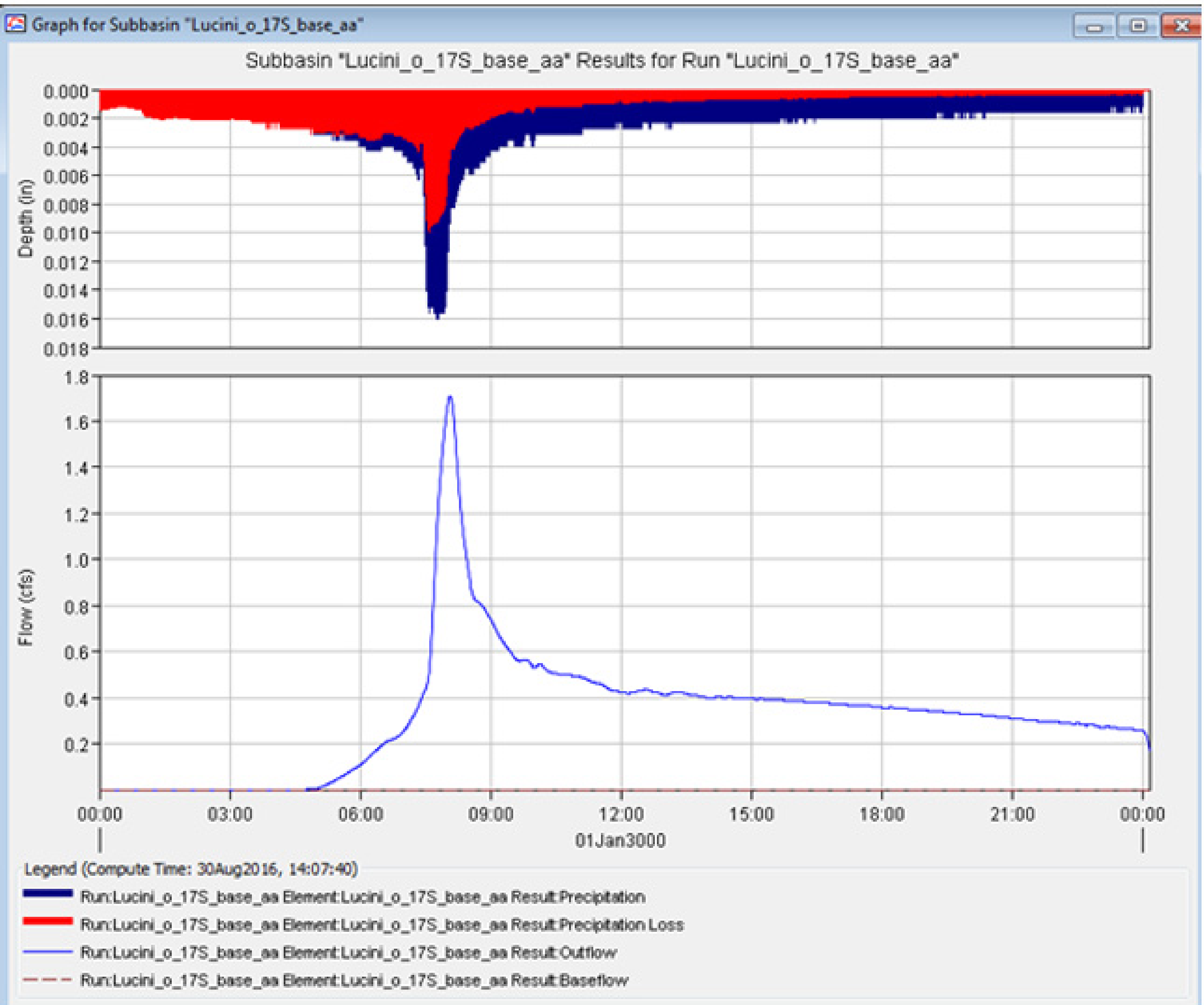
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

Description:	sub1
Downstream:	--None--
*Area (MI2)	0.006781
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Initial Abstraction (IN)
*Curve Number: 77.9
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "Lucini_o_17S_base_aa"
Subbasin "Lucini_o_17S_base_aa" Results for Run "Lucini_o_17S_base_aa"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:07:40)
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation Loss
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Outflow
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Baseflow

Global Summary Results for Run "Lucini_o_17S_base_aa"

Project: Lucini_o_17S_BO   Simulation Run: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 13:38:09   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: IN AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Lucini_o_17S_base_aa	0.006781	2.85	01Jan3000, 08:02	2.63

Summary Results for Subbasin "Lucini_o_17S_base_aa"

Project: Lucini_o_17S_BO   Simulation Run: Lucini_o_17S_base_aa
Subbasin: Lucini_o_17S_base_aa

Start of Run: 01Jan3000, 00:00   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 13:38:09   Control Specifications: Control 1

Volume Units: IN AC-FT

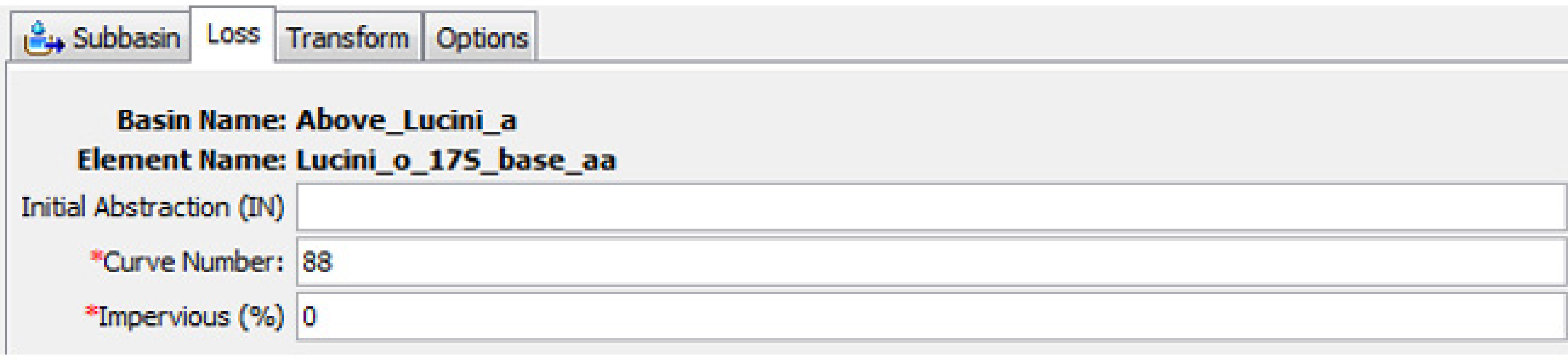
Computed Results

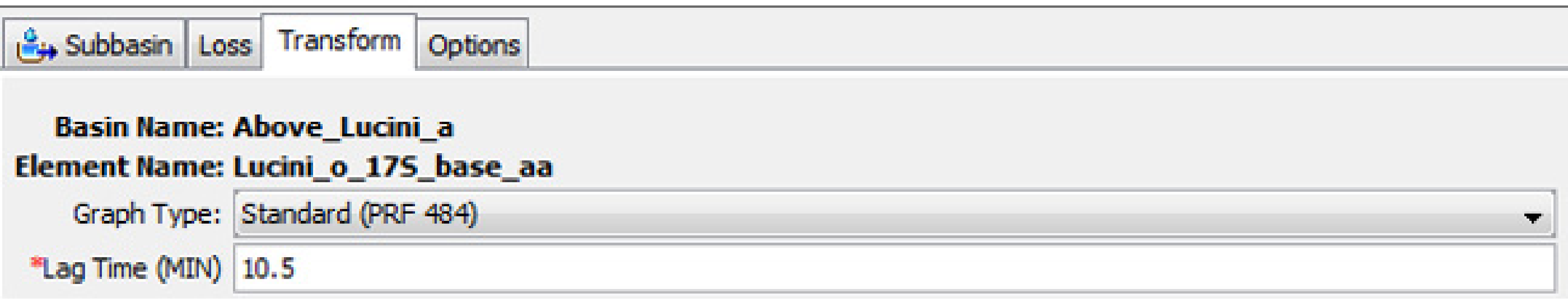
Peak Discharge: 2.85 (CFS)   Date/Time of Peak Discharge: 01Jan3000, 08:02
Precipitation Volume: 3.90 (IN)   Direct Runoff Volume: 2.63 (IN)
Loss Volume: 1.26 (IN)   Baseflow Volume: 0.00 (IN)
Excess Volume: 2.64 (IN)   Discharge Volume: 2.63 (IN)

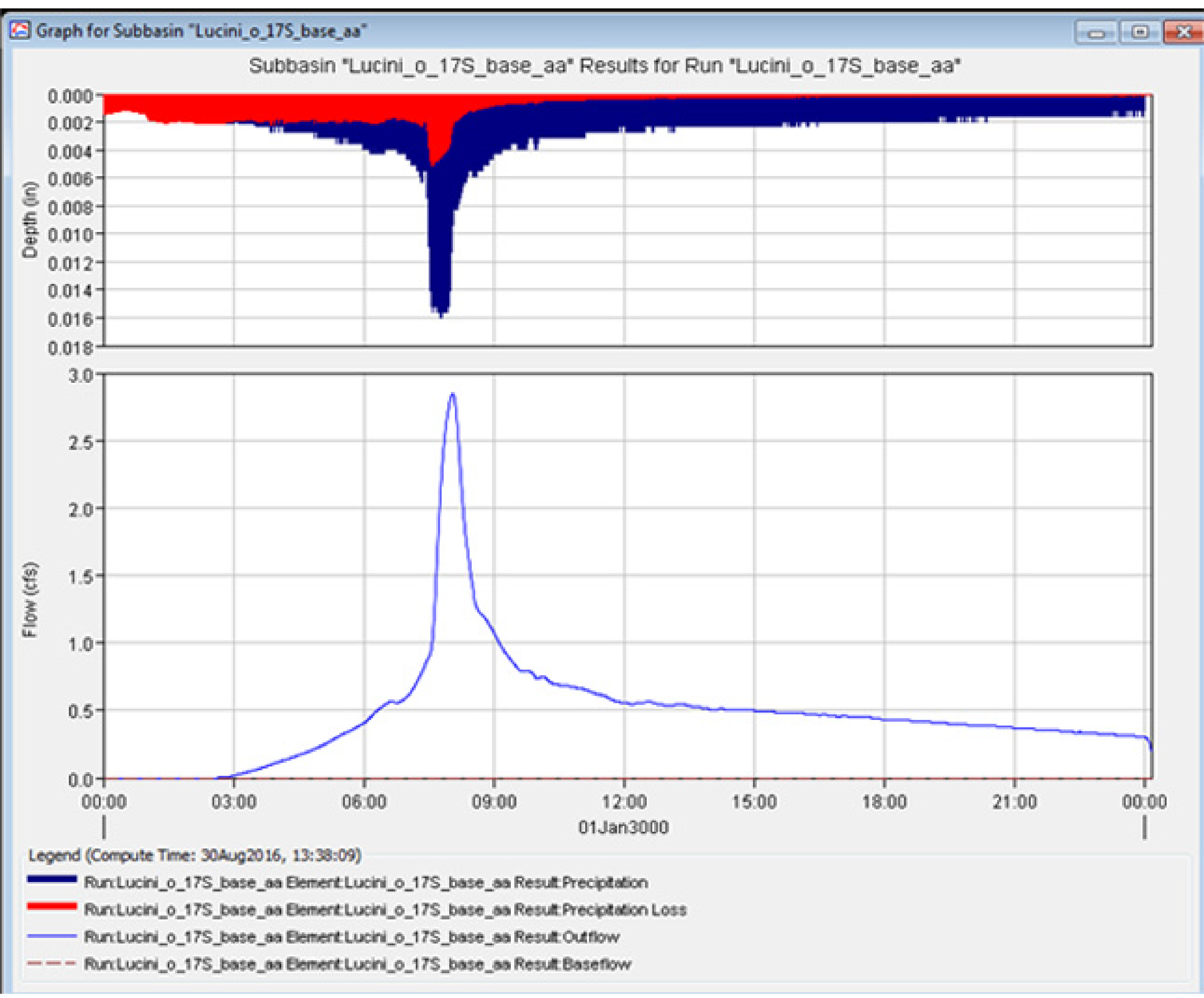
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa

Description: sub1
Downstream: --None--
*Area (MI2) 0.006781
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Initial Abstraction (IN)
*Curve Number: 88
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: Lucini_o_17S_base_aa
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "Lucini_o_17S_base_aa"
Subbasin "Lucini_o_17S_base_aa" Results for Run "Lucini_o_17S_base_aa"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 13:38:09)
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Precipitation Loss
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Outflow
Run:Lucini_o_17S_base_aa Element:Lucini_o_17S_base_aa Result:Baseflow

Summary for Subcatchment 59S: Pro Aux 5

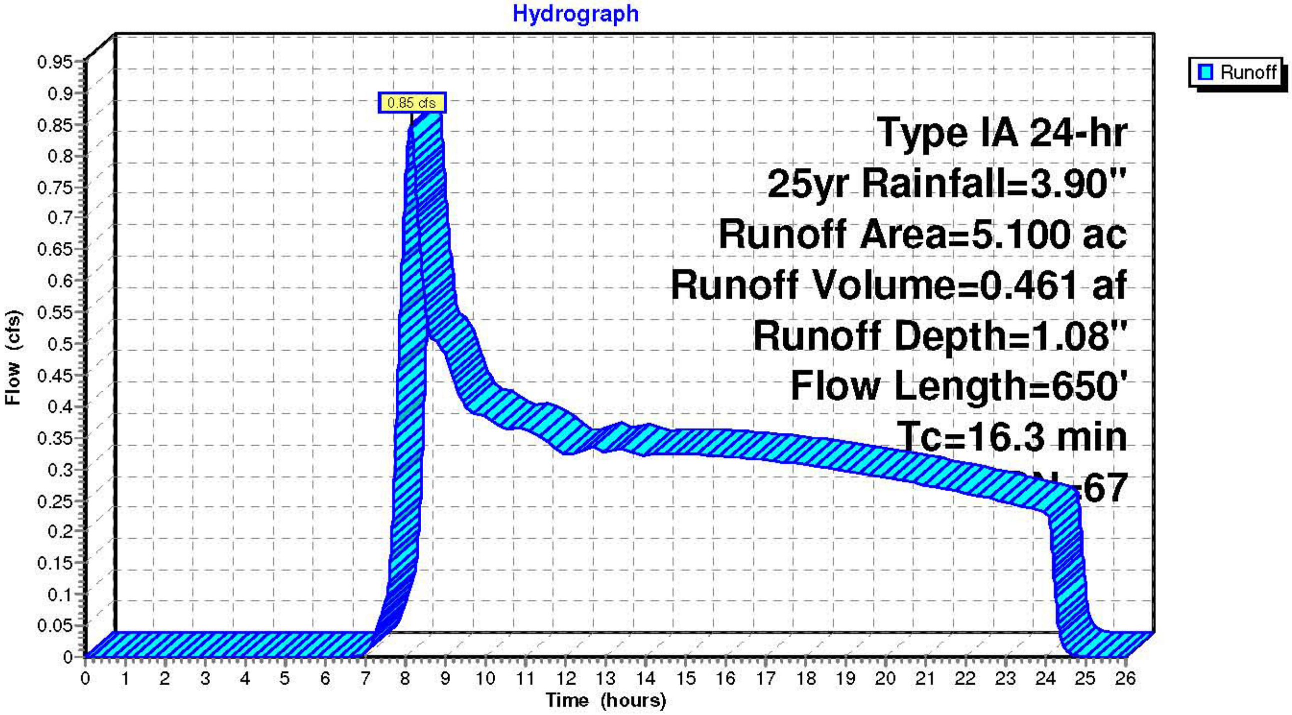
Runoff = 0.85 cfs @ 8.13 hrs, Volume= 0.461 af, Depth= 1.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25yr Rainfall=3.90"

Area (ac)	CN	Description
3.800	65	2 acre lots, 12% imp, HSG B
1.300	74	Farmsteads, HSG B
5.100	67	Weighted Average
4.644		91.06% Pervious Area
0.456		8.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0100	0.09		**Sheet Flow, Field** Cultivated: Residue>20% n= 0.170 P2= 2.50"
6.5	500	0.0200	1.27		**Shallow Concentrated Flow, Field** Cultivated Straight Rows Kv= 9.0 fps
0.5	100	0.0400	3.22		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
16.3	650	Total			

Subcatchment 59S: Pro Aux 5



From County Storm Drainage Report for SW Boones Ferry Road (Jan 2013), PDF Page 101 of 152.

