North Lemmon Valley Prado Ranch Development

Conceptual Drainage Report

Prepared for	Lansing Industries
Project Name	North Lemmon Valley Prado Ranch Development
Project Number	E315012801
Project Manager	Mark Gookin, PE, CFM
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PROFESSIONAL ENGINEER-STATE OF NEVADA
MARK W. GOOKIN
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CIVIL
No 12345

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Prepared for:

Lansing Industries

Prepared by:

Cardno
Shaping the Future

Cardno
5496 Reno Corporate Drive, Reno, NV 89511
775.828.4362

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1 Introduction

1.1 Location/Description

The proposed Prado Ranch development project consists of mixed-use developments including a ± 52 acre multi-phase residential development (Area 1), a ± 185 acre, 6 building Industrial Park development (Area 2), and a ± 817 acre residential development (Areas 3-6) in North Lemmon Valley, NV. The project sites are located along Lemmon Drive: Township 21, Range 19, Sections 14,22,23,26,27,35,34, on APN's 080-461-04,27,30; 080-671-55-57; 080-722-03; 080-281-01; 080-730-11-18; 080-721-03-08; 080-723-01-03; 089-030-01-09. The general location of the project relative to other prominent areas in the Truckee Meadows is presented in Figure 1. The area and phasing plan for the proposed development is displayed in Figures 2 and 3.

1.2 Existing Site Conditions

1.2.1 Area 1

The proposed project site referred to as Area 1 throughout this study is surrounded by the existing Valley Village and Valley Park Estates Subdivisions, Lemmon Valley Park and Elementary school, the Lemmon Valley Wastewater Treatment Facility, and open space. A Majority of the proposed development is within the FEMA mapped 100-year Swan Lake Floodplain, which has a reported water surface elevation of 4923.73 feet above NAVD88. As such, the project will require placement of a significant amount of a fill (+/- 190,080 CY) within the Swan Lake Floodplain, in order to elevate the finished floors of the proposed buildings above the 100-year flood water surface elevation in accordance with the Truckee Meadows Regional Drainage Manual (TMRDM). The southeast portion of the development is also currently designated by FEMA as Zone A Special Flood Hazard Area (SFHA); however, the approved CLOMR Case No. 15-09-2695R would change this designation to Zone X once the associated channel improvements are in place and a LOMR has been received. Therefore, this study was conducted assuming the Zone X designation. The existing topography throughout the Area 1 project site is very flat, with an average slope of 0.87% and contains dirt roads and various unlined drainage channels that terminate at Swan Lake.

The vegetation throughout the undeveloped areas consist of brushes and desert grasses, and the NRCS hydrologic soil classification for the proposed development area is primarily "Type C", with a small area that is classified as "Type D". The soil classifications for the entire Prado Ranch area and contributing watersheds are depicted in Figure 3.

1.2.2 Area 2

The proposed project site referred to as Area 2 throughout this study consists of a proposed industrial park, gas station/convenience store, and small residential development which is surrounded primarily by open space, with the Heppner-02 subdivision to the north and Lemmon Drive to the west. A portion of the Area 2 project site is also within the FEMA mapped 100-year Swan Lake floodplain. Therefore, Area 2 will require placement of additional fill (+/- 474,437 CY) within the Swan Lake Floodplain. The existing topography at the proposed project site consists of relatively flat topography (0.2%-1% slopes), with numerous washes and unmaintained dirt roads throughout the site and surrounding areas. The east and south ends of the proposed site transition into steeper terrain and ridgelines that ultimately make up the sub-catchments of the 3.8 mi^2 watershed that drains through the proposed project site.

The vegetation throughout the watershed primarily consists of brushes and desert grasses, with small areas of trees and some low density developed areas. The NRCS hydrologic soil classifications range from A-D throughout the watershed, with a majority of the soil in the watershed being classified as "Type D".

1.2.3 Areas 3-6

The residential developments that make up Areas 3- 6 are surrounded by the Streeter and Heppner Subdivisions, and a significant amount of open space. The design for these areas is still in the early conceptual phases; however, a small portion of the Area 4 development is within the FEMA mapped 100-year Swan Lake floodplain. Therefore, an additional ± 13,228 CY of fill will be required within the mapped area to elevate the parcels above the Swan Lake 100-year floodplain. There is also a depressed area within the Area 6 development that is designated by FEMA as Zone A, and this depression likely acts as a detention basin during storm events. This depression will be filled as a result of the proposed project and thus requires that the designation be changed to Zone X. The average slope throughout the proposed project site is 1.7% and the open space is made up of washes and both maintained and un-maintained dirt roads. The drainage basin that includes the proposed development is approximately 13.5 square miles, and primarily consists of desert brushes and grasses, with some trees in upper elevations, and the hydrologic soil groups are classified as Types A-D.

1.3 Previous Studies and Relevant Master Plans

A comprehensive hydrologic study was conducted by Schaaf and Wheeler in 2005 and 2006 for the watershed directly adjacent to the Area 2 project site, Golden Valley Wash. However, this analysis only includes catchments that impact the Area 1 project site. Similarly, the 2009 Washoe County Flood Insurance Study (FIS) also addresses drainage in portions of Lemmon Valley, although the project areas, with the exception of Area 1, are not included. 100-year peak runoff estimates for Lemmon Valley from the Washoe County FIS were used to confirm the reasonableness of the results obtained in this study, due to similarities in soil type, elevation, and precipitation patterns. This comparison is discussed further in the next section. The project site is also included in the North Valleys Area Plan, as part of the overall Washoe County Master Plan, and falls within the Lemmon Valley suburban character management area (Washoe County 2010).

2 Existing and Proposed Hydrology

Both existing and proposed storm flows were calculated using the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) Version 4.1. Runoff losses were computed using the SCS-Curve number method and transformation calculations were performed using the SCS Unit Hydrograph method. Runoff losses in the SCS methodology were calculated using composite curve numbers (CN) that were developed for existing and proposed conditions based on soil classifications obtained from the NRCS database and land cover data obtained from USGS National Elevation Dataset. The base curve numbers for antecedent moisture condition 2 (AMC-II) were assigned to areas within the watershed using the recommended values outlined in the TMRDM Table 702 1-4. The composite curve numbers that correspond to each sub basin for the development areas are displayed in along with the sub basin boundaries in Figures 4-6. Where applicable, flows were routed through washes within the sub basins using the Muskingham-Cunge, Muskingham, and watershed lag methods. Post-development flows were routed through the developed areas using the Muskingham-Cunge method in conjunction with the conceptual drainage designs. Lag times were calculated using the methods outlined in the TMRDM. Time of concentration calculations for existing and proposed conditions are provided in Appendix B.

2.1 Existing and Proposed Drainage Basin Boundaries

The drainage basin boundaries were determined from a 10-meter DEM that was obtained from USGS (and checked visually against Washoe County 2-foot contour mapping available online), and boundaries for sub watersheds within the project sites were refined based on higher resolution 1-foot contour topography data obtained from field surveys conducted by Tri State Land Surveying in 2005. The project areas were separated into 3 large drainage basins (Area 1, Area 2, and Areas 3-6) which were then broken into sub basins that were used for both existing and proposed condition calculations. Although the hydrologic model for Golden Valley Wash that was developed as part of the 2006 Schaaf and Wheeler study includes Area 1, the model was re-created with smaller sub-basins in order to analyze the offsite flows contributing to the Area 1 development in further detail.

2.2 Minor and Major Storm flow Calculations

2.2.1 Existing

Major and minor storm flows were calculated based on the NOAA Atlas 14 frequency storms. Per the recommendations outlined in the TMRDM, the 100-year 24-hour storm was used as the major storm event for sizing drainage facilities and the 100-year 10-day storm was used to analyze the off-site runoff volume increase as a result of the proposed project. The minor storm flow calculations were based on the 5-year 24 hour event, and were used to size storm drain infrastructure within the proposed developments in accordance with the TMRDM.

2.2.2 Area 1

The calibrated existing conditions curve number of 66.1 was used for all of the sub-basins in Area 1. The impervious area percentage was estimated for each sub basin based on the Schaaf and Wheeler study, residential density in developed areas, and analysis of areal imagery. Under existing conditions, the calculated peak runoff discharging to Swan Lake from Area 1 was 188 cfs and the calculated total runoff volume for the 100-year 10 day event was 161.5 Acre-feet.

2.2.3 Area 2

The composite curve numbers for existing conditions in Area 2 ranged between 60.3 and 77.3 (Figure 5). The influence of impervious areas on hydrology were included in the composite curve numbers, based on the residential density included in the land use data set. Under existing conditions, the calculated peak runoff for the 100-year 24 hour event at the watershed outlet near the intersection of Lemmon Drive and Arkansans Drive was 499 cfs. The calculated total runoff volume for the 100-year 10 day event was 1,245 Acre-feet.

2.2.4 Areas 3-6

The composite curve numbers for existing conditions in Areas 3-6 ranged between 53.5 and 86.2 (Figure 6). Similar to Area 2, Impervious areas were accounted for as part of the composite curve numbers, with additional impervious area conservatively added to residential developments based on areal imagery. The drainage basins that contribute to and make up Areas 3-6 contain two large depressions that are designated as Zone A by FEMA. As previously mentioned, these depressions likely act as detention basins during peak events, based on analysis of topography data and field reconnaissance. The depression that exists within proposed Area 6 was modeled as a detention basin using the high resolution 1- foot contour topography data to develop a stage volume relationship. The larger depression in the contributing sub-basin was difficult to model as a detention basin due to the limited, low resolution topography generated from the 10-meter DEM. Although this depression is not impacted by the proposed development, it is still important to consider the effects of flood peak attenuation for offsite flows. Therefore, the basin was simulated using the Muskingham routing method, with a very low "X" coefficient, which results in significant flood peak attenuation.
The calculated peak runoff from Areas 3-6 for the 100-year 24 hour event under existing conditions was 1,394 cfs and the calculated total runoff volume for the 100-year 10 day event was 4,016.6 Acre-feet.

2.2.5 Reasonableness of Results

The 24 hour peak flows were checked for reasonableness against peak flows presented in the Washoe County FIS for similar watersheds in Lemmon Valley, which are displayed in Table 1. Although the comparable watersheds are substantially more developed (with the exception of Area 1), the 100-year peak discharges for drainage basins of similar size are significantly higher than the predicted existing conditions peak discharges. Further, the additional contributions in Golden Valley Wash between Lemmon Drive and Browning Drive (969 cfs from 4.4 mi^2) appear to be largely from runoff generated in a less-developed watershed on a similar aspect to the catchments that contribute to the proposed project site. Given that the proposed conditions in this analysis are still less developed than adjacent watersheds, the results of this analysis were consistent with expectations and produced peak discharges that are less than those reported in the Washoe County FIS for adjacent watersheds.

Table 1. 100-year peak discharges from comparable watersheds in the Lemmon Valley Area (FEMA 2009)

Comparable Watershed	Drainage Area (mi^2)	Major Storm Peak Discharge (cfs)
Golden Valley Wash at Browning Drive	4.4	969
Golden Valley Wash at Lemmon Drive	8.88	1,904
Unnamed Tributary to Lemmon Valley Playa	3.61	1,070
Area 1: Prado Ranch Area 1	*0.5*	*Ex: 188, Prp: 246*
Area 2: North Lemmon Valley Industrial Park	*3.8*	*Ex: 499, Prp: 703*
Areas 3-6: Prado Ranch Areas 3,4,5, and 6	*13.5*	*Ex: 1,394, Prp: 1,902*

2.2.6 Proposed

The proposed conditions models were developed by adding additional impervious areas to the sub-basins to account for the proposed designs, and modifying the routing parameters and basin lag times based on the conceptual drainage designs. In Area 2, the proposed conditions were modeled by assuming a CN of 98 (fully developed) for impervious areas and adjusting the composite curve numbers accordingly.

2.2.7 Area 1

The residential developments proposed for Phases 1 and 3 of the Area 1 development were assumed to be 38% impervious based on the guidelines for ¼ acre lots in Table 702 of the TMRDM and similar residential developments in the area. The Phase 2 development consists of multi-family residences, and therefore the impervious area was assumed to be 65%. Proposed condition routing parameters were estimated using the conceptual drainage design displayed in Figure 7. The calculated major storm peak runoff for Area 1 under proposed conditions was 246 cfs and the calculated 100-year 10 day runoff volume was 171.5 Acre-feet, or an increase from existing conditions of 10 Acre-feet.

2.2.8 Area 2

The impervious areas in the industrial park development that comprises a majority of Area 2 were accounted for by assuming a CN of 98 and creating proposed composite curve numbers for the developed sub-basins. The calculated 100-year 24 hour peak runoff for proposed conditions was 703 cfs, and the total runoff volume for the 100-year 10 day event was increased by approximately 66 Acre-feet to 1,311 Acre-feet. The routing parameters for the proposed conditions model were developed using the conceptual drainage design that is discussed further in the next section and displayed in Figure 8. A gas station/convenience store and small residential development on the south side of the industrial park were added to the design after the hydrologic analysis was completed; therefore, it was assumed that the additional 10-day runoff volume added by these areas would be offset through the use of small on-site detention basins within the development.

2.2.9 Areas 3-6

Although the design for Areas 3-6 is very conceptual, estimated impervious area for the sub basins ranged between 20% (for the park area) and 40% (for residences), based on the proposed residential density. The routing parameters for proposed conditions were estimated assuming flow would be conveyed through the developments as shown in Figure 9. The calculated major storm peak runoff at Swan Lake for proposed conditions was increased to 1,902 cfs, which is due to the removal of the storage provided by the +/- 21 AF detention area in addition to the typical increased runoff effects of development. The calculated 100-year 10 day runoff volume was 4,170 Acre-feet, which is a 153.5 Acre-foot increase from existing conditions.

2.3 Existing Drainage Problems

It is unknown whether or not there are drainage problems with the existing roadway crossings during major storm events. However, the extents and elevation of the Swan Lake 100-year floodplain suggest that portions of Lemmon Drive would be inundated by up to two feet of water during the major storm event with the existing development conditions.

3 Proposed Drainage Facilities

3.1 Routing in and around site

3.1.1 Area 1

The off-site and on-site flow for Area 1 will be conveyed through a storm drain system that was sized to convey minor storm flows, with the assumption that the additional portion of the major storm flows would be conveyed within the proposed right of way. For the purpose of this analysis, proposed condition slopes of drainage facilities were assumed to approximate the slope of the existing topography. The required pipe sizes were calculated for various points within the sub watershed and the required diameters for RCP ranged from 18"-24"; however, given the minimum amount of detail in the conceptual designs, inlet locations were not explicitly defined for this analysis. The off-site flows that are conveyed through the Phase 1 and 2 developments, and flows that are generated on-site, would be conveyed to a trapezoidal channel on the north side of the Phase 1 development. The channel was sized for the major storm flows and will require a 2-foot base width with 2:1 side slopes. The depth of flow within the channel ranges between 2.2 and 3.3 feet, and maximum velocities range from 2.9 to 4.3 ft/s. The channel will flow to the existing trapezoidal channel on the East Side of the North Lemmon Valley Wastewater Treatment Facility that conveys flow along Lemmon Drive directly to Swan Lake. Flows from the Phase 3 development will be conveyed directly to existing storm drain channels that drain directly to Swan Lake.

3.1.2 Area 2

A majority of the off-site flow entering the proposed site from the east will be routed around the north end of the developed area through the "Main Channel" with an expected peak flow of 514 cfs at the downstream end of the channel during the major storm event. The proposed trapezoidal channel would require a 15 foot base width and 3:1 side slopes. Peak velocities in the Main Channel are expected to be 4.4 ft/s which would require a rock channel lining with a minimum D_{50} of 5 inches based on preliminary calculations. Maximum flow depths in the channel are expected to be approximately 4.2 feet, and 1 foot of freeboard will be required per TMRDM criteria. The peak flow in the channel includes 36 cfs that would be conveyed to the main channel from the catchments to the southeast of the proposed development via a 24" diameter RCP storm drain lateral, which conveys flow from a proposed detention basin on the southeast side of the proposed development. The detention basin, discussed further in the following section, will add an additional 6.7 acre-feet of storage during the major event, and fits within the proposed topography.

The main channel will flow into a concrete box culvert, which will be required to convey flow under the project site in the Northwest Corner due to a property boundary, unless a drainage easement is able to be obtained. Peak flows from the outlet of this box will be combined with additional on- and off-site flows, and will ultimately be discharged directly to Swan Lake. Maximum velocities in the box culvert are expected to be approximately 9.5 ft/s.

Much of the remaining off-site flow would be routed around the west side of the development through the "West Channel" which has an expected peak flow of 353 cfs. This peak flow includes off-site runoff from the catchments to the south of the project site, as well as a majority of the runoff generated on-site, which would be conveyed to the channel via surface flows. The maximum velocity in the West Channel is expected to be approximately 3.5 ft/s, which would require a rock channel lining with a minimum D_{50} of 3 inches based on preliminary calculations. The maximum flow depth is expected to be 3.4 feet and 1 foot of freeboard will be required per TMRDM criteria. A number of v-ditches will also be required at various concentration points to convey off-site flows to channel and pipe inlets. Maximum velocities in the ditches range between 4.7 and 8.3 ft/s and will require a rock channel lining with minimum D_{50}'s ranging from 6 to 18 inches, based on preliminary calculations.

The onsite flows will be conveyed as surface flows throughout the site via a curb and gutter system, with a maximum velocity times depth (V*D) value of 5.4 ft^2/s occurring during the major storm event. This value is below the 8 ft^2/s maximum V*D criteria outlined in the TMRDM. The on-site surface flows are also expected to meet the additional depth and inundation width criteria for local roadways outlined in the TMRDM.

3.1.3 Areas 3-6

The design for Areas 3-6 is still in an early conceptual phase, however the proposed alignments of right of ways within the developments were used as a basis for sizing and routing channels that would be required to convey the off-site and on-site flows around and through the developments. It was determined that off-site flows and on-site runoff could be conveyed via channels with dimensions as shown in Table 2, which correspond with the outlet points shown in Figure 9.

Table 2. Conceptually sized storm water conveyance infrastructure for Areas 3-6.

			Minor Storm	Major Storm	Conceptual Runoff Conveyance (sized for Major Storm)					
Outlet Point	Code	Drainage Area (mi^2)	Q_5 PRP (cfs)	Q_{100} PRP (cfs)	Channel Shape	side slope, z	b (ft)	depth[1] (ft)	velocity[2] (ft/s)	slope[3] (ft/ft)
Offsite Matterhorn Blvd.	OS-MH	1.3	35.4	256.9	Trapezoidal	2	6	5	4.6	0.005
Offsite Basin E LEM-06	OS-6	0.9	6.9	116	Trapezoidal	2	4	3.5	5.7	0.015
Offsite Basin E LEM-10	OS-10	6.0	118.4	443.5	Trapezoidal	3	12	4.5	5.5	0.007
Offsite Basin HEP-02	OS-H2	0.3	42.6	189.3	Trapezoidal	2	4	4.5	4.3	0.005
Combined Runoff Area 4A	RO-A4A	1.4	50.1	264.8	Trapezoidal	2	8	4.75	4.6	0.005
Combined Runoff Area 6A/B	RO-A6AB	1.6	118.9	404.3	Trapezoidal[4]	2	2	4.6	4.0	0.004
Combined Runoff Area 6C	RO-A6C	6.2	129.5	454.8	Trapezoidal	3	15	4.75	4.8	0.005

Discharge to Swan Lake

	Drainage Area (mi^2)	Q_{100} EX (cfs)	Q_{100} PRP (cfs)
	13.5	1393.8	1901.6

Runoff Volume at Swan Lake (AF)

	10-day Existing	10 day Proposed	Increase
	4016.6	4170.1	153.5

[1] Includes required freeboard

[2] Assumed manning's n of 0.04

[3] Assumed proposed slope matches EG

[4] Assumed flow is split on both sides of roadway (i.e., channel sized for half of flow)

3.2 Detention Requirements

Although runoff volumes are increased for proposed conditions, detention basins are not required to reduce the off-site discharge to pre-development conditions due to the fact that runoff will be discharged directly to Swan Lake, which falls under special requirements in the TMRDM. Pursuant to TMRDM Section 709.2, the addition of fill within the 100-year Swan Lake flood boundary and the increase in runoff volume requires storage volume mitigation to result in "no net increase" of water surface elevations within the playa. The ± 628 Acre-foot storage volume reduction created by the proposed development will be mitigated as shown in Figure 10, which depicts where additional storage volume can be added within the owner's property boundaries and within the 100-year FEMA boundaries. The storage volume mitigation areas will be graded such that these areas are able to drain by gravity, so that standing water will not occur for an extended time period.

Although not required, a detention basin is proposed on the south side of the proposed Area 2 development, as shown in in Figure 4. The basin will store approximately 6.7 acre-feet during the major storm event, and reduce the peak discharge from 165 to 36 cfs in "Lateral 1". Inclusion of the detention basin reduces the required pipe diameter for "Lateral 1" to 24 inches, and substantially reduces the peak discharge at the outlet of the project site. In order to meet the spillway requirements for major local detention facilities outlined in the TMRDM, the proposed detention basin will overflow onto the project site. The overflow discharge that is expected to occur during a 500-year event can be conveyed through roadway gutters and surface flow, in compliance with applicable street flow criteria. The detention basin will have a low flow channel sloped at a minimum of 0.5%, to prevent ponding water from occurring for any extended duration and to allow the detention basin to drain thoroughly within the 3 day maximum detention period outlined in the TMRDM. The detention basin will be designed with a minimum of 1 foot of freeboard above the design water surface elevation for the emergency spillway.

The volume offset areas (Figure 10) could also be considered "backwater detention basins" which will be disconnected from the conveyance infrastructure and provide additional storage for backwater occurring as a result of Swan Lake filling up to the 100-year water surface elevation. These basins will be graded such that they are drained by gravity and do not allow standing water to occur for any extended time period.

3.3 Floodplain modifications and need for FEMA approval

Floodplain modifications and FEMA approval will be required in order to adjust the 100-year Swan Lake boundary based on the addition of fill within the proposed project area and the addition of the storage volume mitigation areas. The area designated as Zone A in proposed Area 6 will also need to be modified. All of the modifications will require a Conditional Letter of Map Revision for placement of fill (CLOMR-F) application to be completed and will be submitted to FEMA with approval of the conceptual design.

3.4 Outfall system and anticipated phasing

The outfall from the Area 2 and Areas 3-6 project sites will require the addition of conveyance infrastructure crossing Lemmon Drive and modification of existing conveyance infrastructure. It is anticipated that the road will be modified to allow placement of a culvert(s) with sufficient capacity to handle the major storm peak flows under conditions where the local watershed is experiencing 100-year rainfall. However, all of the modifications at outfall locations are within the 100-year Swan Lake boundary suggesting that these areas are expected to be inundated during the longer duration 100-year event for Swan Lake, and thus the final design may allow for roadway overtopping. The outfall from Area 1 will be conveyed directly to existing channels within the 100-year Swan Lake Boundary and are also expected to be inundated during the 100-year event. No future facilities are expected to be impacted by the proposed project, due to the fact the runoff will be discharged directly to Swan Lake.

The anticipated phasing for the proposed developments is included in the phasing and area plan (Figure 2), with the exception of the updated Area 1 Phasing Plan, which is displayed in Figure 2b.

4 Conclusions

4.1 Compliance with manual policies and requirements

The conceptual drainage design for the proposed developments complies with the policies and requirements outlined in the TMRDM. The finished floor elevation of the buildings will be set to a minimum of 4924.73 NAVD88, which provides 1 foot of freeboard above the 100-year Swan Lake elevation of 4923.73. The calculations of storm flows were performed using the acceptable HEC-HMS methods and criteria outlined and provided in the TMRDM.

As discussed, the on-site facilities are designed with sufficient capacity to handle major storm peak flows in Area 2 and Areas 3-6, and the infrastructure meets applicable velocity and freeboard requirements. The on-site facilities in Area 1 are capable of handling the minor storm peak flows, and the additional flow during the major event would be conveyed through the right of way in accordance with TMRDM criteria. The increase in 100-year 10 day runoff volume, as well as the loss of Swan Lake storage capacity due to placement of fill at the project site, will be mitigated with additional storage areas such that there will be no net increase in the 100-year water surface elevation of Swan Lake. The proposed detention basin will comply with all design standards and criteria specified in the TMRDM for local major detention facilities.

4.2 Requested Manual exemptions

There are no TMRDM exemptions requested as part of the proposed project.

4.3 Ability to provide emergency all weather access

As previously mentioned, portions of the major access road (Lemmon Drive) to Area 2 and Areas 3-6 are expected to be inundated with approximately 2 feet of water when Swan Lake is at the 100-year elevation. Access within these project areas during the major event will meet the standard of the TMRDM but there are regional access issues as the property would be inaccessible via a major roadway. However, depth, inundation, and V*D criteria for local roadways during major and minor storm events were considered for all on-site facilities included in the conceptual drainage plan. Further analysis of the V*D criteria for Area 1 and Areas 3-6 will be required once a final development designs which include right of way alignments and widths are completed.

4.4 Compliance with floodplain/hazard regulations

As previously mentioned, adding fill within the boundaries of the Swan Lake 100-year flood elevation will require mitigation by adding additional storage to other areas of Swan Lake. The conceptual locations for these areas are shown in Figure 10. These locations are within the developer's property boundaries and will result in no net increase in the 100-year water surface elevation. A FEMA CLOMR-F will also be required and the appropriate information and application will submitted to FEMA with approval of the conceptual drainage plan.

4.5 Effect of development on off-site flows and impact to adjacent downstream properties and drainageways

The pre- and post-development peak discharges and discharge volumes are displayed in Table 3. As expected the peak runoff for Areas 3-6 is increased substantially between existing and proposed conditions due to removal of the depression in Area 6. However, these increased flows will be conveyed via adequate conveyances through the proponent's property to Swan Lake. Although runoff from the project site will be discharged directly to Swan Lake, storage volume will need to be added to other areas within the Swan Lake playa to mitigate placement of fill and the increase in runoff volume. Any impacts to downstream properties are negated by the fact the all downstream properties are within the 100-year Swan Lake floodplain and there will be a no net increase in storage volume as a result of the project.

Table 3. Summary of HEC-HMS results for major, minor, and 10-day storm events

Storm Event	Combined Peak Discharge at Swan Lake (cfs)	Time to Peak (hrs)*	Discharge Volume (Acre-ft)
Area 1			
Existing			
5-year 24 hour (Minor)	44	12.5	15
100-year 24 hour (Major)	188	12.5	43
100-year 10 day	*Volume Analysis Only*		162
Proposed			
5-year 24 hour (Minor)	67	12.3	20
100-year 24 hour (Major)	250	12.3	51
100-year 10 day	*Volume Analysis Only*		172
Area 2			
Existing			
5-year 24 hour (Minor)	120	15.75	74
100-year 24 hour (Major)	499	15.5	278
100-year 10 day	*Volume Analysis Only*		1245
Proposed			
5-year 24 hour (Minor)	164	12.5	103
100-year 24 hour (Major)	703	12.75	334
100-year 10 day	*Volume Analysis Only*		1311
Areas 3-6			
Existing			
5-year 24 hour (Minor)	321	12.6	208
100-year 24 hour (Major)	1394	12.6	802
100-year 10 day	*Volume Analysis Only*		4017
Proposed			
5-year 24 hour (Minor)	484	12.6	275
100-year 24 hour (Major)	1902	12.6	912
100-year 10 day	*Volume Analysis Only*		4170

*Dates used for simulation time window were arbitrarily chosen, but remained consistent through all simulations.

5 Exhibits and Figures

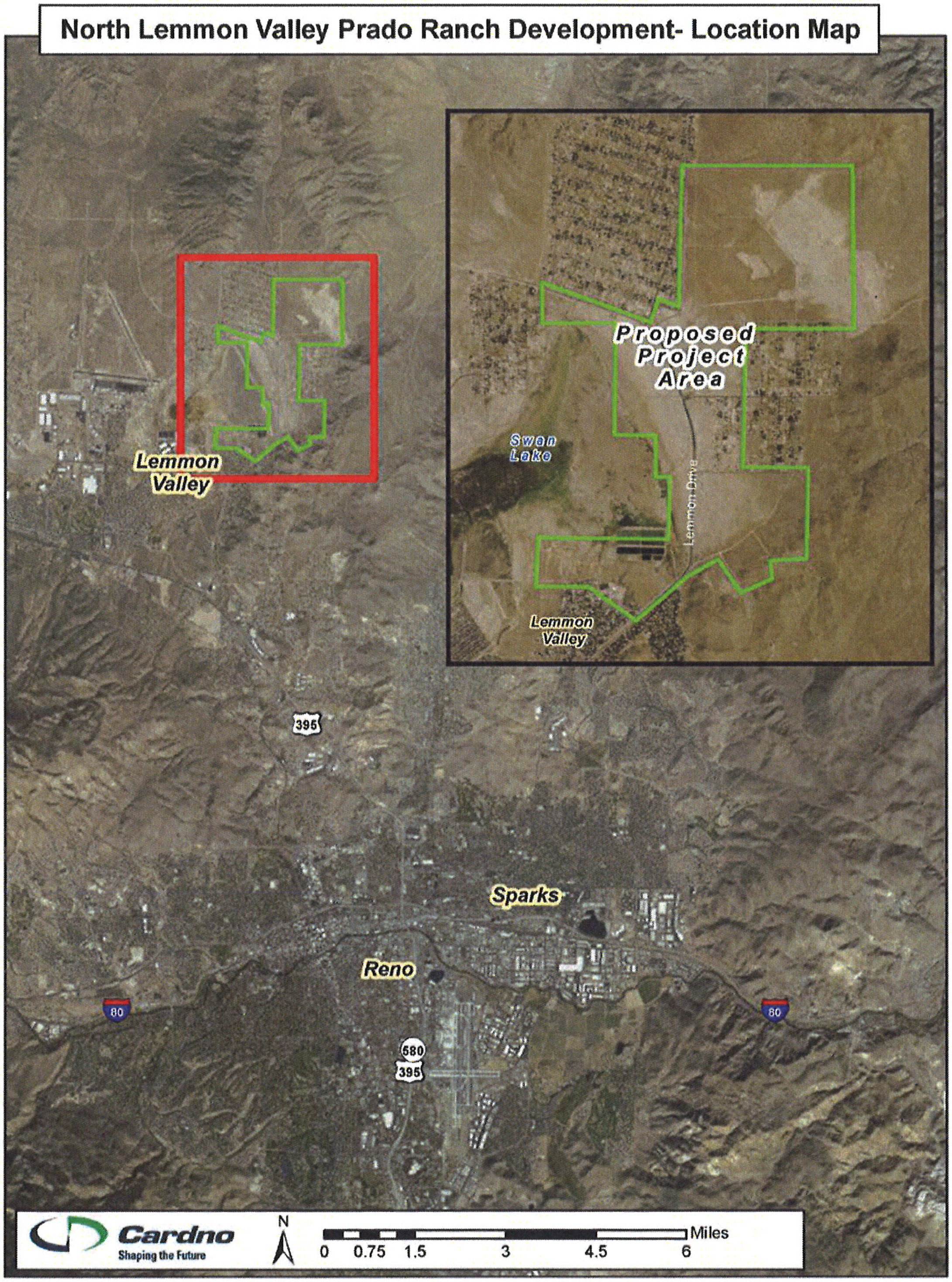


Figure 1. General location of the project area relative to prominent areas in the Truckee Meadows.