Table LU_b. IMPLEMENTED Subbasin Areas with Future Land Use Conditions

Weighted Curve Numbers used in HEC-HMS Hydrologic Modeling for Varying Land Use Cases

Weighted average CN Calculations

Inplemented On-going Land Use (LU)

Area (ac)	CN	Description		
1.9	65	2 acre lot, 12% imp., HSG B		
1.9	92	Urban Districts: Commercial and Business		
1.3	74	Farmsteads, HSG B		LU Case CN
5.1	77.4	Weighted Average	Weighted Average CN	77.4

Implemented, Full Build-out (BO)

Area (ac)	CN	Description		
1.9	85	2 acre lot, 12% imp., HSG B		
1.9	92	Urban Districts: Commercial and Business		
1.3	85	Residential Districts: 1/8 acre		BO Case CN
5.1	87.6	Weighted Average	Weighted Average CN	87.6

Global Summary Results for Run "BF_i_59S"

Project: BF_i_59S Simulation Run: BF_i_59S

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 14:53:52 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
BF_i_59s	0.007956	0.85	01Jan3000, 08:06	1.08

Summary Results for Subbasin "BF_i_59s"

Project: BF_i_59S Simulation Run: BF_i_59S
Subbasin: BF_i_59s

Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 14:53:52 Control Specifications: Control 1

Volume Units: IN AC-FT

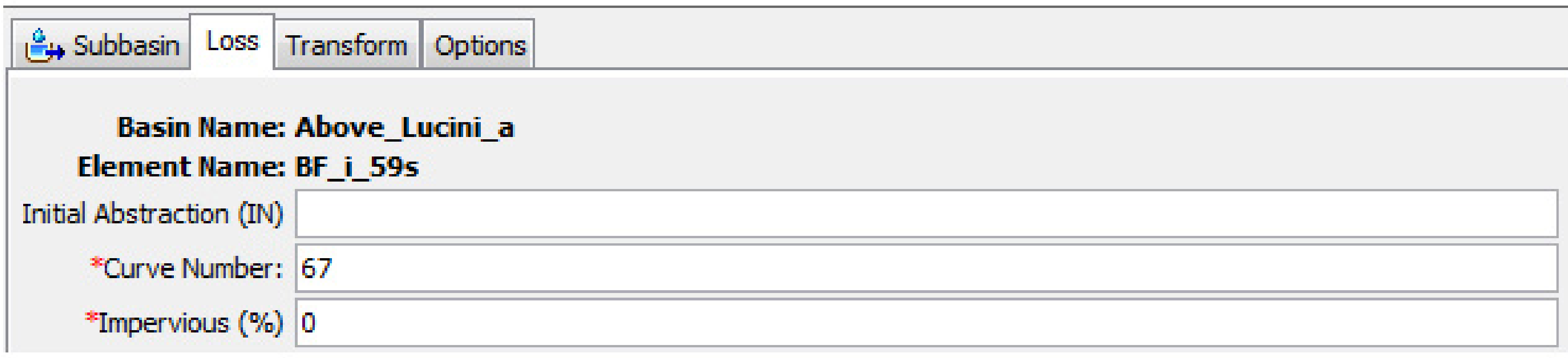
Computed Results

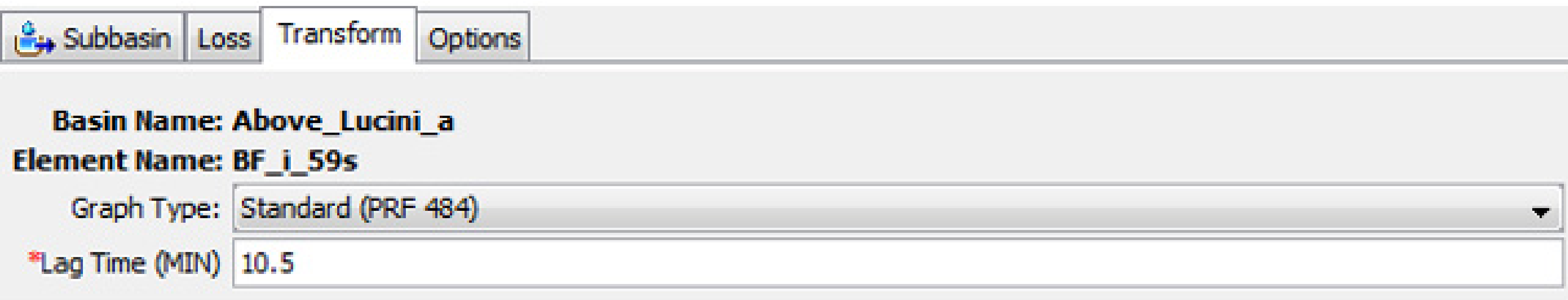
Peak Discharge: 0.85 (CFS) Date/Time of Peak Discharge: 01Jan3000, 08:06
Precipitation Volume: 3.90 (IN) Direct Runoff Volume: 1.08 (IN)
Loss Volume: 2.82 (IN) Baseflow Volume: 0.00 (IN)
Excess Volume: 1.08 (IN) Discharge Volume: 1.08 (IN)

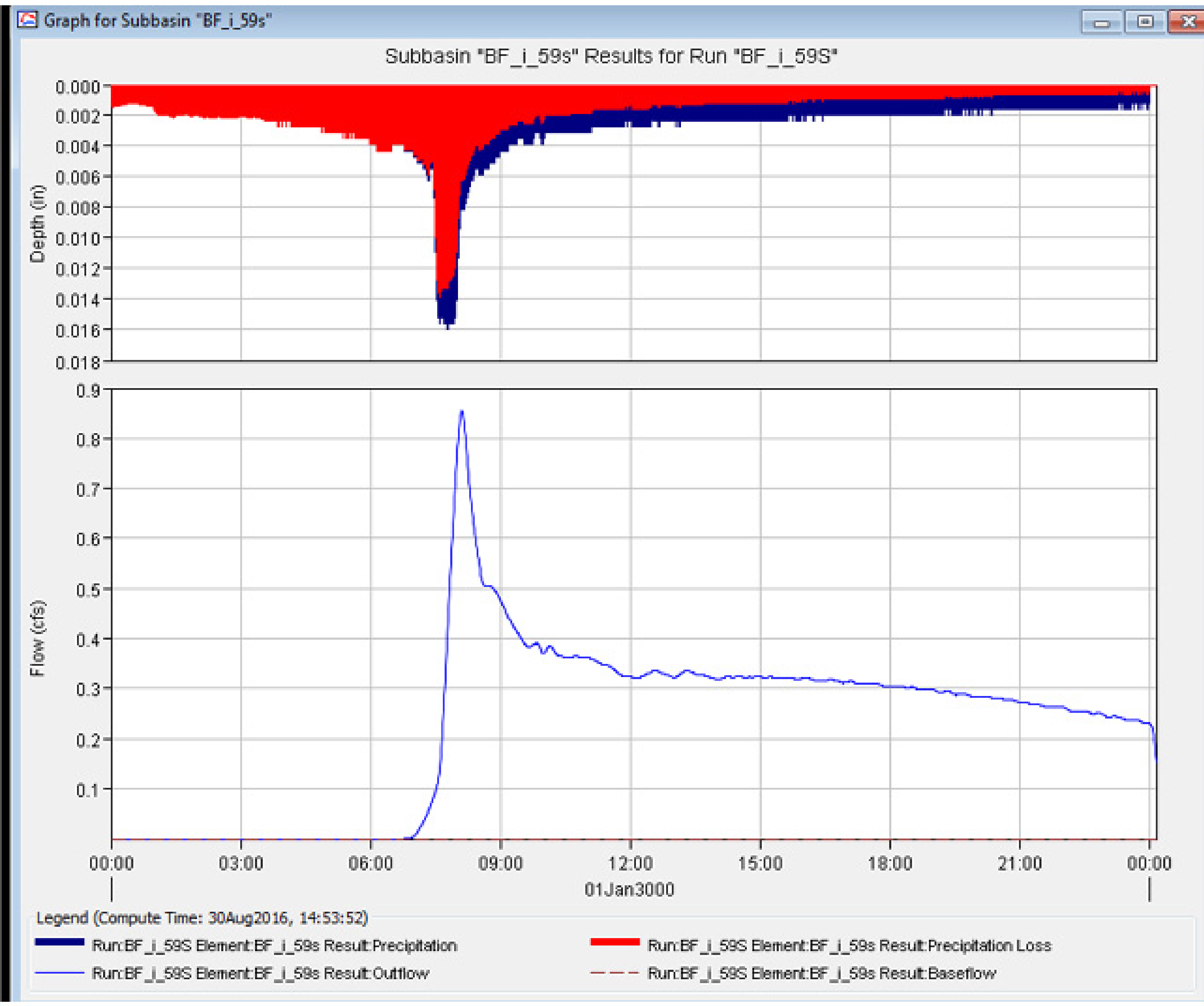
Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: BF_i_59s

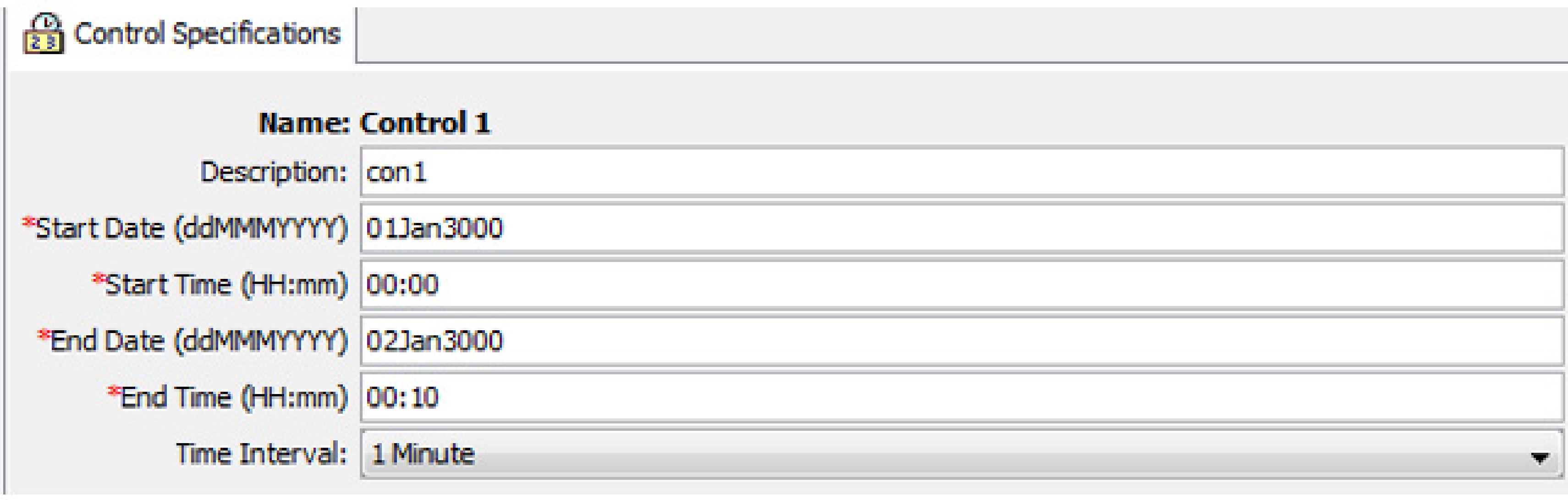
Description: sub1
Downstream: --None--
*Area (MI2) 0.007956
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Initial Abstraction (IN)
*Curve Number: 67
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "BF_i_59s"
Subbasin "BF_i_59s" Results for Run "BF_i_59S"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 14:53:52)
Run:BF_i_59S Element:BF_i_59s Result:Precipitation
Run:BF_i_59S Element:BF_i_59s Result:Precipitation Loss
Run:BF_i_59S Element:BF_i_59s Result:Outflow
Run:BF_i_59S Element:BF_i_59s Result:Baseflow


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Observed Flow: --None--
Observed Stage: --None--
Observed SWE: --None--
Elev-Discharge: --None--
Ref Flow (CFS)
Ref Label:


Control Specifications
Name: Control 1
Description: con1
*Start Date (ddMMMYYYY) 01Jan3000
*Start Time (HH:mm) 00:00
*End Date (ddMMMYYYY) 02Jan3000
*End Time (HH:mm) 00:10
Time Interval: 1 Minute

Global Summary Results for Run "BF_i_59S_base_b"

Project: BF_i_59S_base_b   Simulation Run: BF_i_59S_base_b

Start of Run: 01Jan3000, 00:01   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 12:01   Meteorologic Model: Met 1
Compute Time: 26Aug2016, 10:50:41   Control Specifications: Control 1

Show Elements: All Elements   Volume Units: (•) IN ( ) AC-FT   Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
BF_i_59s_base_b	0.005967	0.64	01Jan3000, 08:07	1.08

Summary Results for Subbasin "BF_i_59s_base_b"

Project: BF_i_59S_base_b   Simulation Run: BF_i_59S_base_b
Subbasin: BF_i_59s_base_b

Start of Run: 01Jan3000, 00:01   Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 12:01   Meteorologic Model: Met 1
Compute Time: 30Aug2016, 11:28:16   Control Specifications: Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Discharge: 0.64 (CFS)   Date/Time of Peak Discharge: 01Jan3000, 08:07
Precipitation Volume: 3.90 (IN)   Direct Runoff Volume: 1.08 (IN)
Loss Volume: 2.82 (IN)   Baseflow Volume: 0.00 (IN)
Excess Volume: 1.08 (IN)   Discharge Volume: 1.08 (IN)

Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b

Description: sub1
Downstream: --None--
*Area (MI2) 0.005967
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--

Subbasin | Loss | Transform | Options

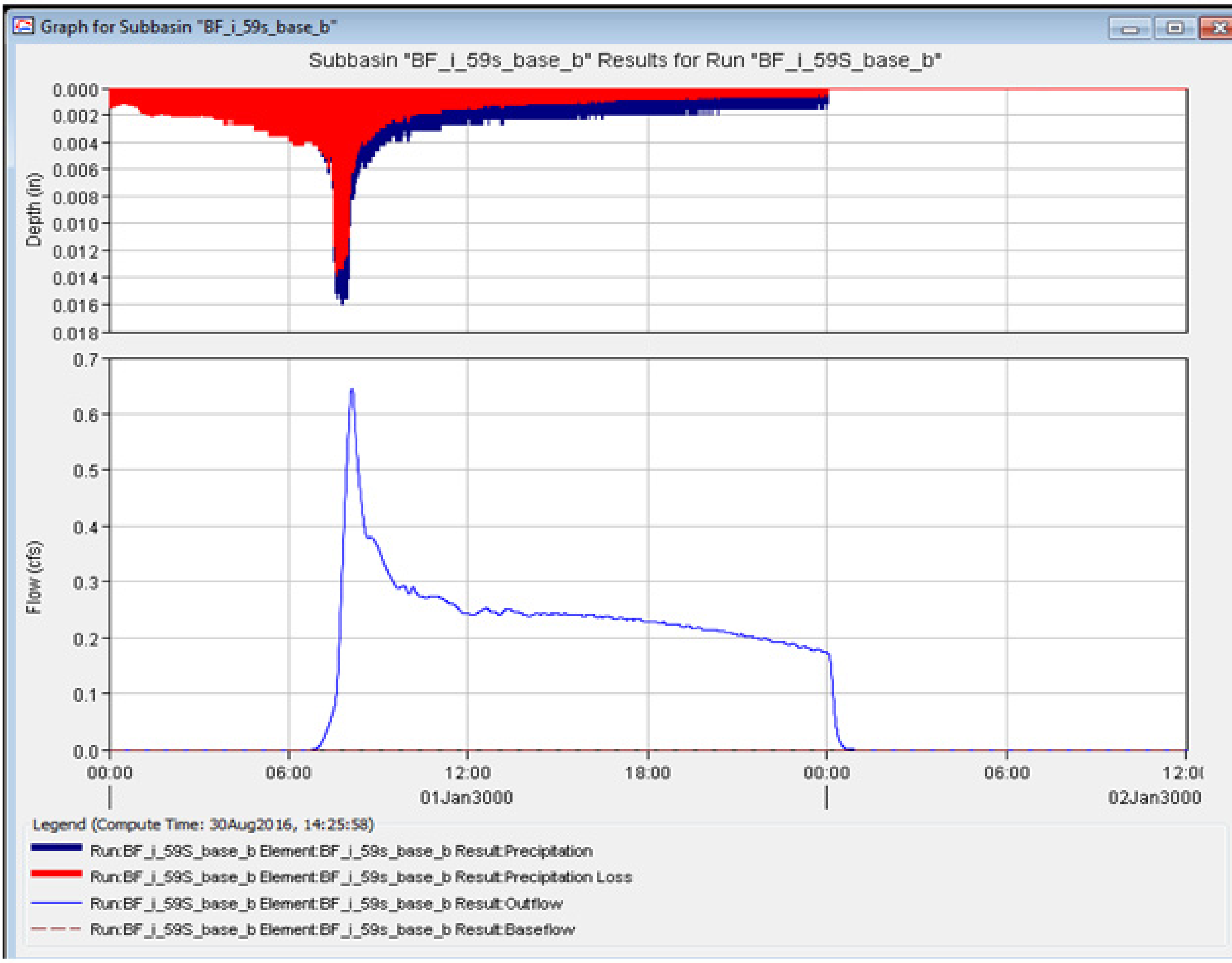
Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b

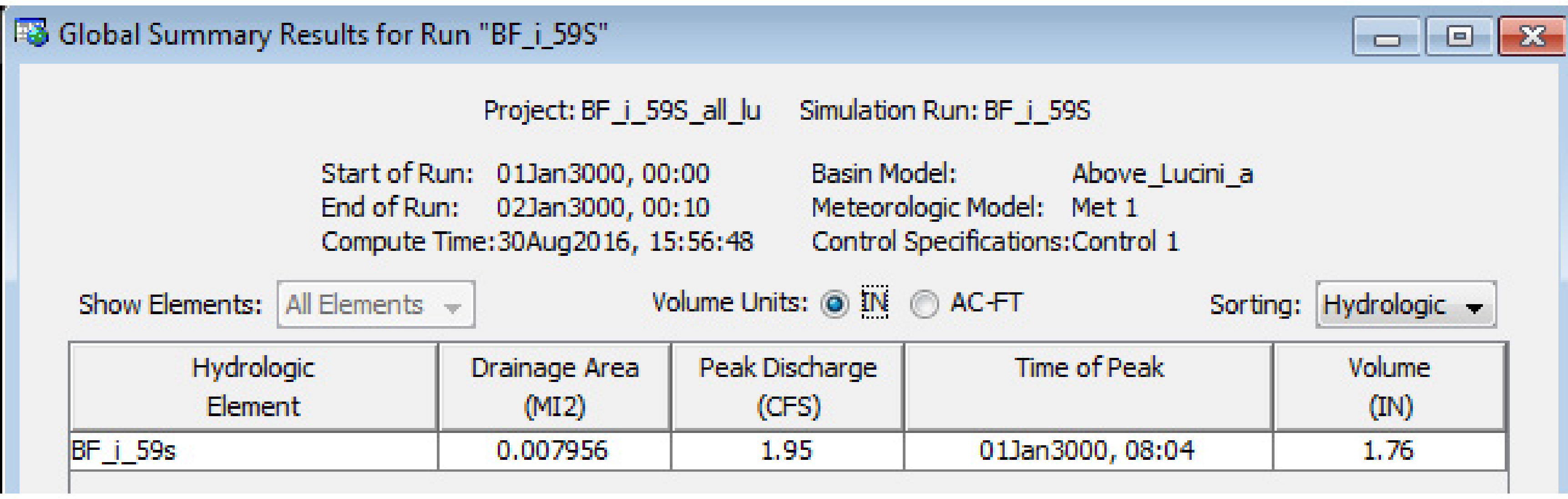
Initial Abstraction (IN)	
*Curve Number:	67
*Impervious (%)	0

Subbasin | Loss | Transform | Options

Basin Name: Above_Lucini_a
Element Name: BF_i_59s_base_b

Graph Type:	Standard (PRF 484)
*Lag Time (MIN)	10.2





Global Summary Results for Run "BF_i_59S"

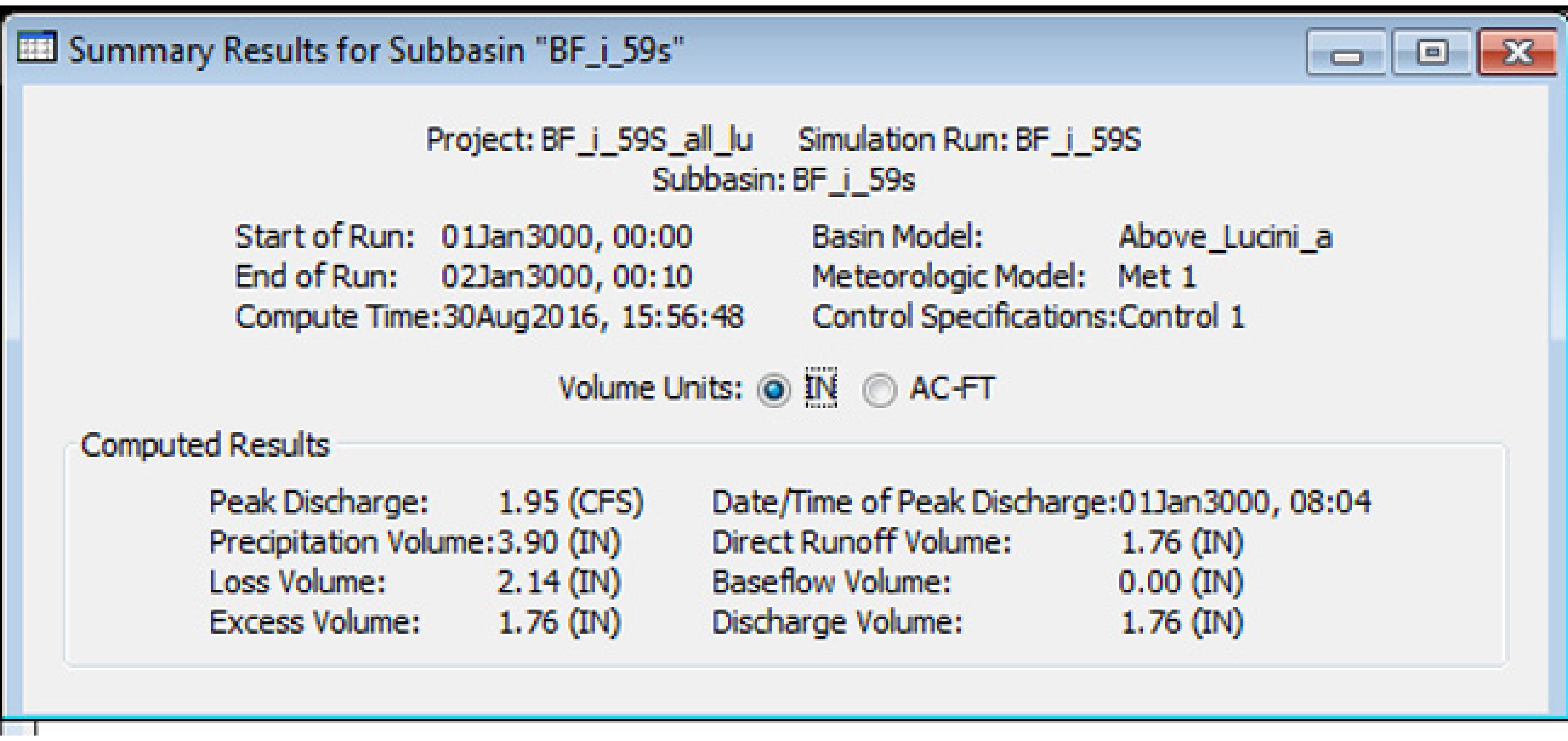
Project: BF_i_59S_all_lu Simulation Run: BF_i_59S

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 15:56:48

Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
BF_i_59s	0.007956	1.95	01Jan3000, 08:04	1.76



Summary Results for Subbasin "BF_i_59s"

Project: BF_i_59S_all_lu Simulation Run: BF_i_59S
Subbasin: BF_i_59s

Start of Run: 01Jan3000, 00:00
End of Run: 02Jan3000, 00:10
Compute Time: 30Aug2016, 15:56:48

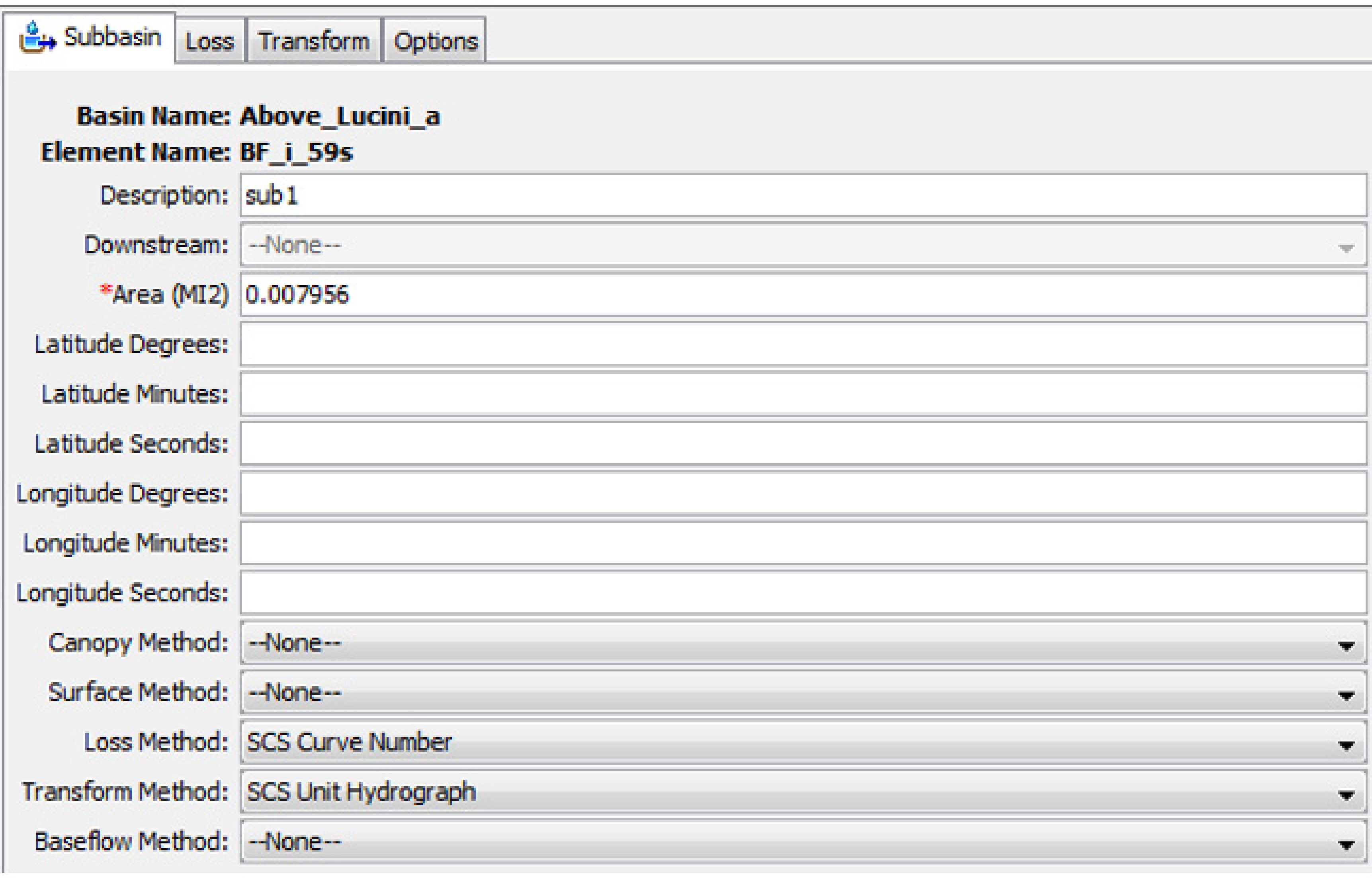
Basin Model: Above_Lucini_a
Meteorologic Model: Met 1
Control Specifications: Control 1

Volume Units: IN AC-FT

Computed Results

Peak Discharge: 1.95 (CFS)
Precipitation Volume: 3.90 (IN)
Loss Volume: 2.14 (IN)
Excess Volume: 1.76 (IN)

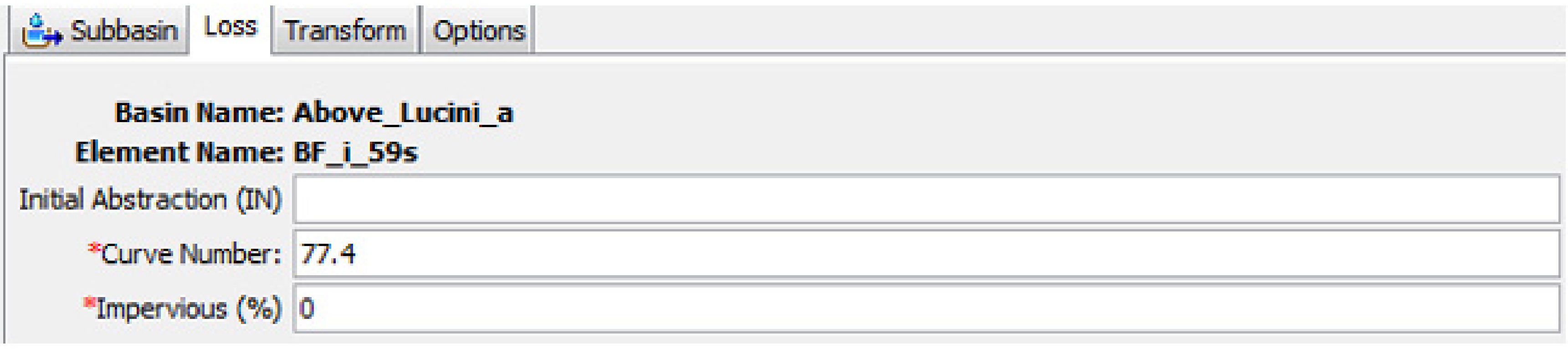
Date/Time of Peak Discharge: 01Jan3000, 08:04
Direct Runoff Volume: 1.76 (IN)
Baseflow Volume: 0.00 (IN)
Discharge Volume: 1.76 (IN)

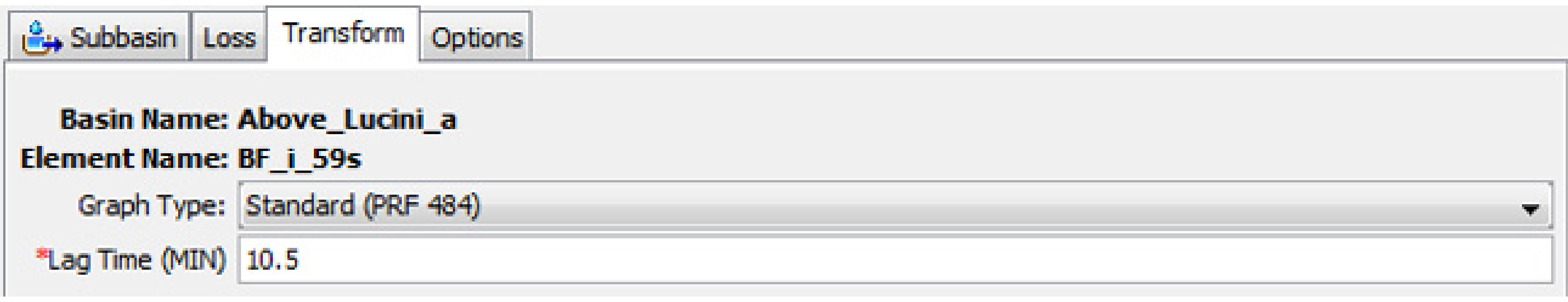


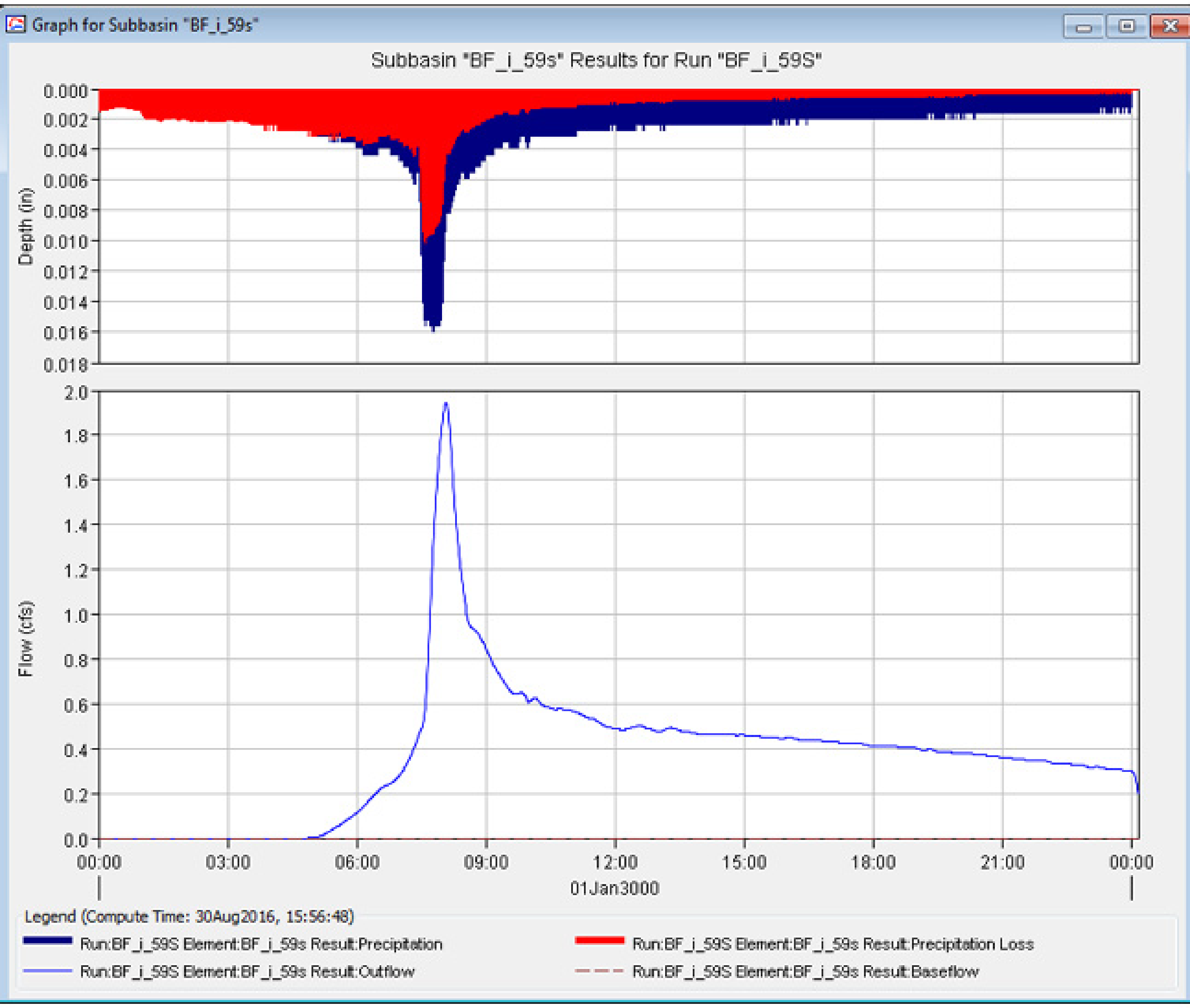
Subbasin | Loss | Transform | Options

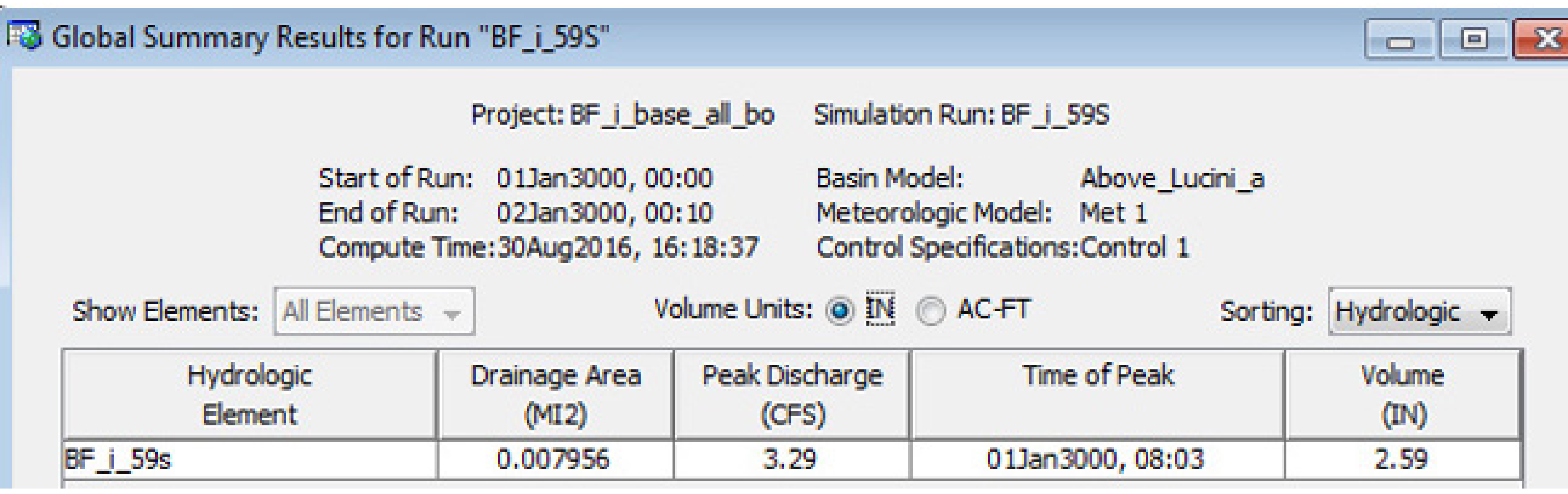
Basin Name: Above_Lucini_a
Element Name: BF_i_59s