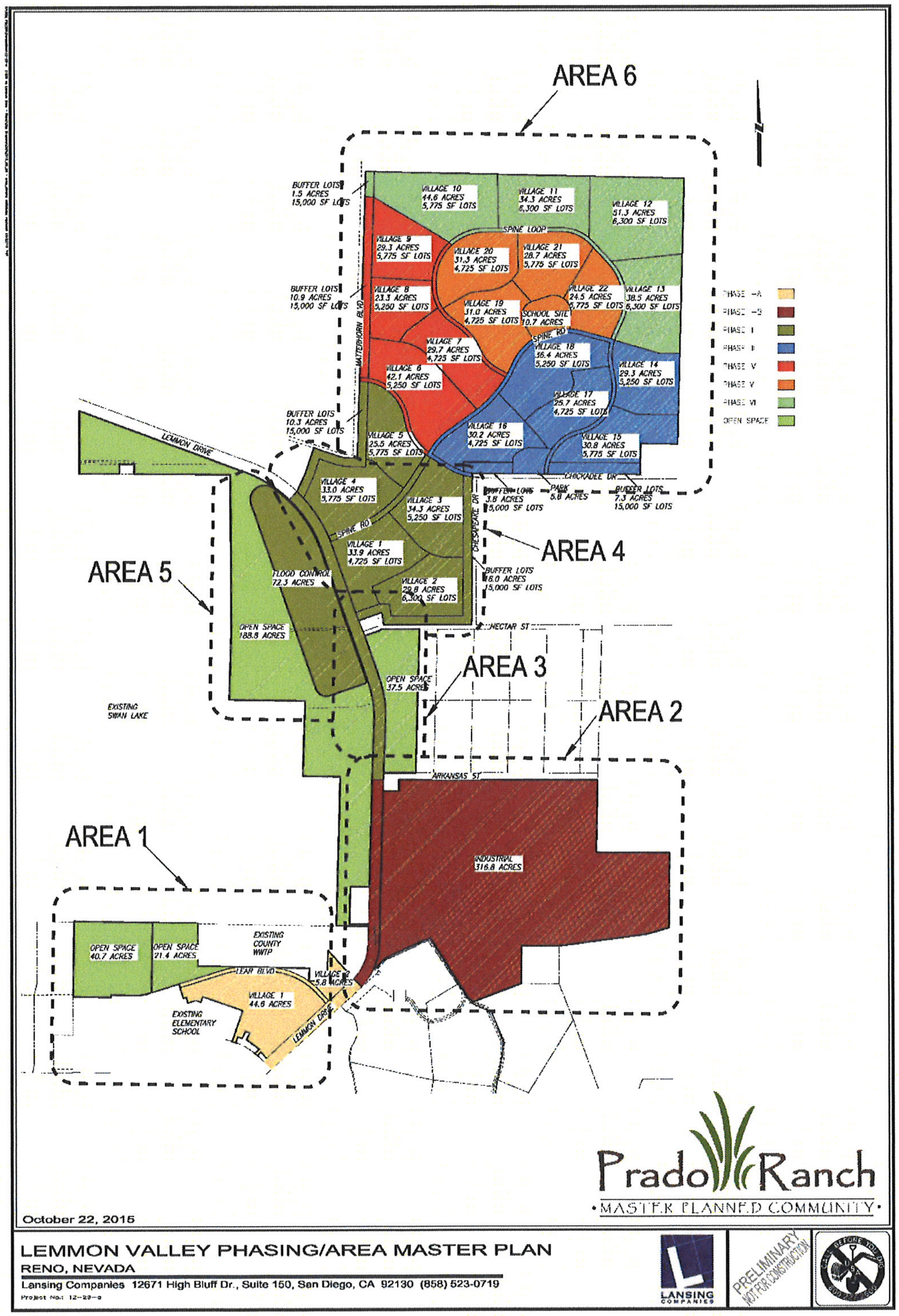


Figure 2. Area and phasing plan for the proposed developments, with the exception of Area 1, which has been updated as shown in Figure 2b.

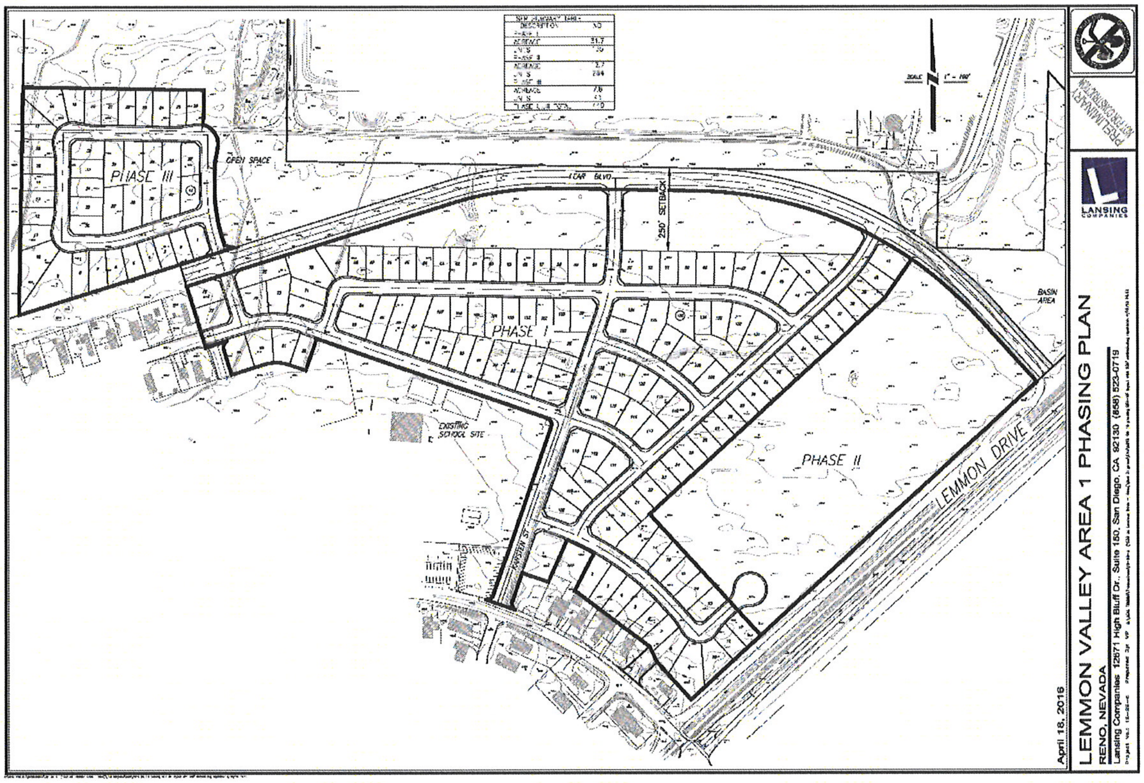


Figure 2b. Area 1 updated phasing Plan.

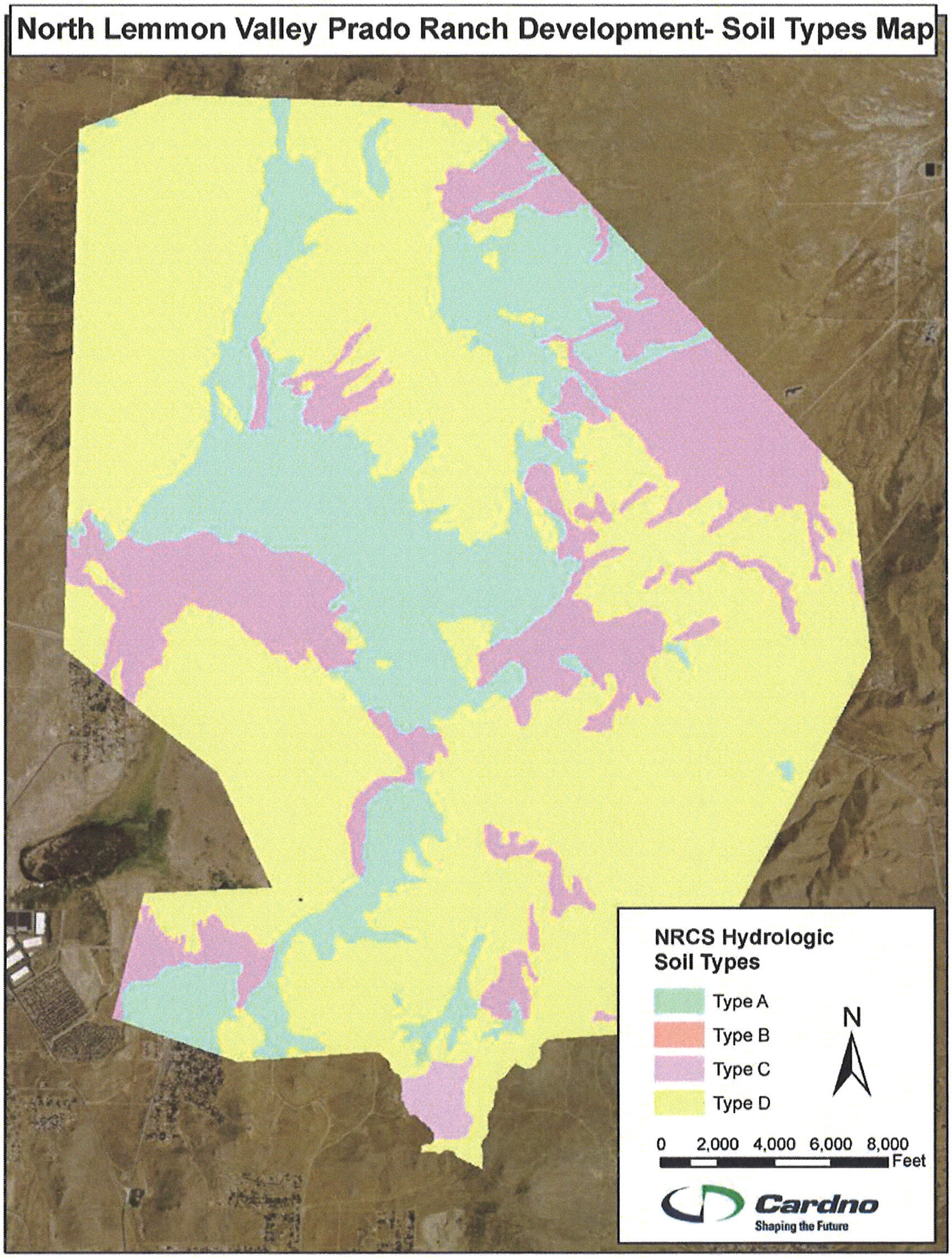
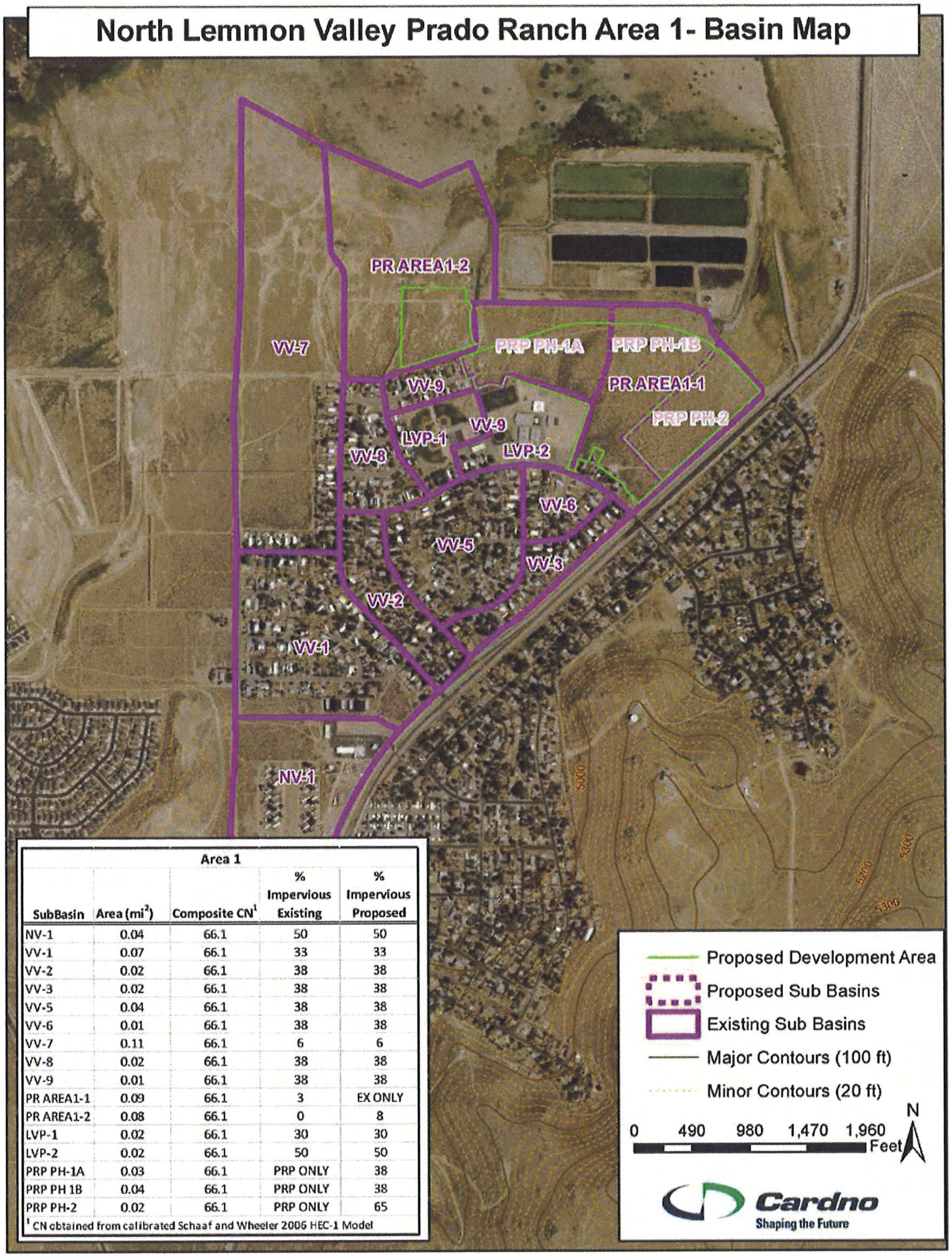


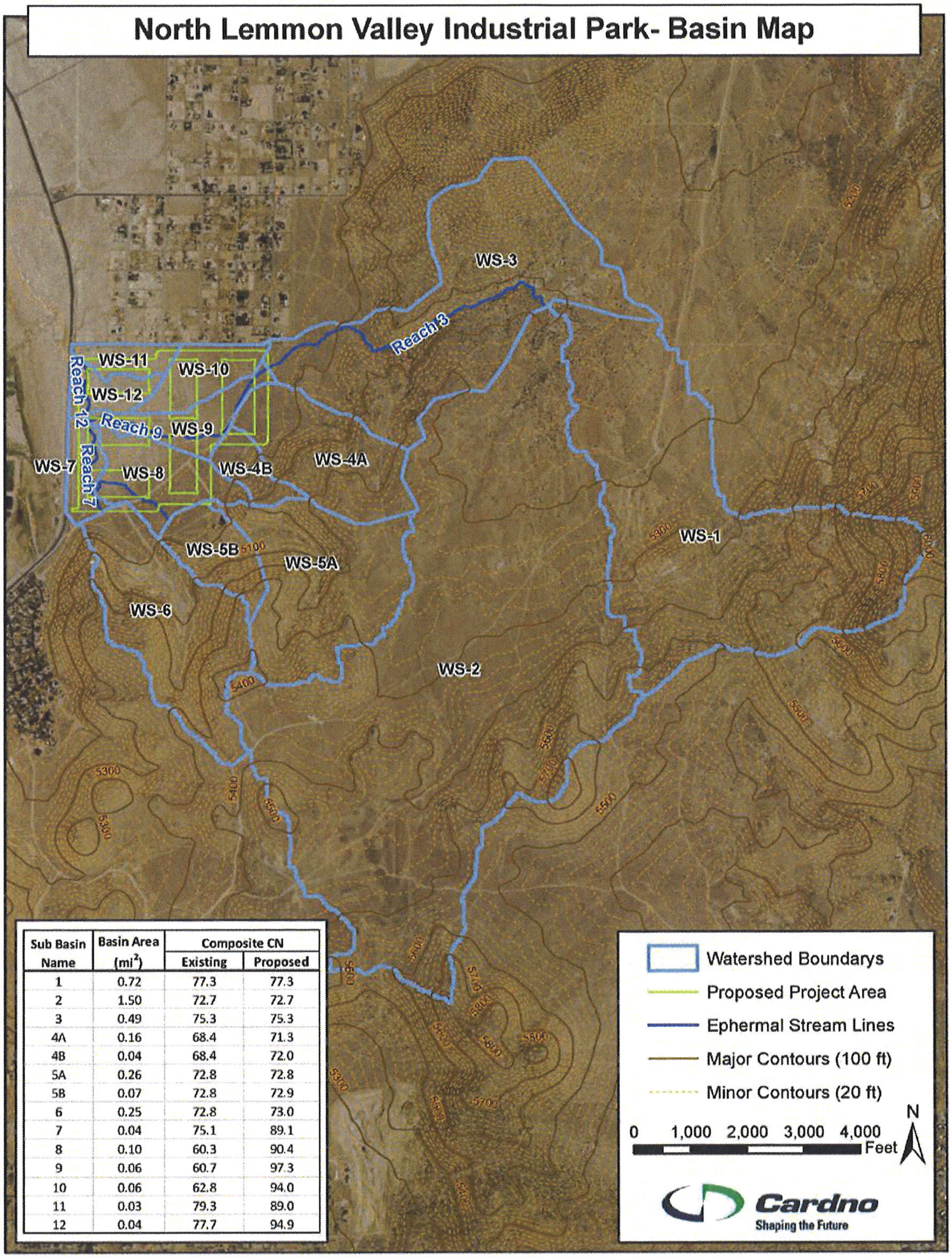
Figure 3. Hydrologic soil types for the project area and off-site basins (USDA NRCS website).



Area 1				
SubBasin	Area (mi²)	Composite CN[1]	% Impervious Existing	% Impervious Proposed
NV-1	0.04	66.1	50	50
VV-1	0.07	66.1	33	33
VV-2	0.02	66.1	38	38
VV-3	0.02	66.1	38	38
VV-5	0.04	66.1	38	38
VV-6	0.01	66.1	38	38
VV-7	0.11	66.1	6	6
VV-8	0.02	66.1	38	38
VV-9	0.01	66.1	38	38
PR AREA1-1	0.09	66.1	3	EX ONLY
PR AREA1-2	0.08	66.1	0	8
LVP-1	0.02	66.1	30	30
LVP-2	0.02	66.1	50	50
PRP PH-1A	0.03	66.1	PRP ONLY	38
PRP PH 1B	0.04	66.1	PRP ONLY	38
PRP PH-2	0.02	66.1	PRP ONLY	65

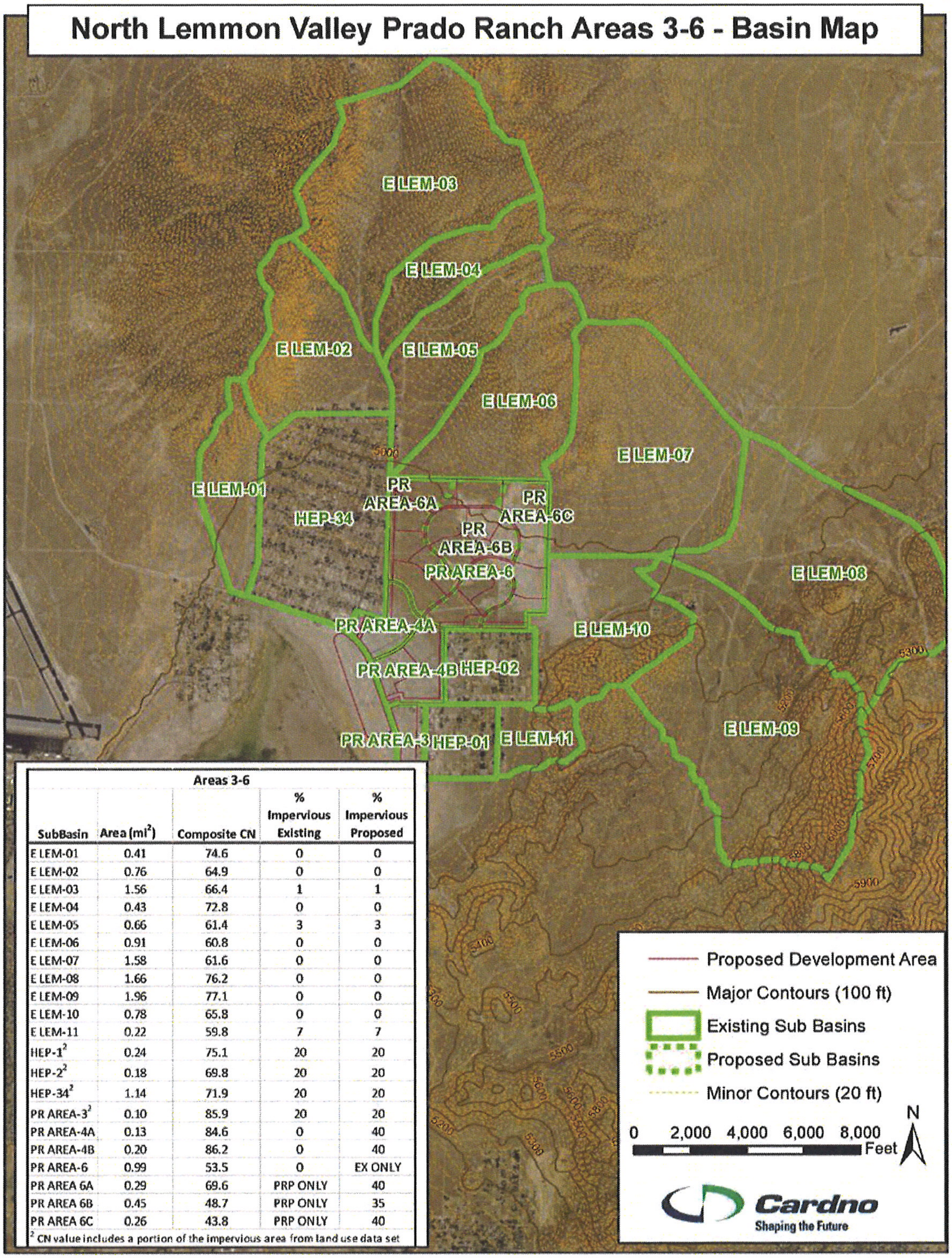
[1] CN obtained from calibrated Schaaf and Wheeler 2006 HEC-1 Model

Figure 4. Drainage basins and associated Curve Numbers for Area 1



Sub Basin Name	Basin Area (mi^2)	Composite CN	
		Existing	Proposed
1	0.72	77.3	77.3
2	1.50	72.7	72.7
3	0.49	75.3	75.3
4A	0.16	68.4	71.3
4B	0.04	68.4	72.0
5A	0.26	72.8	72.8
5B	0.07	72.8	72.9
6	0.25	72.8	73.0
7	0.04	75.1	89.1
8	0.10	60.3	90.4
9	0.06	60.7	97.3
10	0.06	62.8	94.0
11	0.03	79.3	89.0
12	0.04	77.7	94.9

Figure 5. Off-site basins with existing and proposed composite curve numbers for each subbasin.



Areas 3-6				
SubBasin	Area (mi²)	Composite CN	% Impervious Existing	% Impervious Proposed
E LEM-01	0.41	74.6	0	0
E LEM-02	0.76	64.9	0	0
E LEM-03	1.56	66.4	1	1
E LEM-04	0.43	72.8	0	0
E LEM-05	0.66	61.4	3	3
E LEM-06	0.91	60.8	0	0
E LEM-07	1.58	61.6	0	0
E LEM-08	1.66	76.2	0	0
E LEM-09	1.96	77.1	0	0
E LEM-10	0.78	65.8	0	0
E LEM-11	0.22	59.8	7	7
HEP-1[2]	0.24	75.1	20	20
HEP-2[2]	0.18	69.8	20	20
HEP-34[2]	1.14	71.9	20	20
PR AREA-3[2]	0.10	85.9	20	20
PR AREA-4A	0.13	84.6	0	40
PR AREA-4B	0.20	86.2	0	40
PR AREA-6	0.99	53.5	0	EX ONLY
PR AREA 6A	0.29	69.6	PRP ONLY	40
PR AREA 6B	0.45	48.7	PRP ONLY	35
PR AREA 6C	0.26	43.8	PRP ONLY	40

[2] CN value includes a portion of the impervious area from land use data set

Figure 6. Drainage basins and associated curve numbers for Areas 3 through 6.

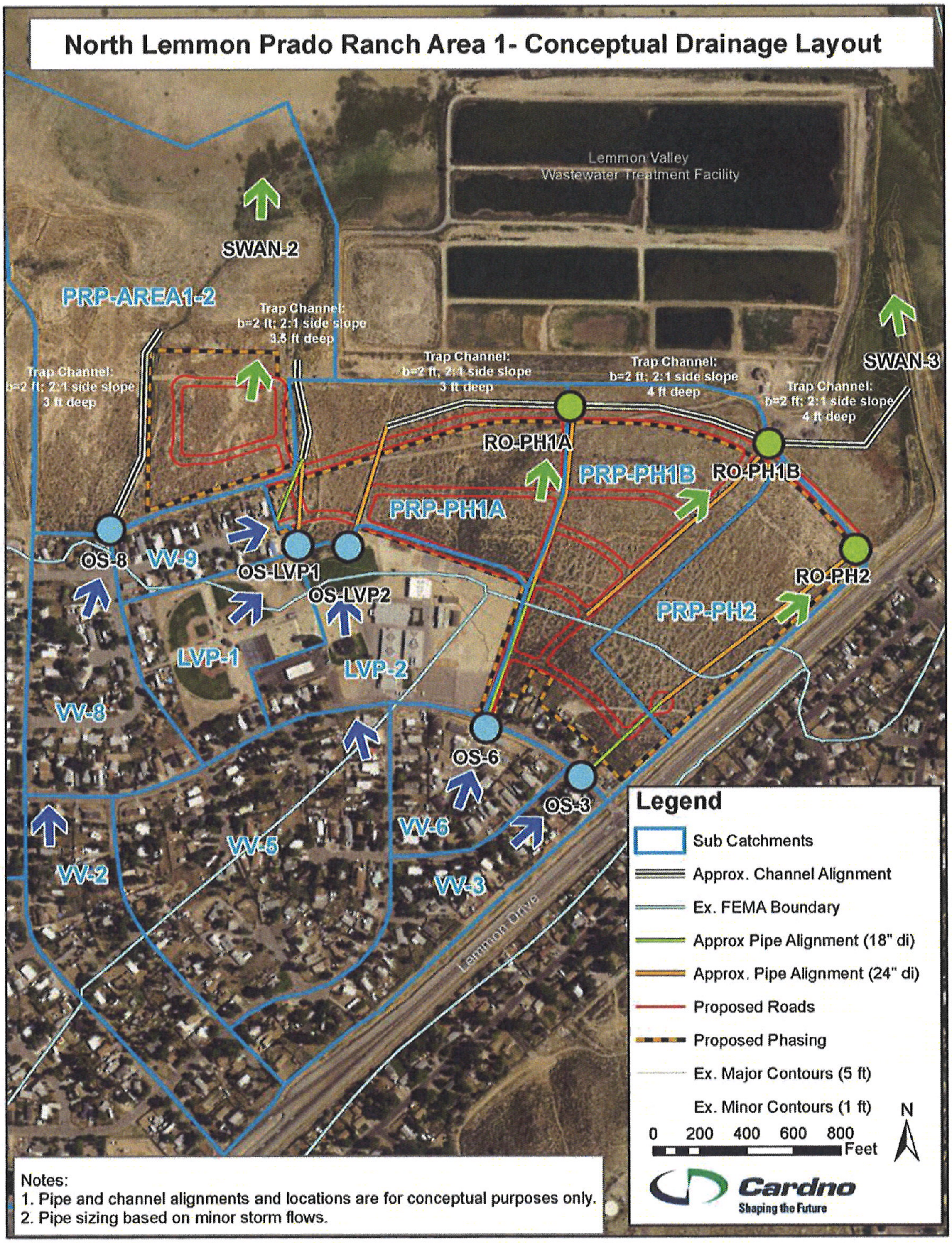


Figure 7. Conceptual drainage plan for the proposed Area 1 development.

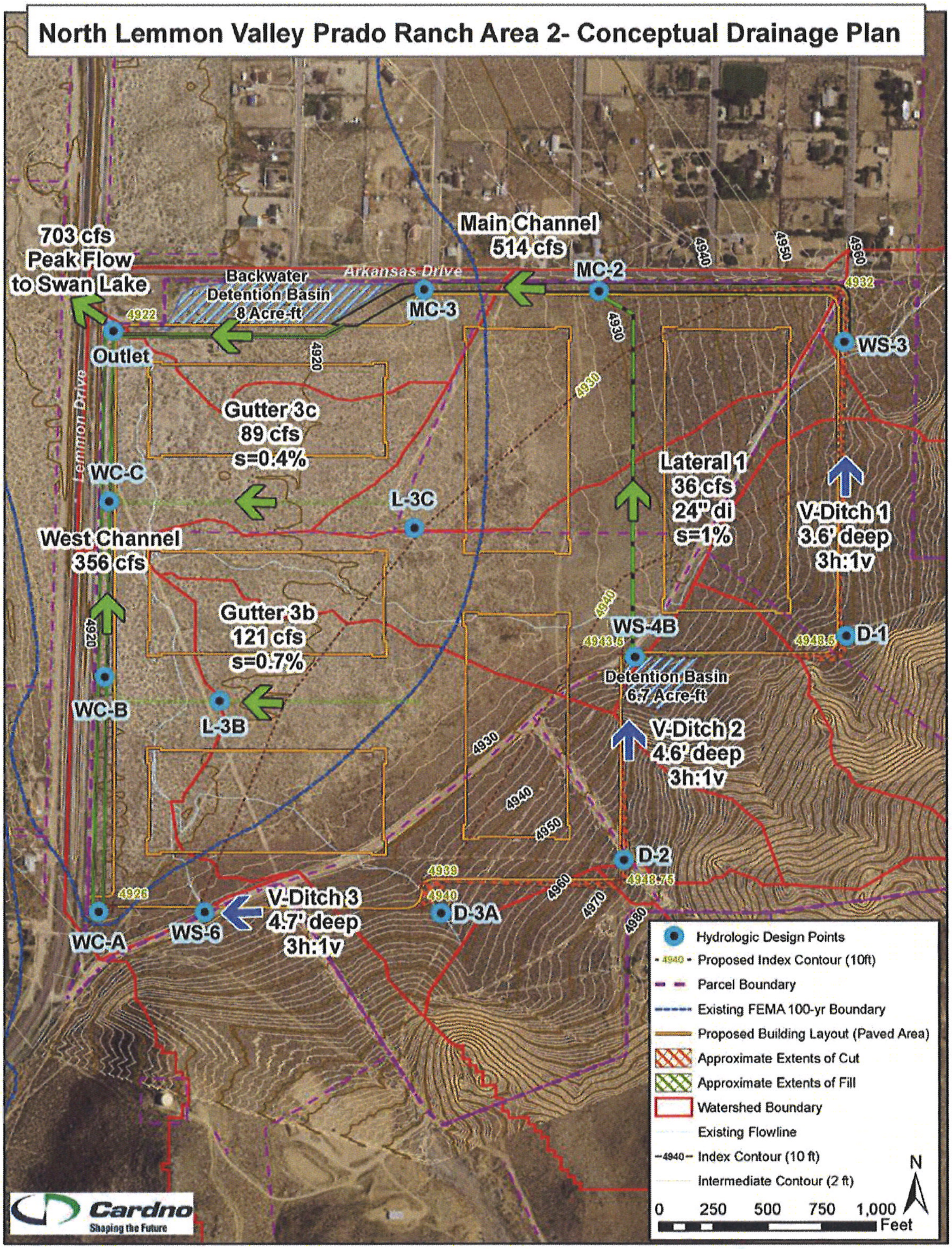


Figure 8. Conceptual drainage plan for the proposed Area 2 development.