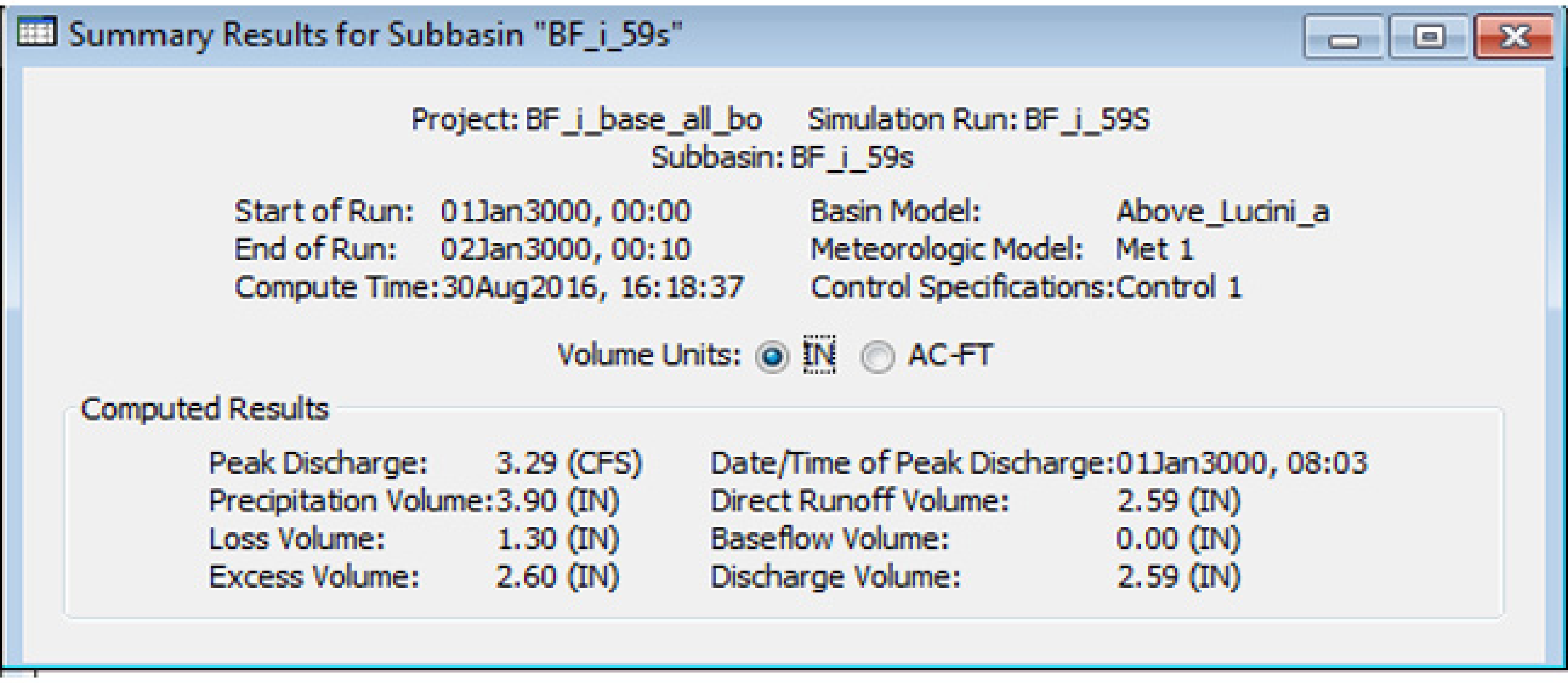
Description:	sub1
Downstream:	--None--
*Area (MI2)	0.007956
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Canopy Method:	--None--
Surface Method:	--None--
Loss Method:	SCS Curve Number
Transform Method:	SCS Unit Hydrograph
Baseflow Method:	--None--

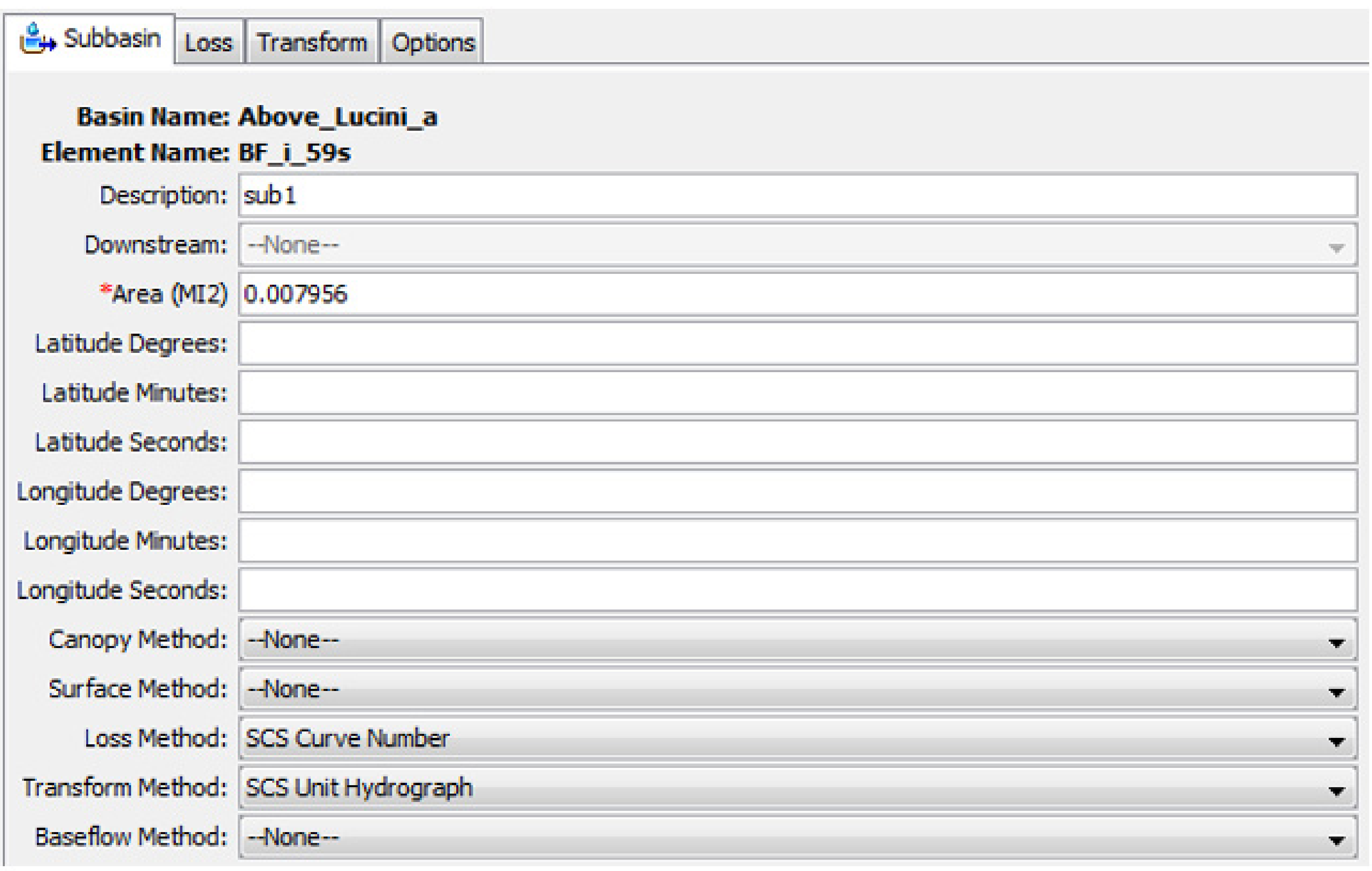

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Initial Abstraction (IN)
*Curve Number: 77.4
*Impervious (%) 0

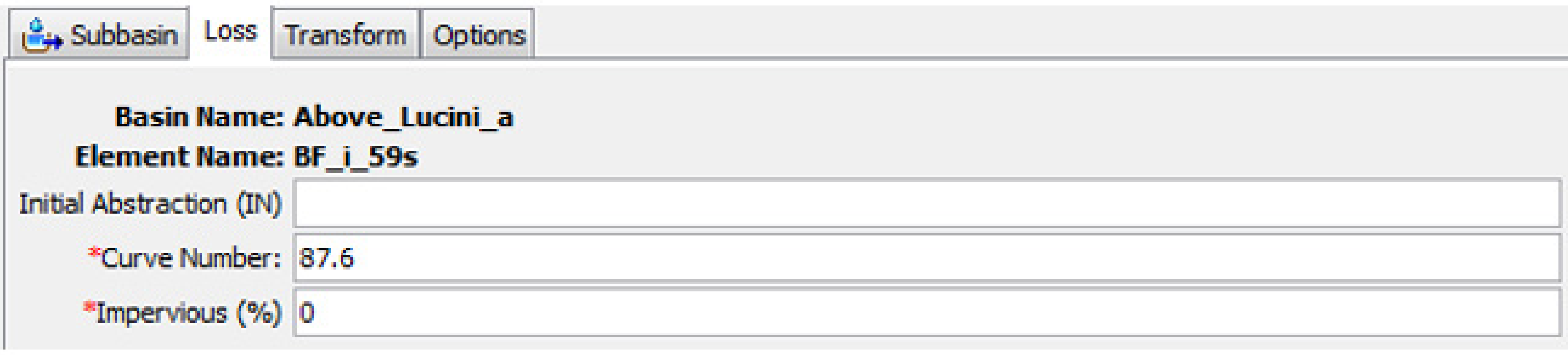

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5

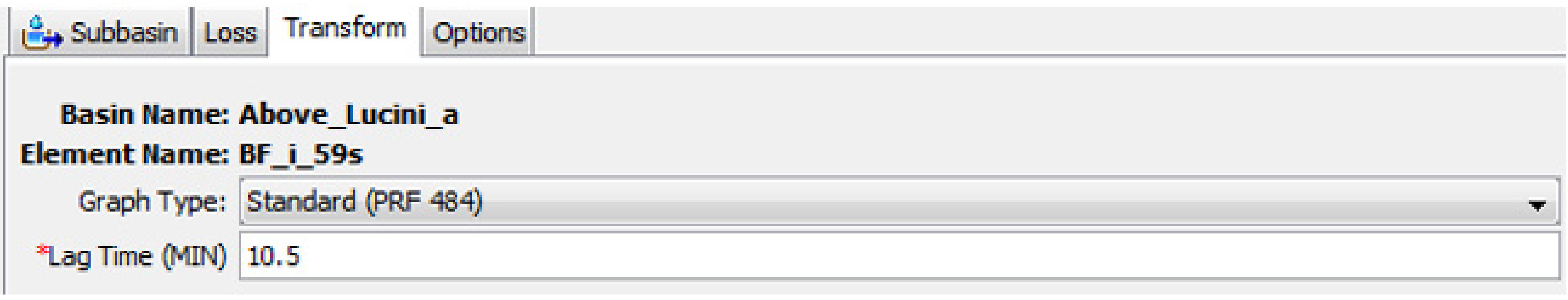

Graph for Subbasin "BF_i_59s"
Subbasin "BF_i_59s" Results for Run "BF_i_59S"
Depth (in)
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
Flow (cfs)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
Legend (Compute Time: 30Aug2016, 15:56:48)
Run:BF_i_59S Element:BF_i_59s Result:Precipitation
Run:BF_i_59S Element:BF_i_59s Result:Precipitation Loss
Run:BF_i_59S Element:BF_i_59s Result:Outflow
Run:BF_i_59S Element:BF_i_59s Result:Baseflow

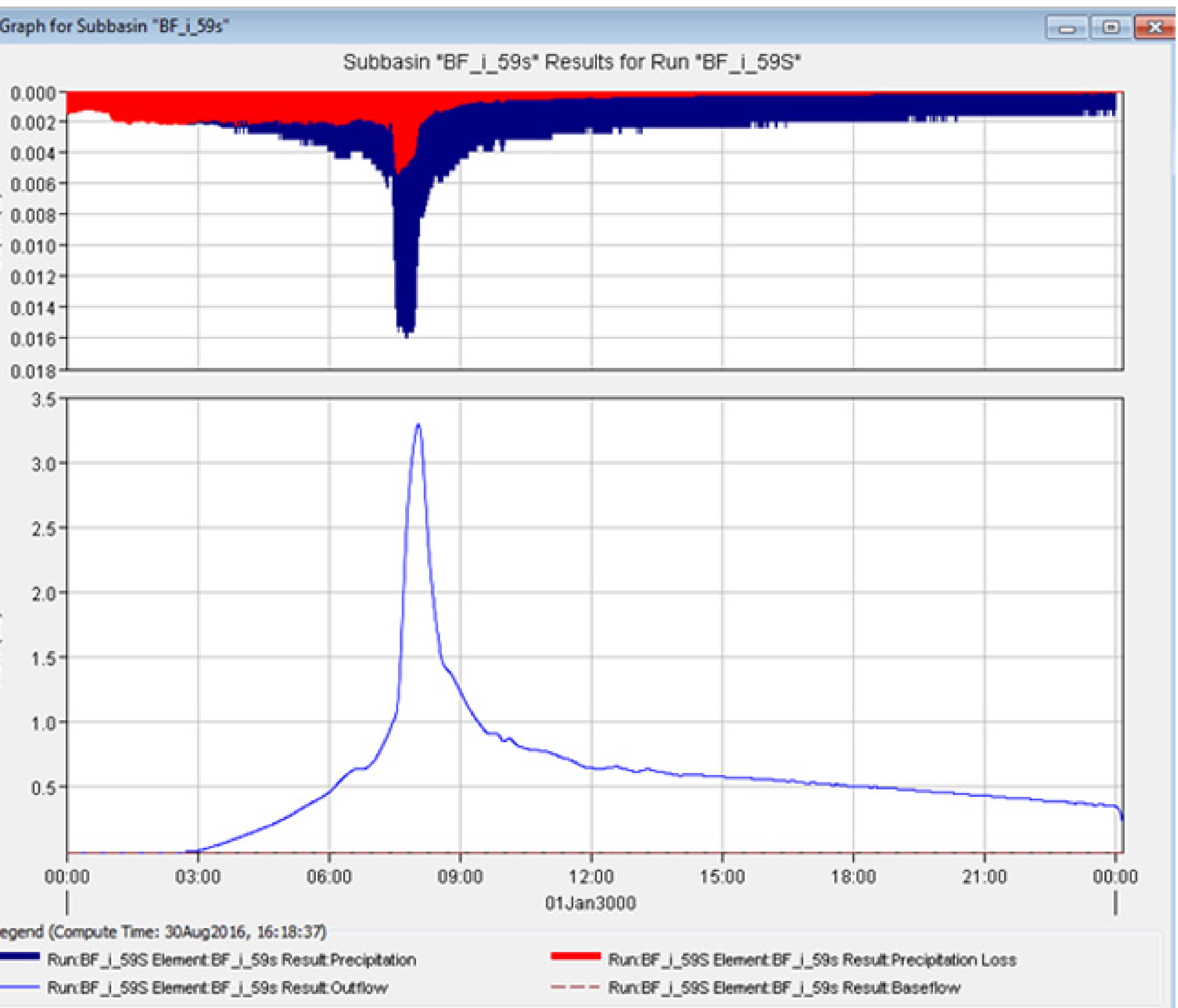

Global Summary Results for Run "BF_i_59S"
Project: BF_i_base_all_bo Simulation Run: BF_i_59S
Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 16:18:37 Control Specifications: Control 1
Show Elements: All Elements Volume Units: IN AC-FT Sorting: Hydrologic
Hydrologic Element | Drainage Area (MI2) | Peak Discharge (CFS) | Time of Peak | Volume (IN)
BF_i_59s | 0.007956 | 3.29 | 01Jan3000, 08:03 | 2.59


Summary Results for Subbasin "BF_i_59s"
Project: BF_i_base_all_bo Simulation Run: BF_i_59S
Subbasin: BF_i_59s
Start of Run: 01Jan3000, 00:00 Basin Model: Above_Lucini_a
End of Run: 02Jan3000, 00:10 Meteorologic Model: Met 1
Compute Time: 30Aug2016, 16:18:37 Control Specifications: Control 1
Volume Units: IN AC-FT
Computed Results
Peak Discharge: 3.29 (CFS) Date/Time of Peak Discharge: 01Jan3000, 08:03
Precipitation Volume: 3.90 (IN) Direct Runoff Volume: 2.59 (IN)
Loss Volume: 1.30 (IN) Baseflow Volume: 0.00 (IN)
Excess Volume: 2.60 (IN) Discharge Volume: 2.59 (IN)


Subbasin Loss Transform Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Description: sub1
Downstream: --None--
*Area (MI2) 0.007956
Latitude Degrees:
Latitude Minutes:
Latitude Seconds:
Longitude Degrees:
Longitude Minutes:
Longitude Seconds:
Canopy Method: --None--
Surface Method: --None--
Loss Method: SCS Curve Number
Transform Method: SCS Unit Hydrograph
Baseflow Method: --None--