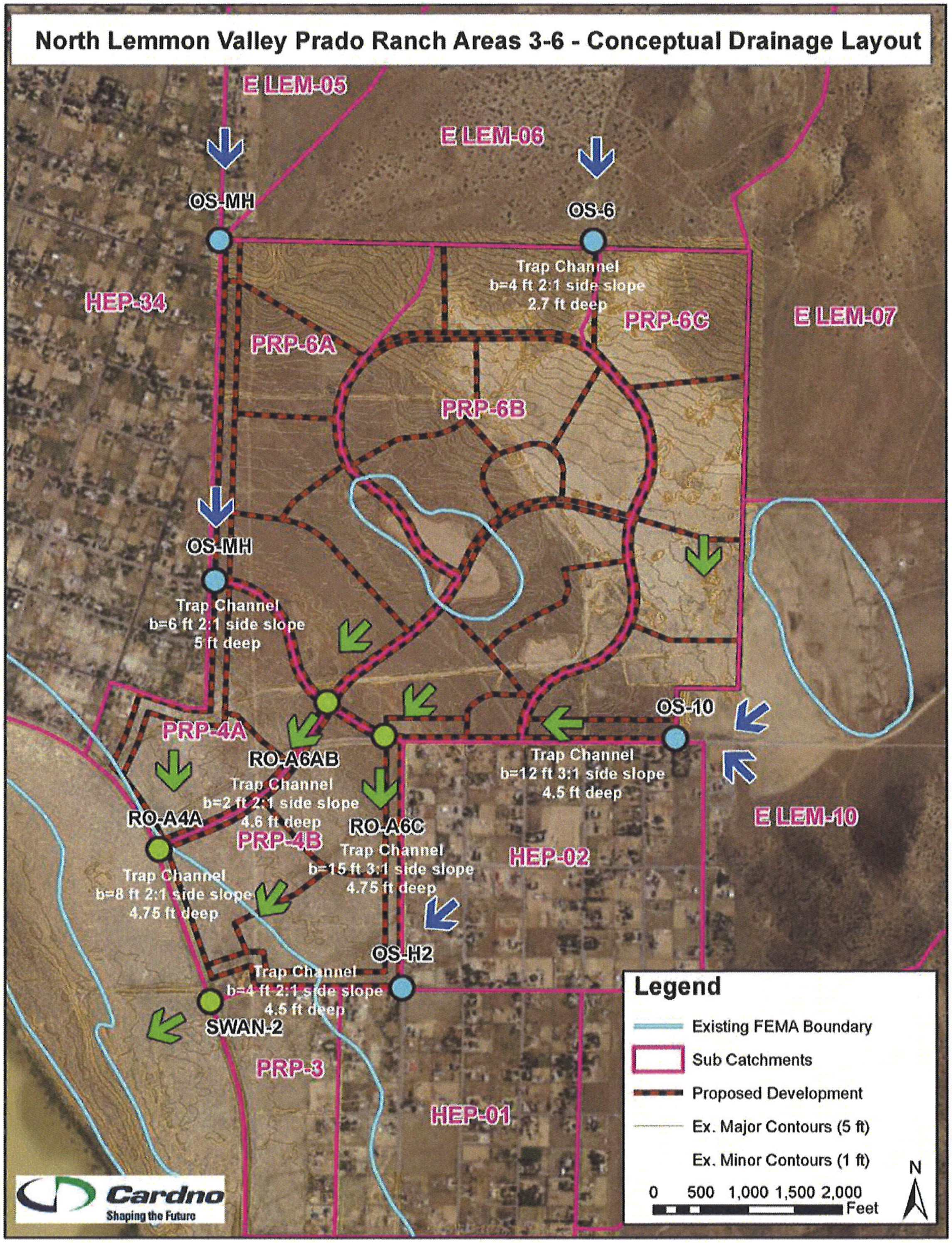
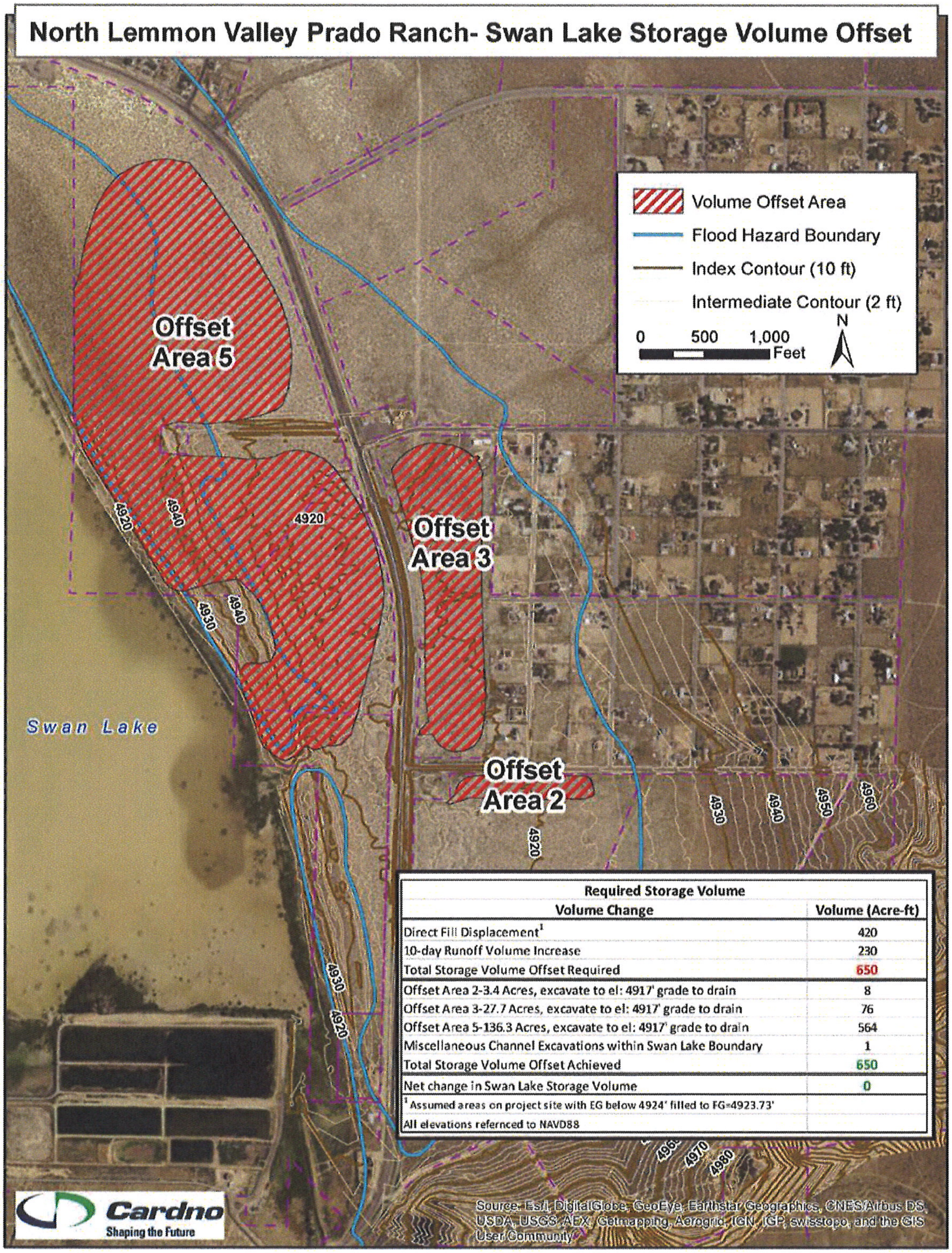


Figure 9. Conceptual Drainage Layout for Areas 3-6



Required Storage Volume	
Volume Change	Volume (Acre-ft)
Direct Fill Displacement[1]	420
10-day Runoff Volume Increase	230
Total Storage Volume Offset Required	650
Offset Area 2-3.4 Acres, excavate to el: 4917' grade to drain	8
Offset Area 3-27.7 Acres, excavate to el: 4917' grade to drain	76
Offset Area 5-136.3 Acres, excavate to el: 4917' grade to drain	564
Miscellaneous Channel Excavations within Swan Lake Boundary	1
Total Storage Volume Offset Achieved	650
Net change in Swan Lake Storage Volume	0
[1] Assumed areas on project site with EG below 4924' filled to FG=4923.73'	
All elevations refernced to NAVD88	

Figure 10. Conceptual layout for storage volume mitigation areas.

6 References

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APPENDIX A

ESA COMPLIANCE TECHNICAL MEMORANDUM

Cardno
Shaping the Future

May 17, 2016

FEMA CLOMR-F ESA Compliance

Technical Memorandum

Date	May 17, 2016
To:	FEMA
From:	Mark Gookin, PE, CFM; Sarah Brown, Environmental Scientist
RE:	**North Lemmon Valley Industrial Park CLOMR-F Application Endangered Species Act Compliance**

FEMA requires consultation on effects to listed species and critical habitat pursuant to the regulations implementing section 7 (50 CFR 402) of the Endangered Species Act (Act) should any occur within a project area. Pursuant to this requirement, Cardno consulted with existing databases and U.S. Fish and Wildlife Service (USFWS) to determine whether any federally listed species are likely to occur in the project area.

Action Being Considered

The action being considered consists of construction of a (+/-) 1,538 Acre residential and industrial park development in North Lemmon Valley, NV. Construction of the development will require placement of a significant amount of fill (+/- 678,000 cubic yards) at the project site and construction of various drainage conveyance facilities to route stormwater through and around the development. These drainage facilities will consist of open channels, reinforced concrete pipe (RCP) culverts, and concrete box culverts. In order to comply with Truckee Meadows Regional Drainage Manual (TMRDM) criteria, the proposed project will also require excavation of approximately 1.05 Million cubic yards of material from the Swan Lake playa to increase storage volume as mitigation for fill placement and increases in runoff volume

Area Being Affected

The area being affected consists of private property in Lemmon Valley, Washoe County, NV, which is shown in Map A. The area consists of a desert landscape with various roads (paved and dirt), open space, and some residential developments.

Threatened or Endangered Species

The IPaC web database (https://ecos.fws.gov/ipac/) administered by USFWS was queried to determine which federally listed species could occur in the vicinity of the proposed project area. Results indicated two species could occur in the area: the Lahontan cutthroat trout (*Oncorhnychus clarkia henshawi*) and Webber's Ivesia (*Ivesia webberi*).

Potential for Impacts to Threatened or Endangered Species

Lahontan cutthroat trout were determined to be absent from the proposed project area due to the lack of perennial water and the lack of any populations within the drainage. Webber's Ivesia is a small flowering plant in the rose family endemic to habitat along the eastern foothills of the northern Sierra Nevada. Critical habitat for Webber's Ivesia exists in Lemmon Valley and surrounding areas in proximity to the proposed project area. The project area was determined to be within the elevational and geographic range of the plant. However, appropriate soil types appeared absent based on aerial imagery. Mapping of critical habitat for *Ivesia webberi* in Washoe County is presented in Map's B-E.

Relevant Information on Potential Impacts and Contact with USFWS

No published reports pertaining to threatened or endangered species within the project area currently exist. Cardno contacted Sarah Kulpa, a botanist in the Reno USFWS office who is knowledgeable about Webber's Ivesia, to get an expert opinion about the likelihood of the species occurring in the project area. She concurred that presence in the proposed project area is unlikely given the lack of appropriate soil types. Her email response is attached below.

From: Kulpa, Sarah <sarah_kulpa@fws.gov>
Sent: Monday, October 05, 2015 2:48 PM
To: Chris Hogle
Subject: Re: Lemmon Valley flood channel project and I. webberi

Hi Chris,

As we discussed on the phone, I do not see any impact to Ivesia webberi mapped occupied and critical habitat. That being said, I searched my records and no surveys have been conducted in the area where your project is located. Surveys were conducted about 0.5 miles south of the project area, just north of Hwy 395 (in the Sky Vista Pkwy/Lemmon Dr Frontage Rd area) and the plant was not found. Your project area has the appropriate elevation and slope for IVWE to occur, but none of the soil types the species is known to occur on are in your project area.

As I mentioned on the phone, the project occurs on private land. For plants, the ESA applies only on Federal lands or if there was a Federal nexus on private lands. It also states that an action (for plants) may not be in violation of State laws. Per your description of the project, the project is on private lands, but does have a Federal nexus because FEMA is involved (so you would work directly with FWS not the State). I am going to forward you another email from our Regional office that explains how FEMA should be dealing with ESA issues. The email addresses CLOMR, but this is just an example of a FEMA issue. It is up to FEMA to make the decision if the project has an effect on a listed species or not. If they make a no effect call, then no further communication with FWS is necessary.

I hope this helps. Call me with any questions.

Sarah

Habitat Analysis

Webber's Ivesia *(Ivesia webberi)* occurs between 4,475 to 6,237 feet in elevation on flats, benches, or terraces above and adjacent to large valleys. All 17 known populations of Webber's ivesia are within the transition zone between the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin (USFWS 2016). Habitat maps of known species locations are compiled and attached as Figures. Sites also do not receive an accumulation of loose sediment or colluvium from upslope (USFWS, 2014). The shallow, clay soils in which the species inhabits are very rocky on the surface; tend to be wet in the spring, but dry out later in the season, causing swell due to the high clay content (USFWs, 2014).

The dry and rocky habitat is typically dominated by Webber's ivesia, along with low sagebrush *(Artemisia arbuscular)*. On many of the known sites, the vegetation could be described as a low sagebrush – Webber's ivesia association, or as a Webber's ivesia-perennial rock garden plant community. On the known sites, perennial grasses such as squirreltail *(Elymus elymoides)* and Sandburg bluegrass (*Poa secunda)* play an important role. Other associated plant species include: low pussytoes *(Antennaria dimorpha)*, Hooker's balsamroot *(Balsamorhiza hookeri)*, scabland fleabane *(Erigeron bloomer)*, bitterroot *(Lewisia rediviva* Pursh), and Beckwith's violet *(Viola beckwithii)* (USFWS, 2014).

Existing Conditions - Soils

The following soils information was obtained from the Natural Resource Conservation Service's (NRCS) Web Soil Survey mapping system. These soils have been analyzed for potential to support *Ivesia webberi*. Full descriptions and a map of the soil units is attached in the *Custom Soil Resource Report for Washoe County Nevada, South Park, Lemmon Valley*, Appendix A-B.

Soil Unit 120 – Doten silty clay, 0 to 2 percent slopes

This soil unit makes up 6.5 acres within the project boundary (0.3% of the total acreage). The soil type is found between 4,500 and 5,500 feet in elevation on lake terraces. The soil is moderately well drained and has a typical profile of 0 to 21 inches: silty clay, and 21 to 62 inches: clay. Depth to restrictive feature is more than 80 inches.

Soil Unit 121 – Doten silty clay, 8 to 15 percent slopes

This soil unit makes up 95.7 acres within the project boundary (4.8% of the total acreage). The soil type is found between 4,500 and 5,500 feet in elevation on lake terraces, is moderately well drained, and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 21 inches: silty clay, and 21-62 inches: clay.

Soil Unit 130 - Greenbrae sandy loam, clayey substratum, 0 to 2 percent slopes

This soil unit makes up 172.2 acres within the project boundary (8.6% of the total acreage). The soil type is found between 4,500 and 5,500 feet in elevation on fan remnants. The soil is well drained with a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 5 inches: sandy loam, 5 to 22 inches: sandy clay loam, 22 to 51 inches: sandy loam, and 51-68 inches: silty clay loam.

Soil Unit 131 – Greenbrae sandy loam, 0 to 2 percent slopes

This soil unit makes up 40.3 acres within the project boundary (2.0% of the total acreage). The soil type is found between 4,500 and 5,500 feet in elevation on fan remnants. The soil is well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 10 inches: sandy loam, 10 to 28 inches: sandy clay loam, and 28 to 63 inches: stratified coarse and to gravelly loam.

Soil Unit 132 - Greenbrae sandy loam, 0 to 2 percent slopes

This soil unit makes up 2.3 acres within the project boundary (0.1% of the total acreage). This soil type is found between 4,500 and 5,500 feet in elevation on fan remnants and piedmonts. The soil is well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 8 inches: sandy loam, 8 to 28 inches: sandy clay loam, and 28 to 63 inches: stratified coarse sand to gravelly loam.

Soil Unit 140 – Haybourne loamy sand, 2 to 4 percent slopes

This soil unit makes up 245.2 acres within the project boundary (12.3% of the total acreage). This soil type is found between 4,500 and 5,900 feet in elevation on alluvial fans, dunes, and fan remnants. The soil is well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 10 inches: loamy sand, 10 to 26 inches: sandy loam, and 26 to 63 inches: stratified gravelly coarse sand to fine sandy loam.

Soil Unit 141 – Haybourne loamy sand, 4 to 8 percent slopes

This soil unit makes up 159.7 acres within the project boundary (8.0% of the total acreage). This soil type is found between 4,500 and 5,900 feet in elevation on alluvial fans, dunes, and fan remnants. The soil is well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 10 inches: loamy sand, 10 to 26 inches: sandy loam, and 26 to 60 inches: stratified gravelly coarse sand to fine sandy loam.

Soil Unit 150 – Doten variant silty clay, slightly saline

This soil unit makes up 159.7 393.6 acres within the project boundary (19.7% of the total acreage). This soil type is found between 4,500 and 5,500 feet in elevation on lake terraces. The soil is moderately well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 5 inches silty clay, and 5 to 72 inches clay.

Soil Unit 151 – Doten variant silty clay, strongly saline

This soil unit makes up 182.9 acres within the project boundary (9.2% of the total acreage). This soil type is found between 4,500 and 5,500 feet in elevation in lake terraces. Soil characteristics are identical to that of the soil unit 150, but with a high saline content.

Soil Unit 160 – Incy sand, 4 to 8 percent slopes

This soil unit makes up 273 acres within the project boundary (13.7% of the total acreage). This soil type is found between 4,500 and 5,500 feet in elevation primarily in dunes, but also fan remnants and alluvial fans. The soil profile is comprised entirely with sand, to a depth of restrictive feature of more than 80 inches.

Soil Unit 240 – Updike loam

This soil unit makes up 220.4 acres within the project boundary (11.1% of the total acreage). This soil type is found between 4,500 and 5,500 feet in elevation in lake terraces and floodplains. The soil is moderately well drained and has a depth to restrictive feature of more than 80 inches. The typical soil profile is 0 to 2 inches: loam, 2 to 20 inches: clay, and 20 to 63 inches: stratified sandy clay loam to clay.

Soil Unit 260 – Acrelane rock-outcrop complex, 15 to 50 percent slopes

This soil unit makes up 46.9 acres within the project boundary (2.4% of the total acreage). This soil type is found between 4,500 and 6,000 feet in elevation on hills and peaks. The soil is well drained and has a restrictive feature at 7 to 20 inches of Paleolithic bedrock. The typical soil profile is 0 to 6 inches: very stony sandy loam, 6 to 10 inches: very gravelly sandy clay loam, and 10 to 60 inches: bedrock.

Soil Unit 360 – Pits

Pits are found in alluvial fans and have varied profiles.

Soil Unit 992 – Playas

This map unit makes up 42.9 acres in the project area (2.2% of total project area). The soil is found in a playa landform, and it poorly drained. Typical profile for plays is 0-6 inches silty clay loam; and 6-60 inches silty clay.

Soil Unit 1040 – Orr Variant Gravelly Sandy Loam

This map unit makes up 111.0 acres in the project area (5.6% of total project area). The soil is found between 4,500 and 5,500 feet in elevation on fan piedmonts, fan remnants, and alluvial fans. The typical profile for this soil unit is 0-18 inches: gravelly sandy loam; 18-39 inches: sandy clay loam; and 39-65 inches: silt loam. This soil is well drained with slopes of 0 to 2 percent, and has a depth to restrictive feature of more than 80 inches.

Existing Conditions – Landcover

Vegetative landcover was obtained from the Nevada Natural Heritage Programs SynthMap database (NNHP, 2008). The following vegetation landcover types are present within the project boundary: Artemisia (arbuscula, tridentata ssp. vaseyana); Artemisia arbuscular; Artemisia nova Shrubland; Artemisia tridentata ssp. (tridentata, wyomingensis); Artemisia tridentata ssp.; Vaseyana Shrubland Alliance; Developed-High Intensity; Developed-Low Intensity; Developed-Open Space; Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland; Great Basin Pinyon-Juniper Woodland; Great Basin Xeric Mixed Sagebrush Shrubland; Inter-Mountain Basins Big Sagebrush Shrubland; Inter-Mountain Basins Greasewood Flat; Inter-Mountain Basins Mixed Salt Desert Scrub; Inter-Mountain Basins Montane Riparian Systems; Inter-Mountain Basins Montane Sagebrush Steppe; Inter Mountains Basins Semi-Desert Grassland; Inter-Mountain Basins Semi-Desert Shrub Steppe; Inter-Mountain Basins Sparsely Vegetated Systems; Introduced Upland Vegetation- Annual and Biennial Forbland; Introduced Upland Vegetation- Annual Grassland; Microphytic Playa Sparse Vegetation; and North American Arid West Emergent Marsh.

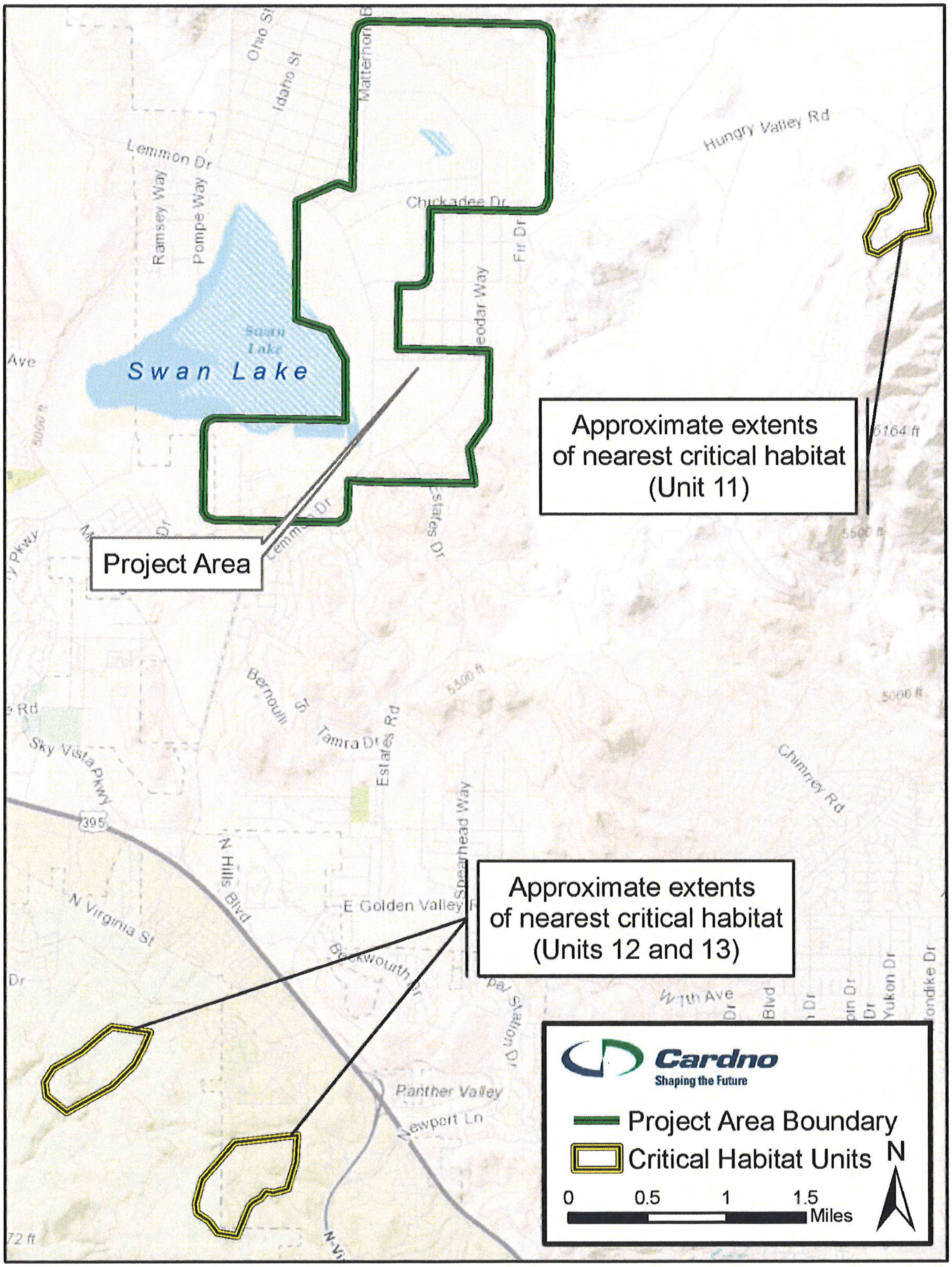
A map of the landcover types within the project boundary is included as Appendix A-C.

Conclusion

Although federally listed species do occur near the project site, no federally listed species are likely to occur in the project area, and are therefore not expected to be impacted by the proposed project. Review of soils and their associated vegetative landcover types within the project boundary indicate that potential habitat to support the species *Ivesia webberi* is not present within proposed project boundaries.

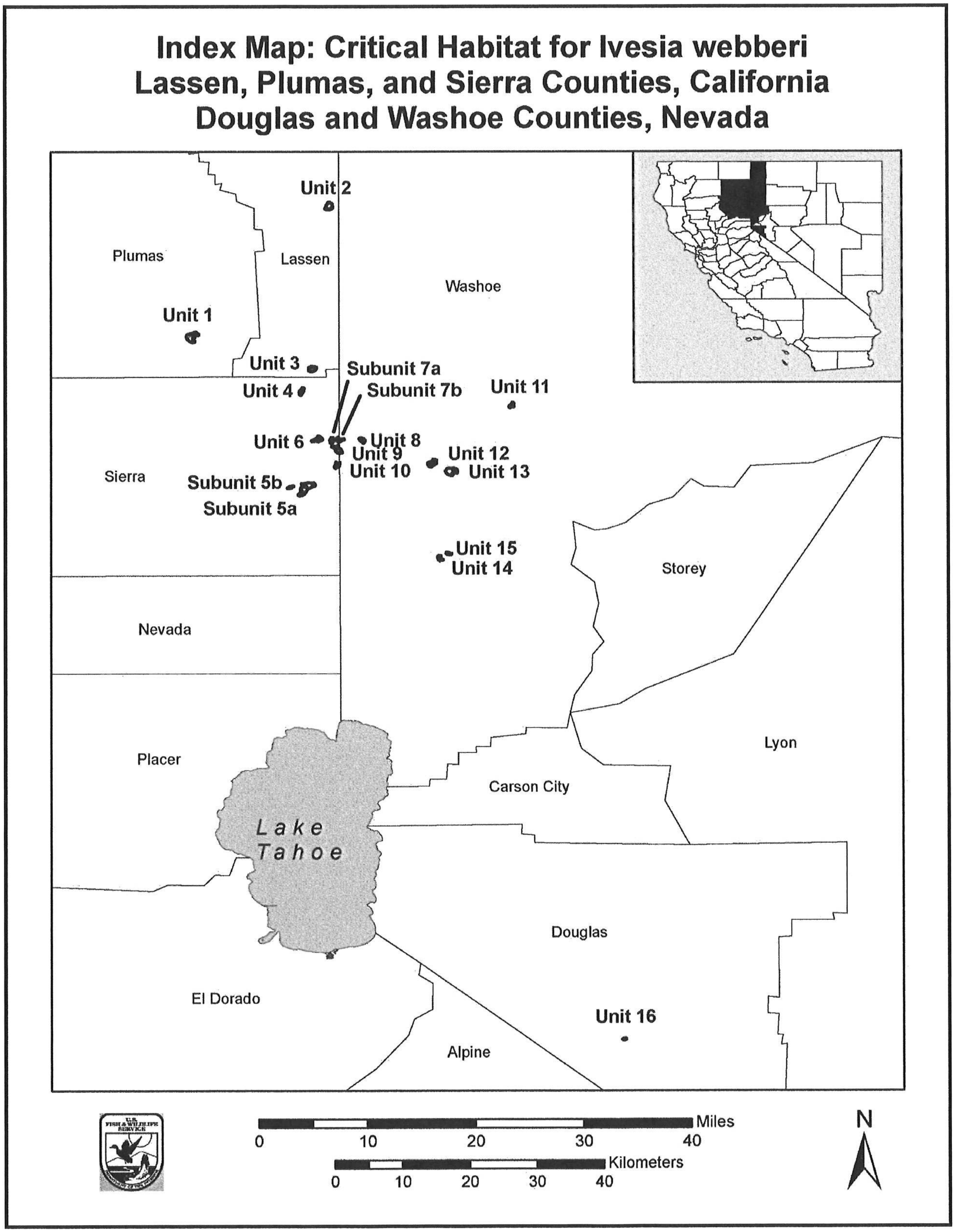
As no federally listed species are likely to occur in the project area, it is anticipated that there is no potential for a "Take" (meaning to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct), to occur to threatened and endangered species present in the county as a result of the project.

Map A



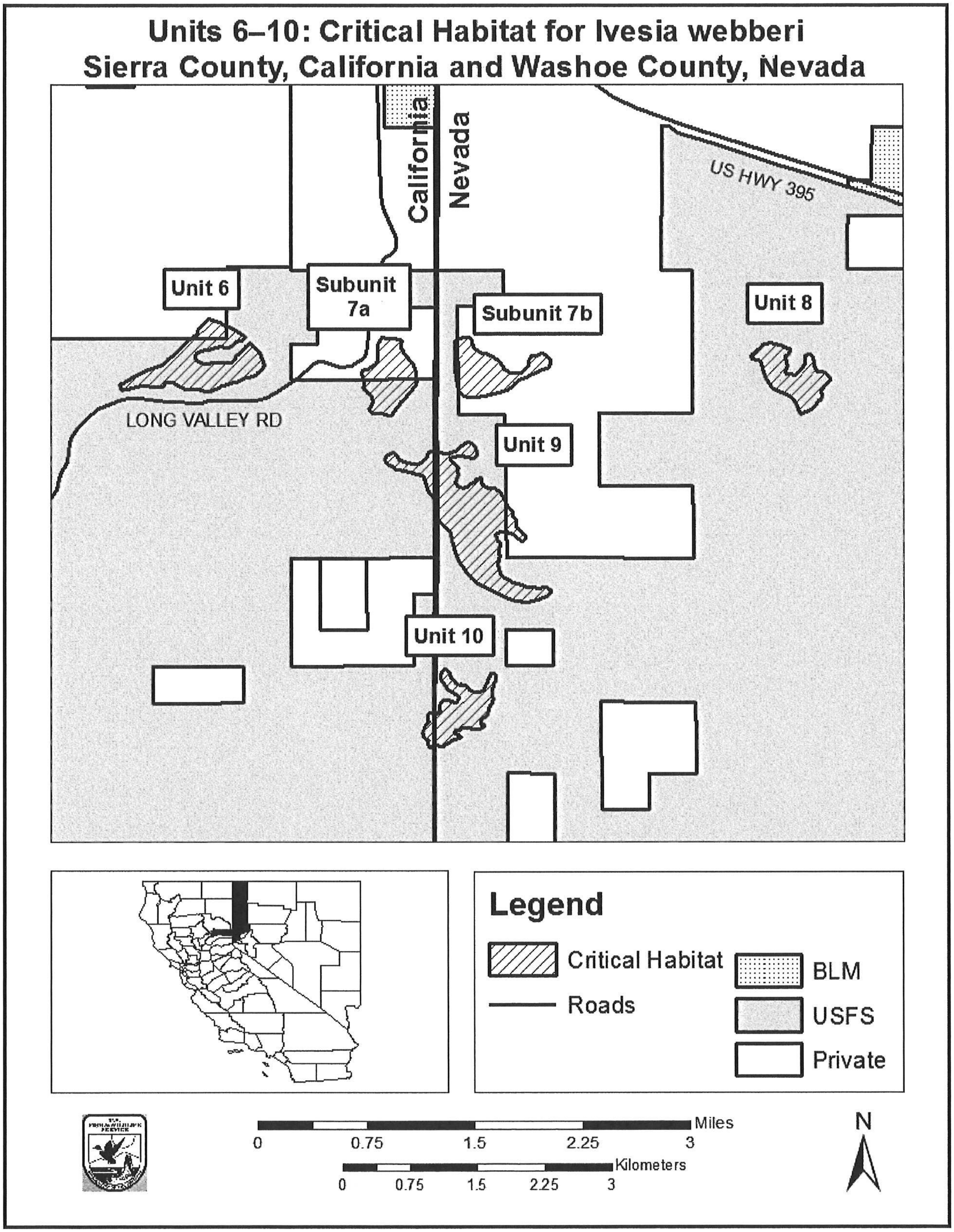
Approximate extents of nearest critical habitat (Unit 11)
Project Area
Approximate extents of nearest critical habitat (Units 12 and 13)
Swan Lake
Lemmon Dr
Ramsey Way
Pompe Way
Ohio St
Idaho St
Matterhorn Blvd
Chickadee Dr
Fir Dr
Cedar Way
Estates Dr
Hungry Valley Rd
Bernoulli St
Tamra Dr
Estates Rd
Sky Vista Pkwy
Chimney Rd
395
N Hills Blvd
Spearhead Way
E Golden Valley Rd
N Virginia St
Beckwourth Dr
Panther Valley
Newport Ln
W 7th Ave
Yukon Dr
5164 ft
5500 ft
5000 ft
Cardno
Shaping the Future
Project Area Boundary
Critical Habitat Units
0
0.5
1
1.5
Miles
N

Map B



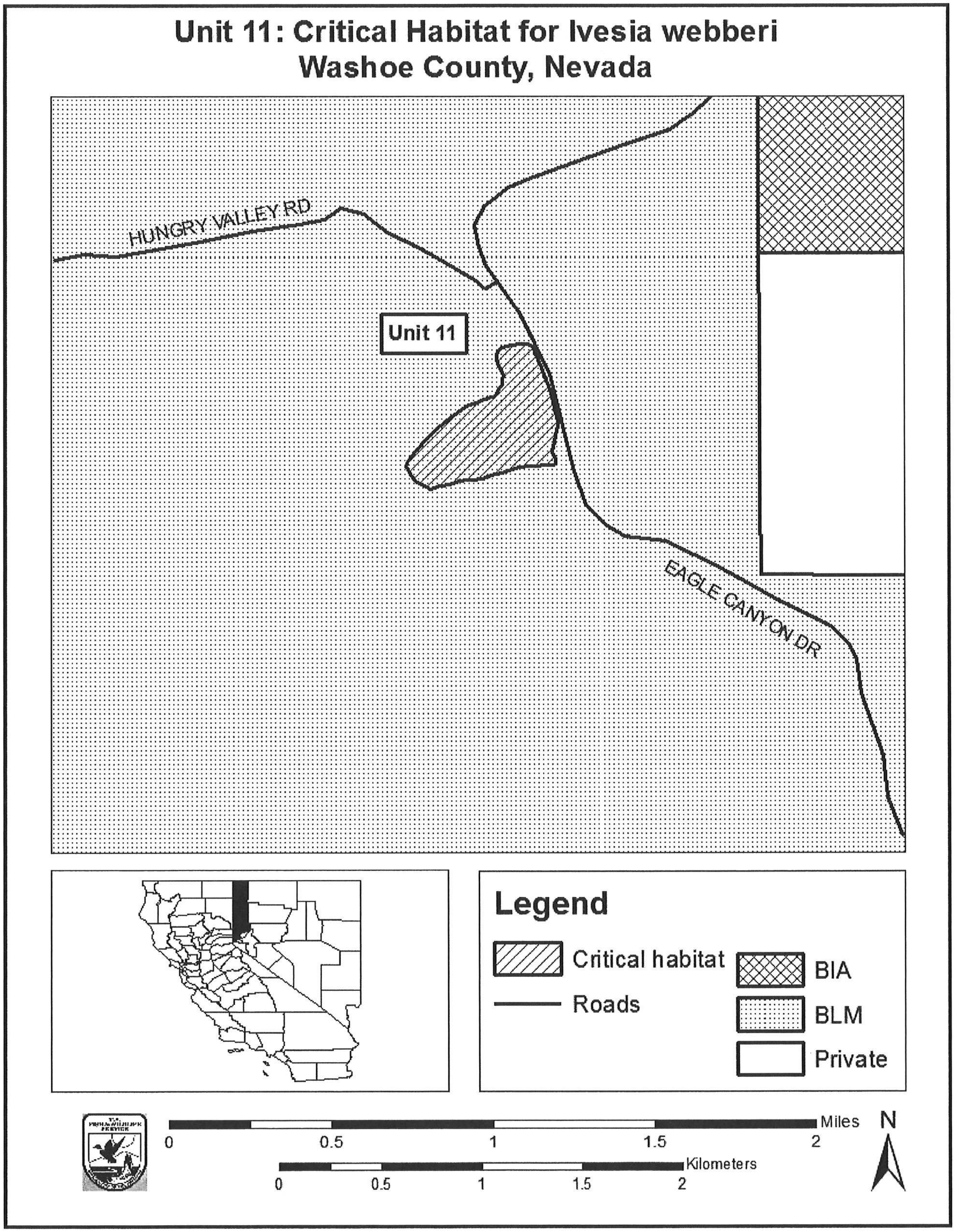
Index Map: Critical Habitat for Ivesia webberi
Lassen, Plumas, and Sierra Counties, California
Douglas and Washoe Counties, Nevada
Unit 2
Plumas
Lassen
Washoe
Unit 1
Unit 3
Subunit 7a
Unit 4
Subunit 7b
Unit 11
Unit 6
Unit 8
Unit 9
Unit 10
Unit 12
Unit 13
Sierra
Subunit 5b
Subunit 5a
Unit 15
Unit 14
Storey
Nevada
Placer
Lyon
Carson City
Lake Tahoe
Douglas
El Dorado
Unit 16
Alpine
Miles
0
10
20
30
40
Kilometers
0
10
20
30
40
N

Map C

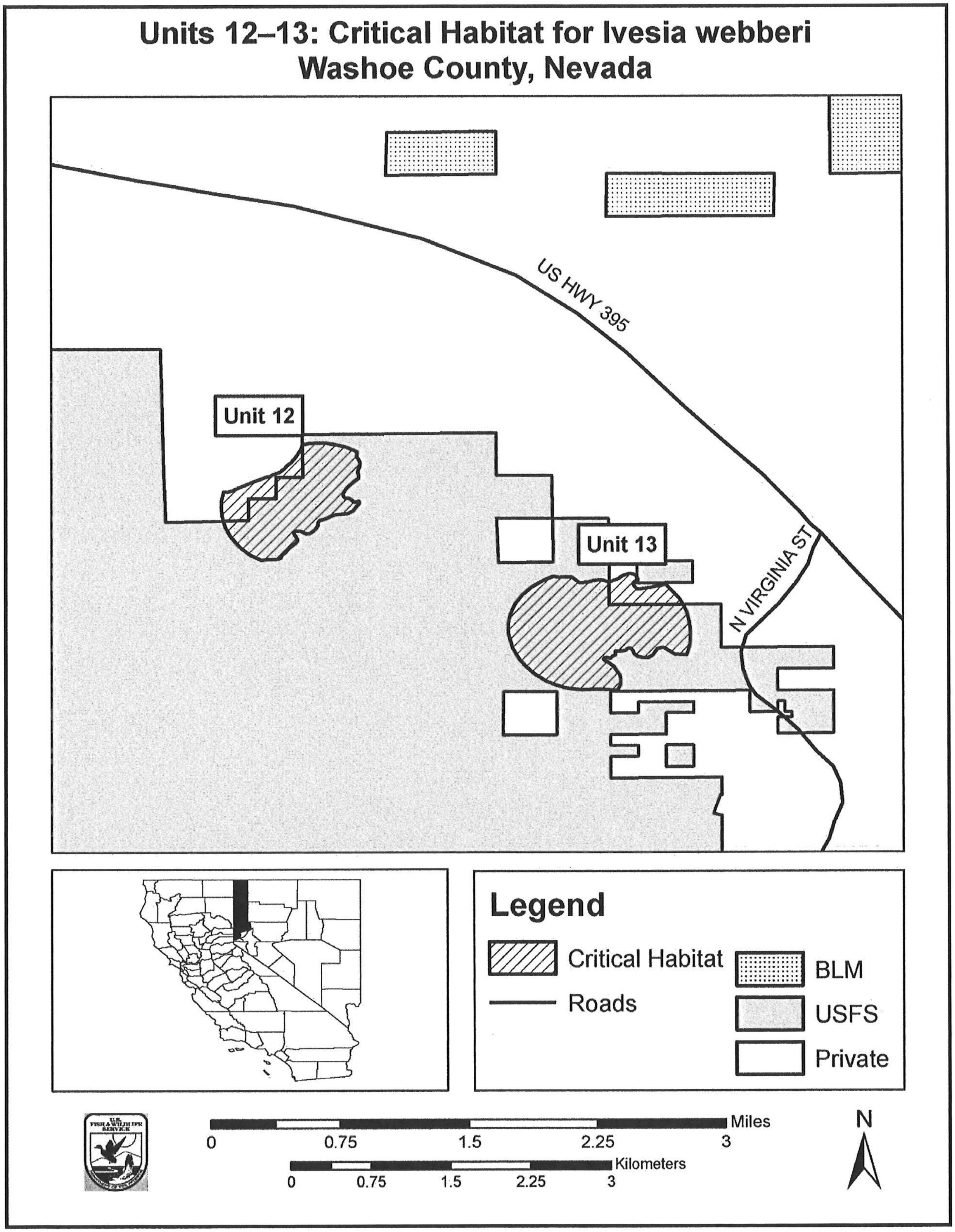


Units 6–10: Critical Habitat for Ivesia webberi
Sierra County, California and Washoe County, Nevada
California
Nevada
US HWY 395
Unit 6
Subunit 7a
Subunit 7b
Unit 8
LONG VALLEY RD
Unit 9
Unit 10
Legend
Critical Habitat
Roads
BLM
USFS
Private
Miles
0
0.75
1.5
2.25
3
Kilometers
0
0.75
1.5
2.25
3
N

Map D


Unit 11: Critical Habitat for Ivesia webberi
Washoe County, Nevada
HUNGRY VALLEY RD
Unit 11
EAGLE CANYON DR
Legend
Critical habitat
Roads
BIA
BLM
Private
0
0.5
1
1.5
2
Miles
Kilometers
N

Map E


Units 12–13: Critical Habitat for Ivesia webberi
Washoe County, Nevada
US HWY 395
Unit 12
Unit 13
N VIRGINIA ST
Legend
Critical Habitat
Roads
BLM
USFS
Private
Miles
0
0.75
1.5
2.25
3
Kilometers
0
0.75
1.5
2.25
3
N

Appendix A-A

USFWS Correspondence

From: Kulpa, Sarah <sarah_kulpa@fws.gov>
Sent: Monday, October 05, 2015 2:48 PM
To: Chris Hogle
Subject: Re: Lemmon Valley flood channel project and I. webberi

Hi Chris,

As we discussed on the phone, I do not see any impact to Ivesia webberi mapped occupied and critical habitat. That being said, I searched my records and no surveys have been conducted in the area where your project is located. Surveys were conducted about 0.5 miles south of the project area, just north of Hwy 395 (in the Sky Vista Pkwy/Lemmon Dr Frontage Rd area) and the plant was not found. Your project area has the appropriate elevation and slope for IVWE to occur, but none of the soil types the species is known to occur on are in your project area.

As I mentioned on the phone, the project occurs on private land. For plants, the ESA applies only on Federal lands or if there was a Federal nexus on private lands. It also states that an action (for plants) may not be in violation of State laws. Per your description of the project, the project is on private lands, but does have a Federal nexus because FEMA is involved (so you would work directly with FWS not the State). I am going to forward you another email from our Regional office that explains how FEMA should be dealing with ESA issues. The email addresses CLOMR, but this is just an example of a FEMA issue. It is up to FEMA to make the decision if the project has an effect on a listed species or not. If they make a no effect call, then no further communication with FWS is necessary.

I hope this helps. Call me with any questions.

Sarah

Appendix A-B

Custom Soil Resource Report for Washoe County, Nevada South Part Lemmon Valley

U.S. FISH AND WILDLIFE SERVICE

Species Report for *Ivesia webberi* (Webber's ivesia)

Nevada Fish and Wildlife Office
1/8/2014

EXECUTIVE SUMMARY

Ivesia webberi is a low, spreading, perennial forb with grayish-green foliage, dark red, wiry stems, and yellow flowers arranged in capitate cymes. This species is associated with an open, sparsely vegetated plant community on vernally moist, clay soils that shrink and swell upon drying and wetting. The specialized, clay soils are well developed, a process estimated to take a few thousand years, and likely cannot be recreated or restored once they are lost. Limited seed dispersal and an apparent lack of recruitment further restrict the occupied range and distribution of *I. webberi*.

Ivesia webberi has a geographic range of approximately 165 acres (ac) (66.8 hectares (ha)) comprising five counties in California and Nevada along the transition zone between the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin. The species is known historically from a total of 17 populations, but one has been extirpated and a portion of another (one of four subpopulations) is possibly extirpated. Of the remaining 16 populations, the status of 2 is unknown, meaning we assume the species is still present at these locations but the available information is dated or otherwise insufficient to evaluate factors affecting the species. For the remaining 14 populations where the species' status is better understood, 10 occupy less than 5 ac (2.02 ha). Reliable estimation of population sizes or trends in *I. webberi* is complicated because estimates have usually been obtained by different observers employing a variety of means and levels of survey effort. The only available estimates of abundance suggest a combined total between 990,814 and 5,029,394 individuals across the 16 extant populations. However, we have very little confidence in these estimates.

Due to the restricted range, specialized habitat requirements, and limited recruitment and dispersal of *Ivesia webberi*, populations of this species are vulnerable to ongoing and future threats that affect both individual plants and their habitat. All populations are potentially affected by a feedback loop between wildfire and nonnative, invasive plant species: 10 populations have experienced fire, and 12 populations have been invaded by nonnative, invasive plants. Eleven populations are intersected by off-highway vehicle (OHV) routes or other road corridors. Four populations on private land and two populations on public land either have already been impacted by or may be impacted by development in the near future. Two populations are currently grazed by cattle, and another seven occur within vacant grazing allotments that could be re-opened (to grazing) to alleviate pressures on other, nearby grazing allotments.

The individual and synergistic effects from nonnative, invasive species, wildfires, OHVs and roads, development, and livestock grazing have resulted in the loss and degradation of occupied habitat and continue to reduce the availability of habitat suitable for dispersal and population expansion. Given current climate change projections, we anticipate that future climatic conditions will favor further invasion by nonnative plant species and are likely to contribute to an increase in the frequency, spatial extent, and severity of wildfires. The alteration of precipitation and temperature patterns may decrease survivorship of *Ivesia webberi* by causing physiological stress, altering phenology, and reducing recruitment events and/or seedling establishment. These alterations in climatic conditions are likely to exacerbate the existing factors affecting *I. webberi* and its habitat in the future.

Seventy-two percent of habitat for *Ivesia webberi* is on Federal land (69 percent on USFS and 3 percent on BLM). The U.S Forest Service (USFS) drafted a rangewide Conservation Strategy (CS) for *I. webberi* that is intended to guide conservation actions for the species on Forest Service lands. This CS was signed in 2010, and 30 percent (13 of the 39) of the location-specific actions proposed for *I. webberi* on USFS-administered lands have been initiated. The CS will likely result in long-term benefits to *I. webberi*, although certain threats such as nonnative, invasive plant species and modified fire regime are likely to have landscape-scale impacts that will continue to present challenges to *I. webberi* conservation. There are no conservation strategies for populations on Bureau of Land Management (BLM), California Department of Fish and Wildlife (CDFW), and private lands.

BACKGROUND

Legal or Formal Status

Endangered Species Act

Ivesia webberi A. Gray (Webber's ivesia) was elevated to candidate status under the Endangered Species Act (ESA) on June 13, 2002, and has maintained this status since. Candidate species are plants and animals for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation has been precluded by other higher-priority listing activities.

State of Nevada

Ivesia webberi has been declared by the Nevada Division of Forestry (NDF) to be threatened with extinction pursuant to Nevada Revised Statutes (N.R.S.) 527.260–.300 and was added to the State list of fully protected species of native flora (Nevada Administrative Code 527.010) in 2004. Removing or destroying plants on the State's fully protected list is prohibited except under special permit issued by NDF (N.R.S. 527.270).

State of California

Ivesia webberi is not listed by California under the California Endangered Species Act (CESA), but is eligible for State listing. This species has a California Native Plant Society's (CNPS) 1B.1 rank (seriously threatened in California with over 80 percent of occurrences threatened and high degree and immediacy of threat; CNPS 2013, *http://www.rareplants.cnps.org/detail/936.html*, accessed January 29, 2013). All CNPS 1B ranked plants meet the definitions under the Native Plant Protection Act (Section 1901, Chapter 10) and CESA (Sections 2062 and 2067) of the California Department of Fish and Wildlife (CDFW) Code and therefore must be fully considered during the environmental documentation process under the California Environmental Quality Act (CEQA) (Public Resources Code Section 21000 et seq.).

Bureau of Land Management

Ivesia webberi is a Bureau of Land Management (BLM) sensitive species. Populations of *I. webberi* on BLM land are managed under BLM 6840 Manual, Release 6–125, revised as of December 12, 2008 (BLM 2008, pp. 1-48). BLM policy is to manage candidate species (as designated under the ESA) as sensitive species, defined as "species that require special management or considerations to avoid potential future listing" (BLM 2008, Glossary, p. 5). The stated objective for sensitive species is to initiate proactive conservation measures that reduce or eliminate threats to minimize the likelihood of and need for listing (BLM 2008, 6840.02). Conservation, as it applies to BLM sensitive species, is defined as "the use of programs, plans, and management practices to reduce or eliminate threats affecting the status of the species, or improve the condition of the species' habitat on BLM-administered lands" (BLM 2008, Glossary, p. 2).

U.S. Forest Service

Ivesia webberi is listed on the Regional Forester's Sensitive Plant List for the Intermountain and Pacific Region of the U.S. Forest Service (USFS; Bergstrom 2009, p. 3). Populations of *I. webberi* on USFS land are managed as sensitive species under Forest Service Manual 2600, Chapter 2670 (USFS 2005, pp. 1–22). Sensitive species are defined by the USFS as species that are currently or predicted to have a downward trend in population numbers, density, or habitat that would reduce a species' existing distribution (USFS 2005, p. 12). Forest activities are required to be conducted to avoid actions that may cause a sensitive species to become threatened or endangered (USFS 2005, pp. 3–4).

Species Description

Ivesia webberi is a member of the Rosaceae (rose family). It is a low, spreading, perennial forb up to 9.8 inches (in) (25 centimeters (cm)) across with greenish-gray foliage and dark red, wiry stems (Figure 1). The 1.2–2.8 in (3–7 cm) long leaves are mostly clustered around the base of the stems, with 4–8 pairs of leaflets crowded at the tip, and are generally covered with long, silky grayish hairs. The inflorescence is a capitate or subcapitate cyme (i.e., a flat-topped inflorescence in a head-like or head shaped cluster) with 5–15 flowers per group. Flowers are about 0.4 in (10 millimeters (mm)) across and bright yellow with 5 stamens and petals that are much smaller than the sepals. The whole plant becomes reddish-tinged late in the season. Flowering typically begins in May and extends through June (Witham 2000, p. 9; Ertter 2012; *http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=29467*, accessed November 5, 2012)

FIGURE 1.—*Ivesia webberi.* S. Kulpa, USFWS

Taxonomy

Lemmon discovered *Ivesia webberi* in Sierra Valley, Plumas County, California, in 1872, and Gray (1874, p. 71) described it as a new species. Greene (1887, p. 105) included it in *Potentilla*, whereas Rydberg (1898, p. 149) treated it as *Horkelia*. Keck (1938, p. 129) resolved the taxonomy and returned this species to the genus *Ivesia*, where it has remained. The generic distinctions between *Ivesia*, *Potentilla*, and *Horkelia* have been unclear, but more recent treatments have maintained the three genera as distinct (Ertter 1989, p. 231). The various taxonomic treatments of these genera would not, however, call into question the validity of *I. webberi* as a distinct species, regardless of its generic placement (Witham 2000, p. 6). The current validity of this taxon is reviewed on the Jepson Flora Project website (Ertter 2012; *http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=29467*, accessed on November 5, 2012), which parallels the printed The Jepson Manual, Second Edition. *Ivesia webberi* is still the accepted name for this taxon native to California and Nevada.

Phenology and Life History

New leaves and flowering stems of *Ivesia webberi* appear to emerge in response to higher soil temperatures in the spring, and populations have been observed in full flower during the last week in May (Witham 2000, p. 19). Flowers open throughout the month of June, but individuals likely begin flowering in early May and some may produce flowers as late as the middle of July (Witham 2000, p. 19). The fruits, which are small, dry, and indehiscent or an achene, are likely mature in about a month, between mid-June and the end of July (Witham 2000, p. 19). While there are 5 to 15 flowers grouped as a ball on each flowering stalk, the number of achenes produced by each flower varies from 3 to 8 (Bergstrom 2009, p. 16). By late summer the plants are dried out, die back to the root caudex, and are difficult to locate (Bergstrom 2009, p. 15).

Pollinators specific to *I. webberi* have not been identified. However, Witham (2000, p. 20) notes that in general, most *Ivesia* species appear to reproduce from seed with insect-mediated pollination occurring between flowers of the same or different plants. Floral visitors have been observed frequenting the flowers of *Ivesia aperta* var. *canina*, which co-occurs with *I. webberi* at one population (USFWS 5–subpopulation Dog Valley Meadow; Johnson 2007, unpubl. photos). These floral visitors can only represent presumed pollinators because they were not observed to be carrying pollen and they represent the best available information regarding possible pollinators of *I. webberi*.

There are no studies available regarding the reproductive strategy for *Ivesia webberi*. Seeds of *Ivesia webberi* are relatively large and unlikely to be dispersed by wind or animal vectors. Upon maturation of the inflorescence and fruit, seeds are likely to fall to the ground and become lodged in crevices in the rocky, pavement-like clay soils in the immediate vicinity of parent plants (Witham 2000, p. 20). Depressions and crevices in soil frequently serve as seed accumulation or seedling establishment sites in arid ecosystems because they trap seeds and often have higher soil water due to trapped snow and accumulated precipitation (Reichman 1984, pp. 9–10; Eckert *et al.* 1986, pp. 417–420). Therefore, Witham (2000, p.20) suggests that *I. webberi* may be limited by the prevention of seed dispersal (atelochory) which may partially explain the lack of colonization of nearby seemingly suitable, but unoccupied habitat.

Demographic monitoring has not been conducted for *Ivesia webberi*. Early surveys (1991) noted a balanced age-class structure for *I. webberi* populations (Witham 1991, pp. 4–10). However, more recent surveys (2000–2012) indicate low recruitment with populations consisting of predominantly mature plants (Witham 2000, p. 19; J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey 2005; K. Howle and L. Henault, unpubl. survey 2009; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c). The establishment and persistence of new plants could be related to annual fluctuations in precipitation, such that prolonged cycles of consistent drought throughout summer may depress new plant establishment (Bergstrom 2009, p. 16). Demographic monitoring of plants at all sites is needed to understand variation in plant establishment, growth, and reproductive potential, especially since the current trend is for populations to be dominated by mature individuals.

Habitat

Ivesia webberi occurs between 4,475 to 6,237 feet (ft) (1,364 to 1,901 meters (m)) in elevation on flats, benches, or terraces above and adjacent to large valleys (Steele and Roe 1996, unpubl. survey; Witham 2000, p.16; Howle and Henault 2009, unpubl. survey). The occupied sites vary from slightly concave to slightly convex or gently sloped (0–15°) and occur on all aspects (Witham 2000, p. 16). Sites also do not receive an accumulation of loose sediment or colluvium from upslope (Witham 2000, p. 16).

Populations of *Ivesia webberi* occur on a variety of soil series types, including, but not limited to: Reno—a fine, smectitic, mesic Abruptic Xeric Argidurid; Xman—a clayey, smectitic, mesic, shallow Xeric Haplargids; Aldi—a clayey, smectitic, frigid Lithic Ultic Argixerolls; and Barshaad—a fine, smectitic, mesic Aridic Palexeroll (USDA NRCS (U.S. Department of Agriculture Natural Resources Conservation Services) 2007, 2009a, 2009b, 2012a, 2012b). These soils are derived from andesitic, volcanic rock and the majority have an argillic (i.e., clay) horizon within 19.7 in (50 cm) of the soil surface (Witham 2000, p. 16; USDA NRCS 2007, 2009a, 2009b, 2012a, 2012b). An argillic horizon is defined as a subsurface horizon with a significantly higher percentage of clay than the overlying soil material (Soil Survey Staff 2010, p. 30). The clay content (percent by weight) of an argillic horizon must be 1.2 times the clay content of an overlying horizon (Soil Survey Staff 1999, p. 31). Agrillic horizons are illuvial, meaning they form below the soil surface, but it may be exposed at the surface later due to erosion. Typically there is little or no evidence of illuvial clay movement in soils on young landscapes; therefore, soil scientists have concluded that the formation of an argillic horizon required at least a few thousand years (Soil Survey Staff 1999, p.29). This argillic horizon represents a time-landscape relationship that can be locally and regionally important because its presence indicates that the geomorphic surface has been relatively stable for a long period of time (Soil Survey Staff 1999, p. 31).

The shallow, clay soils in which *Ivesia webberi* inhabits are very rocky on the surface and tend to be wet in the spring, but dry out as the season progresses (Zamudio 1999, p. 1). The high clay content in the soils creates a shrink-swell behavior as the soils wet and dry, which helps to "heave" rocks in the soil profile to the surface and creates the rocky surface "pavement" (Zamudio 1999, p. 1). The unique soils and hydrology of *I. webberi* sites may exclude competition from other species (Zamudio 1999, p. 1; Witham 2000, p. 16). The shrink-swell of the clay zone, which extends into the subsoil, favors perennials with deep taproots or annuals with shallow roots that can complete their life cycle before the surface soil dries out (Zamudio 1999, p. 1; Witham 2000, pp. 16, 20). The root systems of tap-rooted perennial forbs are suited to soil with clay subsoils because the roots branch profusely under the crown, spread laterally, and penetrate the clay B horizon along vertical cleavage planes (Hugie *et al.* 1964, p. 200). The roots are flattened, but unbroken by shrink-swell activity (Hugie *et al.* 1964, p. 200). Early maturing plants, such as *I. webberi*, presumably prefer soils with these heavy clay horizons because of the abundant spring moisture, which essentially saturates the surface horizons with water.

The vernally moist, but otherwise dry and rocky habitat is typically dominated by *Ivesia webberi*, along with *Artemisia arbuscula* Nutt. (low sagebrush). On many of the sites, the vegetation could be described as an *A. arbuscula* - *I. webberi* association or as an *I. webberi*-perennial rock garden-type plant community. On a few sites, perennial grasses such as *Elymus elymoides* (Raf.) Swezey (squirreltail) and *Poa secunda* J. Presl (Sandburg bluegrass) play an important or even co-dominant role (Witham 1991, p. 2; 2000, p. 17 and Appendix 1, p. 5). Other associated plant species include: *Antennaria dimorpha* (Nutt.) Torr. & A. Gray (low pussytoes), which occurs at almost all occupied sites, *Balsamorhiza hookeri* (Hook.) Nutt. (Hooker's balsamroot), *Erigeron bloomeri* A. Gray (scabland fleabane), *Lewisia rediviva* Pursh (bitter root), and *Viola beckwithii* Torr. & A. Gray (Beckwith's violet) (Witham 2000, p 17; J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey, 2005; K. Howle and L. Henault, unpubl. survey 2009; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c, BLM, unpubl. survey, 2011, BLM, unpubl. survey 2012a; C. Schnurrenber, unpubl. survey, 2013).

Range and Distribution

Many of those working with *Ivesia webberi* have used the terms "site," "location," "occurrence" (often, but not always, in reference to Natural Heritage Program Element Occurrence (EO) records), "population," and "subpopulation" interchangeably. Others have aggregated smaller sites into populations according to subjective criteria which have never been explicitly defined. This generates discrepancies among sources with respect to reporting abundance and distribution of the species, with the net result being that different sources (and even different surveys by the same source) are usually not comparable. The tendency to treat each spatially discrete *I. webberi* location as a separate population can also suggest more populations than may actually exist. For the purposes of this document, the USFWS has applied spatial mapping standards devised by NatureServe and its network of Natural Heritage Programs (NatureServe 2004, entire) to aggregate 22 known, spatially discrete locations (whether extant or extirpated) of *I. webberi* into 17 spatially discrete units which we herein regard as probable "populations" of the species (Table 1). This document uses the term "subpopulation" only when necessary to reference a portion of 1 or more of these 17 populations. For further ease of reference, the USFWS has assigned a unique numerical identifier to all populations (Table 1, column 1), which is cross-referenced to corresponding Nevada Natural Heritage Program (NNHP) and California Natural

Diversity Database (CNDDB) EO numbers, where they have been assigned to known locations (Table 1, column 5). All known populations of *I. webberi* are restricted to the transition zone between the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin (Witham 2000, p. 15). *Ivesia webberi* occupies approximately 165 ac (66.8 ha) of lands managed by the USFS (69 percent), BLM (3 percent), CDFW (12 percent), and private owners (16 percent). As discussed below, 1 of these 17 populations is presumed extirpated; the 16 remaining (extant) populations are depicted in Figure 2.

Until 1990–1991, nearly all the California populations and many of the Nevada populations of *Ivesia webberi* were known only from historic herbarium collections. Field surveys sponsored in 1990 and 1991 by the Plumas, Tahoe, and Humboldt-Toiyabe National Forests succeeded in relocating a few of these historical populations (USFWS 1, 5–subpopulation Dog Valley Meadow, and 13) and documenting new populations around the California-Nevada border (USFWS 6 and 7) (Duron 1990, entire; Witham 1991, entire). Subsequent, expanded survey efforts in 1997–1998 rediscovered all known populations (USFWS 1, 2, 3, 4, 5–subpopulation Dog Valley Meadow, 6, 7, 8, 13, 14, and 16) and documented one additional population in Nevada (USFWS 12) (Witham 2000, entire). Between 2006 and 2013, four new populations (USFWS 9, 10, 11, and 15) and two new subpopulations (USFWS 5–subpopulation Upper Dog Valley and USFWS 9–subpopulation Stateline Road 1b) were documented, all within 3 mi (4.8 km) of previously existing populations, with the exception of USFWS 11 (J. Picciani, unpubl. survey 2006; K. Howle and L. Henault, unpubl. survey 2009; J. Morefield, unpubl. survey 2010a; K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b; K. Howle and N. Chardon, unpubl. survey, 2011c; C. Schnurrenber, unpubl. survey, 2013). Population USFWS 11 is approximately 8 mi (12.9 km) from the closest populations (USFWS 12 and 13; Figure 2).

Several *Ivesia webberi* locations reported in early literature either have no corresponding herbarium specimens, or there is insufficient information on the label to determine the location (either approximate or precise) from which the original specimen was collected (Witham 2000, p. 11). Still other historical records appear to be erroneous and warrant mention here. Two records in the CNDDB (2012) are suspected to be erroneous—Webber Lake and Indian Valley, both in California. Witham (2000, p. 14) explains that although these two locations were noted by Gray (1874, p. 71), Lemmon (1908, p. 20) identified Dr. Webber's Sierra Valley property as the *I. webberi* location (where, as with Webber Lake, Dr. Webber also owned property). Subsequent work by Keck (1938, p. 130) supports Lemmon's locality interpretation, in that Keck was unable to find any collections in the Gray herbarium labeled Indian Valley or otherwise attributed to Dr. Webber. Lastly, Witham (2000, p. 14) surveyed the vicinity of Webber Lake, but found no suitable habitat for the species. In Nevada, *I. webberi* identified as from the Pyramid Lake area is also likely to have been labeled erroneously. Herbarium labels from 1959 specify a desert area and very sandy hillside with an elevation around 4,000 ft (1,219 m; University of Nevada, Reno (UNR) herbarium 2012; *http://contentdm.library.unr.edu/cdm4/search.php?CISOROOT=/herb,* accessed on November 6, 2012). Witham (2000, p. 14) surveyed for potential suitable habitat in this location and found none; additionally, the described habitat of "desert area" and "very sandy hillside" is completely unlike any of the known habitat of *I. webberi* in California and Nevada.