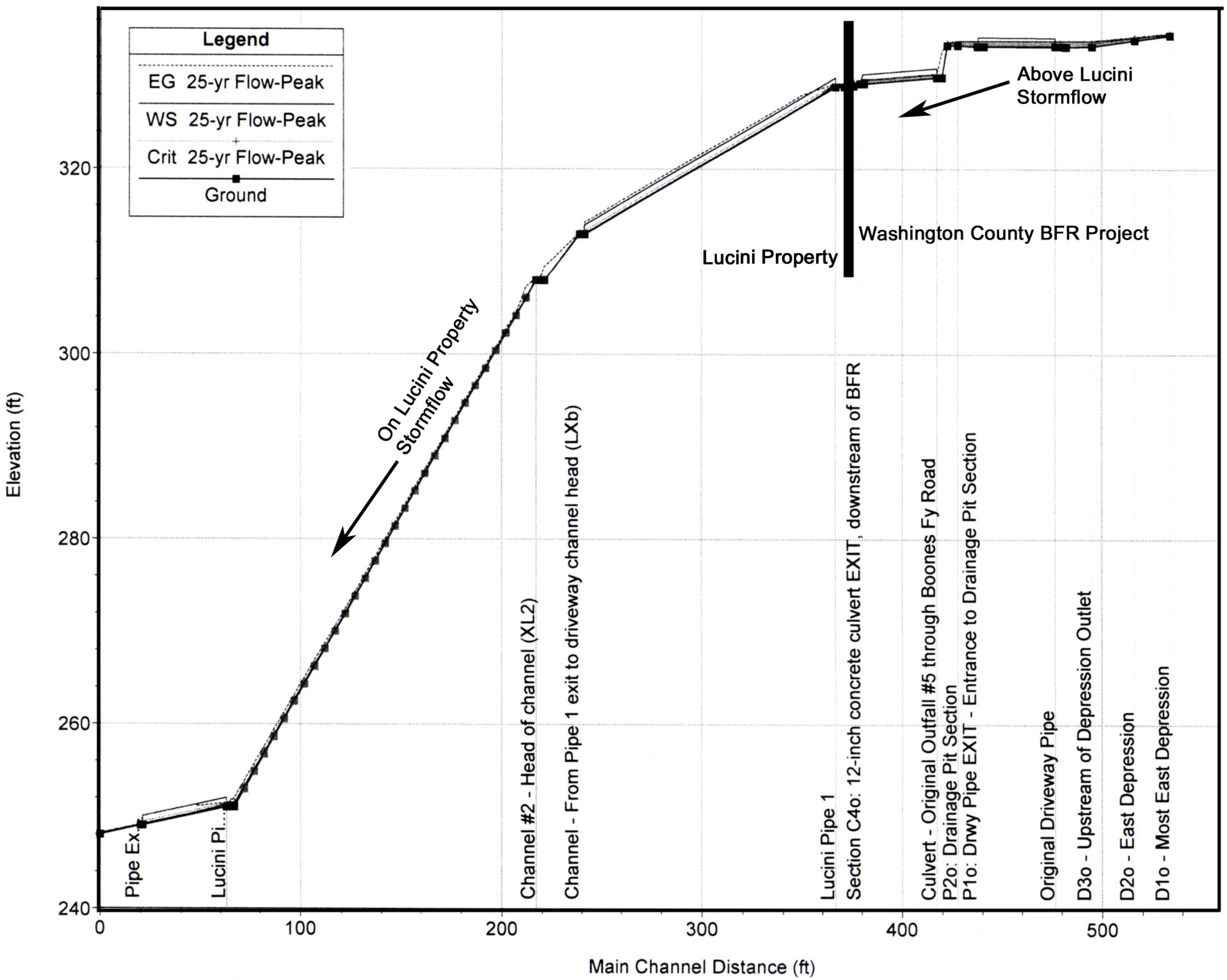

Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Initial Abstraction (IN)
*Curve Number: 87.6
*Impervious (%) 0


Subbasin
Loss
Transform
Options
Basin Name: Above_Lucini_a
Element Name: BF_i_59s
Graph Type: Standard (PRF 484)
*Lag Time (MIN) 10.5


Graph for Subbasin "BF_i_59s"
Subbasin "BF_i_59s" Results for Run "BF_i_59S"
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016
0.018
3.5
3.0
2.5
2.0
1.5
1.0
0.5
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan3000
egend (Compute Time: 30Aug2016, 16:18:37)
Run:BF_i_59S Element:BF_i_59s Result:Precipitation
Run:BF_i_59S Element:BF_i_59s Result:Precipitation Loss
Run:BF_i_59S Element:BF_i_59s Result:Outflow
Run:BF_i_59S Element:BF_i_59s Result:Baseflow

Appendix I

Figure I-1. HEC-RAS Hydraulic Profile of ORIGINAL Pipe and Ditch Conditions at 0.89 cfs
Above and On the Lucini Property



Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Cor_Orig 0.89cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	0.89	334.50	334.76	334.68	334.77	0.011532	0.91	0.98	7.60	0.44
o_17S	142.4	25-yr Flow-Peak	0.89	334.00	334.30	334.30	334.38	0.056691	2.20	0.40	2.67	0.99
o_17S	121.3	25-yr Flow-Peak	0.89	333.30	333.96	333.67	333.97	0.002925	0.81	1.10	3.37	0.25
o_17S	108.4	25-yr Flow-Peak	0.89	333.24	333.93		333.93	0.001875	0.62	1.44	4.44	0.19
o_17S	105.7	25-yr Flow-Peak	0.89	333.30	333.91	333.67	333.93	0.004143	0.92	0.97	3.16	0.29
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	0.89	333.28	333.92		333.92	0.000206	0.28	3.19	6.83	0.07
o_17S	56.6	25-yr Flow-Peak	0.89	333.40	333.90		333.91	0.006810	1.04	0.85	3.44	0.37
o_17S	51.5	25-yr Flow-Peak	0.89	333.40	333.73	333.73	333.82	0.056356	2.31	0.39	2.31	1.00
o_17S	48.8	25-yr Flow-Peak	0.89	329.94	329.97	330.09	332.61	1.800609	13.05	0.07	2.70	14.46
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	0.89	329.27	329.68	329.68	329.79	0.057239	2.57	0.35	1.67	1.00
o_17S	4.8	25-yr Flow-Peak	0.89	329.00	329.42	329.37	329.47	0.027824	1.86	0.48	2.30	0.72
o_17S	0.00	25-yr Flow-Peak	0.89	328.92	329.20	329.20	329.28	0.059737	2.16	0.41	2.89	1.01
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	0.89	313.00	313.20		313.22	0.009717	1.04	0.85	4.60	0.43
o_17S	-132	25-yr Flow-Peak	0.89	313.00	313.11	313.11	313.17	0.067286	1.91	0.47	4.33	1.03
o_17S	-150	25-yr Flow-Peak	0.89	308.00	308.03	308.11	309.03	7.363283	8.05	0.11	4.08	8.63
o_17S	-152	25-yr Flow-Peak	0.89	308.00	308.22	308.13	308.24	0.009842	1.04	0.85	4.67	0.43
o_17S	-154	25-yr Flow-Peak	0.89	308.00	308.13	308.13	308.19	0.098000	1.97	0.45	3.97	1.03
o_17S	-302	25-yr Flow-Peak	0.89	251.00	251.35	251.48	251.80	0.375062	5.44	0.16	0.95	2.31
o_17S	-304	25-yr Flow-Peak	0.89	251.00	251.48	251.48	251.60	0.062529	2.78	0.32	1.33	1.00
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	0.89	249.00	249.07	249.07	249.12	0.086052	1.65	0.54	7.66	1.09
o_17S	-369	25-yr Flow-Peak	0.89	248.00	248.17	248.09	248.18	0.010007	0.92	0.97	6.51	0.42

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: Err_Orig 1.17cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	1.17	334.50	334.79	334.71	334.80	0.011156	0.96	1.22	8.48	0.44
o_17S	142.4	25-yr Flow-Peak	1.17	334.00	334.34	334.34	334.42	0.054613	2.32	0.50	2.98	0.99
o_17S	121.3	25-yr Flow-Peak	1.17	333.30	334.02	333.72	334.03	0.003334	0.88	1.32	3.89	0.27
o_17S	108.4	25-yr Flow-Peak	1.17	333.24	333.99		333.99	0.002252	0.68	1.72	5.31	0.21
o_17S	105.7	25-yr Flow-Peak	1.17	333.30	333.97	333.72	333.98	0.004599	1.02	1.14	3.43	0.31
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	1.17	333.28	333.98		333.98	0.000257	0.33	3.57	7.09	0.08
o_17S	56.6	25-yr Flow-Peak	1.17	333.40	333.95		333.97	0.006985	1.13	1.04	3.79	0.38
o_17S	51.5	25-yr Flow-Peak	1.17	333.40	333.77	333.77	333.86	0.054365	2.44	0.48	2.58	1.00
o_17S	48.8	25-yr Flow-Peak	1.17	329.94	329.97	330.12	332.68	1.308928	13.20	0.09	2.70	12.83
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	1.17	329.27	329.73	329.73	329.85	0.057477	2.76	0.42	1.85	1.01
o_17S	4.8	25-yr Flow-Peak	1.17	329.00	329.36	329.41	329.53	0.105970	3.29	0.36	1.98	1.37
o_17S	0.00	25-yr Flow-Peak	1.17	328.92	329.24	329.24	329.32	0.056489	2.27	0.52	3.24	1.00
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	1.17	313.00	313.23		313.25	0.010699	1.19	0.99	4.68	0.45
o_17S	-132	25-yr Flow-Peak	1.17	313.00	313.12	313.13	313.20	0.088360	2.31	0.51	4.36	1.19
o_17S	-150	25-yr Flow-Peak	1.17	308.00	308.05	308.14	308.67	2.370216	6.36	0.18	4.14	5.31
o_17S	-152	25-yr Flow-Peak	1.17	308.00	308.07	308.15	308.45	0.831842	4.94	0.24	3.54	3.37
o_17S	-154	25-yr Flow-Peak	1.17	308.00	308.15	308.15	308.22	0.091385	2.11	0.55	4.16	1.02
o_17S	-302	25-yr Flow-Peak	1.17	251.00	251.38	251.54	251.91	0.374716	5.82	0.20	1.05	2.35
o_17S	-304	25-yr Flow-Peak	1.17	251.00	251.54	251.54	251.67	0.060366	2.93	0.40	1.48	1.00
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	1.17	249.00	249.09	249.09	249.14	0.070877	1.72	0.68	7.83	1.03
o_17S	-369	25-yr Flow-Peak	1.17	248.00	248.20	248.11	248.21	0.010001	1.01	1.16	6.77	0.43

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: LU_Orig 1.71cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

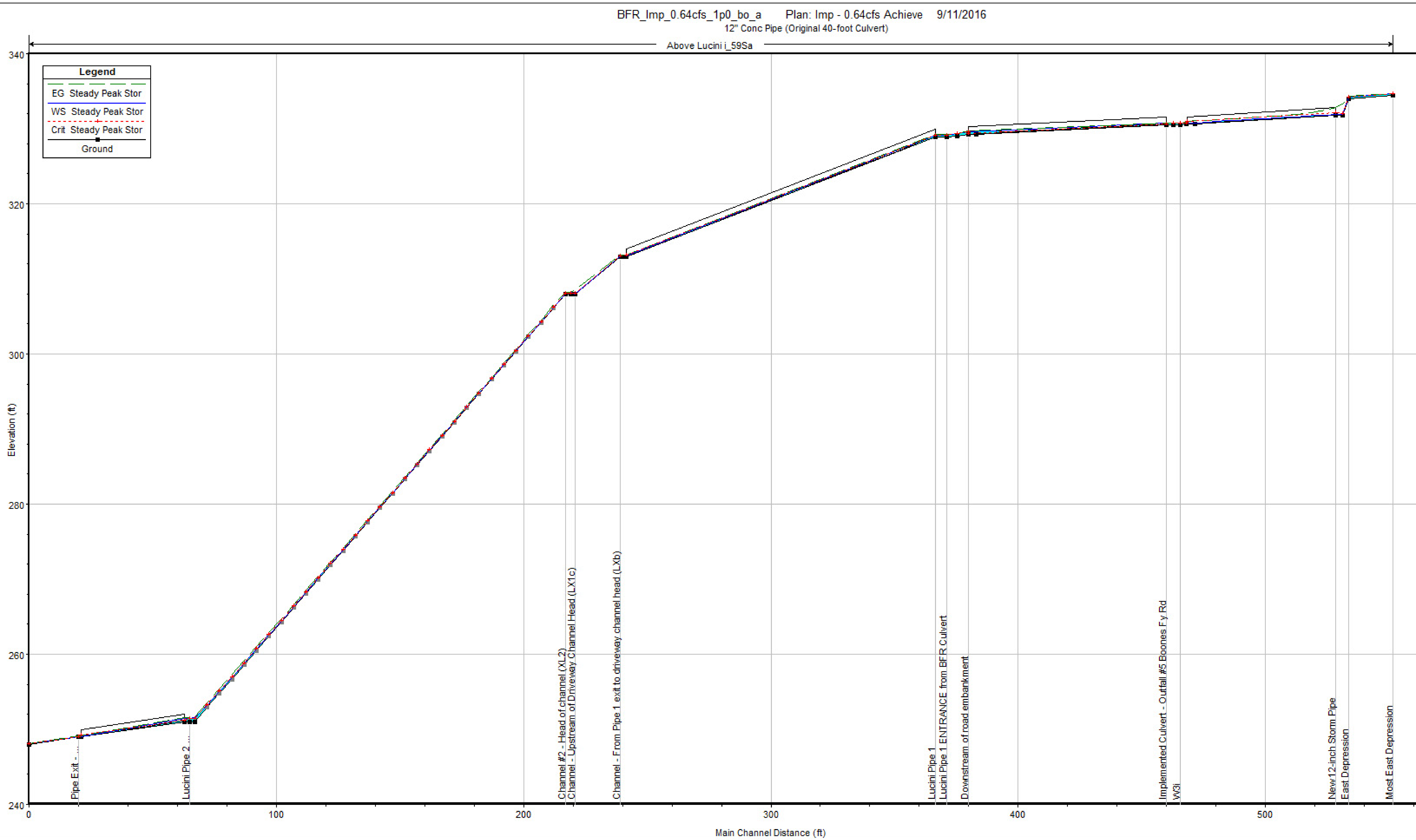
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	1.71	334.50	334.84	334.74	334.85	0.010207	1.02	1.68	9.94	0.44
o_17S	142.4	25-yr Flow-Peak	1.71	334.00	334.39	334.39	334.49	0.054093	2.54	0.67	3.44	1.01
o_17S	121.3	25-yr Flow-Peak	1.71	333.30	334.11	333.79	334.13	0.004242	0.97	1.77	5.54	0.30
o_17S	108.4	25-yr Flow-Peak	1.71	333.24	334.07		334.08	0.002629	0.76	2.24	6.65	0.23
o_17S	105.7	25-yr Flow-Peak	1.71	333.30	334.05	333.79	334.07	0.006123	1.18	1.46	4.45	0.36
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	1.71	333.28	334.06		334.06	0.000351	0.41	4.18	7.48	0.10
o_17S	56.6	25-yr Flow-Peak	1.71	333.40	334.02		334.05	0.007513	1.28	1.34	4.31	0.40
o_17S	51.5	25-yr Flow-Peak	1.71	333.40	333.83	333.83	333.94	0.051589	2.63	0.65	3.00	0.99
o_17S	48.8	25-yr Flow-Peak	1.71	329.94	329.99	330.17	332.78	0.843351	13.41	0.13	2.70	10.87
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	1.71	329.27	329.80	329.80	329.94	0.054404	2.97	0.58	2.16	1.01
o_17S	4.8	25-yr Flow-Peak	1.71	329.00	329.41	329.47	329.62	0.113652	3.71	0.46	2.25	1.44
o_17S	0.00	25-yr Flow-Peak	1.71	328.92	329.29	329.29	329.38	0.052889	2.43	0.70	3.78	1.00
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	1.71	313.00	313.28		313.31	0.011691	1.40	1.23	4.83	0.49
o_17S	-132	25-yr Flow-Peak	1.71	313.00	313.16	313.17	313.26	0.078067	2.56	0.67	4.47	1.17
o_17S	-150	25-yr Flow-Peak	1.71	308.00	308.05	308.17	309.02	2.947858	7.88	0.22	4.16	6.07
o_17S	-152	25-yr Flow-Peak	1.71	308.00	308.31	308.20	308.33	0.011372	1.34	1.27	5.30	0.48
o_17S	-154	25-yr Flow-Peak	1.71	308.00	308.20	308.20	308.28	0.081682	2.31	0.74	4.49	1.00
o_17S	-302	25-yr Flow-Peak	1.71	251.00	251.44	251.62	252.08	0.375093	6.40	0.27	1.21	2.40
o_17S	-304	25-yr Flow-Peak	1.71	251.00	251.53	251.62	251.83	0.139144	4.41	0.39	1.46	1.51
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	1.71	249.00	249.12	249.12	249.18	0.061679	1.90	0.90	8.08	1.00
o_17S	-369	25-yr Flow-Peak	1.71	248.00	248.24	248.15	248.26	0.010004	1.15	1.49	7.20	0.45

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: BO_Orig 2.85cfs River: Above Lucini Reach: o_17S Profile: 25-yr Flow-Peak

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
o_17S	160.2	25-yr Flow-Peak	2.85	334.50	334.92	334.80	334.94	0.009158	1.11	2.57	12.28	0.43
o_17S	142.4	25-yr Flow-Peak	2.85	334.00	334.48	334.48	334.60	0.049261	2.79	1.02	4.24	1.00
o_17S	121.3	25-yr Flow-Peak	2.85	333.30	334.25	333.89	334.27	0.004561	1.06	2.70	7.96	0.32
o_17S	108.4	25-yr Flow-Peak	2.85	333.24	334.21		334.22	0.002898	0.87	3.27	8.71	0.25
o_17S	105.7	25-yr Flow-Peak	2.85	333.30	334.18	333.89	334.21	0.007433	1.30	2.19	6.73	0.40
o_17S	87.4		Culvert									
o_17S	66.4	25-yr Flow-Peak	2.85	333.28	334.19		334.20	0.000519	0.55	5.23	8.11	0.12
o_17S	56.6	25-yr Flow-Peak	2.85	333.40	334.14		334.18	0.008075	1.49	1.91	5.15	0.43
o_17S	51.5	25-yr Flow-Peak	2.85	333.40	333.93	333.93	334.06	0.050191	2.96	0.96	3.66	1.01
o_17S	48.8	25-yr Flow-Peak	2.85	329.94	330.02	330.27	332.92	0.469839	13.68	0.21	2.70	8.68
o_17S	28.6		Culvert									
o_17S	8.8	25-yr Flow-Peak	2.85	329.27	329.93	329.93	330.09	0.049951	3.27	0.87	2.66	1.00
o_17S	4.8	25-yr Flow-Peak	2.85	329.00	329.50	329.58	329.77	0.111470	4.18	0.68	2.74	1.48
o_17S	0.00	25-yr Flow-Peak	2.85	328.92	329.38	329.38	329.49	0.049294	2.69	1.06	4.64	0.99
o_17S	-65		Culvert									
o_17S	-130	25-yr Flow-Peak	2.85	313.00	313.36		313.41	0.013243	1.74	1.64	5.08	0.54
o_17S	-132	25-yr Flow-Peak	2.85	313.00	313.23	313.24	313.36	0.064030	2.89	0.98	4.68	1.11
o_17S	-150	25-yr Flow-Peak	2.85	308.00	308.07	308.24	309.65	3.452740	10.07	0.28	4.21	6.85
o_17S	-152	25-yr Flow-Peak	2.85	308.00	308.39	308.27	308.43	0.012447	1.62	1.76	5.95	0.52
o_17S	-154	25-yr Flow-Peak	2.85	308.00	308.27	308.27	308.38	0.076003	2.64	1.08	5.02	1.01
o_17S	-302	25-yr Flow-Peak	2.85	251.00	251.53	251.77	252.36	0.375560	7.28	0.39	1.47	2.48
o_17S	-304	25-yr Flow-Peak	2.85	251.00	251.74	251.77	251.96	0.064544	3.76	0.76	2.04	1.09
o_17S	-326.5		Culvert									
o_17S	-349	25-yr Flow-Peak	2.85	249.00	249.17	249.17	249.24	0.055550	2.21	1.29	8.50	1.00
o_17S	-369	25-yr Flow-Peak	2.85	248.00	248.33	248.20	248.35	0.010003	1.35	2.10	7.93	0.46