There is one credible historical record indicating that *Ivesia webberi* occurred in the American Valley in California (California Department of Fish and Wildlife (CDFW) 2012, p. 2). Within the American Valley, historical locations for *I. webberi* now support the town of Quincy, thus it is presumed extirpated from this location (Duron 1990, pp. 12–13; this is population USFWS 17 in Table 1). In Nevada, vague herbarium records report *I. webberi* in the vicinity of Hunter and Alum Creeks (UNR herbarium 2012; *http://contentdm.library.unr.edu/cdm4/search.php?CISOROOT=/herb,* accessed on November 6, 2012). Although most terraces in these areas are now either covered in houses or residential landscaping (Witham 1991, p. 10; Witham 2000, p. 13), there are two extant populations (USFWS 15 or 16, Table 1) in the vicinity of these creeks; on this basis, and for purposes of this status assessment, we have not assumed the species to have been extirpated from these areas. Therefore, no Nevada populations are known or presumed extirpated.

Additional surveys of potential habitat in American, Indian, and Genesee Valleys in Plumas County, California, in the vicinity of known occurrences in western Washoe County, Nevada (2,055 ac (539 ha) surveyed), and in the Pine Nut Mountains, Douglas and Washoe Counties, Nevada (1,900 ac (579 ha) surveyed) documented no additional populations of the species (Duron 1990, pp. 13–14; Witham 2000, p. 13, Appendix 1, pp. 3–4). It is possible that additional *Ivesia webberi* sites may be found outside of these areas, however, field observations indicate that a site that looks suitable from a distance usually ends up being too dry or lacks the shallow clay soils associated with the species (Witham 2000, p. 14). In California, the western rim of Upper Long Valley in Sierra County is the only area that may support high quality potential habitat that has not been surveyed, but this area is primarily private property and is unlikely to be surveyed (Witham 2000, p. 19).

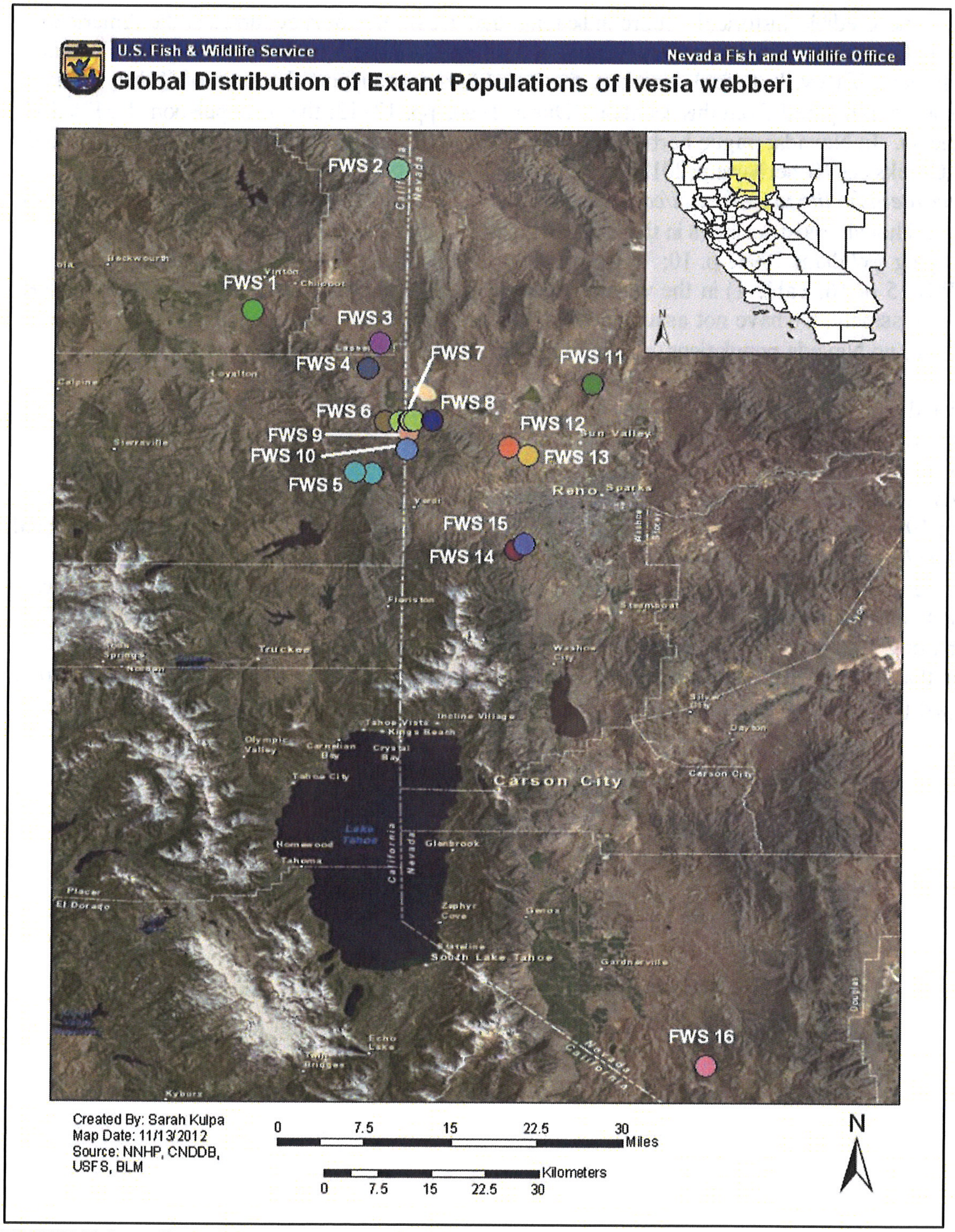


FIGURE 2.—Global distribution of extant populations of *Ivesia webberi*. Circles represent the geographic center of extant, mapped occurrences. Circles in close proximity to each other that are depicted in the same color represent occurrences that were grouped together by the USFWS as populations, according to NatureServe mapping standards (NatureServe 2004, entire).

TABLE 1.—Summary of *Ivesia webberi* populations in Nevada and California.

Population (USFWS)	Site Name	State	County	EO *	EO Rank **	# of Surveys	Population estimate range(s)	Estimated area (ac/ha)	Land Owner	Threats ***
1	Sierra Valley	CA	Plumas	CA 1	B	3	50–10,000	44.80 (18.12)	BLM Private State	f g n o
2	Constantia	CA	Lassen	CA 11	E	1	100–999	1.91 (0.77)	BLM	f
3	East of HJWA, Evans Canyon	CA	Lassen	CA 10	D	3	115–130	0.14 (0.06)	BLM	f
4	Hallelujah Junction WA	CA	Sierra	CA 8	D	3	300–400	0.05 (0.02)	State	f
5	Dog Valley Meadow	CA	Sierra	CA 4	A	1	100,000	71.58 (28.97)	USFS	f n o
	Upper Dog Valley	CA	Sierra		BC	1	5,000	0.99 (0.40)	USFS	f n o
6	White Lake Overlook	CA	Sierra	CA 7	E	1	10,000	13.56 (5.49)	USFS	f
7	Mules Ear Flat	CA	Sierra	CA 6	D	1	<100	0.14 (0.06)	USFS	f n o
	Three Pine Flat	NV	Washoe	NV 2	C	1	1,000	1.13 (0.46)	Private	f n o
	Halfway Slope	NV	Washoe	NV 4	H	1	1,000	0.31 (0.13)	Private	d f n o
	Jeffrey Pine Saddle	NV	Washoe	NV 3	C	1	1,000	0.42 (0.17)	Private	f n o
8	Ivesia Flat	NV	Washoe	NV 8	BC	1	100,000	0.73 (0.30)	USFS	f n o
9	Stateline Road 1a	NV	Washoe		C	1	1,000	7.03 (2.84)	USFS	d f n
	Stateline Road 1b	NV	Washoe		D	1	50	0.01 (0.004)	USFS	d f o
10	Stateline Road 2	NV	Washoe		C	1	2,000	4.03 (1.63)	USFS	d f n
11	Hungry Valley	NV	Washoe		D	1	2,120	0.16 (0.06)	BLM	f g n o
12	Black Springs	NV	Washoe	NV 5	C	2	>500 to 1,000	6.31 (2.55)	USFS	f n o
13	Raleigh Heights	NV	Washoe	NV 7	B	5	<100,000–4,000,000	9.55 (3.86)	USFS	f n o
14	Dutch Louie Flat	NV	Washoe	NV 9	AC	4	600,000–693,795	1.35 (0.55)	Private	d f n o
15	The Pines Powerline	NV	Washoe	NV 15	AC	2	63,300	0.14 (0.06)	Private	d f n o
16	Dante Mine Road	NV	Douglas	NV 1	C	7	3,179–36,500	0.56 (0.23)	BLM Private	d f n o

17	American Valley	CA	Plumas	CA 2	X	historical collection from 1886, area searched in 1990 and no plants seen, suitable habitat eliminated, presumed extirpated

Table 1.—Footnotes:
*EO = Element occurrences mapped in the NNHP (NV) or CNDDB (CA) databases. Populations without numbers indicate unlogged in the NNHP or CNDDB databases.
**EO rank = Element occurrence ranks established by the NNHP or CNDDB based on NatureServe protocol (NatureServe Explorer; *http://www.natureserve.org/explorer/*, accessed December 11, 2012). Letters reflect an assessment of estimated viability (species) or ecological integrity; refer to the text for the corresponding rank definitions.
***Threats = **d:** private/municipal development, **f:** wildfire and suppression activities, **g:** animal grazing/trampling, **n:** nonnative, invasive plant species, and **o:** OHV use and/or road corridors

Abundance and Population Trend

Reliable estimation of population sizes or trends in *Ivesia webberi* is complicated by multiple factors. Estimates of population size (in terms of the abundance of individuals) have usually been obtained by different observers employing a variety of means and levels of survey effort. At one extreme, observations consist of coarse estimates (e.g., individuals ranging from 0 to 100, 100 to 999, > 1,000, etc.); at the other extreme, they consist of meticulous counts of every plant present. Still other observers have estimated abundance by extrapolating from counts within a small portion of occupied habitat (delimited with or without the use of plots and/or transects, usually without random placement of these sampling units). To be reliable, surveys (whether for purposes of estimating size or detecting trends) for *Ivesia webberi* must occur during the narrow spring window when plants are flowering, because by late summer plants dry out and die back to the root caudex, and are difficult to detect (Bergstrom 2009, p. 15). Surveys outside of this window are therefore likely to underestimate the number of individuals present. Finally, differences in the methods used to map populations create additional discrepancies, in that boundaries vary considerably in terms of the unoccupied (but presumed suitable) and/or buffer habitat included. Protocols used to map the California populations are apt to result in a substantial overestimate of the actual occupied area (Witham 2000, p. 12).

The combined total of available estimates of individual plants at the 16 extant populations ranges between 990,814 and 5,029,394 individuals. We have very little confidence in these estimates of abundance; we present them solely because they represent the only available estimates for *Ivesia webberi*. Eight of the 16 extant populations have a single population estimate; therefore, population trends at these 8 locations cannot be determined (Table 1). Of the remaining eight populations, two are characterized by two estimates of abundance; and one of these two populations appears to be stable when estimates are compared. Although three or more surveys have occurred at the remaining populations, survey data and methods are too variable to infer trends.

Current Status of Populations and Habitat

In this section, we summarize information on the status of *Ivesia webberi* populations (i.e., surveys, population estimates, threats). We also use a method developed by NatureServe for categorically ranking each population and/or subpopulation in terms of its relative quality (i.e., abundance, age class distribution, abiotic and biotic conditions, landscape context). We first present rank criteria as specifically developed for *Ivesia webberi* by NatureServe, followed with site information including the ranks assigned to each location.

NatureServe Element Occurrence Ranking Criteria

NatureServe and its network of Natural Heritage Programs use the generic approach for ranking EOs to provide a succinct assessment of the estimated viability (probability of persistence) of mapped occurrences of any given tracked entity (Hammerson *et al.* 2008, entire). These ranks provide an estimation of the likelihood, that if current conditions prevail, a species occurrence will persist for a period of time. Because EO ranks are used to represent the overall "quality" of an occurrence as it currently exists, they are based solely on criteria that represent the present status of the occurrence such as size (abundance), occupied area, abiotic and biotic conditions, and landscape context. Future threats are not used to "downgrade" an occurrence rank, but ongoing events that result in inexorable degradation of occurrence quality are considered. While the generic approach to ranking EOs is used for most species, specific criteria for assigning ranks A through D have been developed for particular species, such as *Ivesia webberi*, (NatureServe Explorer; *http://www.natureserve.org/explorer/*, accessed December 11, 2012), and are presented below.

> **Excellent Viability (A):** SIZE: At least 4,000 maximum detectable individuals occupying at least 9.89 ac (4 ha) of apparently suitable habitat. CONDITION: Multiple age classes present in ratios appropriate to generation time of population. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Less than 5 percent cover of exotic plant species. Less than 5 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area is relatively unfragmented and includes ecological processes needed to sustain the population and its habitat.
>
> **Good Viability (B):** SIZE: At least 1,000 maximum detectable individuals occupying at least 2.47 ac (1 ha) of apparently suitable habitat. CONDITION: Multiple age classes present in ratios appropriate to generation time of population. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Less than 10 percent cover of exotic plant species. Less than 10 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area includes the ecological processes needed to sustain the population and its habitat, though it may be significantly fragmented, invaded by exotics, or otherwise impacted by humans.
>
> **Fair Viability (C):** SIZE: At least 200 maximum detectable individuals occupying at least 0.49 ac (0.2 ha) of apparently suitable habitat. CONDITION: Multiple age classes present, but often in ratios indicating reduced or irregular recruitment. Evidence of flowering and fruiting, seedlings, or other indications that reproductive mechanisms are intact. Up to 50 percent cover of exotic plant species and/or up to 50 percent cover of significant anthropogenic impacts. LANDSCAPE CONTEXT: Surrounding area may be heavily fragmented, disturbed, and/or invaded by exotics, but still includes the ecological processes needed to sustain the population and its habitat.

Poor Viability (D): SIZE: less than 200 maximum detectable individuals occupying and/or less that 0.49 ac (0.2 ha) of apparently suitable habitat occupied. CONDITION: Little or no evidence of successful or sustainable reproduction (poor age class distribution, no seedlings, and/or no evidence of flowering, fruiting, etc.). Cover of exotic plant species and/or significant anthropogenic impacts may exceed 50 percent. LANDSCAPE CONTEXT: Surrounding area may be heavily fragmented, disturbed, and/or invaded by exotics, with some of the ecological processes needed to sustain the population and its habitat no longer intact.

In addition to these species-specific criteria for *Ivesia webberi*, the following generic EO ranks have been established by NatureServe (Hammerson *et al.* 2008) and applied in our assessment of this species:

Verified Extant (E): Occurrence recently has been verified as still existing, but sufficient information on the factors used to estimate viability of the occurrence has not yet been obtained. The E rank is used when the occurrence is thought to be extant, but an A, B, C, D, or combination rank cannot be assigned.

Failed to Find (F): Occurrence has not been found despite a search by an experienced observer at a time and under conditions appropriate for the occurrence at a location where it was previously reported, but the occurrence still might be confirmed to exist at the location with additional field survey efforts.

Historical (H): Recent field information verifying the continued existence of the occurrence is lacking. Examples of this rank include occurrences based only on historical collection data, or occurrences that previously were ranked A, B, C, D, or E, but that are now, without field survey work, considered to be possibly extirpated due to general loss or degradation of the environment in the area (i.e., there has been a known major disturbance since the last observation such that the continued existence of the occurrence is in doubt).

Extirpated (X): Adequate surveys by one or more experience observers at times and under conditions appropriate for the species at the occurrence location, or other persuasive evidence, indicate that the species no longer exists there or that the habitat or environment of the occurrence has been destroyed to such an extent that it can no longer support the species.

Site Accounts

USFWS 1 – Sierra Valley

USFWS 1 is the type locality for *Ivesia webberi*. Property owners within this site include the BLM, State of California, and private. Mapping efforts indicate that the population encompasses 44.8 ac (18.1 ha) or 27.17 percent of the total amount of occupied habitat mapped for *I. webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California populations have been characterized as substantial overestimates of actual occupied area (Witham 2000, p. 12); thus, this population likely occupies a much smaller area. The population has been surveyed three times (1990, 1992, and 1998). The 1990 survey estimated 2,000 individuals (C. Witham and G. Kareofelas, unpubl. survey, 1990), the 1992 survey was only on BLM land and estimated 50 individuals (G. Schoolcraft, unpubl. survey, 1992), and the 1998 survey estimated 10,000 individuals total on private and State lands (G. Schoolcraft, unpubl. survey, 1998). Note that, the 1998 survey was conducted in August when plants are typically dried out and difficult to locate. The north and east edges of the population are invaded by the nonnative, invasive, annual grass *Bromus tectorum* L. (cheatgrass) and have been heavily grazed by domestic sheep and cattle. An off-highway vehicle (OHV) trail also transects the population (Duron 1990, p. 9; Witham 1991, p. 9; G. Schoolcraft, unpubl. survey, 1992; G. Schoolcraft, unpubl. survey, 1998). Although this population may meet the criteria for an EO rank of "A" in terms of number of individuals and acreage, anthropogenic factors (OHVs, grazing, and nonnative, invasive plants) have prompted us to assign a rank of "B" to this population.

USFWS 2 – Constantia
USFWS 2 occurs on BLM land. This population occupies 1.91 ac (0.77 ha) or 1.16 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed once in 1996 and estimated to contain 100–999 individuals. Nothing is known about the condition of the habitat at this site (H. Steele and L. Roe, unpubl. survey 1996). Based upon this information and the above EO rank criteria, we assigned a rank of "E" to this population.

USFWS 3 – East of Hallelujah Junction Wildlife Area, Evans Canyon
USFWS 3 occurs on BLM land. Unlike other *Ivesia webberi* populations, this population's co-dominant species is *Artemisia tridentata* Nutt. (big sagebrush) and not *Artemisia arbuscula* (C. Krumm and G. Clifton, unpubl. survey 1996). This population occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. A 1996 survey estimated that 100–999 *I. webberi* individuals were present (C. Krumm and G. Clifton, unpubl. survey 1996). In July 2007 a wildfire burned through this population; a 2008 survey could not locate any individuals (Sustain Environmental Inc. 2009, p. III-19). However, a 2013 survey relocated this population and estimated that 115–130 *I. webberi* individuals were present (S. Kulpa and J. Johnson, unpubl. survey 2013a). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 4 – Hallelujah Junction Wildlife Area
USFWS 4 occurs on State land owned by the CDFW. This population occupies 0.05 ac (0.02 ha) or 0.03 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. A 1992 survey estimated that 200 *I. webberi* individuals were present (C. Witham, unpubl. survey 1992). In July 2007 a wildfire burned through this population; a 2008 survey could not locate any individuals (Sustain Environmental Inc. 2009, p. III-19). However, a 2013 survey relocated this population and estimated that 300–400 *I. webberi* individuals were present (S. Kulpa and J. Johnson, unpubl. survey 2013b). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 5 – Dog Valley Meadow and Upper Dog Valley
USFWS 5–subpopulation Dog Valley Meadow occurs on USFS land. This subpopulation is

located within drier portions of Dog Valley Meadow (Bergstrom 2009, p. 10). Mapping efforts indicate that the subpopulation encompasses 71.78 ac (29.05 ha) or 43.41 percent of the total amount of occupied habitat mapped for *I. webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California subpopulations have been characterized as substantial overestimates of actual occupied area (Witham 2000, p. 12), thus this subpopulation likely occupies a much smaller area within Dog Valley Meadow. This subpopulation was surveyed in 1991 and estimated to contain 100,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991a). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant. It also receives high recreational use due to its proximity to Reno and Verdi, Nevada, and OHV use has been observed in the meadow (Bergstrom 2009, pp. 10, 25). Additionally, *Poa bulbosa* L. (bulbous bluegrass), a nonnative, invasive grass, has expanded into the periphery of the subpopulation from nearby, abandoned irrigation ditches (Bergstrom 2009, p. 24). Based upon this information and the above EO rank criteria, we assigned a rank of "A" to this subpopulation.

USFWS 5–subpopulation Upper Dog Valley occurs on USFS land. This subpopulation occupies a gentle toe-slope on the eastern side of the valley. This subpopulation occupies 0.99 ac (0.4 ha) or 0.6 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2009 and estimated to contain 5,000 individuals (K. Howle and L. Henault, unpubl. survey 2009). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). OHV activities have occurred across a portion of the population as evidenced by wheel ruts (Bergstrom 2009, p. 10). *Bromus tectorum* is also present within this subpopulation. Based upon this information and the above EO rank criteria, we assigned a rank of "BC" to this subpopulation.

USFWS 6 – White Lake Overlook
USFWS 6 occurs on USFS land. Mapping efforts indicate that the population encompasses 13.56 ac (5.49 ha) or 8.22 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. However, as noted (above in *Abundance and Population Trend*), protocols used to map this and other California populations have been characterized as substantial overestimates of actual occupied area (Witham 2000, p. 12), thus this population likely occupies a much smaller area. This population was surveyed in 1991 and estimated to contain 10,000 individuals (C. Witham and G. Kareofelas, unpubl. survey, 1991b). This population was historically grazed, but the grazing allotment is currently vacant (Bergstrom 2009, p. 27). Although described as relatively undisturbed in the survey report, this site has not been surveyed since; therefore the current condition of the habitat is unknown (C. Witham and G. Kareofelas, unpubl. survey, 1991b). Based upon this information and the above EO rank criteria, we assigned a rank of "E" to this population.

USFWS 7 – Mules Ear Flat, Three Pines Flat, Halfway Slope, and Jeffrey Pine Saddle
USFWS 7–subpopulation Mules Ear Flat occurs on USFS land. This subpopulation occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain less than 100 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991c). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). OHV

damage has been observed within the subpopulation and several dirt roads are within its vicinity. *Bromus tectorum* is invading the margins of this subpopulation (Bergstrom 2009, p. 12). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this subpopulation.

USFWS 7–subpopulation Three Pines Flat is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 1.13 ac (0.46 ha) or 0.69 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991d). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). OHV damage has been observed within the subpopulation and several dirt roads are within its vicinity. Nonnative, invasive plant species are also present within this subpopulation (C. Witham and G. Kareofelas, unpubl. survey 1991d). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this subpopulation.

USFWS 7–subpopulation Halfway Slope is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 0.31 ac (0.13 ha) or 0.19 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991e). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this subpopulation (BLM, Geospatial Data 2012b). At the time of the 1991 survey, OHV damage and nonnative, invasive plants were observed within the subpopulation and several dirt roads were within its vicinity. In 2004, a private residence and road were constructed within its boundaries, likely extirpating this subpopulation (observed using ESRI ArcGIS Imagery Basemap satellite imagery; C. Witham and G. Kareofelas, unpubl. survey 1991e). Given the extent of habitat alteration that has occurred since the species was last observed at this location, we assigned a rank of "H" to this subpopulation.

USFWS 7–subpopulation Jeffrey Pine Saddle is on private land within the Humboldt-Toiyabe National Forest boundary. This subpopulation occupies 0.42 ac (0.17 ha) or 0.25 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was surveyed in 1991 and estimated to contain 1,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991f). This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A 1984 wildfire burned through this population (BLM, Geospatial Data 2012b). OHV damage has been observed within the subpopulation and several dirt roads are within its vicinity. Nonnative, invasive plants are also present within this subpopulation (C. Witham and G. Kareofelas, unpubl. survey 1991f). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this subpopulation.

USFWS 8 – Ivesia Flat
USFWS 8 occurs on USFS land. This population occupies 0.73 ac (0.3 ha) or 0.44 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed in 1997 and estimated to contain 100,000 individuals (C.Witham, unpubl. survey 1997a). This population was historically grazed, but the USFS grazing allotment is currently vacant

(Bergstrom 2009, p. 27). This population is situated between two USFS roads with evidence of an overgrown user-created OHV trail traversing the population. *Bromus tectorum* is also present within this population (Bergstrom 2009, p. 8). Based upon this information and the above EO rank criteria, we assigned a rank of "BC" to this population.

USFWS 9 – Stateline Road 1a and 1b
USFWS 9–subpopulation Stateline Road 1a occurs on USFS land. This subpopulation occupies 7.03 ac (2.84 ha) or 4.26 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2011 during surveys along the proposed Bordertown to California Transmission Line preferred Stateline Route (USFS 2012a, entire). It is estimated to contain 1,000 individuals. This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). *Taeniatherum caput-medusae* (L.) Nevski (medusahead), a nonnative, annual grass, is invading this subpopulation (K. Howle and N. Chardon, unpubl. survey, 2011a; K. Howle and N. Chardon, unpubl. survey, 2011b). Although this subpopulation may meet the criteria for a rank of "B" in terms of number of individuals and acreage, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "C" to this population.

USFWS 9–subpopulation Stateline Road 1b occurs on USFS land. This subpopulation occupies 0.01 ac (0.004 ha) or 0.01 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This subpopulation was discovered in 2013 during surveys along the proposed Bordertown to California Transmission Line (C. Schnurrenberger, unpubl. survey 2013). It is estimated to contain 50 individuals. This subpopulation was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). This subpopulation is situated along an old roadbed that is now blocked off and does not appear to experience much foot traffic, however could experience disturbance from road maintenance. Very few nonnative, invasive plant species are in this area (C. Schnurrenberger, unpubl. survey 2013). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 10 – Stateline Road 2
USFWS 10 occurs on USFS land. This population occupies 4.03 ac (1.63 ha) or 2.44 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2011 during surveys along the proposed Bordertown to California Transmission Line preferred Stateline Route (USFS 2012a, entire). It is estimated to contain 2,000 individuals. This population was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). *Taeniatherum caput-medusae* is invading this population (K. Howle and N. Chardon, unpubl. survey, 2011c). Although this population may meet the criteria for a rank of "B" in terms of number of individuals and acreage, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "C" to this population.

USFWS 11 – Hungry Valley
USFWS 11 occurs on BLM land. This population occupies 0.16 ac (0.06 ha) or 0.1 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2010 and estimated to contain 2,120 individuals (J. Morefield, unpubl. survey 2010a). In 1999, a wildfire burned through this population (BLM, Geospatial Data 2012b). A high-density residential development is within a few miles of the population, thus it is used for recreation as

evidenced by OHV tracks and dirt roads bisecting the population. Additionally, the population is grazed by cattle and *Bromus tectorum* is present (J. Morefield, unpubl. survey 2010a; S. Kulpa, unpubl. data 2012). Based upon this information and the above EO rank criteria, we assigned a rank of "D" to this population.

USFWS 12 – Black Springs
USFWS 12 occurs on USFS lands. This population occupies 6.31 ac (2.55 ha) or 3.83 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. The population has been surveyed twice (2000 and 2004). The 2000 survey estimated less than 500 individuals (K. Zamudio, unpubl. survey, 2000a) and the 2004 survey estimated 1,000 individuals (J. Baggs and J. Fraser, unpubl. survey 2004). However, the 2000 survey was conducted in September when plants are typically dried out and difficult to locate. This population was historically grazed, but the USFS grazing allotment is currently vacant (Bergstrom 2009, p. 27). A dirt road from a subdivision adjacent to the USFS boundary runs parallel to the site and intersects a crossroad at the upper boundary of the population (Bergstrom 2009, p. 9). Additionally, USFS Route #41465 bisects the population (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012*)*. *Bromus tectorum* is also present within and adjacent to the population (J. Baggs and J. Fraser, unpubl. survey 2004). Based upon this information and the above EO rank criteria, we assigned a rank of "C" to this population.

USFWS 13 – Raleigh Heights
USFWS 13 occurs on USFS lands. This population occupies 9.55 ac (3.86 ha) or 5.79 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed five times—1991 (C. Witham and G. Kareofelas, unpubl. survey 1991g), 1997 (C. Witham, unpubl. survey 1997b), 1999 (K. Zamudio, unpubl. survey 1999b), 2000 (K. Zamudio, unpubl. survey 2000b), and 2002 (J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002a), but population estimates were only provided during two of the five surveys (1991 and 1997). Population estimates varied greatly, from 100,000 individuals in 1991 to 4,000,000 individuals in 1997, further illustrating complications in inferring population trends from these survey data. This population's proximity to the urban interface with high recreational use, as well as the periodicity of fire within the Peavine area is of concern (Bergstrom 2009, p. 8). User-created OHV trails and USFS Routes #21549 and #21550 bisect the population (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012). *Bromus tectorum* and *Taeniatherum caput-medusae* are located adjacent to and within this population (J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002a; USFS, Geospatial Data 2010). Although this population may meet the criterion for a rank of "A" in terms of number of individuals and approaches the criterion for acreage, the extent of degradation from OHV impacts and nonnative, invasive plant species prompts us to assign a rank of "B" to this population.

USFWS 14 – Dutch Louie Flat
USFWS 14 occurs on private lands. This population occupies 1.35 ac (0.55 ha) or 0.82 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was surveyed three times (1997, 2002, and 2006). The 1997 survey estimated 600,000 individuals (C. Witham, unpubl. survey 1997c), the 2002 survey did not provide an estimate of individuals

(J. Baggs, J. Fraser, and K. Crowell, unpubl. survey 2002b), and the 2006 survey estimated 693,795 individuals (Wood Rogers 2007, Tables 2 and 3, pp. 5–6). This population is bisected by a number of dirt roads that receive a high amount of recreational use from OHVs, hikers, and mountain bikes. *Taeniatherum caput-medusae* is established in dense patches throughout this population (Bergstrom 2009, p. 9). In 2007, this area was slated for subdivision development, but this has been delayed (Wood Rogers 2007, Tables 2 and 3, pp. 5–6). In 2012, a wildfire burned through this population (BLM, Geospatial Data 2012b). A 2013 survey confirmed that the species still persisted at this location; however, infestation by *T. caput-medusae* is much worse and may have already outcompeted I. webberi in portions of this population (S. Kulpa, E. Bergstrom, and C. Ghiglieri, unpubl. survey 2013). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "AC" to this population. .

USFWS 15 – The Pines Powerline

USFWS 15 occurs on private lands. This population occupies 0.14 ac (0.06 ha) or 0.08 percent of the total amount of occupied habitat mapped for *Ivesia webberi*. This population was discovered in 2006 during pre-construction surveys for a proposed housing development that has since been delayed. It was estimated to contain 63,300 individuals (J. Picciani, unpubl. survey 2006; Wood Rogers 2007, Tables 2 and 3, pp. 5–6). This population is bisected by a number of dirt roads that receive a high amount of recreational use from OHVs, hikers, and mountain bikes. *Taeniatherum caput-medusae* is established in dense patches throughout this population (Bergstrom 2009, p. 9). In 2011, a wildfire burned through this population (BLM, Geospatial Data 2012b), and a 2013 survey confirmed that this species still persisted at this location (S. Kulpa and E. Hourihan, unpubl. survey 2013). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the acreage occupied and the extent of the infestation from *Taeniatherum caput-medausae* prompts us to assign a rank of "AC" to this population.