BFR_Imp_0.64cfs_1p0_bo_a Plan: Imp - 0.64cfs Achieve 9/11/2016
12" Conc Pipe (Original 40-foot Culvert)
Above Lucini i_59Sa
Legend
EG Steady Peak Stor
WS Steady Peak Stor
Crit Steady Peak Stor
Ground
Elevation (ft)
Main Channel Distance (ft)
Pipe Exit - ...
Lucini Pipe 2 ...
Channel #2 - Head of channel (XL2)
Channel - Upstream of Driveway Channel Head (LX1c)
Channel - From Pipe 1 exit to driveway channel head (LXb)
Lucini Pipe 1
Lucini Pipe 1 ENTRANCE from BFR Culvert
Downstream of road embankment
Implemented Culvert - Outfall #5 Boones Fy Rd
W3i
New 12-inch Storm Pipe
East Depression
Most East Depression
340
320
300
280
260
240
0
100
200
300
400
500

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 0.64cfs Ach River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	0.64	334.50	334.73	334.66	334.74	0.011869	0.84	0.76	6.68	0.44
i_59Sa	157.5	Steady Peak Stor	0.64	334.00	334.27	334.27	334.33	0.059196	2.06	0.31	2.34	0.99
i_59Sa	154.8	Steady Peak Stor	0.64	331.80	331.87	332.03	333.24	0.289235	9.41	0.07	1.00	6.36
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	0.64	330.60	330.75	330.75	330.82	0.005384	2.15	0.30	2.00	0.98
i_59Sa	91.8	Steady Peak Stor	0.64	330.55	330.75	330.70	330.79	0.002079	1.59	0.40	2.00	0.62
i_59Sa	89.1	Steady Peak Stor	0.64	330.55	330.70	330.70	330.77	0.005576	2.17	0.29	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	0.64	329.27	329.63	329.63	329.72	0.059744	2.40	0.27	1.47	0.99
i_59Sa	4.3	Steady Peak Stor	0.64	329.00	329.36	329.32	329.41	0.030271	1.77	0.36	2.00	0.73
i_59Sa	0.00	Steady Peak Stor	0.64	328.92	329.17	329.17	329.23	0.060142	2.00	0.32	2.55	0.99
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	0.64	313.00	313.18		313.19	0.006681	0.82	0.78	4.55	0.35
i_59Sa	-132	Steady Peak Stor	0.64	313.00	313.09	313.09	313.14	0.078006	1.77	0.36	4.26	1.07
i_59Sa	-150	Steady Peak Stor	0.64	308.00	308.03	308.10	308.55	3.864839	5.82	0.11	4.08	6.25
i_59Sa	-152	Steady Peak Stor	0.64	308.00	308.20	308.11	308.21	0.006900	0.83	0.77	4.53	0.36
i_59Sa	-154	Steady Peak Stor	0.64	308.00	308.11	308.11	308.16	0.098240	1.76	0.36	3.80	1.00
i_59Sa	-302	Steady Peak Stor	0.64	251.00	251.59	251.42	251.62	0.010996	1.33	0.48	1.63	0.43
i_59Sa	-304	Steady Peak Stor	0.64	251.00	251.42	251.42	251.53	0.065191	2.60	0.25	1.16	0.99
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	0.64	249.00	249.06	249.06	249.09	0.075315	1.40	0.46	7.57	1.00
i_59Sa	-369	Steady Peak Stor	0.64	248.00	248.14	248.07	248.15	0.010003	0.82	0.78	6.25	0.41

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 0.85cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	0.85	334.50	334.76	334.68	334.77	0.010967	0.88	0.97	7.54	0.43
i_59Sa	157.5	Steady Peak Stor	0.85	334.00	334.30	334.30	334.37	0.059039	2.21	0.39	2.60	1.01
i_59Sa	154.8	Steady Peak Stor	0.85	331.80	331.89	332.08	333.29	0.215416	9.51	0.09	1.00	5.60
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	0.85	330.60	330.78	330.78	330.87	0.004860	2.31	0.37	2.00	0.95
i_59Sa	91.8	Steady Peak Stor	0.85	330.55	330.79	330.73	330.84	0.002135	1.77	0.48	2.00	0.64
i_59Sa	89.1	Steady Peak Stor	0.85	330.55	330.73	330.73	330.82	0.005435	2.39	0.36	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	0.85	329.27	329.68	329.68	329.78	0.057611	2.55	0.33	1.64	1.00
i_59Sa	4.3	Steady Peak Stor	0.85	329.00	329.33	329.36	329.46	0.093919	2.90	0.29	1.80	1.26
i_59Sa	0.00	Steady Peak Stor	0.85	328.92	329.21	329.21	329.27	0.044824	1.92	0.44	3.00	0.88
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	0.85	313.00	313.21		313.22	0.007623	0.95	0.90	4.62	0.38
i_59Sa	-132	Steady Peak Stor	0.85	313.00	313.11	313.11	313.16	0.075371	1.95	0.44	4.31	1.08
i_59Sa	-150	Steady Peak Stor	0.85	308.00	308.03	308.11	308.67	3.636185	6.39	0.13	4.10	6.25
i_59Sa	-152	Steady Peak Stor	0.85	308.00	308.05	308.13	308.51	1.668853	5.47	0.16	3.37	4.49
i_59Sa	-154	Steady Peak Stor	0.85	308.00	308.13	308.13	308.18	0.092597	1.91	0.45	3.96	1.00
i_59Sa	-302	Steady Peak Stor	0.85	251.00	251.66	251.47	251.69	0.010986	1.43	0.59	1.81	0.44
i_59Sa	-304	Steady Peak Stor	0.85	251.00	251.47	251.47	251.59	0.065314	2.79	0.30	1.29	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	0.85	249.00	249.07	249.07	249.11	0.084703	1.61	0.53	7.65	1.08
i_59Sa	-369	Steady Peak Stor	0.85	248.00	248.16	248.10	248.18	0.010013	0.91	0.94	6.47	0.42

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 1.95cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

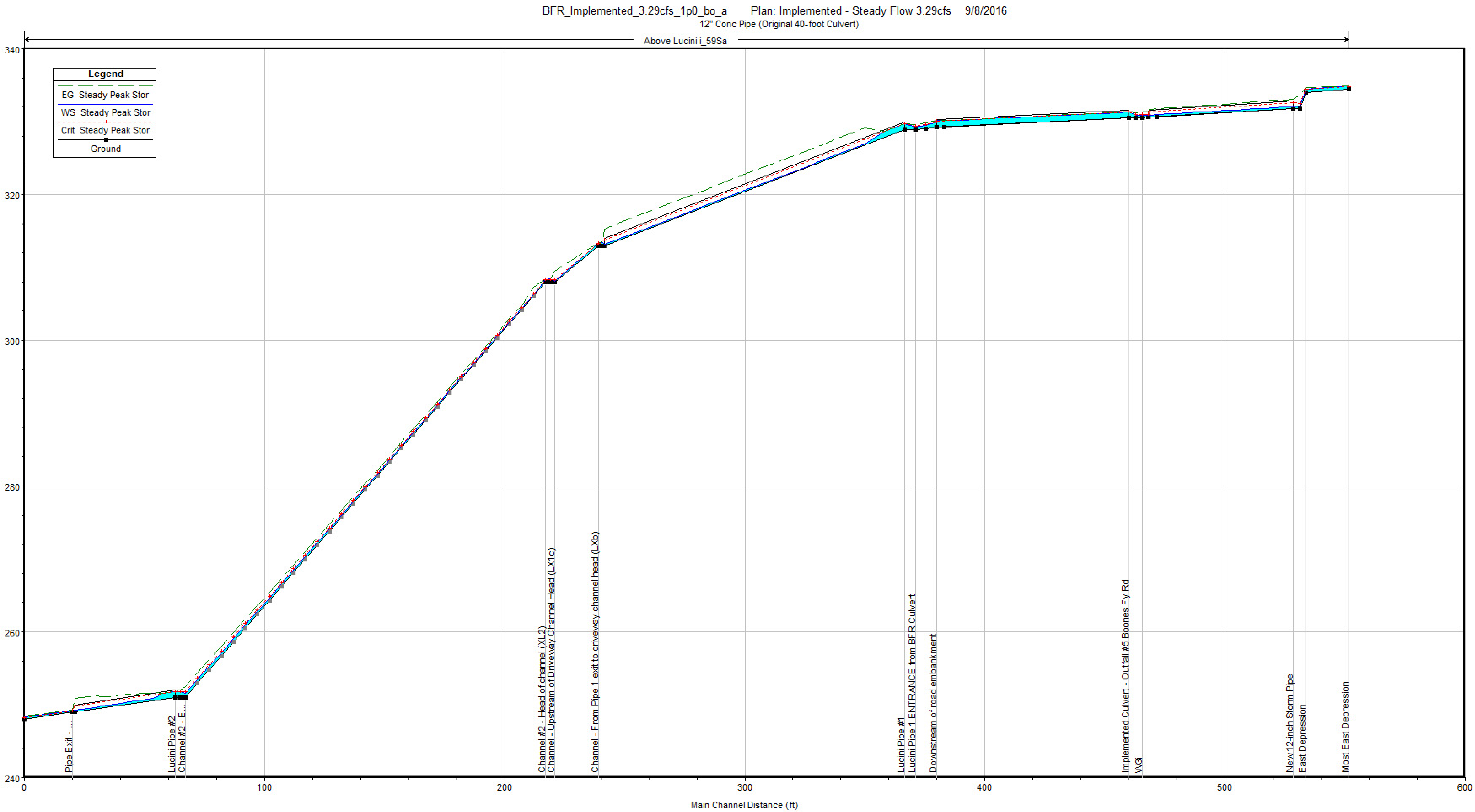
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	1.95	334.50	334.85	334.75	334.87	0.010335	1.06	1.84	10.41	0.44
i_59Sa	157.5	Steady Peak Stor	1.95	334.00	334.41	334.41	334.52	0.051301	2.58	0.76	3.65	1.00
i_59Sa	154.8	Steady Peak Stor	1.95	331.80	332.00	332.29	333.49	0.098788	9.80	0.20	1.00	3.87
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	1.95	330.60	330.94	330.91	331.07	0.003944	2.87	0.68	2.00	0.87
i_59Sa	91.8	Steady Peak Stor	1.95	330.55	330.96	330.86	331.05	0.002295	2.40	0.81	2.00	0.66
i_59Sa	89.1	Steady Peak Stor	1.95	330.55	330.86	330.86	331.01	0.005240	3.16	0.62	2.00	1.00
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	1.95	329.27	329.84	329.84	329.98	0.052108	3.02	0.65	2.29	1.00
i_59Sa	4.3	Steady Peak Stor	1.95	329.00	329.44	329.50	329.65	0.105045	3.72	0.52	2.40	1.40
i_59Sa	0.00	Steady Peak Stor	1.95	328.92	329.31	329.31	329.41	0.053963	2.54	0.77	3.96	1.01
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	1.95	313.00	313.32		313.35	0.009015	1.34	1.45	4.97	0.44
i_59Sa	-132	Steady Peak Stor	1.95	313.00	313.18	313.19	313.28	0.061572	2.49	0.78	4.55	1.06
i_59Sa	-150	Steady Peak Stor	1.95	308.00	308.06	308.19	309.21	3.355479	8.62	0.23	4.17	6.52
i_59Sa	-152	Steady Peak Stor	1.95	308.00	308.36	308.21	308.38	0.008566	1.27	1.54	5.66	0.43
i_59Sa	-154	Steady Peak Stor	1.95	308.00	308.21	308.21	308.30	0.080059	2.39	0.82	4.61	1.00
i_59Sa	-302	Steady Peak Stor	1.95	251.00	251.46	251.66	252.14	0.375315	6.62	0.29	1.27	2.42
i_59Sa	-304	Steady Peak Stor	1.95	251.00	251.66	251.66	251.82	0.058525	3.30	0.59	1.80	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	1.95	249.00	249.13	249.13	249.19	0.064594	2.02	0.97	8.15	1.03
i_59Sa	-369	Steady Peak Stor	1.95	248.00	248.26	248.16	248.29	0.010003	1.20	1.63	7.37	0.45

Profile Output Table - Standard Table 1

File Options Std. Tables Locations Help

HEC-RAS Plan: IMP 3.29cfs River: Above Lucini Reach: i_59Sa Profile: Steady Peak Stor

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
i_59Sa	175.3	Steady Peak Stor	3.29	334.50	334.94	334.82	334.96	0.009048	1.15	2.87	12.99	0.43
i_59Sa	157.5	Steady Peak Stor	3.29	334.00	334.51	334.51	334.64	0.049598	2.90	1.13	4.47	1.01
i_59Sa	154.8	Steady Peak Stor	3.29	331.80	332.13	332.49	333.66	0.064421	9.91	0.33	1.00	3.03
i_59Sa	120		Culvert									
i_59Sa	94.5	Steady Peak Stor	3.29	330.60	330.90	331.04	331.37	0.016296	5.49	0.60	2.00	1.77
i_59Sa	91.8	Steady Peak Stor	3.29	330.55	330.85	330.99	331.32	0.016296	5.49	0.60	2.00	1.77
i_59Sa	89.1	Steady Peak Stor	3.29	330.55	330.90	330.99	331.24	0.010077	4.68	0.70	2.00	1.39
i_59Sa	49		Culvert									
i_59Sa	9.1	Steady Peak Stor	3.29	329.27	329.96	329.96	330.14	0.050085	3.39	0.97	2.80	1.01
i_59Sa	4.3	Steady Peak Stor	3.29	329.00	329.53	329.61	329.81	0.102500	4.20	0.78	2.93	1.43
i_59Sa	0.00	Steady Peak Stor	3.29	328.92	329.30	329.40	329.60	0.164469	4.39	0.75	3.91	1.77
i_59Sa	-65		Culvert									
i_59Sa	-130	Steady Peak Stor	3.29	313.00	313.43		313.47	0.009499	1.63	2.02	5.30	0.47
i_59Sa	-132	Steady Peak Stor	3.29	313.00	313.26	313.27	313.39	0.057058	2.94	1.12	4.77	1.07
i_59Sa	-150	Steady Peak Stor	3.29	308.00	308.08	308.27	309.51	2.468790	9.60	0.34	4.25	5.96
i_59Sa	-152	Steady Peak Stor	3.29	308.00	308.46	308.29	308.50	0.009105	1.51	2.18	6.46	0.46
i_59Sa	-154	Steady Peak Stor	3.29	308.00	308.29	308.29	308.41	0.073053	2.73	1.21	5.21	1.00
i_59Sa	-302	Steady Peak Stor	3.29	251.00	251.56	251.81	252.44	0.373059	7.52	0.44	1.55	2.50
i_59Sa	-304	Steady Peak Stor	3.29	251.00	251.81	251.81	252.02	0.054487	3.66	0.90	2.22	1.01
i_59Sa	-326.5		Culvert									
i_59Sa	-349	Steady Peak Stor	3.29	249.00	249.18	249.18	249.27	0.056065	2.33	1.41	8.63	1.01
i_59Sa	-369	Steady Peak Stor	3.29	248.00	248.35	248.22	248.38	0.010012	1.42	2.32	8.17	0.47



BFR_Implemented_3.29cfs_1p0_bo_a Plan: Implemented - Steady Flow 3.29cfs 9/8/2016
12" Conc Pipe (Original 40-foot Culvert)
Above Lucini i_59Sa
Legend
EG Steady Peak Stor
WS Steady Peak Stor
Crit Steady Peak Stor
Ground
Pipe Exit - ...
Lucini Pipe #2
Channel #2 - E...
Channel #2 - Head of channel (XL2)
Channel - Upstream of Driveway Channel Head (LX1c)
Channel - From Pipe 1 exit to driveway channel head (LXb)
Lucini Pipe #1
Lucini Pipe 1 ENTRANCE from BFR Culvert
Downstream of road embankment
Implemented Culvert - Outfall #5 Boones Fy Rd
W3i
New 12-inch Storm Pipe
East Depression
Most East Depression
Main Channel Distance (ft)

ATTACHMENT #4

MAPS WITHIN PROPOSED UPDATE TO THE CITY'S MASTER PLAN

PROPOSED MAPS:
-CONTAIN DATED INFORMATION
-OMISSION OF RELAVENT AND NESSARY INFORMATION REQUIRED FOR LAND USE PLANNING

An example of questionable information provided within many maps within the proposed Stormwater Management Plan for the City, is **Figure 2-2 Project Area Overview**.