USFWS 16 – Dante Mine Road

USFWS 16 represents the only occurrence in Douglas County, Nevada, and it is the southernmost extent of the distribution of *Ivesia webberi*. It occurs on a combination of BLM and private lands. This population occupies 0.56 ac (0.23 ha) or 0.34 percent of the total amount of occupied habitat mapped for *I. webberi*. This population has been surveyed seven times (1991, 1997, 2004, 2005, 2010, 2011, and 2012). The 1991 survey estimated 10,000 individuals (C. Witham and G. Kareofelas, unpubl. survey 1991h), while the 1997 survey estimated 36,500 individuals (C. Witham, unpubl. survey 1997d). The 2004, 2005, and 2010 surveys all estimated 23,000 individuals (J. Morefield, unpubl. survey 2004; J. Morefield, unpubl. survey 2005; J. Morefield, unpubl. survey 2010b). Both the 2011 and 2012 surveys utilized randomly placed 3.3 ft^2 (1 m^2) quadrats to extrapolate plant density estimates (D. Tonenna, BLM, pers. comm. 2012). The 2011 survey was only a partial survey and estimated 3,179 individuals (BLM, unpubl. survey, 2011), while the 2012 survey was a complete survey and estimated 18,399 individuals (BLM, unpubl. survey 2012a). Roads define the western and northern perimeters of the population, but the population does not extend into the Highway 395 right-of-way. *Bromus tectorum* is present within this population (J. Morefield, unpubl. survey 2004). In 2012, a wildfire burned through this population; follow-up surveys suggest that the fire severity was light and likely did not damage *I. webberi*, but some of the emergency fire suppression activities may have (D. Tonenna, pers. comm. 2012). Although this population may meet the criteria for a rank of "A" in terms of number of individuals, the small extent of occupied habitat and presence of nonnative, invasive plant species prompts us to assign a rank of "C" to this population.

USFWS 17 – American Valley
USFWS 17 is known from a historical collection from 1886 (Witham 2000, Appendix 1, p. 2). Survey work in 1990 indicated that areas that had the most potential suitable habitat for *Ivesia webberi* were already developed, and they are now part of the town of Quincy. No *I. webberi* was encountered in these areas, nor were any known plant associates (Duron 1990, p. 13). Based upon this information and the above EO rank criteria, we assigned a rank of "X" to this population.

Summary of Populations

A total of 21 occurrences make up the 17 known *Ivesia webberi* populations (Table 1 and Figure 2). One population (USFWS 17) is extirpated. Of the remaining 16 populations, the status of 2 is unknown because both (USFWS 2 and 6) have such limited data their relative viability cannot be determined. Fourteen of the populations (containing a total of 19 occurrences) can be assessed in terms of their relative viability or habitat. Of these, a portion of one population (USFWS 5–subpopulation Dog Valley Meadow) meets the "A" (excellent viability) ranking criteria. Two populations (USFWS 14 and 15) are ranked "AC" (excellent to fair viability). One population (USFWS 8) and a portion of another (USFWS 5–subpopulation Upper Dog Valley) are ranked "BC" (good to fair viability). One subpopulation (USFWS 7–Halfway Slope) is ranked "H" (historical) due to development. The remaining 10 populations (containing a total of 13 occurrences) are ranked "B" (good viability; 2 populations), "C" (fair viability; 3 populations and 3 subpopulations), and "D" (poor viability; 3 populations and 2 subpopulation).

CONSERVATION ACTIONS AND EFFORTS

USFS Conservation Strategy

The USFS has management authority for the majority of *Ivesia webberi* populations (i.e., 8 of the 16 extant populations), and prepared a Conservation Strategy (CS) for this species in 2009 (Bergstrom 2009, pp. 1–46) that was signed in 2010. The CS identifies existing and potential concerns on Federal, State, and private lands including recreational impacts from OHVs; land and road development; nonnative, invasive plant species; wildfire; livestock grazing; climate change; and other natural factors. The overall resource management objective is to maintain the viability of *I. webberi* populations and effectively prevent its potential decline consistent with Forest Service Manual 2672.1 and the Toiyabe National Forest Land and Resource Management Plan (USFS 1986, p. IV-51). The CS proposes 10 management measures to achieve this objective: (1) Maintain current populations; (2) design actions to prevent loss of habitat, including priority potential habitat; (3) implement the CS; (4) coordinate with other Federal and State agencies and city and county governments; (5) conduct demographic and plant community monitoring on USFS lands; (6) close or reroute existing roads and trails to avoid populations; (7) develop management options for priority potential habitat areas on the National Forest for the purpose of developing an out-planting program; (8) maintain site-specific survey standards for all projects proposed within potential habitat; (9) highlight conservation and management of occupied and potential habitat through the Forest Plan Revision including an evaluation of the opportunity to close all or portions of grazing allotments, or the addition of exclosures to address the threat posed by livestock; and (10) collection and long-term storage of seed in an appropriate repository (Bergstrom 2009, pp. 28–30).

The CS addresses the entire range of *Ivesia webberi,* and the USFS implements conservation actions on their lands. Of the proposed management measures in the CS, 13 of the 39 location-specific actions for *I. webberi* on USFS land have been funded and implemented, as highlighted in Appendix A, Table 1.A. (E. Bergstrom, USFS, pers. comm. 2012). At least one location-specific management action has been implemented at five populations to help ameliorate impacts to the species including impacts from roads and/or nonnative, invasive species. For example, barriers have been created on a campground access road that goes through one of three populations on USFS lands (USFWS 5–subpopulation Upper Dog Valley) crossed by roads, but the roads within the remaining two populations are still open or unbarricaded. The USFWS is partnering with the USFS to close or barricade roads within one of the two other populations (USFWS 13) crossed by roads, although implementation of this work has not begun. Nonnative, invasive plant species are present at all eight populations on USFS land and treatments have been initiated at two populations. Demographic monitoring called for in the CS is inherently labor-intensive and full implementation has yet to be achieved as a result of funding and manpower constraints. The CS will likely result in long-term benefits to *I. webberi,* although threats such as nonnative, invasive plant species such as *Bromus tectorum* and *Taeniatherum caput-medusae* and modified fire regime have landscape-scale impacts that will continue to present challenges to *I. webberi* conservation.

BLM

The BLM has management authority for 4 of the 16 populations of *Ivesia webberi*. A formal conservation strategy for this species on BLM lands has not yet been developed, although the Carson City BLM office monitored population USFWS 16 in 2011 and 2012 (D. Tonenna, pers. comm. 2012; BLM, unpubl. survey 2012a). As discussed below, this population is subject to threats from wildfire, nonnative, invasive plant species, and development.

FACTORS AFFECTING THE SPECIES

Ivesia webberi has specialized habitat requirements, as described above, that restrict its distribution along a relatively narrow corridor on the eastern edge of the northern Sierra Nevada and the northwestern edge of the Great Basin Desert (Figure 2). Within this landscape, several factors are currently altering habitat structure and composition to the general detriment of native species, including *I. webberi*. Specific examples of such factors include: (1) nonnative, invasive plant species, (2) modified wildfire regimes, (3) OHV use and road development, (4) other forms of development associated with agricultural, residential, or other land use, and (5) livestock grazing. Lastly, climate change may influence the degree to which many of these threats, individually or collectively, may affect *I. webberi*. We discuss the manner in which these factors are affecting *I. webberi* in the following paragraphs.

Nonnative, Invasive Plant Species

Nonnative, invasive plant species, such as *Bromus tectorum* (cheatgrass), *Taeniatherum caput-medusae* (medusahead), and *Poa bulbosa* (bulbous bluegrass) have become established and are part of the associated plant community at 12 of the 16 extant *Ivesia webberi* populations (USFWS 1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16). Nonnative, invasive plant species negatively affect *I. webberi* due to increased wildfire frequency (see *Modified Wildfire Regime* below), altered ecological function, competition with and displacement of native plant species, and degradation of the quality and composition of the *Artemisia arbuscula*-perennial bunchgrass-forb habitat in which *I. webberi* occurs (D'Antonio and Vitousek 1992, pp. 68–72; Gonzalez *et al.* 2008, entire; Mazzola *et al.* 2011, pp. 514–515; Pierson *et al.* 2011, entire). In addition, most climate change models project conditions conducive to the further spread of nonnative, invasive annual grasses (like *B. tectorum* and *T. caput-medusae*; see *Climate Change* below; Chambers and Pellant 2008, p. 32; Bradley *et al.* 2010, pp. 312–316; Balch *et al.* 2013, pp. 179–183).

Bromus tectorum displaces native plants, such as *Ivesia webberi*, by prolific seed production, early germination, and competitive abilities for the extraction of water and nutrients (Rice *et al.* 1992, entire; Pellant 1996, pp. 3–4; Chambers *et al.* 2007, pp. 117–120, 141–142). For example, *B. tectorum* soil seed banks can range from 5,000 to 15,000 seeds/m², which ensures high propagule pressure on native species (Humphrey and Shupp 2001, pp. 88–90; Mazzola *et al.*, 2010, p. 523). Bradley and Mustard (2006, p. 1146) found that the best indicator for predicting future invasions of *B. tectorum* was the proximity to current infestations of this species. Twelve of the 16 extant populations of *I. webberi* (USFWS 1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16) have already been invaded by *B. tectorum*. The remaining four *I. webberi* populations (USFWS 2, 3, 4, and 6) are within 1 to 15 mi (1.6 to 24.1 km) of populations already infested by *B. tectorum*, and it is likely that *B. tectorum* is present within the intervening habitat.

Taeniatherum caput-medusae overlaps in distribution and habitat requirements with *Bromus tectorum*. *Taeniatherum caput-medusae* cover increases and spreads rapidly under a frequent wildfire regime, and may even out-compete *B. tectorum* (Archer 2001, entire; Brooks and Pyke 2001, p.5). *Taeniatherum caput-medusae* seeds can germinate in fall, winter, or spring, and seedlings can produce flowers and seeds throughout the growth season (Young 1992, p. 247). When dry, *T. caput-medusae* vegetation decomposes slowly, allowing it to build a thick mat of dead or dying vegetation that suppresses growth and recruitment in native species, eventually effectively eliminating them (Davies 2008, pp. 110–111). Five of the 16 extant populations of *I. webberi* (USFWS 9, 10, 13, 14, and 15) have been infested with *T. caput-medusae* and are within 2 mi (3.2 km) of 4 additional *I. webberi* populations (USFWS 6, 7, 8, and 12) that currently lack *T. caput-medusae*.

Poa bulbosa is a nonnative, invasive grass found within one *Ivesia webberi* population (USFWS 5) and occurs within the meadow community in areas of past disturbance and along some abandoned irrigation ditches (Bergstrom 2009, p. 11). Like *Bromus tectorum* and *Taeniatherum caput-medusae*, *P. bulbosa* germinates early and is often the first invading species on shallow soils that are moist only during the spring (Locke and Burrill 1994, p. 1). Since *P. bulbosa* prefers vernally moist shallow soils similar to areas occupied by *I. webberi*, there is potential for future displacement of *I. webberi*.

Conservation measures designed to reduce the threat of nonnative, invasive plant species are addressed in the USFS CS for *Ivesia webberi* (Bergstrom 2009, pp. 28–39). Invasive plant species are present at all eight populations of *Ivesia webberi* on USFS land. The USFS CS includes conservation measures to control and treat populations of *Poa bulbosa* at USFWS 5 and *Taeniatherum caput-medusae* at USFWS 13. *Taeniatherum caput-medusae* at USFWS 10 was also treated, even though this population was discovered after completion of the CS. Controlling or eliminating nonnative, invasive plants from *I. webberi* habitat or ecosystems surrounding its habitat is a significant challenge due to the vast spatial scale of the problem, logistical and budgetary constraints, and the evolving methodology for restoring ecosystems back to their natural condition (Richards *et al.* 1998, entire; D'Antonio and Chambers 2006, pp. 260–279).

Nonnative, invasive plant species pose a threat to *Ivesia webberi* because they have the ability to overtake and displace *I. webberi* from its habitat, while contributing to increases in the frequency, spatial extent, and severity of wildfires. At this time, there are no feasible means for controlling the spread of *Bromus tectorum*, *Taeniatherum caput-medusae* on a landscape-scale basis or the subsequent increases in wildfire frequency (see *Modified Wildfire Regime* below). Therefore, based on the lack of effective landscape-scale control mechanisms, the demonstrated invasion of nonnative plants in the range of the species, and the likely increases in cover of these species based on their successful invasive characteristics, we expect the threat from nonnative, invasive plant species to continue and likely increase in the future within the range of *I. webberi*.

Modified Wildfire Regime

Wildfire was historically infrequent in the Great Basin because the native plant communities made up of annuals and perennial bunchgrasses did not provide sufficient fine fuels to carry large-scale wildfires (Whisenant 1990, p. 6; D'Antonio and Vitousek 1992, pp. 74–75; Brooks and Pyke 2001, p. 5). The bare spaces between widely-spaced shrubs and the low fuel load of the native annuals and perennial bunchgrasses generally prevented fire from spreading, and fires that did burn were restricted to isolated patches (Whisenant 1990, p. 6; Brooks and Pyke 2001, p. 5). The historic fire return interval for *Artemisia tridentata* communities is typically between 30 and 70 years (Whisenant 1990, p. 4). However, in *Artemisia arbuscula* communities, mean fire return intervals are considerably longer than in *Artemisia tridentata* communities due to lower productivity and fuel accumulations (Miller and Rose 1999, p. 557; Knick *et al.* 2005, p. 5). For instance, in *Artemisia arbuscula-Poa secunda* communities such as those in which *Ivesia webberi* occurs, the average historic fire return interval is probably greater than 100 years (Young and Evans 1981, pp. 501–505; Miller and Rose 1999, p. 557).

Beginning in the late 1800s, the widespread invasion of nonnative plant species, particularly annual grasses such as *Bromus tectorum* and *Taeniatherum caput-medusae*, has created a bed of continuous fine fuels across the sagebrush landscape in many areas (D'Antonio and Vitousek 1992, 73; Knapp 1996, p. 45; Brooks *et al.* 2004, entire; Davies *et al.* 2011, p. 2575). This has resulted in more frequent fires due to greater horizontal fuel continuity, increased fuel surface-to-volume ratio, and lower fuel (i.e., plant tissue) moisture content and thus increased flammability

(Brooks *et al.* 2004, pp. 679–680). Past wildfires likely had a minimal impact on *Ivesia webberi* due to the sparsely vegetated, rocky habitat and lower fuel accumulations within this species' habitat (Bergstrom 2009, p. 23). However, the spread of nonnative, invasive plant species into *I. webberi* habitat and adjacent plant communities has altered historic fire regimes by contributing to more frequent wildfires that burn more intensely. Not only could wildfires kill *I. webberi* individuals, higher-severity wildfires are more likely to consume *I. webberi* seedbanks, resulting in reduced likelihood of regeneration and recruitment in *I. webberi* populations impacted by fire.

Post-fire conditions facilitate the invasion and establishment of nonnative plant species, thus creating a positive feedback loop between increased fire frequencies and the spread of nonnative, invasive, annual grasses (D'Antonio and Vitousek 1992, 73; Brooks and Pyke 2001, p. 5; Brooks *et al.* 2004, p. 678). Nonnative, invasive plants promote recurrent fires, which in turn convert high-diversity native communities to low-diversity communities dominated by nonnative species; these communities then burn more frequently and eventually create a monoculture of nonnative, invasive species, displacing native species, including *Ivesia webberi*. Ten *I. webberi* populations have already experienced wildfire: USFWS 3 and 4 (burned in 1997), USFWS 7, 8, 9, and 10 (burned in 1984), USFWS 11 (burned in 1999), USFWS 14 and 16 (burned in 2012), and USFWS 15 (burned in 2011) (BLM, Geospatial Data 2012b). At populations USFWS 3 and 4 *I. webberi* could not be relocated the year following the 1997 wildfire event that burned through these populations, despite the fact that these surveys were conducted during the appropriate time of year by qualified personnel (Sustain Environmental Inc. 2009, p. III-19). Both populations were verified to still be extant in 2013 (S. Kulpa and J. Johnson, unpubl. survey 2013a and 2013b), however whether or not population size (number of plants) was appreciably affected by this wildlife event cannot be evaluated from available survey data. Additionally, a 1999 wildfire (BLM, Geospatial Data 2012b) burned USFWS 11 and plants were subsequently discovered here in 2010 (J. Morefield, unpubl. survey 2010a). This suggests that this species may be able to persist after some fire events, though persistence is likely dependent on fire severity, frequency and timing (time of year). Additionally, *Bromus tectorum* (USFWS 7, 8, 9, 10, 11, 14, 15, and 16) and/or *Taeniatherum caput-medusae* (USFWS 9, 10, 14, and 15) has been documented within all *I. webberi* populations that have experienced fire, as well as within several populations that haven't yet burned (USFWS 1, 5, and 13).

As the urban interface continues to expand into wildlands, wildfire suppression activities required to protect human life and property will intensify, increasing the likelihood of potential impacts from suppression activities to *Ivesia webberi* and its habitat (Witham 2000, p. 22). The relatively flat and accessible terrain of *I. webberi* habitats provides convenient areas on which to establish staging areas for wildfire suppression activities (Witham 2000, p. 22; Bergstrom 2009, p. 22). Wildfire suppression activities could result in *I. webberi* plants being trampled, soils being disturbed or compacted, and invasive, nonnative plant species being spread into areas disturbed by suppression activities. In 2012, a wildfire burned through USFWS 16 and follow-up surveys suggest that the fire was slight and likely did not damage plants, but some of the suppression activities may have (D. Tonenna, pers. comm. 2012). *I. webberi* populations within the Peavine Mountain area close to the Reno urban area (USFWS 8, 11, 12, 13, 14, and 15) are most susceptible to threats from suppression activities due to the proximity of the area to the urban interface, increased human use of the area, and the higher frequency of fire within this area (Bergstrom 2009, p. 8).

As the coverage of nonnative, invasive species continues to increase in these areas, it is reasonable to expect that these *Ivesia webberi* populations that have already experienced wildfire, will experience it again, given the demonstrated positive feedback cycle between wildfire and nonnative, invasive species (D'Antonio and Vitousek 1992, p. 73; Brooks and Pyke 2001, p. 5; Brooks *et al.* 2004, p. 678; Balch *et al.* 2013, pp. 180–182). Also, climate change models project a likely increase in fire frequency within the range inhabited by *I. webberi* (see *Climate Change* below). Thus, wildfire contributes to increases in the establishment and spread of nonnative, invasive species within the range of *I. webberi*, which further increases the likelihood of more frequent and intense wildfires across its range, which also increases the likelihood of potential impacts from wildfire suppression activities.

Off Highway Vehicle Use and Road Corridors

In the past 10 to 20 years, with the growth of the human population and associated development, OHV impacts have increased in *Ivesia webberi* habitat (Bergstrom 2009, p. 22). Eleven *I. webberi* populations (USFWS 1, 5, 7, 8, 9, 11, 12, 13, 14, 15, and 16) are adjacent to and/or are intersected by dirt roads, and have been affected to some degree by road development and OHV use (Table 1; Witham 2000, p. 22; J. Morefield, unpubl. survey 2010a, S. Kulpa, unpubl. data 2012; C. Schnurrenberger, unpubl. survey 2013). Authorized and unauthorized roads have caused loss, degradation, and fragmentation of *I. webberi* habitat. Roads can alter the hydrology of a site, and compacted road surfaces can limit *I. webberi* population expansion. In addition, vehicles often leave the road, compacting soils, crushing plants, and providing a means for nonnative plant species to invade otherwise remote, intact habitats (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). Brooks and Lair (2005, p. 8) and others (Brooks and Pyke 2001, p. 4; Gelbard and Belnap 2003, entire) found that vehicular pathways are the primary pathway for nonnative, invasive plant species into arid and semi-arid systems because vehicles serve as the dispersal vector for nonnative, invasive propagules, and disturbance within vehicle routes facilitate the establishment of invading plant species. Fire frequency has also been shown to be higher in areas of OHV use (Brooks and Pyke 2001, p. 4). Witham (2000, p. 21) has observed permanent loss of plants where OHV disturbance has been continuous, such as on well-used road beds bisecting habitat.

The 2006 USFS Travel Management Plan (TMP) for Peavine Mountain, an area which encompasses nine populations of *Ivesia webberi* on both public and private lands (USFWS 5, 7, 8, 9, 10, 12, 13, 14, and 15) includes provisions that designate motorized and non-motorized trails, and prohibits motor vehicle use off of designated routes (USFS 2006a, pp. 1–8). An Environmental Assessment prepared for this action concluded that USFS Sensitive Species, *I. webberi* included, may be impacted if inadvertent or illegal trampling occurs, but that the closure and rerouting of roads would ultimately benefit sensitive plant populations by reducing the threat of trampling and by allowing native and rare plant communities to be restored (USFS 2006b, p. 23). In 2008, the USFS published a Motor Vehicle Use Map (MVUM) for Peavine Mountain and other areas, reflecting (in part) the 2006 TMP for Peavine Mountain (USFS 2009, p. 1). The TMP and MVUM for Peavine Mountain are intended to benefit rare plants because motor vehicle use off of designated routes is prohibited. Designated roads open to all vehicles; however, continue to bisect certain *I. webberi* populations. For instance, USFS Route number

#41645 bisects USFWS 12 and USFS Routes #21549 and #21550 bisect USFWS 13 (USFS 2012b; *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5305083.pdf*, accessed on November 20, 2012). Unauthorized OHV use remains particularly high within *I. webberi* populations on USFS lands close to the Reno urban area (USFWS 8, 12, and 13), likely due to limited enforcement resources (Reno Gazette-Journal 2007, 2012).

Development

Development for agricultural, residential, commercial, or other purposes can affect *Ivesia webberi* through various forms of habitat loss, degradation, or fragmentation. Impacts can be direct in the form of uprooting or burying plants and their propagules beneath overturned soils, and the permanent conversion of habitat to non-suitable conditions or indirect, through increased nonnative plant invasions, OHV use, and/or human-caused wildfire. Development has resulted in the extirpation of one *I. webberi* population (USFWS 17) and likely a portion of another (USFWS 7–subpopulation Halfway Slope). We review the various forms of ongoing or planned development activities at remaining *I. webberi* populations below.

Public land development

The USFS has proposed to authorize construction and operation of approximately 10 mi (16 km) of new 120-kV overhead transmission line between NV Energy's Bordertown and California Substations (USFS 2012a, entire). The majority of the preferred route – the Stateline alignment – would cross USFS land (approximately 7 mi (11.3 km)), with shorter segments crossing private land (approximately 2.5 mi (4 km)) and BLM land (approximately 0.5 mi (0.8 km)) (USFS 2011, p. 1). This preferred alternative would bisect two *Ivesia webberi* populations (USFWS 9 and 10) and parallel a portion of a third (USFWS 7–subpopulation Three Pines Flat).

Three alternative alignments are being considered: Mitchell, Peavine, and Poeville. The Mitchell Alignment is 10.8 mi (17.4 km) long and crosses an area previously disturbed by wildfire and uses existing transmission corridors. The Peavine Alignment is 10.3 mi (16.6 km) and crosses through *Artemisia tridentata* habitat, and is the most visually-sensitive alignment for approximately 0.50 mi (0.8 km) of the route. The Poeville Alignment is the longest route (18.5 mi (29.8 km) but would be located within existing transmission line corridors and reduce the total miles crossing USFS land (USFS 2011, p. 2). With regard to potential adverse effects to *I. webberi*, the Mitchell alignment is not appreciably different from the preferred alternative (i.e., it would bisect populations USFWS 9 and 10 and parallel the Three Pines Flat subpopulation of USFWS 7). The Peavine alignment would parallel two portions of population USFWS 7 (subpopulations–Halfway Slope and Jeffrey Pine Saddle). However, the Poeville alignment would not impact any of the *I. webberi* populations.

If *Ivesia webberi* plants are not avoided during construction, they would likely be uprooted or buried, resulting in plant mortality or destruction of seeds or propagules, and the possible extirpation of entire population or subpopulations. With the exception of the Poeville alignment (which would not affect *I. webberi* populations), the preferred and alternative alignments would require the construction of temporary roads within or in close proximity of existing *I. webberi* populations. As previously discussed, roads degrade and fragment habitat by creating pathways for the spread of nonnative species and facilitating OHV activity (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). *Taeniatherum caput-medusae* (a nonnative, invasive, annual grass discussed above in *Nonnative, Invasive Plant Species*) is already established within and surrounding populations USFWS 9 and 10, and further soil disturbance in the vicinity of this species is likely to facilitate its expansion into *I. webberi* populations, potentially resulting in displacement of *I. webberi* in these areas (Witham 2000, Appendix 1, p. 1; Bergstrom 2009, pp. 25–26). Access roads created for the construction or maintenance of this transmission line are also prone to subsequent, unauthorized use by OHV activity, which (as discussed above) not only serves as a source of direct plant mortality (through uprooting or crushing established individuals), but contributes to other threats by facilitating the spread of nonnative, invasive plant species, and thus accelerating the positive feedback loop between nonnative species and wildfires.

The final location of the transmission line has not been selected. The USFS is currently analyzing this project and the Final Environmental Impact Statement should be complete in December 2013.

Private land development

There is ongoing or planned residential and/or commercial development at all *I. webberi* populations in Nevada that occur on private lands (USFWS 7, 14, 15, and 16). All or substantial portions of four populations (USFWS 7, 14, 15 and 16) occur on private lands within the greater metropolitan area of Reno, Nevada (Table 1, Figure 2). We discuss the development threat posed to each of these populations below.

Population USFWS 7 spans the California-Nevada State line and consists of four subpopulations (Table 1; Figure 2). One of its subpopulations (Mules Ear Flat) is located on USFS lands in California; the remainder of the population (subpopulations–Three Pine Flat, Halfway Slope, and Jeffrey Pine Saddle) is located on private lands in Nevada on 1.9 ac (0.77 ha) of habitat. The Nevada parcels comprising these three subpopulations consisted of undeveloped rural land in 1991, but have since been fenced and new roads have been graded in the area (Witham 2000, p. 22). In 2004, a private residence and road were constructed within the boundaries of one subpopulation (Halfway Slope), likely extirpating this subpopulation. The building permits for this house (issued in 2003) predated the 2004 listing of *Ivesia webberi* by the State of Nevada, therefore no legal protections were in place as of that time (Washoe County 2003, p. 1-2). However, visual inspection of ESRI ArcGIS Imagery Basemap satellite imagery reveals roads immediately adjacent to the two other subpopulations comprising this population (Three Pines Flat and Jeffrey Pines Saddle), illustrating that threats from roads and other forms of private development actions continue to affect this population.

Populations USFWS 14 and 15 occur on private land that has been proposed for development (Witham 2000, Appendix 1, p. 1; Wood Rogers 2007, p. 5). As noted above (Legal Status – State of Nevada), the listing of *Ivesia webberi* by the State of Nevada in 2004 requires that landowners obtain a permit from the Nevada Department of Forestry (NDF) prior to removing or destroying plants of this or any other listed species on their property. A permit application submitted to NDF in November 2007 sought permission to destroy 0.87 ac (0.35 ha) of the 1.49-

ac (0.6 ha) habitat supporting these two populations (Wood Rogers 2007, Tables 2 and 3, pp. 5–6; 2008, Table 3, p. 3). Road alignments will parallel the remaining 0.62 ac (0.25 ha) of habitat. This application was subsequently amended to preserve an additional 0.068 ac (0.028 ha) of habitat within USFWS 14 (now 0.80 ac (0.32 ha) of impacted habitat). The conserved habitat has been degraded by dense stands of *Taeniatherum caput-medusae* and consists of low densities of *I. webberi* (Wood Rogers 2008, Table 3, p. 3). The NDF and the applicant have concluded their negotiations regarding possible modifications to the proposed development to avoid or minimize effects to *I. webberi*, although the USFWS filed comments with NDF expressing continued concerns about the level of impact to this population (USFWS 2008, p. 1). The Conditional Permit for the Disturbance or Destruction of Endangered Species has not yet been issued by NDF, nor have building permits been issued for these parcels (NDF 2008, p. 1; Christopherson 2011; Washoe County Geographic Information System website *http://wcgisweb.washoecounty.us/website/*, accessed on November 19, 2012). While this may reflect a temporary downturn in the local economy and thus rates of home construction, we continue to regard development of this population as a foreseeable threat.

Population USFWS 16 lies about 50 mi (80 km) south of the nearest Reno population in the Pine Nut Mountains in Douglas County, Nevada. One corner of this population is on BLM land; the rest of the population is on private land. Residential development may be a threat to this population, although its proximity to U.S. Highway 95 may make it more valuable for commercial development (Witham 2000, p. 25, Appendix 1, p. 1).

Livestock Grazing

Livestock use has the potential to result in negative effects to *Ivesia webberi*, depending on factors such as stocking rate and season of use. Evidence of significant herbivory on *Ivesia webberi* has not been observed (Witham 2000, p. 20). Impacts from cattle use are primarily from trampling and substrate disturbance (Witham 2000, p. 20; S. Kulpa, unpubl. data 2012). Livestock use has also been suggested as a contributing factor to the spread of nonnative, invasive plant species (Young *et al.* 1972, entire; Hobbs and Huenneke 1992, p. 329; Loeser *et al.* 2007, pp. 94–95). The gentle topography within *I. webberi* habitat may make population areas attractive for permittees to install salt licks, fences, and other range modifications that concentrate livestock and thus trampling impacts (Witham 2000, p. 21); however, we have not documented such impacts to *I. webberi*.

Livestock grazing currently occurs on BLM land at two populations (USFWS 1 and 11). Grazing on these lands is regulated under the Federal Land Policy Management Act (FLPMA), which is a multiple-use mandate that allows for various activities such as grazing, mining, OHV recreation, as well as resource conservation actions, on BLM land. Under FLPMA, BLM has the ability to establish and implement special management areas such as Areas of Critical Environmental Concern to reduce or eliminate actions that adversely affect species of concern, such as *Ivesia webberi*; however, there are no special management designations for *I. webberi* on any BLM lands.

At this time, livestock grazing is not occurring within or near *Ivesia webberi* populations on USFS land. Seven populations (USFWS 5, 6, 7, 8, 9, 10, and 12) occur within historic grazing allotments which are currently vacant (Bergstrom 2009, p. 27). None of these allotments have been formally closed to grazing; therefore, these allotments could be restocked in the future to alleviate grazing pressures or other constraints elsewhere across the Humboldt-Toiyabe National Forest. This would be analyzed through a NEPA Range Recession process scheduled for the Carson Ranger District in 2016 (Bergstrom 2009, p. 27).

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions (For these and other examples, see IPCC 2007, p. 30; and Solomon *et al.* 2007, pp. 35–54, 82–85). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007, pp. 5–6 and figures SPM.3 and SPM.4; Solomon *et al.* 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007, pp. 8–12). Therefore, we use "downscaled" regional projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling).

In the Great Basin, where *Ivesia webberi* occurs, temperatures have risen 0.9 to 2.7 °F (0.5 to 1.5°C) and are projected to warm another 3.8 to 10.3 °F (2.1 to 5.7 °C) over the rest of the century (Chambers and Pellant 2008, p. 29; Finch 2012, p. 4). Winter temperatures are projected to increase by 3.6 to 16.2 °F (2 to 9 °C), which will change the balance of temperature and precipitation resulting in earlier spring snow runoff (Stewart *et al.* 2005, p. 1152), declines in snowpack (Knowles *et al.* 2006, p. 4557; Mote *et al.* 2005, entire), and increased frequency of drought and fire events (Seager *et al.* 2007, pp. 1181–1184; Littell *et al.* 2009, pp. 1014–1019; Abatzoglou and Kolden 2011, pp. 474–475). Under projected future conditions, the cover of sagebrush in the Great Basin region is anticipated to be dramatically reduced (Neilson *et al.* 2005, p. 154). Warmer temperatures and greater concentration of atmospheric carbon dioxide create conditions favorable for nonnative, invasive plant species, such as *Bromus tectorum*, potentially exacerbating the positive feedback cycle between invasive annual grasses and fire frequency (Chambers and Pellant 2008, p. 32; Bradley *et al.* 2010, pp. 312–316; Balch *et al.* 2013, pp. 179–183).