T**he Legend within Figure 2-2 provides keys as to the location of**

- **Open Space-Parks/Greenways/Natural Areas/Private***
- **Open Space- WPA/Setbacks/NRPO/Wetlands**

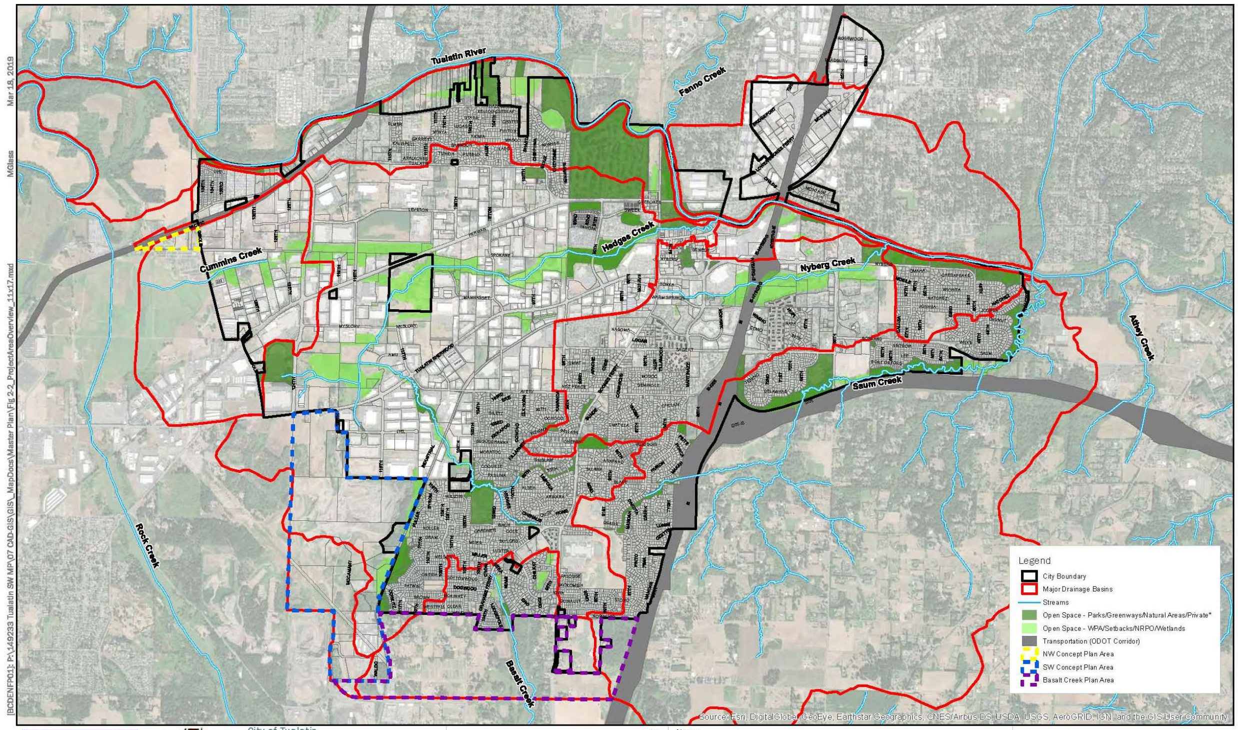
However, there is no indication of the wetlands, and multiple Natural Resources known to exist within the Basalt Creek Area and within the Basalt Creek Canyon.

Many of these types of Natural Resources may be negatively affected by stormwater drainage, and an accurate assessment as to the quantity, quality and location of Natural Resources which are to be conserved and protected should be assessed evaluated and memorialized within a Stormwater Management Plan and integrated into the City's Governing Documents for to provide and assure consistency within the City's various Land Use Plans.

Another factor not denoted within the maps within proposed Stormwater Management Plan, is the identification of the "Natural Area" within the Basalt Creek Canyon.

This area which contains wetlands and various Natural Resources requiring conservation and protection was identified within the Basalt Creek Concept Plan in which both Cities agreed to have "joint management" of the "Natural Area". It would seem reasonable this information which might impact Land Use Planning within the Basalt Creek Area and is downstream from the Basalt Creek lands already annexed into the City, would be identified on the Figure 2-2 map, and include additional information within the narrative of the proposed Stormwater Management Plan as a potential constraint or limitation in the planning of Stormwater Management in the area or upstream from the "Natural Area".

This map also includes the notation of "Brown and Caldwell City of Tualatin Stormwater Master Plan Date: April 2019 Project 149233 in the lower left corner of the map. An assumption would be that the information provided within this map would be current and accurate as of April 2019- the date indicated on the lower left corner of the map. It is unknown how current the information contained within this map may be but lacking the inclusion of information Basalt Creek Area lands already within the City's boundaries, makes one question when the data for this map was last collected.



Brown AND Caldwell

City of Tualatin

City of Tualatin
Stormwater Master Plan

Date: April 2019
Project: Project 149233

0 2,250 4,500 Feet

N

Notes:
1. Projection: NAD 1983 State Plane Oregon North (feet)

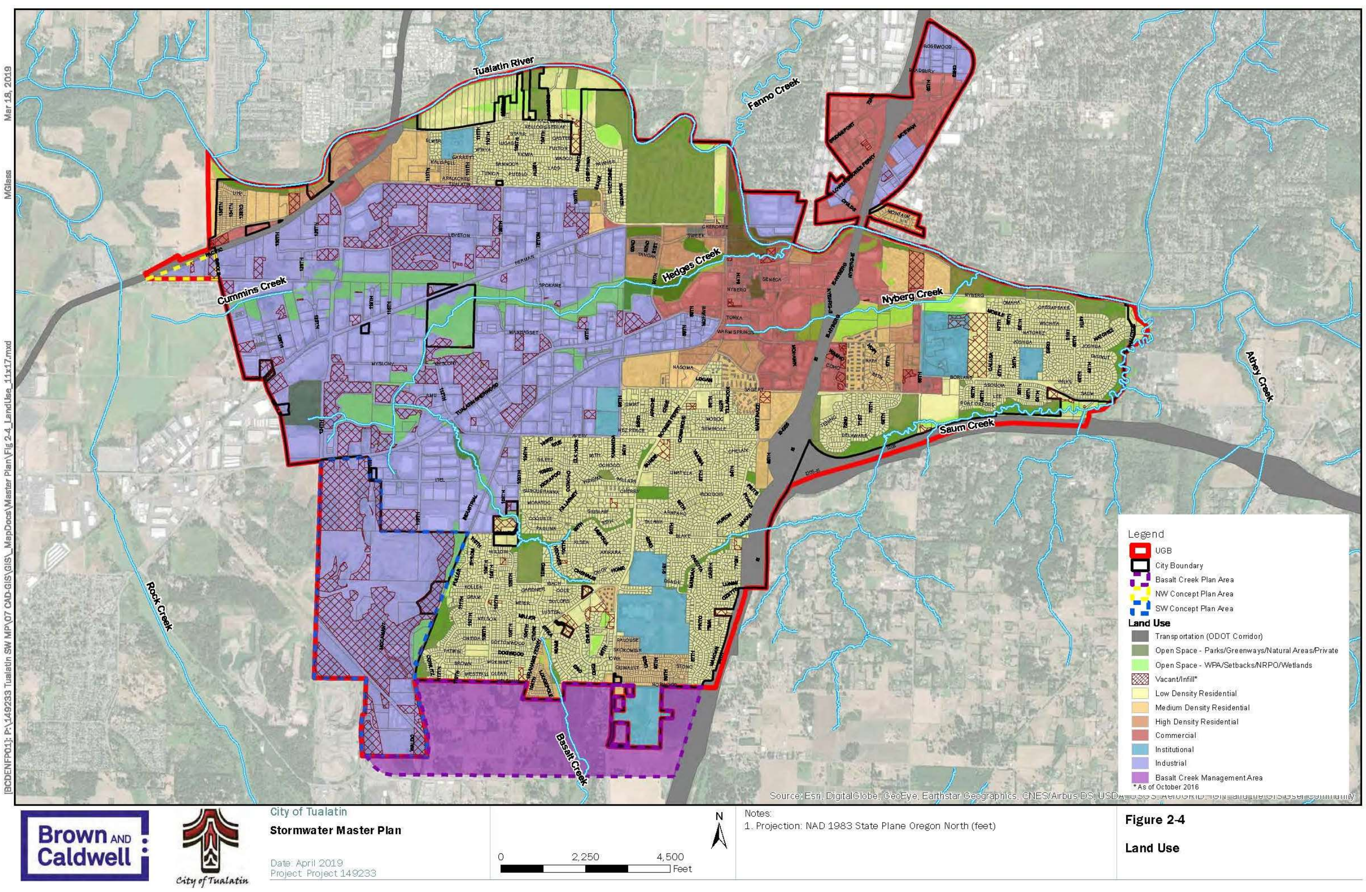
Figure 2-2

Project Area Overview

Figure 2-4 "Land Use" Map Not Consistent with City's Current Land Use Zoning
also provides the notation of "Brown and Caldwell City of Tualatin Stormwater Master Plan Date: April 2019 Project 149233 in the lower left corner of the map.

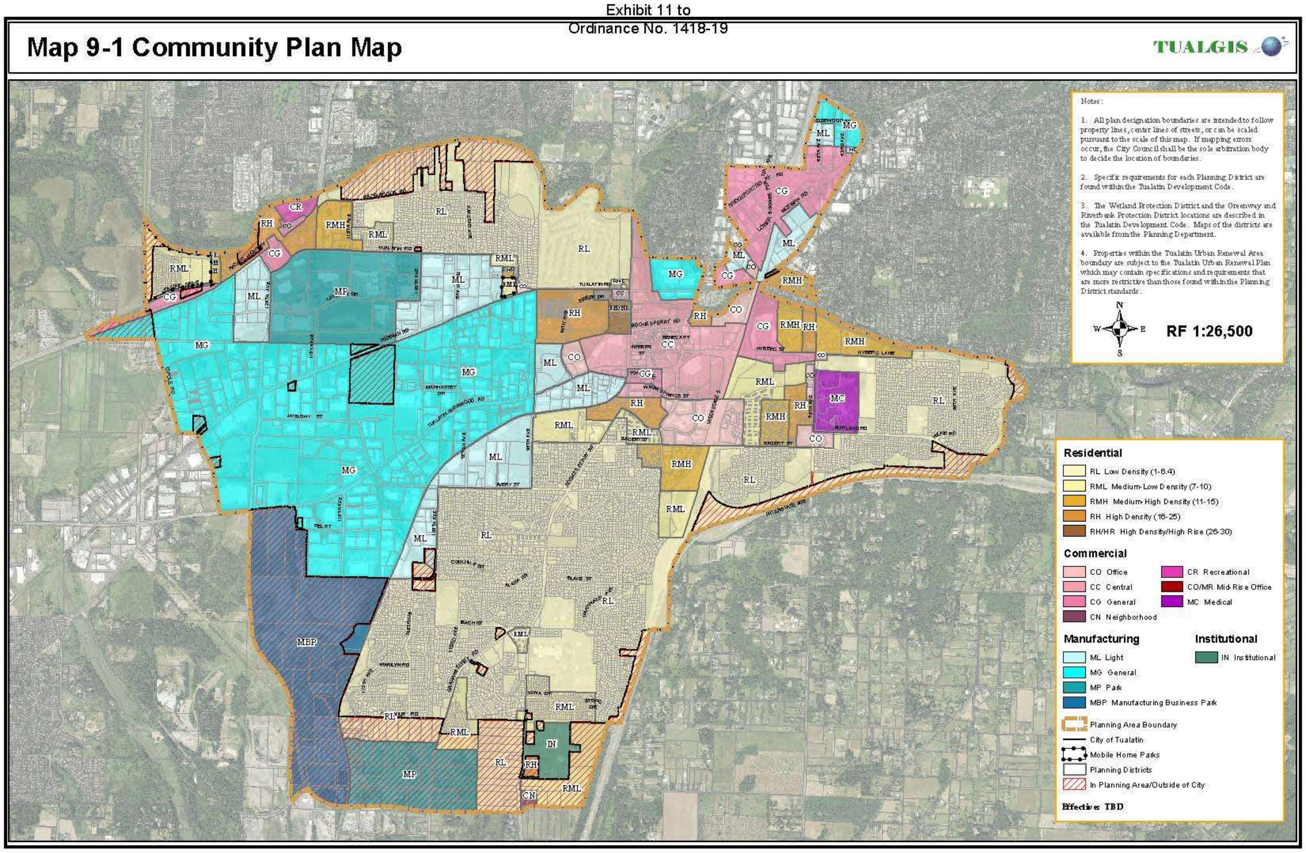
Yet, an asterisk notation within the Legend box states, "* As of October 2016".
Major changes have occurred as to Land Use within the City of Tualatin in the four years since this map was apparently generated.

The information provided as to the Land Use zoning or designations do not accurately reflect the Land Use Planning Actions of the Basalt Creek Concept Plan adopted in 2018, nor the City of Tualatin Basalt Creek Comprehensive Plan. Land Use Zoning within the Basalt Creek Area does not provide accurate information of current Land Use Zoning and Planning within the Basalt Creek Area and may hinder the planning for Stormwater Management in the assessment of current and future needs based upon type of land use. Approximately 60 acres within the Basalt Creek Area have already been annexed into the City of Tualatin, and into the responsibilities and regulations of the City for Land Use planning- including Stormwater Management.



The proposed Stormwater Master Plan Update is not consistent with the Land Use Plan adopted by the City in 2019 in Ordinance 1418-19, and consequently would not be compliant with Statewide Planning Goal #2

Exhibit 11 to
Ordinance No. 1418-19

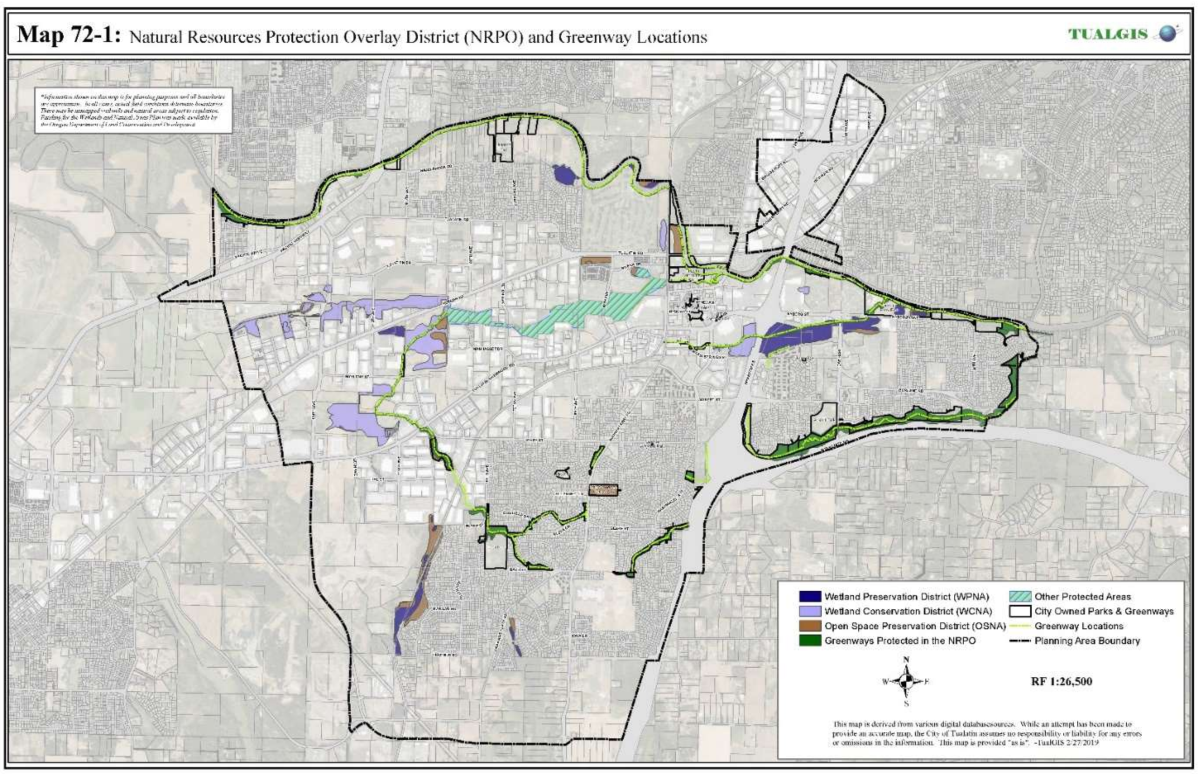


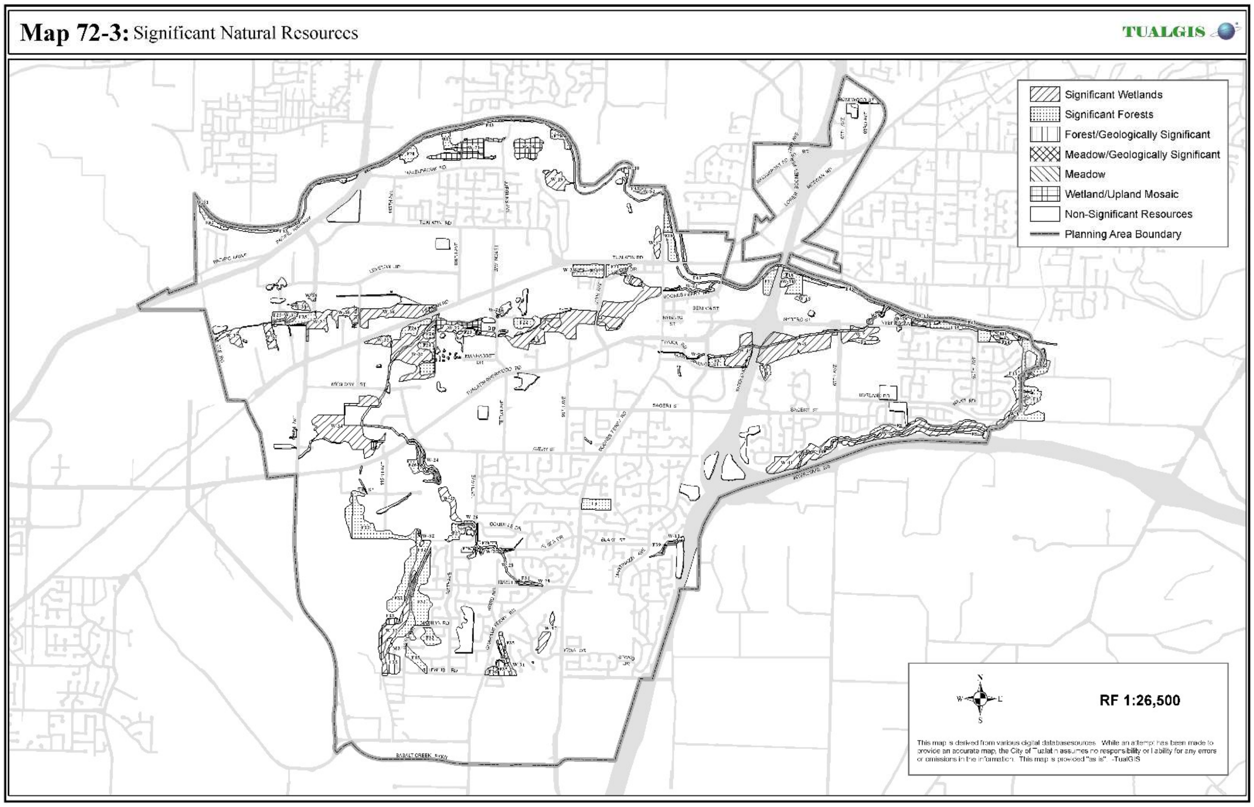
72-1 Natural Resources Protection Overlay district (NRPO) and Greenway Locations
72-3 Significant Natural Resources
There is an absence of necessary information provided for the Basalt Creek Area for Natural Resources

Lacking necessary evaluations as to the level, location and quality of Natural Resources within the Basalt Creek Area within the proposed Stormwater Management Master Plan Update, it would be difficult for the City of Tualatin to utilize the maps adopted into the City's Governing Documents (as part of the adoption of the Basalt Creek Comprehensive (Ord. [1427-19](#) , § 47, 11-25-19)), as supportive or back up documents to the proposed Update, as these maps obtained from the City's website do not identify or provide substantive information as to the multiple Natural Resources which are known to exist within the Basalt Creek Area.

City of Tualatin Maps downloaded from the City's municipal Code website
https://library.municode.com/or/tualatin/codes/development_code?nodeId=THDECOTUOR_APXAMA

also lack essential information necessary for the development of a Land Use Plan, or effective implementation of a Land Use Action within the Basalt Creek Area and are not suitable support documents for the proposed Update to the City's proposed Stormwater Management Master Plan Update.





There are signficant inconsistancies in the level of acknolwedgement and identification of various Natural Resourcse which are required to be evaluated for potential impact within all Land Use Plans, and Planning Actions. The omission of pertenant information regarding the existance of multipe Natural Resources within the northern portion of the Basalt Creek Area as presented within the City's Governing Documents, and within the City's proposed Stormwater Master Plan update are notable.

However, the City included the Basalt Creek Concept Plan document adopted by the City in 2018, and utilized as a supporting document to the Basalt Creek Comprehensive Plan in 2019 did provide needed information as to Land Use evaluative factors such as the Natural Resources and contraints which exist within the Basalt Creek Area.

Examples of pertenent documentation from the Basalt Creek Concept Plan as to the quanity and quality of these Natural Resources is provided including a summary of a rational for inclusion of this information into the Basalt Creek Land Use Concept Plan.

Metro Title 13: Nature in Neighborhoods

Title 13 requires local jurisdictions to protect and encourage restoration of a continuous ecologically viable streamside corridor system integrated with upland wildlife habitat and the urban landscape. Metro's regional habitat inventory in 2001 identified the location and health of fish and wildlife habitat based on waterside, riparian and upland habitat criteria. These areas were named Habitat Conservation Areas.

Table 7 Title 13 HCA Categories with Acreage

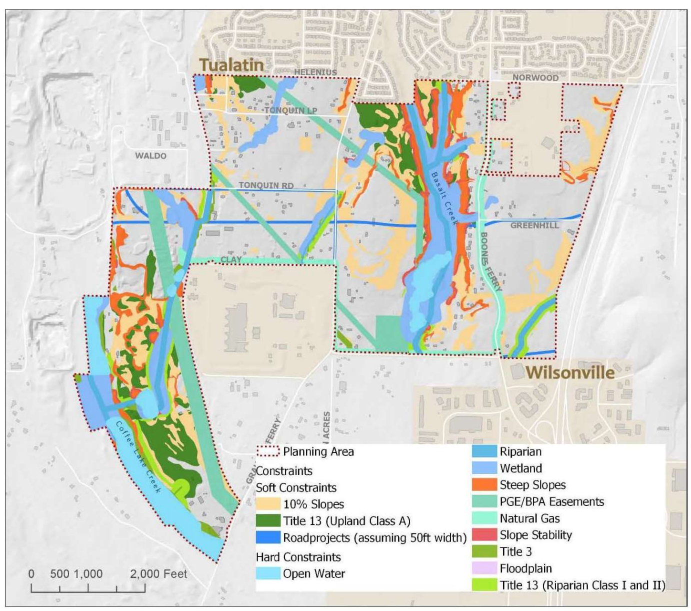
HCA Categories	Acres	Description
Riparian Wildlife Habitat Class I	130	Area supports 3 or more riparian functions
Riparian Wildlife Habitat Class II	31	Area supports 1 or 2 primary riparian functions
Riparian Wildlife Habitat Class III	7	Area supports only secondary riparian functions outside of wildlife areas
Upland Wildlife Habitat Class A	103	Areas with secondary riparian value that have high value for wildlife habitat
Upland Wildlife Habitat Class B	72	Area with secondary riparian value that have medium value for wildlife habitat
Upland Wildlife Habitat Class C	37	Areas with secondary riparian value that have low value for wildlife habitat
Designated Aquatic Impact	52	Area within 150 ft. of streams, river, lakes, or wetlands

Exhibit 2 to
Ordinance No. 1418-19

Environmental constraints are summarized below and unless otherwise noted were fully excluded from the developable land input in the scenario testing for the Basalt Creek Concept Plan:

- Open Water
- Streams
- Wetlands
- Floodplains (50% reduction of developable area)
- Title 3 Water Quality and Flood Management protections
- Title 13 Nature in Neighborhoods (20% reduction of developable area in areas designated Riparian Habitat Classes I and II)
- Steep Slopes (25% slopes and greater)

Figure 13 Natural Resources Map



It is unclear as to the rational for the omission of pertenent information required to be an evaluated compent in the development of all Land Use Plans and implmentation of Planning Actions have not been included within the proposed Stormwater Master Plan Update, nor in the City's Governing Documents as provided via the City's

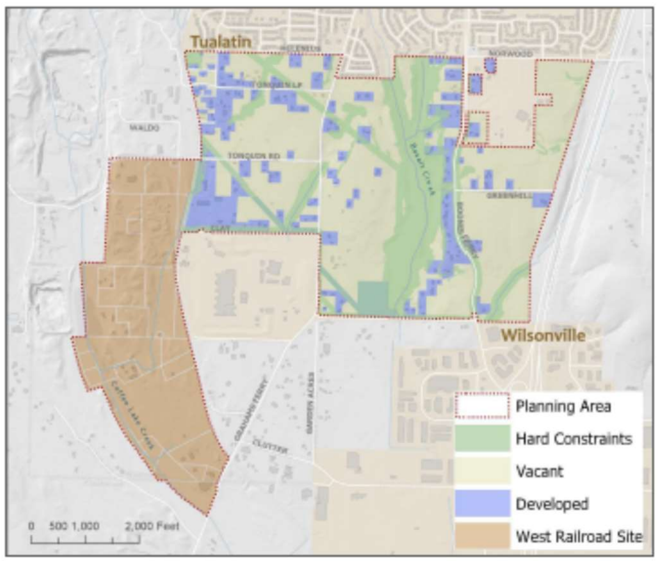
Exhibit 2 to
Ordinance No. 1418-19

The goal is to classify every parcel within the Planning Area into one of the categories described below:

Table 2 Land Supply within the Basalt Creek Planning Area by Type and with Acreage.

Land Supply by Type and Acreage		
Land Type	**Acres**	**Description**
Vacant Land	331	Unconstrained land that is ready to build with no major structures located on the site
Developed Land	125	Land already built upon which includes acreage covered by roadways
Constrained Land	153	Land that cannot be built upon due to environmental or other hard constraints
West Railroad Area	238	Excluded from development plan due to large amount of constraints and limited access
Total Land Supply	**847**	

Figure 6 Land Supply by Type.



21

From: Steve Koper
Sent: Tuesday, January 12, 2021 1:26 PM
To: Tabitha Boschetti
Subject: FW: FW: Tualatin Planning Commission

Follow Up Flag: Follow up
Flag Status: Completed

From: G Lucini <grluci@gmail.com>
Sent: Sunday, January 10, 2021 1:28 PM
To: Steve Koper <skoper@tualatin.gov>; Hayden Ausland <hausland@tualatin.gov>; Kim McMillan <kmcmillan@tualatin.gov>
Cc: Council <council@tualatin.gov>
Subject: Re: FW: Tualatin Planning Commission

Please include this correspondence as part of the Public Record for the City of Tualatin's proposed Land Use Action to Update the City's Stormwater Master Plan Update.

As a method to contact and directly submit Citizen Input to the State's mandated Committee for Citizen Involvement (CCI) or City's State authorized alternate, nor is a direct method to contact the City of Tualatin Planning Commission, provided on the City's designated Public website, would the City provide us assurance a copy of this communication is provided in a timely manner to these Committees/Commissions which make recommendations to the Governing Bodies for making the City's Land Use decisions.

Thank you for the invitation to the City of Tualatin Planning Commission Meeting scheduled for 1-21-2021, sent on 1-6-2021.

The email did not specify the reason for the invitation to the virtual Planning Commission Meeting and did not include an agenda of topics to be discussed during the Public Meeting of the TPC on 1-21-2021 (a major requirement of Notice for Public Meetings).

Nor has the agenda for this meeting been posted to the City's website Calendars for Public Meetings.

It is unclear from the invitation, and unclear from a somewhat comprehensive review of the City's website- as to which role and function Tualatin Planning Commission will be conducting business on 1-21-2021.

Consequently, my husband and I are somewhat confused as to the purpose of the invitation; the subject/s to be discussed; and specifics as to how the virtual meeting will be conducted.

1. **Would you provide information as to any administrative procedures- including any time limits for Citizen verbal comments/discussions, or other limitations or constraints -which might apply to us during the 1-21-2021 meeting.**

2. Understanding the need for a virtual meeting, how does a member of the Public provide the members of the TPC access to documents which may provide clarification or support of Citizen Concerns to be discussed during the TPC virtual meeting?

3. Will the City provide us a copy of the agenda for the 1-21-2021 TPC meeting?

A. Would the City clarify if the purpose of the TPC meeting on 1-21-2021 will be to conduct the business and responsibilities of a Planning Commission, or to implement and fulfill the differing role and functions of a State mandated Committee for Citizen Involvement?

In reviewing the November and December 2020 agendas for the Tualatin Planning Commission (TPC) as posted as part of General Notice on the City's Calendar of Public Meetings website for the City, it was noted the TPC agendas did not list an agenda item for a Citizen Comment period and did not list agenda items relating to the specifics of implementation and review for mandated components of the Oregon Statewide Planning Goal #1 for Citizen Involvement.

B. Is the City's <u>proposed Update to the Stormwater Master Plan</u> an agenda item for the 1-21-2021 meeting?

My husband and I previously submitted Citizen Comments to the City on 12-15-2020-during the City's designated Citizen Comment period for the proposed draft of the Update to the City's Stormwater Master Plan.

As of yet, we have not received a response from the City or elected or appointed officials on the substantial comments we provided to the City. Our comments were also supported by multiple relevant documents.

Included within those documents, was a review and comments of draft as posted to the City's website on the 12-1-2020, and a review of the City's supporting technical documents, by an extremely professionally qualified consultant. In addition, we provided copies of the stormwater conveyance system within the NE Basalt Creek Area; hydraulic modeling within the NE Basalt Creek Area (including lands recently annexed to the City and portions within the future jurisdiction of the City) and conclusions from the previously conducted studies by our consultant. This type of necessary relevant information relating to Stormwater Management within the NE Basalt Creek area was missing from the City's proposed Stormwater Management Master Plan.

Due to the wealth of information we already provided to the City, and the extent of our concerns regarding the proposed Stormwater Master Plan draft in its current form, coupled with the lack of feedback we have receive from the City-it is curious to us as to why the City might have this proposed Land Use Action brought before the City's Planning Commission at this time.

As we would like to be prepared for the 1-21-2021 meeting, should the Stormwater Master Plan Update be an agenda item up for discussion, we would like to understand the purpose and intent for bringing this proposed Land Use Plan before the TPC.

- **Will the TPC be meeting in the role of the Planning Commission to review the proposed draft of the Update to the City's Stormwater Master Plan as part of the City's Land Use process and possibly be making recommendations on forwarding the proposed draft to the City Council for adoption?**

Or

- **Will the TPC be meeting as the City's designated Committee for Citizen Involvement-**

  - **to assure effective two-way communication with citizens by providing a mechanism for effective communication between citizens and elected and appointed officials**

  - **providing further information or providing us a response and rational to the comments and concerns we submitted to the City on 12-15-2020,**

  - **to provide a method for Citizen Involvement within the Preparation of Plans and Implementation Measures, Plan Content, Plan Adoption, Minor Changes and Major Revisions in the Plan, and Implementation Measures?**

4. We understand the City has designated the TPC as the City's Committee for Citizen Involvement (CCI) for the City's Land Use Planning process.

The State's Goal #1 for Citizen Involvement requires *"If the planning commission is to be used in lieu of an independent CCI, its members shall be selected by an open, well-publicized public process"*

As the proposed Update to the City's Stormwater Master Plan will potentially affect hundreds of acres of lands within the Basalt Creek Area- which were not previously included within the previous Stormwater Master Plan---has the City Council selected and provided a CCI member *"broadly representative of geographic areas and interests related to land use"* within the Basalt Creek Area as per the State's requirements for an open well- publicized public process?

City of Tualatin's Implementation of Statewide Land Use Planning Goal #1 for Citizen Involvement Mandated Committee for Citizen Involvement (CCI) verses Mandated Publicized Citizen Involvement Program

We cannot locate a publicized program on the City's website which *"clearly defines the procedures"* by which the general public (regardless of location of residence) is provided continuous involvement in the on-going land-use planning process- including *"Preparation of Plans and Implementation Measures, Plan Content, Plan Adoption, Minor Changes and Major Revisions in the Plan, and Implementation Measures."*

My husband and I want to understand the various aspects (and any subsequent proposed changes) of the proposed Land Use Plan Update to the City's Stormwater Master Plan. And we wish to effectively participate in all phases of this Proposed Land Use Action as part of Citizen Engagement and Involvement for this proposed Land Use Action (as per Oregon Statewide Land Use Planning Goals #1 OAR 660-015-0000(1) and #2 OAR 660-015-0000(2)).

As the Oregon Statewide Land Use Planning Goal #1 for Citizen Involvement states *"the Citizen Involvement Program shall be appropriate to the scale of the planning effort"*, it would be assumed a proposed Land Use Master Plan Update which impacts the entirety of the lands within the current City Limits, and additional lands within the northern portion of the Basalt Creek Area under the future jurisdiction the City, and has taken years to create-would require the scale of the Citizen Involvement Program for this proposed Land Use Plan Update to be fairly large and extensive.

Specifically, to the TPC meeting on 1-21-2021, since we have not been able to find clear information as to the Goal #1 requirement for a Citizen Involvement Program to be use for this proposed Master Plan Update, we submit the following information and questions to the City.

Should the proposed draft of the Stormwater Master Plan be on the TPC 1-21-21 agenda, we would like to be able to have access to timely accurate information, and access to any changes or the most recent draft version on the proposed Land Use Master Plan Update<u>- to allow for a reasonable timeframe to review and understand the proposed Land Use Plan ---prior to the 1-21-2021 TPC Public Meeting.</u>

5. In the future, if any changes have been made – or will be made -to the proposed draft and/or the related technical documents since the City posted information on the City's website for the Citizen Comment Period ending 12-15-2020---

A. **Will the City provide the Public easily identifiable internet access–to any changes to the proposed (as posted to the City's website on 12-1-2020, and/or any future iterations), which contain <u>major</u> or <u>minor</u> changes to the proposed Stormwater Master Plan Update?**

B. To assure that technical information is available to the Public in an understandable form- If the City makes any subsequent changes to the 12-1-2020 version of the proposed draft (referenced in #5A) **– will the City identify/ indicate any future changes to the proposed Land Use Plan (perhaps by strikeouts, highlights, or by other means) within all future proposed versions or drafts of the proposed Land Use Plan?**

C. **Will the City provide appropriate General Notice, and appropriate Actual Notice to Interested Persons, of any Public Meetings on any proposed major or minor changes to the 12-1-2020 draft (as referenced in #5 A) of the City's Update to the Stormwater Master Plan- or future iterations?**

As a reminder, my husband and I have previously identified ourselves to the City as Interested Persons who have submitted written request to be provided Actual Notice of any/all future Public Meetings regarding the proposed Update to the City of Tualatin Stormwater Master Plan.

D. **In the future, will the City make available to the Public via internet access any proposed changes to, or to the most current iterations of the 12-1-2020 draft of the Master Plan Update (as referenced in #5 A)---*<u>within a reasonable timeframe to allow for Public review and understanding, prior</u>* <u>to any/all Public Meetings which may be held to forward the proposed Update within the City's Land Use Planning process</u>?**

It should be noted, the answers to some of these questions will impact the Public's ability to address the challenges created by the COVID-19 pandemic.

Again, thank you for your invitation to the Tualatin Planning Commission meeting on 1-21-2021.

We look forward to a timely reply to this email, and a response to our comments submitted to the City on 12-15-2020 regarding the proposed Update to the City's Stormwater Master Plan.

Regards,

John and Grace Lucini

On Wed, Jan 6, 2021 at 1:57 PM Steve Koper <skoper@tualatin.gov> wrote:

> Good afternoon Grace,
>
> I wanted to notify you of the upcoming Planning Commission meeting, so please consider this a formal invitation to the Planning Commission meeting on January 21st from 6:30 to 9:30PM.
>
> Regards,
>
> Hayden Ausland, CPSWQ
> Engineering Associate - Water Quality
> City of Tualatin
> hausland@tualatin.gov
> 503-691-3037
>
> -----Original Appointment-----
> From: Steve Koper <skoper@tualatin.gov>
> Sent: Wednesday, January 6, 2021 11:27 AM
> To: Steve Koper; Kim McMillan; Hayden Ausland
> Subject: Tualatin Planning Commission
> When: Thursday, January 21, 2021 6:30 PM-9:30 PM (UTC-08:00) Pacific Time (US & Canada).
> Where:
> https://us02web.zoom.us/j/83673581282?pwd=K3MyM3AzL1NIdmRIL2xJYWtJV2tQdz09
>
> Community Development is inviting you to a scheduled Zoom meeting.
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> Passcode: 542101
> One tap mobile
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>
> Meeting ID: 836 7358 1282
> Passcode: 542101
> Find your local number: https://us02web.zoom.us/u/kzyVFAssf