Plant species, such as *Ivesia webberi,* that have a restricted range, specialized habitat requirements, and limited recruitment and dispersal have a higher risk of extinction due to demographic uncertainty and random environmental events (Shaffer 1987, pp. 69–75; Lande 1993, pp. 911–927; Hawkins *et al.* 2008, pp. 41–42). The potential for a population to adapt in a changing climate will be in part determined by the lifespan of the species and the age at which it reaches reproductive maturity, which are not known for *I. webberi* (Jump and Peñuelas 2005, p. 1013). Increasing temperatures and drought frequency could adversely affect *I. webberi* by causing physiological stress, altering phenology, and reducing recruitment events and/or seedling establishment (Parmesan 2006, pp. 642–644; Hawkins *et al* 2008, pp. 16–32). Human-modified landscapes have modified and fragmented *I. webberi* habitat such that gene flow between populations may be reduced, which may affect the species' ability to adapt to a changing climate (Jump and Peñuelas 2005, p. 1014; Haskins and Keel 2012, p. 230). Some plant species may not be able to adapt quickly enough to match the pace or magnitude of climate change (Jump and Peñuelas 2005, p. 1016), or they may not have the genetic diversity or capability to adapt or persist at their current location (Haskins and Keel 2012, p. 230).

The direct, long-term impact from climate change to *Ivesia webberi* is yet to be determined. However, as described above, the invasion of nonnative plant species and the associated wildfire regime changes currently pose a threat to *I. webberi* and the habitat in which it resides. Under current climate change projections, we anticipate that future climatic conditions will favor invasion by nonnative plant species that fire frequency will continue to increase and the extent and severity of fires may increase as well. The alteration of precipitation and temperature patterns as a result of climate change also may result in decreased survivorship of *I. webberi* by causing physiological stress, altered phenology, and reduced recruitment events and/or seedling establishment. Climate change thus may exacerbate impacts from other factors currently affecting *I. webberi* and its habitat such as invasive plants and increased wildfire frequency.

Summary of Factors Affecting the Species

Nonnative, invasive plant species and a modified fire regime are impacting the quality and composition of the *Artemisia arbuscula*-perennial bunchgrass-forb habitat where *Ivesia webberi* occurs. Nonnative, invasive plant species can outcompete and displace *I. webberi* from its habitat, while high-intensity or frequent wildfires can kill *I. webberi* plants and destroy the seedbank. Ten *I. webberi* populations have already experienced a wildfire and 12 populations are invaded by nonnative, invasive plant species. Because there are no feasible means for controlling the spread of nonnative, invasive species given their extent and rapid rate of spread across the Great Basin landscape, we expect the likelihood that future wildfires will degrade *I.*

webberi habitat will increase as well. Additionally, as wildfire frequency increases, the potential for damage to *I. webberi* and its habitat from wildfire suppression activities also increases due to the relatively flat and accessible terrain in which it inhabits. Therefore, we expect impacts caused by the interaction between nonnative, invasive plant species and wildfire to continue and likely increase within the range of *I. webberi*.

During the past 10 to 20 years, the urban interface has expanded into *Ivesia webberi* habitat, leading to increased OHV use and road corridors in these areas. OHV use and road corridors are impacting 11 of the 16 populations of *Ivesia webberi*. These activities can kill or damage individual plants, and modify habitat by compacting soils, and fragmenting both occupied and potential habitat, which in turn precludes or reduces potential recruitment and population expansion of *I. webberi*. OHV and other road corridors also create vectors for nonnative, invasive plant species to invade otherwise remote, intact habitats. Since the urban interface will continue to expand, we expect the threat from OHVs and road corridors to continue and likely to increase within the range of *I. webberi*.

At seven populations of *Ivesia webberi*, development either has already occurred, or is being planned. Development can cause various forms of habitat loss, degradation, and fragmentation. Development impacts to *I. webberi* range from direct mortality (from uprooting, burying, or killing individuals) to the facilitation of nonnative, invasive plant species infestations and human-caused wildfires, which further fragments and isolates remaining populations. The impact of development has resulted in the permanent loss of *I. webberi* and its habitat, such as was the case for one population (USFWS 17) and the likely case for the presumed loss of a portion of another (USFWS 7, subpopulation Halfway Slope). Although the populations most likely to be developed occur on private land (USFWS 14 and 15) and are relatively small, these represent some of the highest-density populations of *I. webberi* across the species' range. In addition to the threat of development on private lands, the proposed NV Energy Bordertown to California transmission line may impact three populations distributed across a combination of public and private lands. Therefore, we regard development as likely to affect portions of six populations across the range of the species.

Livestock grazing may result in direct impacts to individual *Ivesia webberi* plants due to trampling, while also creating patterns of soil disturbance that in turn alter habitat function and create conditions conducive to the invasion of nonnative plant species. Two *I. webberi* populations are currently grazed by cattle. Another seven populations occur within vacant grazing allotments that are not currently affected by grazing, but that could be re-opened (to grazing) to alleviate pressures on other, nearby grazing allotments. Therefore, while grazing is currently not impacting a substantial number of populations, the re-opening of grazing allotments that are currently vacant could increase these impacts to *I. webberi* in the future.

Given current climate change projections, we anticipate that future climatic conditions will favor invasion by nonnative plant species, and contribute to increases in the frequency, spatial extent, and severity of wildfires. The alteration of precipitation and temperature patterns may result in decreased survivorship of *I. webberi* due to physiological stress of individual plants, altered phenology, and reduced seedling establishment and plant recruitment. These alterations in climatic conditions are likely to exacerbate impacts to *I. webberi* from other factors currently affecting *I. webberi* such as invasive plants and increased wildfire.

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APPENDIX A: Table A.1.

TABLE A.1.—Location-specific actions proposed in the rangewide Conservation Strategy for *Ivesia webberi* (Bergstrom 2009, Appendix 1), and actions implemented to date.

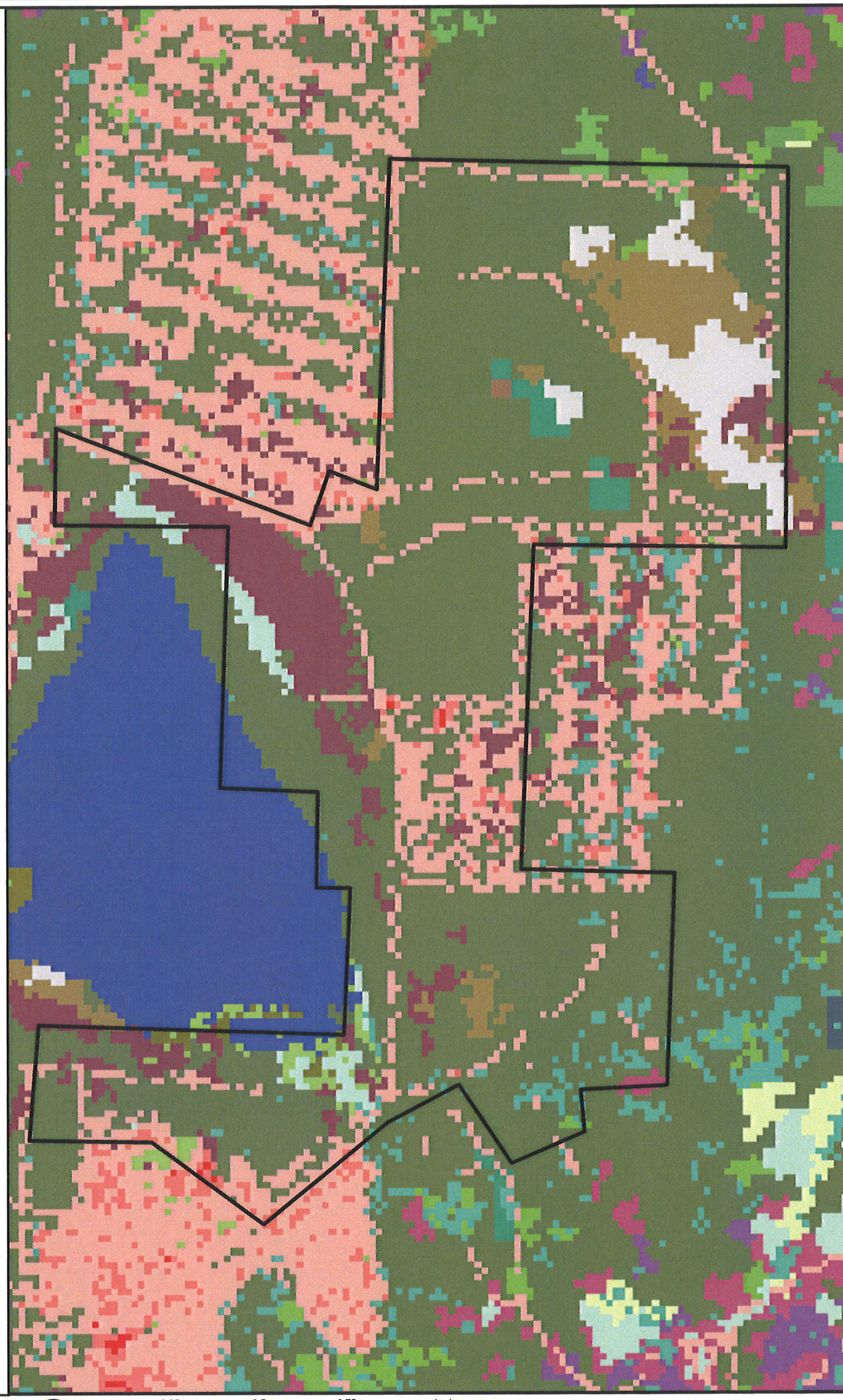
Population (USFWS)	Site Name	Recommended Action	Year Implemented
5	Dog Valley Meadow	Seed collection and long-term storage	2010
		Remove conifer encroachment in and adjacent to meadow	2011
		Establish demographic plots within the population and evaluate yearly	2011, not done in 2012
		Evaluate treatment methods to control Poa bulbosa and implement test plots	not implemented; more research needed on *Poa bulbosa*
		Monitor *Poa bulbosa* treatments	
		Implement control measures for *Poa bulbosa* within the meadow based on test plots	
		Prepare interpretive plan and signing to highlight rare plant resources within the Botanical Area	not implemented
		Complete a pollinator assessment	not yet implemented
		Remove cross-fencing within the meadow system and establish a perimeter fence along meadow boundary	not implemented, funding secured for a portion of fencing in 2013
	Upper Dog Valley	Create a barrier along USFS Route #038 to prevent road access across population	2010
		Effectiveness monitoring of road barriers	2012
		Establish statistical estimate of the population and mark the other boundaries of the occurrence	not implemented
		Monitor the establishment of Poa bulbosa within the population and evaluate Ivesia webberi distribution based on boundary delineation	not implemented
6	White Lake Overlook	Evaluate threats to population and determine possible options for habitat protection	not implemented
		Delineate boundaries of population	not implemented
7	Mules Ear Flat	Evaluate threats to population and determine possible options for habitat protection	not implemented
		Collect demographic and density data using a permanently marked sample of plants	not implemented
		Delineate boundaries of population	not implemented
8	Ivesia Flat	Fencing of population to close non-system bisecting roads	2010
		Seed collection and long-term storage	2010
		Informative signs	2011
		Effectiveness monitoring of habitat improvements	2011 evaluated, fencing was not evaluated in 2012
		Demographic monitoring over 10 years with pollination evaluation	not implemented
9	Stateline Road 1a	Actions not identified in Conservation Strategy because population discovered after 2009	
	Stateline Road 1b	Actions not identified in Conservation Strategy because population discovered after 2009	

10	Stateline Road 2	Actions not identified in Conservation Strategy because population discovered after 2009, however *Taeniatherum caput-medusae* infestation adjacent to rare plants was treated in 2011 by USFS.	
12	Black Springs	Acquire private property adjacent to USFS land with occupied *Ivesia webberi* habitat	2008
		Seed collection and long-term storage	2010
		Boulder placement along the road prism or closure	not implemented
		Establish statistical estimate of the population and permanent photoplots	not implemented
		Effectiveness monitoring of habitat protection measures	not implemented
13	Raleigh Heights	seed collection and long-term storage	2010
		Treatment of *Taeniatherum caput-medusae* surrounding population	on-going
		Demographic monitoring over 10 years with pollination evaluation	not implemented
		Coordinate with a botanical garden or University to conduct a seed bank assessment including germination trials	not implemented
		Close selected roads within population vicinity (roads are part of Peavine TMP)	partially funded by the USFWS; not implemented; requires NEPA
Northern Portion Carson Ranger District Potential Habitat Evaluation		Habitat modeling	being conducted by Nevada Natural Heritage Program
		Field verify potential habitat models	
Peavine Potential Habitat Evaluation		Close 3 non-system roads which influence potential habitat polygons identified by Witham (2000)	not implemented
		Collect seed for nursery cultivation and transplant seedlings to potential habitat polygons	not implemented
		Effectiveness monitoring of habitat protection measures	not implemented
		Transplant site seedling survival surveys	not implemented

Appendix A-C

NNHP Landcover Figure

- Project Boundary
- Artemisia (arbuscula, tridentata ssp. vaseyana)
- Artemisia arbuscula
- Artemisia nova Shrubland
- Artemisia tridentata ssp. (tridentata, wyomingensis)
- Artemisia tridentata ssp. vaseyana Shrubland Alliance
- Developed-High Intensity
- Developed-Low Intensity
- Developed-Medium Intensity
- Developed-OpenSpace
- Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
- Great Basin Pinyon-Juniper Woodland
- Great Basin Xeric Mixed Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Greasewood Flat
- Inter-Mountain Basins Mixed Salt Desert Scrub
- Inter-Mountain Basins Montane Riparian Systems
- Inter-Mountain Basins Montane Sagebrush Steppe
- Inter-Mountain Basins Semi-Desert Grassland
- Inter-Mountain Basins Semi-Desert Shrub-Steppe
- Inter-Mountain Basins Sparsely Vegetated Systems
- Introduced Upland Vegetation-Annual and Biennial Forbland
- Introduced Upland Vegetation-Annual Grassland
- Microphytic Playa Sparse Vegetation [placeholder]
- North American Arid West Emergent Marsh



0 0.25 0.5 0.75 1 mi

0 0.35 0.7 1.05 1.4 km

1:28,000

Vegetation / Landcover Map

Nevada Natural Heritage Program SynthMap
North Lemmon Valley Industrial Park
Washoe County, Nevada

USGS 7.5' Quads:
San Emidio Desert North and
San Emidio Desert South, Nevada 1990
T29N, R23E

Map Prepared By Cardno
5/9/2016

Cardno
Shaping the Future

5496 Reno Corporate Drive
Reno, Nevada 89511

ph. (775) 828-4362
fax (775) 828-4367

www.cardno.com

Map Projection: NAD 1983 UTM Zone 11N

APPENDIX B

CALCULATIONS

A.1 Runoff Calculations

Area 1

Sub-Basin Data			Initial/Overland Time (ti)			Travel Time, overland (tt)				Travel Time, channel (tt)				tc (ti + tt)	tc Urbanized Basins Check			Remarks
Designation	R	Area, Ac	Length, ft	Slope, %	ti, Min	Length, ft	Slope, %	Vel, ft/s	tt, min	Length, ft	Slope, %	Vel, ft/s	tt, min	tc, min	Total Length, ft	tc, min	tc Min	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
NV-1	0.7	26.9	380	1.0%	14.3	1290	1.0%	0.5	43.0	685	0.5%	4.0	2.9	60.2	2355	23.1	23.1	
VV-1	0.9	41.6	211	0.5%	6.5	500	0.8%	1.4	6.0	2029	0.4%	0.9	37.6	50.0	2740	25.2	25.2	
VV-2	0.9	14.7	58	0.5%	3.4				0.0	1744	0.6%	1.0	29.1	32.4	1801	20.0	20.0	
VV-3	0.9	11.5	250	0.5%	7.0				0.0	2165	0.7%	1.1	32.8	39.8	2415	23.4	23.4	
VV-5	0.9	25.6	251	0.5%	7.1				0.0	1741	0.6%	1.0	29.0	36.1	1992	21.1	21.1	
VV-6	0.9	7.7	201	0.5%	6.3				0.0	1025	0.5%	1.0	18.0	24.3	1226	16.8	16.8	
VV-7	0.9	70.4	208	0.5%	6.4	2448		1.2	34.0	1524	1.0%	0.5	50.8	91.2	4180		91.2	Sub Basin not considered Urban
VV-8	0.9	12.8	198	0.5%	6.3				0.0	932	0.9%	2.0	7.8	14.0	1130	16.3	14.0	
VV-9	0.9	5.1	146	1.0%	4.3				0.0	692	0.0%	2.0	5.8	10.0	838	14.7	10.0	
PR AREA1-1	0.9	58.2	266	0.5%	7.3	1545	0.4%	0.5	51.5	0	0.0%			58.8	1811		58.8	Sub Basin not considered Urban
PR AREA1-2	0.7	48.6	33	0.5%	5.3	992	0.6%	0.5	33.1	996	0.2%	0.5	33.2	71.6	2021		71.6	Sub Basin not considered Urban
LVP-1	0.9	10.2	78	0.5%	4.7	1139	0.5%	0.8	25.3	0	0.0%	0.0		30.0	1217	16.8	16.8	
LVP-2	0.5	14.7	333	0.5%	25.6	645	0.6%	0.6	0.0	200	0.9%	1.0	3.3	28.9	1178	16.5	16.5	
Proposed Basins																		
prp ph-1a (Proposed)	0.9	348.2	149	0.3%	6.7	880	0.2%	1.0	14.8	387	0.2%	4.0	1.6	23.2	1416	17.9	17.9	
PRP PH-1B (Proposed)	0.9	25.0	150	0.7%	4.9				0.0	1687	0.7%	1.7	16.7	21.6	1837	20.2	20.2	
PRP PH-2 (Proposed)	0.9	14.1	150	0.5%	0.0				0.0	1241	0.4%	1.2	17.0	17.0	1391	17.7	17.0	

Area 2

Existing Conditions

North Lemmon Valley Industrial Park: Time of Concentration Calcs

Calculated by: MG,PB Jan-2016

Sub Basin Data			Initial/Overland time (t_i)			Travel time (t_t)				t_c ($t_i + t_t$)	t_c Urban Check		Final t_c
Basin Name	R	Area (Ac)	Length (ft)	Slope (%)	ti (min)	Length (ft)	Slope (%)	Vel[1] (ft/s)	tt (min)	tc min	Total Length (ft)	t_t (min)	(min)
1	0.63	460.8	250	4.9%	7.9	9615	2.9%	2.1	76.3	84.2	9865	64.8	84.2
2	0.57	960	150	3.7%	7.5	12508	0.9%	1.8	115.8	123.3	12658	80.3	123.3[2]
3	0.60	313.6	500	5.0%	11.7	7602	1.9%	2.1	60.3	72.0	8102	55.0	72.0
4A	0.51	104.96	150	5.1%	7.5	7336	1.5%	1.8	67.9	75.5	7486	51.6	75.5
4B	0.51	23.04	95	3.8%	6.6	4378	3.8%	1.95	37.4	44.0	4473	34.9	44.0
5A	0.57	166.4	500	6.7%	11.3	9134	2.7%	2.2	69.2	80.5	9634	63.5	80.5
5B	0.57	44.8	200	6.9%	7.1	5887	4.6%	2.2	44.6	51.7	6087	43.8	51.7
6	0.57	160	500	8.2%	10.6	5328	2.3%	2.7	32.9	43.5	5828	42.4	43.5
7	0.60	24.32	100	0.5%	11.3	1973	0.5%	0.7	47.0	58.3	2073	21.5	58.3
8	0.41	62.08	100	1.5%	10.9	2024	0.6%	1.2	28.1	39.0	2124	21.8	39.0
9	0.41	39.68	100	0.6%	15.0	4223	0.3%	0.7	100.5	115.5	4323	34.0	115.5
10	0.44	37.12	500	0.5%	33.7	4030	0.5%	0.7	95.9	129.7	4530	35.2	129.7
11	0.66	19.2	10	0.5%	3.2	2180	0.3%	0.7	51.9	55.1	2190	22.2	55.1
12	0.64	24.32	10	0.4%	3.6	1885	0.4%	0.6	53.3	56.9	1895	20.5	56.9

[1]Velocity based on Chart in Figure 701 (TMRDM)

[2]Equation 710 (TMRDM) used to calculate lag time because basin area is greater than 1 square mile

Proposed Conditions

Basin Name	**4A**	**7**	**8**	**9**	**10**	**11**	**12**
Developed slope	1.0%	1.0%	1.0%	0.5%	0.5%	0.2%	0.4%
Shallow Concentrated Flow Length (ft)	3588	755	1600	1630	1585	1485	1135
Assumed Velocity[1] (ft/s)	1.8	2.0	2.0	1.5	1.5	0.9	1.3
Additional Flow Length (ft)	763	1738	936	0	370	--	790
Assumed Velocity[1] (ft/s)	4.5[2]	2.0	1.5	1.5	1.5	--	2.0
Additional Distance to Junction (ft)	--	--	578	1622	--	165	--
Assumed Velocity[1] (ft/s)	--	--	1.5	1.3	--	0.9	--
total t_c (min)	43.5	20.8	30.2	39.1	21.7	30.2	21.3
Total Length (ft)	4351	2493	3114	3252	1955	1650	1925
t_c urban check (min)	34.2	23.9	27.3	28.1	20.9	19.2	20.7

[1]Velocity based on Chart in Figure 701 (TMRDM)

[2]Velocity based on calculated peak velocity in V-ditch 1

Areas 3-6

Sub-Basin Data				Initial/Overland Time (ti)			Travel Time, overland (tt)				Travel Time, channel (tt)				tc (ti + tt)	tc Urbanized Basins Check			Remarks
Designation	R	Area Mi2	Area, Ac	Length, ft	Slope, %	ti, Min	Length, ft	Slope, %	Vel, ft/s	tt, min	Length, ft	Slope, %	Vel, ft/s	tt, min	tc, min	Total Length, ft	tc, min	tc,min	
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
E LEM-1	0.6	0.41	264.7	170	7.9%	5.9	2441	5.5%	2.1	19.4	5744	1.1%	1.7	56.6	81.9	8355	56.4	81.9	Sub Basin not considered Urban
E LEM-2	0.4	0.76	485.4	150	4.3%	9.1	7212	3.1%	1.8	68.7					77.8	7362	50.9	77.8	Sub Basin not considered Urban
E LEM-3	0.5	1.56	999.4	250	3.7%	11.3	6424	2.7%	1.6	66.9	5483	1.4%	1.9	47.4	125.6	12157	77.5		Lag Equation Used Area >1mi2
E LEM-4	0.6	0.43	272.3	500	7.1%	11.1	7828	2.8%	1.6	81.5	303	0.7%	1.3	3.7	96.4	8631	58.0	96.4	Sub Basin not considered Urban
E LEM-5	0.4	0.66	419.9	292	4.5%	12.7	7141	3.0%	1.7	70.0	3471	0.9%	1.5	38.4	121.1	10904	70.6	121.1	Sub Basin not considered Urban
E LEM-6	0.4	0.91	580.2	387	4.5%	14.7	7172	2.7%	1.6	74.7					89.4	7559	52.0	89.4	Sub Basin not considered Urban
E LEM-7	0.4	1.58	1011.1	500	2.8%	19.4	11805	1.8%	1.4	140.5					160.0	12305	78.4		Lag Equation Used Area >1mi2
E LEM-8	0.6	1.66	1061.0	337	4.6%	9.6	15295	0.6%	0.8	339.9					349.5	15632	96.8		Lag Equation Used Area >1mi2
E LEM-9	0.6	1.96	1253.5	228	10.8%	5.8	16242	1.8%	1.5	186.7					192.5	16470	101.5		Lag Equation Used Area >1mi2
E LEM-10	0.5	0.78	497.3	159	0.5%	17.8	5043	0.3%	0.4	238.6					256.4	5202	38.9	256.4	Sub Basin not considered Urban
E LEM-11	0.4	0.22	137.8	406	5.7%	14.2	3097	1.9%	1.2	42.3					56.5	3503	29.5	56.5	Sub Basin not considered Urban
HEP-1	0.9	0.24		422	0.1%	18.4	0	0.1%	0.3	0.0	4102	0.1%	2.0	34.2	52.5	4524	35.1	35.1	
HEP-2	0.9	0.18	115.5	184	0.1%	13.2	0	0.1%	0.3	0.0	5165	0.5%	4.0	21.5	34.7	5349	39.7	34.7	
HEP-34	0.9	1.14	729.0	183	0.1%	12.2	0	1.1%	0.9	0.0	9343	1.1%	5.0	31.1	43.4	9526	62.9	43.4	Developed area, lag equation not used
PR AREA-3	0.9	0.10	64.2	97	0.5%	4.4	1129	0.5%	0.6	29.2	1704	0.5%	1.1	24.9	58.5	2930	26.3	58.5	Sub Basin not considered Urban
PR AREA-4A	0.7	0.13	83.9	163	0.8%	9.4	1460	0.8%	0.8	31.9	1228	0.8%	1.4	14.6	55.8	2851	25.8	55.8	Sub Basin not considered Urban
PR AREA 4B	0.9	0.20	127.1	200	0.1%	10.1	2883	0.5%	0.6	76.1	623	0.5%	1.2	8.9	95.0	3706	30.6	95.0	Sub Basin not considered Urban
PR AREA 6	0.3	0.99	633.6	0	3.3%	0.0	4108	3.2%	1.8	38.7					38.7	4108	32.8	38.7	Sub Basin not considered Urban
Proposed Basins																			
PR AREA 4A (Proposed)		0.13	83.2	0		0.0	0				3769	0.5%	1.4	44.6	44.6	3769	30.9	30.9	
PR AREA 4B (Proposed)		0.2	128.0	0		0.0	0				4194	0.4%	1.3	54.4	54.4	4194	33.3	33.3	
PR AREA 6A (Proposed)	0.5	0.288	184.3	442	5.2%	12.5	0	0.9%	2.0	0.0	6635	0.9%	1.9	58.1	70.6	7077	49.3	49.3	
PR AREA 6B (Proposed)	0.3	0.446	285.4	442	5.2%	18.5	1008	5.3%	3.0	5.6	5490	1.6%	2.6	35.3	59.4	6940	48.6	48.6	
PR AREA 6C (Proposed)	0.2	0.256	163.8	0	5.2%	0.0	0	0.9%	2.0	0.0	8861	2.2%	3.0	48.5	48.5	8861	59.2	48.5	

HEC-HMS Inputs/Outputs:

Area 1

Basin: AREA1_EX

Last Modified Date: 20 May 2016

Last Modified Time: 18:53:39

Version: 4.1

Filepath Separator: \

Unit System: English

Missing Flow To Zero: No

Enable Flow Ratio: No

Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No

End:

Subbasin: VV-5

Last Modified Date: 13 May 2016

Last Modified Time: 23:05:24

Canvas X: 2270643.854343586

Canvas Y: 1.4906922385139277E7

Area: 0.04

Downstream: J-VV-5 Outlet

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 12.6

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: VV-2

Last Modified Date: 13 May 2016

Last Modified Time: 23:04:44

Canvas X: 2270474.2687691487

Canvas Y: 1.4906279790957477E7

Area: 0.023

Downstream: R-Patrician Dr Gutter

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 12

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R-Patrician Dr Gutter

Last Modified Date: 13 May 2016

Last Modified Time: 22:54:33

Canvas X: 2271051.719171712

Canvas Y: 1.4907908011764705E7

From Canvas X: 2270095.612767468

From Canvas Y: 1.4907453624562688E7

Downstream: J-VV-5 Outlet

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1089

Energy Slope: 0.0064

Mannings n: 0.05

Bottom Width: 1

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J-VV-5 Outlet

Last Modified Date: 13 May 2016

Last Modified Time: 22:13:45

Canvas X: 2271051.719171712

Canvas Y: 1.4907908011764705E7

Downstream: R-overland Park

End:

Reach: R-overland Park

Description: Routing reach through park and school area

Last Modified Date: 24 May 2016

Last Modified Time: 18:48:13

Canvas X: 2270919.189571124

Canvas Y: 1.4908797853368655E7

From Canvas X: 2271051.719171712

From Canvas Y: 1.4907908011764705E7

Downstream: J-SD Outlet Park

Route: Lag

Lag: 15.16

Channel Loss: None

End:

Subbasin: LVP-2

Last Modified Date: 20 May 2016

Last Modified Time: 18:32:01

Canvas X: 2271228.215763121

Canvas Y: 1.4908232753659897E7

Area: 0.023

Downstream: J-SD Outlet Park

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 50

Curve Number: 66.1

Transform: SCS

Lag: 9.26

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: LVP-1

Last Modified Date: 20 May 2016

Last Modified Time: 18:40:41

Canvas X: 2270619.1860416676

Canvas Y: 1.49080530399716E7

Area: 0.016

Downstream: J-SD Outlet Park

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 30

Curve Number: 66.1

Transform: SCS

Lag: 10.06

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: VV-9

Last Modified Date: 20 May 2016

Last Modified Time: 18:37:18

Canvas X: 2270239.7904774835

Canvas Y: 1.4908492340098549E7

Area: 0.008

Downstream: J-SD Outlet Park

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 6.02

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-SD Outlet Park

Last Modified Date: 20 May 2016

Last Modified Time: 18:54:05

Canvas X: 2270919.189571124

Canvas Y: 1.4908797853368655E7

Downstream: R PR AREA1-1 Channel

End:

Reach: R PR AREA1-1 Channel

Last Modified Date: 16 May 2016

Last Modified Time: 16:23:22

Canvas X: 2270359.599603015

Canvas Y: 1.491022957241876E7

From Canvas X: 2270919.189571124

From Canvas Y: 1.4908797853368655E7

Downstream: Outlet-PR AREA1-2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 752

Energy Slope: 0.0067

Mannings n: 0.055

Bottom Width: 2

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: VV-1

Last Modified Date: 13 May 2016

Last Modified Time: 23:04:25

Canvas X: 2269082.7079629716

Canvas Y: 1.4906071530156553E7

Area: 0.065

Downstream: J Fleetwood Dr SD Inlet

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 32.8

Curve Number: 66.1

Transform: SCS

Lag: 15.13

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J Fleetwood Dr SD Inlet

Last Modified Date: 13 May 2016

Last Modified Time: 20:38:22

Canvas X: 2269737.6956553534

Canvas Y: 1.4907501579352375E7

Downstream: R Fleetwood Dr SD

End:

Reach: R Fleetwood Dr SD

Description: Storm Drain on Fleetwood Drive

Last Modified Date: 24 May 2016

Last Modified Time: 18:44:07

Canvas X: 2269770.5380691504

Canvas Y: 1.490870200606823E7

From Canvas X: 2269737.6956553534

From Canvas Y: 1.4907501579352373E7

Downstream: J SD outlet 1

Route: Muskingum Cunge

Channel: Circular

Length: 930

Energy Slope: 0.0075

Mannings n: 0.013

Diameter: 1

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J SD outlet 1

Last Modified Date: 16 May 2016

Last Modified Time: 16:21:51

Canvas X: 2269770.5380691504

Canvas Y: 1.490870200606823E7

Downstream: SD outlet1

End:

Subbasin: VV-8

Last Modified Date: 13 May 2016

Last Modified Time: 23:08:45

Canvas X: 2270055.318288342

Canvas Y: 1.4907725783563897E7

Area: 0.02

Downstream: SD outlet1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 8.4

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: SD outlet1

Last Modified Date: 16 May 2016

Last Modified Time: 16:23:22

Canvas X: 2270359.599603015

Canvas Y: 1.491022957241876E7

From Canvas X: 2269770.5380691504

From Canvas Y: 1.490870200606823E7

Downstream: Outlet-PR AREA1-2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1974

Energy Slope: 0.01047

Mannings n: 0.055

Bottom Width: 2

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA1-2

Last Modified Date: 13 May 2016

Last Modified Time: 22:49:59

Canvas X: 2270275.4743682663

Canvas Y: 1.4909062912569832E7

Area: 0.076

Downstream: Outlet-PR AREA1-2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0

Curve Number: 66.1

Transform: SCS

Lag: 43

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: Outlet-PR AREA1-2

Last Modified Date: 16 May 2016

Last Modified Time: 16:23:22

Canvas X: 2270359.599603015

Canvas Y: 1.491022957241876E7

Downstream: Swan Lake

End:

Subbasin: PR AREA1-1

Last Modified Date: 13 May 2016

Last Modified Time: 22:50:10

Canvas X: 2272528.4775782675

Canvas Y: 1.4908239335766176E7

Area: 0.091

Downstream: J-Outlet PR AREA1-1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 2.6

Curve Number: 66.1

Transform: SCS

Lag: 35.25

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: VV-3

Description: Lag time includes routing through proposed area of 32.6 min

Last Modified Date: 16 May 2016

Last Modified Time: 15:38:42

Canvas X: 2271477.818107979

Canvas Y: 1.4907014694216989E7

Area: 0.018

Downstream: R- VV3 Lag thru PRArea1-1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 14.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- VV3 Lag thru PRArea1-1

Last Modified Date: 24 May 2016

Last Modified Time: 18:55:42

Canvas X: 2272456.259299822

Canvas Y: 1.49092810835083E7

From Canvas X: 2271827.26139078

From Canvas Y: 1.4907793453532947E7

Downstream: J-Outlet PR AREA1-1

Route: Muskingum

Muskingum K: 0.543

Muskingum x: 0.01

Muskingum Steps: 1

Channel Loss: None

End:

Subbasin: VV-6

Description: Includes additional lag time for routing through PRP AREA 1-1 of 39.14 min

Last Modified Date: 24 May 2016

Last Modified Time: 18:42:32

Canvas X: 2271358.0089824474

Canvas Y: 1.4907543851188088E7

Area: 0.012

Downstream: R VV-6 Lag thru PR Area1-1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 38

Curve Number: 66.1

Transform: SCS

Lag: 10.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R VV-6 Lag thru PR Area1-1

Last Modified Date: 24 May 2016

Last Modified Time: 18:55:45

Canvas X: 2272456.259299822

Canvas Y: 1.49092810835083E7

From Canvas X: 2271637.563608688

From Canvas Y: 1.490789329447089E7

Downstream: J-Outlet PR AREA1-1

Route: Muskingum

Muskingum K: 0.652

Muskingum x: 0.01

Muskingum Steps: 1

Channel Loss: None

End:

Junction: J-Outlet PR AREA1-1

Last Modified Date: 16 May 2016

Last Modified Time: 15:49:48

Canvas X: 2272456.259299822

Canvas Y: 1.49092810835083E7

Downstream: Swan Lake

End:

Subbasin: VV-7

Last Modified Date: 24 May 2016

Last Modified Time: 20:45:12

Canvas X: 2269270.6035480164

Canvas Y: 1.4907464211983787E7

Area: 0.11

Downstream: Outlet VV-7

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 5.65

Curve Number: 66.1

Transform: SCS

Lag: 54.73

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: Outlet VV-7

Last Modified Date: 13 May 2016

Last Modified Time: 22:37:20

Canvas X: 2268906.2717042943

Canvas Y: 1.4910883326209491E7

Downstream: Swan Lake

End:

Sink: Swan Lake

Last Modified Date: 13 May 2016

Last Modified Time: 22:37:30

Canvas X: 2270862.391170872

Canvas Y: 1.4910908860578027E7

End:

Subbasin: NV-1

Last Modified Date: 13 May 2016

Last Modified Time: 23:04:10

Canvas X: 2269011.746940782

Canvas Y: 1.4904947986801565E7

Area: 0.042

Downstream: NV-1 Outlet

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 50

Curve Number: 66.1

Transform: SCS

Lag: 13.85

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: NV-1 Outlet

Last Modified Date: 16 May 2016

Last Modified Time: 15:30:38

Canvas X: 2270249.7745712777

Canvas Y: 1.4905736730211318E7

End:

Basin Schematic Properties:

Last View N: 5000.0

Last View S: -5000.0

Last View W: -5000.0

Last View E: 5000.0

Maximum View N: 1.4911098188578866E7

Maximum View S: 1.4904708368550502E7

Maximum View W: 2268748.914373249

Maximum View E: 2273837.310372319

Extent Method: Maps

Buffer: 0

Draw Icons: Yes

Draw Icon Labels: Name

Draw Map Objects: No

Draw Gridlines: No

Draw Flow Direction: No

Fix Element Locations: No

Fix Hydrologic Order: No

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\ShapeFiles\Area1\Area1SubBasinsEX.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\ShapeFiles\Area1\SubBasinsPRP.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: No

End:

Basin: Area1OffsitePRP

Last Modified Date: 27 April 2016

Last Modified Time: 20:34:04

Version: 4.1

Filepath Separator: \

Unit System: English

Missing Flow To Zero: No

Enable Flow Ratio: No

Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No

End:

Subbasin: Gold6

Last Modified Date: 27 April 2016

Last Modified Time: 20:31:44

Canvas X: 2273891.2805763213

Canvas Y: 1.49047182746744E7

Area: 0.93

Downstream: Junction-1-2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 4

Curve Number: 74.5

Transform: SCS

Lag: 51

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: Gold5

Last Modified Date: 27 April 2016

Last Modified Time: 20:30:15

Canvas X: 2271466.754217069

Canvas Y: 1.4904140335251555E7

Area: 0.36

Downstream: Junction-Gold4 and Gold5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 17

Curve Number: 69.4

Transform: SCS

Lag: 33

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: Gold4

Last Modified Date: 27 April 2016

Last Modified Time: 20:30:03

Canvas X: 2269845.7046164065

Canvas Y: 1.4903336858492965E7

Area: 0.03

Downstream: Junction-Gold4 and Gold5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 27

Curve Number: 73.5

Transform: SCS

Lag: 13.2

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: Junction-Gold4 and Gold5

Last Modified Date: 27 April 2016

Last Modified Time: 20:32:52

Canvas X: 2269690.647698082

Canvas Y: 1.4904690082507432E7

Downstream: Reach-1

End:

Reach: Reach-1

Last Modified Date: 27 April 2016

Last Modified Time: 20:32:51

Canvas X: 2272411.191810499

Canvas Y: 1.4907636163955593E7

From Canvas X: 2269690.647698082

From Canvas Y: 1.4904690082507433E7

Downstream: Junction-1-2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 3800

Energy Slope: 0.0029

Mannings n: 0.04

Bottom Width: 12

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Junction: Junction-1-2

Last Modified Date: 27 April 2016

Last Modified Time: 20:33:01

Canvas X: 2272411.191810499

Canvas Y: 1.4907636163955593E7

Downstream: Reach-3

End:

Reach: Reach-3

Last Modified Date: 27 April 2016

Last Modified Time: 20:33:01

Canvas X: 2273891.2805763213

Canvas Y: 1.4908989387970058E7

From Canvas X: 2272411.191810499

From Canvas Y: 1.4907636163955593E7

Downstream: Junction-3-out

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1530

Energy Slope: 0.0029

Mannings n: 0.04

Bottom Width: 12

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: Gold7

Last Modified Date: 27 April 2016

Last Modified Time: 20:30:34

Canvas X: 2274271.87483039

Canvas Y: 1.490738243445288E7

Area: 0.13

Downstream: Junction-3-out

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 8

Curve Number: 72.8

Transform: SCS

Lag: 24

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: Junction-3-out

Last Modified Date: 27 April 2016

Last Modified Time: 20:30:34

Canvas X: 2273891.2805763213

Canvas Y: 1.4908989387970058E7

End:

Subbasin: LEM8

Last Modified Date: 27 April 2016

Last Modified Time: 20:39:13

Canvas X: 2270550.5087906076

Canvas Y: 1.490825639162889E7

Area: 0.69

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 45.9

Curve Number: 66.1

Transform: SCS

Lag: 123.6

Unitgraph Type: STANDARD

Baseflow: None

End:

Basin Schematic Properties:

Last View N: 5000.0

Last View S: -5000.0

Last View W: -5000.0

Last View E: 5000.0

Maximum View N: 1.4911371626078859E7

Maximum View S: 1.4901729904975787E7

Maximum View W: 2268748.3287356906

Maximum View E: 2278061.6026565544

Extent Method: Maps

Buffer: 0

Draw Icons: Yes

Draw Icon Labels: Name

Draw Map Objects: No

Draw Gridlines: No

Draw Flow Direction: No

Fix Element Locations: No

Fix Hydrologic Order: No

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\ShapeFiles\Area1\HydroBasins_prevstudy.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

End:

Area 2

Basin: North LV existing
Description: Existing conditions.
Last Modified Date: 1 February 2016
Last Modified Time: 18:09:39
Version: 4.1
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: Subbasin-2
Last Modified Date: 6 January 2016
Last Modified Time: 20:37:17
Canvas X: 2280316.8236129778
Canvas Y: 1.4905266990450965E7
Area: 1.5
Downstream: Junction-1-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.7

Transform: SCS
Lag: 104.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-1
Last Modified Date: 31 December 2015
Last Modified Time: 01:18:54
Canvas X: 2285536.4758506105
Canvas Y: 1.4908292803810202E7
Area: 0.72
Downstream: Junction-1-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 77.3

Transform: SCS
Lag: 50.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-1-2
Description: Upstream Junction
Last Modified Date: 29 December 2015
Last Modified Time: 20:32:44
Canvas X: 2282587.3072828986
Canvas Y: 1.4913265489497365E7
Downstream: Reach3
End:

Reach: Reach3
Last Modified Date: 31 December 2015
Last Modified Time: 17:42:57
Canvas X: 2277497.70551778
Canvas Y: 1.4911914832306273E7
From Canvas X: 2282587.3072828986
From Canvas Y: 1.4913265489497365E7
Downstream: Junction-3

Route: Lag
Lag: 66
Channel Loss: None
End:

Subbasin: Subbasin-3
Last Modified Date: 31 December 2015
Last Modified Time: 01:27:56
Canvas X: 2282072.8578150608
Canvas Y: 1.4914065678132035E7
Area: 0.49
Downstream: Junction-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 75.3

Transform: SCS
Lag: 43

Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-3
Last Modified Date: 6 January 2016
Last Modified Time: 19:52:13
Canvas X: 2277497.70551778
Canvas Y: 1.4911914832306273E7
Downstream: Reach-9
End:

Reach: Reach-9
Last Modified Date: 31 December 2015
Last Modified Time: 19:17:08
Canvas X: 2274424.78658541
Canvas Y: 1.4911243626701795E7
From Canvas X: 2277497.70551778
From Canvas Y: 1.4911914832306273E7
Downstream: Junction-7-8-9

Route: Lag
Lag: 60
Channel Loss: None
End:

Subbasin: Subbasin-5a
Last Modified Date: 6 January 2016
Last Modified Time: 20:03:38
Canvas X: 2278469.128128192
Canvas Y: 1.4908798871846331E7
Area: 0.26
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.8

Transform: SCS
Lag: 49.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-6
Last Modified Date: 31 December 2015

Last Modified Time: 01:42:37
Canvas X: 2276031.317208983
Canvas Y: 1.4907202837874006E7
Area: 0.25
Downstream: Reach-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.8

Transform: SCS
Lag: 26
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Reach-7
Description: lag reach shallow flow
Last Modified Date: 31 December 2015
Last Modified Time: 19:17:26
Canvas X: 2274424.78658541
Canvas Y: 1.4911243626701795E7
From Canvas X: 2274734.8163383743
From Canvas Y: 1.490953059744531E7
Downstream: Junction-7-8-9

Route: Lag
Lag: 28
Channel Loss: None
End:

Subbasin: Subbasin-4a
Last Modified Date: 6 January 2016
Last Modified Time: 20:34:03
Canvas X: 2278279.7792824716
Canvas Y: 1.4910624410594532E7
Area: 0.164
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 68.4

Transform: SCS
Lag: 45.3
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-8
Last Modified Date: 31 December 2015
Last Modified Time: 01:42:45
Canvas X: 2276308.4449216337
Canvas Y: 1.4910129211036908E7
Area: 0.097
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 60.3

Transform: SCS
Lag: 23
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-5b
Last Modified Date: 6 January 2016
Last Modified Time: 20:03:22
Canvas X: 2276850.775818471
Canvas Y: 1.4908545684310634E7
Area: 0.07
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.8

Transform: SCS
Lag: 32
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-9
Last Modified Date: 31 December 2015
Last Modified Time: 01:41:27
Canvas X: 2276749.5142102237
Canvas Y: 1.4911083212391147E7
Area: 0.062
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 60.7

Transform: SCS
Lag: 69
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-10
Last Modified Date: 6 January 2016
Last Modified Time: 20:12:05
Canvas X: 2276292.908024269
Canvas Y: 1.4911964111770911E7
Area: 0.058
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 62.8

Transform: SCS
Lag: 77.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-7
Last Modified Date: 31 December 2015

Last Modified Time: 01:41:24
Canvas X: 2274304.003604943
Canvas Y: 1.4909835756464822E7
Area: 0.038
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 75.1

Transform: SCS
Lag: 35
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-4b
Last Modified Date: 6 January 2016
Last Modified Time: 19:52:41
Canvas X: 2277764.126250807
Canvas Y: 1.4909974258063775E7
Area: 0.036
Downstream: Junction-7-8-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 68.4

Transform: SCS
Lag: 26.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-7-8-9
Last Modified Date: 6 January 2016
Last Modified Time: 20:11:42
Canvas X: 2274424.78658541
Canvas Y: 1.4911243626701795E7
Downstream: Reach-12
End:

Reach: Reach-12
Last Modified Date: 31 December 2015
Last Modified Time: 17:17:24
Canvas X: 2274214.279657234
Canvas Y: 1.4912313567146016E7
From Canvas X: 2274424.78658541
From Canvas Y: 1.4911243626701795E7
Downstream: Outlet Junction

Route: Muskingum Cunge
Channel: Triangular
Length: 1307
Energy Slope: 0.0015
Mannings n: 0.1
Side Slope: 15
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-12
Last Modified Date: 31 December 2015
Last Modified Time: 17:10:18
Canvas X: 2274920.8320709765
Canvas Y: 1.4911567948995665E7
Area: 0.038
Downstream: Outlet Junction

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 77.7

Transform: SCS
Lag: 32
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-11
Last Modified Date: 31 December 2015
Last Modified Time: 17:17:31
Canvas X: 2275374.1557808435
Canvas Y: 1.491219187177483E7
Area: 0.03
Downstream: Outlet Junction

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79.3

Transform: SCS
Lag: 33
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Outlet Junction
Description: Junction Downstream
Last Modified Date: 6 January 2016
Last Modified Time: 20:11:34
Canvas X: 2274214.279657234
Canvas Y: 1.4912313567146016E7
Downstream: Outlet
End:

Sink: Outlet
Description: Swan Lake
Last Modified Date: 31 December 2015
Last Modified Time: 17:17:32
Canvas X: 2273847.4797201375
Canvas Y: 1.4912617022070216E7
End:

Basin: North LV proposed
Description: Proposed conditions including conceptual drainage plan infrastructure
Last Modified Date: 1 February 2016
Last Modified Time: 18:14:14
Version: 4.1
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: Subbasin-2
Last Modified Date: 31 December 2015
Last Modified Time: 16:57:45
Canvas X: 2281784.5745946383
Canvas Y: 1.4904458087205198E7

Area: 1.5
Downstream: Junction-1-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.7

Transform: SCS
Lag: 104.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-1
Last Modified Date: 31 December 2015
Last Modified Time: 01:18:54
Canvas X: 2285536.4758506105
Canvas Y: 1.4908292803810202E7
Area: 0.72
Downstream: Junction-1-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 77.3

Transform: SCS
Lag: 50.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-1-2
Description: Upstream Junction
Last Modified Date: 29 December 2015
Last Modified Time: 20:32:44
Canvas X: 2282587.3072828986
Canvas Y: 1.4913265489497365E7
Downstream: Reach3
End:

Reach: Reach3

Last Modified Date: 5 January 2016
Last Modified Time: 23:44:30
Canvas X: 2277623.427180912
Canvas Y: 1.4912123556329312E7
From Canvas X: 2282587.3072828986
From Canvas Y: 1.4913265489497365E7
Downstream: Junction-3

Route: Lag
Lag: 66
Channel Loss: None
End:

Subbasin: Subbasin-3
Last Modified Date: 31 December 2015
Last Modified Time: 01:27:56
Canvas X: 2282072.8578150608
Canvas Y: 1.4914065678132035E7
Area: 0.49
Downstream: Junction-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 75.3

Transform: SCS
Lag: 43
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-4a
Last Modified Date: 6 January 2016
Last Modified Time: 20:31:52
Canvas X: 2278589.8358771265
Canvas Y: 1.4910682736685906E7
Label X: -42.0
Label Y: 25.0
Area: 0.164
Downstream: Junction-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0
Curve Number: 72.1

Transform: SCS
Lag: 26.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-3
Last Modified Date: 6 January 2016
Last Modified Time: 00:11:57
Canvas X: 2277623.427180912
Canvas Y: 1.4912123556329312E7
Downstream: MainChannel1
End:

Reach: MainChannel1
Last Modified Date: 6 January 2016
Last Modified Time: 00:11:57
Canvas X: 2276743.253749482
Canvas Y: 1.4912172003180077E7
From Canvas X: 2277623.427180912
From Canvas Y: 1.4912123556329312E7
Downstream: OutletLat1

Route: Muskingum Cunge
Channel: Trapezoid
Length: 1058
Energy Slope: 0.01
Mannings n: 0.03
Bottom Width: 5
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-5a
Last Modified Date: 6 January 2016
Last Modified Time: 00:14:55
Canvas X: 2278479.661784997
Canvas Y: 1.4908794037963687E7
Area: 0.26
Downstream: Ditch2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0

Curve Number: 72.8

Transform: SCS
Lag: 21.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Ditch2
Last Modified Date: 1 February 2016
Last Modified Time: 18:10:21
Canvas X: 2276871.253723446
Canvas Y: 1.4910577535535779E7
From Canvas X: 2276756.639113001
From Canvas Y: 1.4909708614047581E7
Downstream: Detention Basin 4B

Route: Muskingum Cunge
Channel: Triangular
Length: 984
Energy Slope: 0.005
Mannings n: 0.033
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-4b
Last Modified Date: 20 January 2016
Last Modified Time: 22:08:12
Canvas X: 2277692.703984073
Canvas Y: 1.4909974474665074E7
Area: 0.036
Downstream: Detention Basin 4B

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 68.4

Transform: SCS
Lag: 13.3
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: Detention Basin 4B

Last Modified Date: 1 February 2016
Last Modified Time: 18:26:31
Canvas X: 2276871.253723446
Canvas Y: 1.4910577535535779E7
Downstream: Lateral 1
Auxiliary Flow To: Det Basin Overflow

Route: Controlled Outflow
Routing Curve: Elevation-Area
Initial Outflow Equals Inflow: Yes
Elevation-Area Table: Elevation Area Detention 4B
Adaptive Control: On
Main Tailwater Condition: None
Auxiliary Tailwater Condition: None

Conduit: Orifice
Conduit Outlet: Main
Orifice Coefficient: 0.65
Orifice Area: 3.1416
Centerline Elevation: 4936
Number Barrels: 1
End Conduit:

Spillway: Broad-Crested Spillway
Spillway Outlet: Auxiliary
Spillway Crest Length: 45
Spillway Crest Elevation: 4943
Spillway Coefficient: 3.3
End Spillway:

Evaporation Method: Zero Evaporation
End Evaporation:
End:

Reach: Lateral 1
Description: Detention Basin outlet
Last Modified Date: 1 February 2016
Last Modified Time: 18:10:42
Canvas X: 2276743.253749482
Canvas Y: 1.4912172003180077E7
From Canvas X: 2276871.253723446
From Canvas Y: 1.4910577535535779E7
Downstream: OutletLat1

Route: Muskingum Cunge
Channel: Circular
Length: 1700
Energy Slope: 0.01
Mannings n: 0.013
Diameter: 2
Use Variable Time Step: No
Channel Loss: None
End:

Reach: Det Basin Overflow
Description: Overflow routing through streets within project area
Last Modified Date: 1 February 2016
Last Modified Time: 18:26:45
Canvas X: 2276743.253749482
Canvas Y: 1.4912172003180077E7
From Canvas X: 2276904.2281114967
From Canvas Y: 1.4910665481693996E7
Downstream: OutletLat1

Route: Muskingum Cunge
Channel: 8-point
Length: 1700
Energy Slope: 0.01
Mannings n: 0.013
Left Mannings n: 0.013
Right Mannings n: 0.013
Cross Section Name: Street XS
Use Variable Time Step: No
Invert Elevation: 4943
Channel Loss: None
End:

Junction: OutletLat1
Last Modified Date: 30 January 2016
Last Modified Time: 00:40:59
Canvas X: 2276743.253749482
Canvas Y: 1.4912172003180077E7
Downstream: MainChannel2
End:

Reach: MainChannel2
Last Modified Date: 6 January 2016
Last Modified Time: 00:04:18
Canvas X: 2275805.3646854213
Canvas Y: 1.4912245769735679E7
From Canvas X: 2276743.253749482
From Canvas Y: 1.4912172003180077E7
Downstream: MainChannel 2-3

Route: Muskingum Cunge
Channel: Trapezoid
Length: 930.5
Energy Slope: 0.01
Mannings n: 0.03
Bottom Width: 5
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-10

Last Modified Date: 27 January 2016
Last Modified Time: 20:28:22
Canvas X: 2276292.908024269
Canvas Y: 1.4911964111770911E7
Area: 0.058
Downstream: MainChannel 2-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 94.1

Transform: SCS
Lag: 12.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: MainChannel 2-3
Last Modified Date: 1 February 2016
Last Modified Time: 18:13:17
Canvas X: 2275805.3646854213
Canvas Y: 1.4912245769735679E7
Downstream: MainChannel3
End:

Reach: MainChannel3
Last Modified Date: 20 January 2016
Last Modified Time: 20:56:25
Canvas X: 2274302.0941854
Canvas Y: 1.4912406329178909E7
From Canvas X: 2275805.3646854213
From Canvas Y: 1.4912245769735679E7
Downstream: Outlet Junction

Route: Muskingum Cunge
Channel: Rectangular
Length: 1496
Energy Slope: 0.01
Mannings n: 0.013
Width: 8
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-6
Last Modified Date: 18 January 2016
Last Modified Time: 22:49:27

Canvas X: 2276031.317208983
Canvas Y: 1.4907202837874006E7
Area: 0.25
Downstream: Junction 5b-6

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.8

Transform: SCS
Lag: 26
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-5b
Last Modified Date: 19 January 2016
Last Modified Time: 18:58:06
Canvas X: 2276726.8366134274
Canvas Y: 1.4908722080351742E7
Area: 0.07
Downstream: Ditch3A

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 72.8

Transform: SCS
Lag: 12.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reach: Ditch3A
Last Modified Date: 28 January 2016
Last Modified Time: 19:22:17
Canvas X: 2274369.016862872
Canvas Y: 1.4909660179119132E7
From Canvas X: 2275487.7989778705
From Canvas Y: 1.4909532964930205E7
Downstream: Junction 5b-6

Route: Muskingum Cunge
Channel: Triangular
Length: 1095
Energy Slope: 0.01
Mannings n: 0.03
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Junction: Junction 5b-6
Last Modified Date: 28 January 2016
Last Modified Time: 19:24:15
Canvas X: 2274369.016862872
Canvas Y: 1.4909660179119132E7
Downstream: Ditch 3A-2
End:

Reach: Ditch 3A-2
Last Modified Date: 28 January 2016
Last Modified Time: 19:24:15
Canvas X: 2274369.016862872
Canvas Y: 1.4909660179119132E7
From Canvas X: 2274369.016862872
From Canvas Y: 1.4909660179119132E7
Downstream: Inlet West Channel

Route: Muskingum Cunge
Channel: Triangular
Length: 473
Energy Slope: 0.01
Mannings n: 0.03
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Junction: Inlet West Channel
Last Modified Date: 28 January 2016
Last Modified Time: 19:22:52
Canvas X: 2274369.016862872
Canvas Y: 1.4909660179119132E7
Downstream: West Channel A
End:

Reach: West Channel A
Last Modified Date: 28 January 2016
Last Modified Time: 19:24:15
Canvas X: 2274325.1295301006
Canvas Y: 1.4910467789870758E7
From Canvas X: 2274369.016862872
From Canvas Y: 1.4909660179119132E7

Downstream: West Channel A-B

Route: Muskingum Cunge
Channel: Trapezoid
Length: 820.5
Energy Slope: 0.0016
Mannings n: 0.03
Bottom Width: 20
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-8
Last Modified Date: 27 January 2016
Last Modified Time: 20:52:39
Canvas X: 2276308.4449216337
Canvas Y: 1.4910129211036908E7
Area: 0.097
Downstream: West Channel A-B

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90.4

Transform: SCS
Lag: 17.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: West Channel A-B
Last Modified Date: 1 February 2016
Last Modified Time: 18:14:01
Canvas X: 2274325.1295301006
Canvas Y: 1.4910467789870758E7
Downstream: West Channel B
End:

Reach: West Channel B
Last Modified Date: 19 January 2016
Last Modified Time: 23:50:05
Canvas X: 2274300.7151952256
Canvas Y: 1.4911436563240502E7
From Canvas X: 2274325.1295301006
From Canvas Y: 1.4910467789870758E7
Downstream: West Channel B-C

Route: Muskingum Cunge
Channel: Trapezoid
Length: 920
Energy Slope: 0.0016
Mannings n: 0.03
Bottom Width: 20
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-9
Last Modified Date: 27 January 2016
Last Modified Time: 20:28:13
Canvas X: 2276201.407065239
Canvas Y: 1.4911075678625003E7
Label X: 13.0
Label Y: -2.0
Area: 0.062
Downstream: West Channel B-C

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 97.5

Transform: SCS
Lag: 16.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-7
Last Modified Date: 27 January 2016
Last Modified Time: 20:27:53
Canvas X: 2274304.003604943
Canvas Y: 1.4909835756464822E7
Area: 0.038
Downstream: West Channel B-C

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0

Curve Number: 89

Transform: SCS
Lag: 12.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: West Channel B-C
Last Modified Date: 1 February 2016
Last Modified Time: 18:14:14
Canvas X: 2274300.7151952256
Canvas Y: 1.4911436563240502E7
Downstream: West Channel C
End:

Reach: West Channel C
Last Modified Date: 20 January 2016
Last Modified Time: 21:00:19
Canvas X: 2274302.0941854
Canvas Y: 1.4912406329178909E7
From Canvas X: 2274300.7151952256
From Canvas Y: 1.4911436563240502E7
Downstream: Outlet Junction

Route: Muskingum Cunge
Channel: Trapezoid
Length: 770
Energy Slope: 0.0016
Mannings n: 0.03
Bottom Width: 20
Side Slope: 3
Use Variable Time Step: No
Channel Loss: None
End:

Subbasin: Subbasin-12
Last Modified Date: 27 January 2016
Last Modified Time: 20:28:41
Canvas X: 2274920.8320709765
Canvas Y: 1.4911567948995665E7
Area: 0.038
Downstream: Outlet Junction

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: SCS
Lag: 12.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Subbasin-11
Last Modified Date: 27 January 2016
Last Modified Time: 20:28:27
Canvas X: 2275380.9812887
Canvas Y: 1.4912207583765693E7
Area: 0.03
Downstream: Outlet Junction

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 89.1

Transform: SCS
Lag: 11.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Outlet Junction
Description: Junction Downstream
Last Modified Date: 18 January 2016
Last Modified Time: 22:48:17
Canvas X: 2274302.0941854
Canvas Y: 1.4912406329178909E7
Downstream: Outlet
End:

Sink: Outlet
Description: Swan Lake
Last Modified Date: 31 December 2015
Last Modified Time: 17:17:32
Canvas X: 2273847.4797201375
Canvas Y: 1.4912617022070216E7
End:

Area 3

Basin: Area3456_EXFinal

Last Modified Date: 24 May 2016

Last Modified Time: 17:17:54

Version: 4.1

Filepath Separator: \

Unit System: English

Missing Flow To Zero: No

Enable Flow Ratio: No

Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No

End:

Subbasin: E LEM-9

Last Modified Date: 16 May 2016

Last Modified Time: 21:21:17

Canvas X: 2288371.6711880965

Canvas Y: 1.4911056440928426E7

Area: 1.96

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 77.1

Transform: SCS

Lag: 106.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-8

Last Modified Date: 16 May 2016

Last Modified Time: 21:21:09

Canvas X: 2291529.092037861

Canvas Y: 1.4918802646746514E7

Area: 1.66

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 76.2

Transform: SCS

Lag: 116.3

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-7

Last Modified Date: 16 May 2016

Last Modified Time: 21:21:02

Canvas X: 2282333.1091771415

Canvas Y: 1.4927404168164324E7

Area: 1.58

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 61.6

Transform: SCS

Lag: 89.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-E LEM-7 and 8

Last Modified Date: 12 May 2016

Last Modified Time: 21:06:29

Canvas X: 2283497.2677890547

Canvas Y: 1.4920354947548063E7

Downstream: R-Lag Reach E LEM-10

End:

Reach: R-Lag Reach E LEM-10

Last Modified Date: 23 May 2016

Last Modified Time: 20:11:19

Canvas X: 2278879.243948346

Canvas Y: 1.4918004504526889E7

From Canvas X: 2283497.2677890547

From Canvas Y: 1.4920354947548063E7

Downstream: J-Outlet E LEM-10

Route: Muskingum

Muskingum K: 3.6

Muskingum x: 0.01

Muskingum Steps: 1

Channel Loss: None

End:

Subbasin: E LEM-10

Last Modified Date: 23 May 2016

Last Modified Time: 20:11:47

Canvas X: 2282935.554836932

Canvas Y: 1.491802347842594E7

Area: 0.78

Downstream: J-Outlet E LEM-10

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 65.8

Transform: SCS

Lag: 153.87

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet E LEM-10

Last Modified Date: 12 May 2016

Last Modified Time: 22:19:15

Canvas X: 2278879.243948346

Canvas Y: 1.4918004504526889E7

Downstream: R-PRP AREA6

End:

Reach: R-PRP AREA6

Last Modified Date: 24 May 2016

Last Modified Time: 17:07:56

Canvas X: 2273430.105693537

Canvas Y: 1.4916588914448101E7

From Canvas X: 2278879.243948346

From Canvas Y: 1.4918004504526889E7

Downstream: J-Outlet PRP AREA 4A

Route: Muskingum Cunge

Channel: Triangular

Length: 6707

Energy Slope: 0.0067

Mannings n: 0.065

Side Slope: 100

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-6

Last Modified Date: 24 May 2016

Last Modified Time: 16:36:23

Canvas X: 2279038.312321187

Canvas Y: 1.4921949821028411E7

Area: 0.99

Downstream: EX Detention Basin

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 53.5

Transform: SCS

Lag: 23.22

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-6

Last Modified Date: 24 May 2016

Last Modified Time: 16:36:15

Canvas X: 2279471.80541042

Canvas Y: 1.492853015624147E7

Area: 0.91

Downstream: J-E LEM-06 OUTLET

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 60.8

Transform: SCS

Lag: 76.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-E LEM-06 OUTLET

Last Modified Date: 23 May 2016

Last Modified Time: 19:33:44

Canvas X: 2278050.2290064474

Canvas Y: 1.4923128165906373E7

Downstream: EX Detention Basin

End:

Reservoir: EX Detention Basin

Last Modified Date: 12 May 2016

Last Modified Time: 23:27:47

Canvas X: 2276881.790867774

Canvas Y: 1.4920485478347823E7

Downstream: R-PRP AREA6 Outlet

Route: Controlled Outflow

Routing Curve: Elevation-Storage

Initial Storage: 0

Elevation-Storage Table: EX Detention El v Storage

Adaptive Control: On

Main Tailwater Condition: None

Auxiliary Tailwater Condition: None

Spillway: Broad-Crested Spillway

Spillway Outlet: Main

Spillway Crest Length: 330

Spillway Crest Elevation: 2

Spillway Coefficient: 3.2

End Spillway:

Evaporation Method: Zero Evaporation

End Evaporation:

End:

Reach: R-PRP AREA6 Outlet

Last Modified Date: 24 May 2016

Last Modified Time: 17:14:23

Canvas X: 2273430.105693537

Canvas Y: 1.4916588914448101E7

From Canvas X: 2276881.790867774

From Canvas Y: 1.4920485478347823E7

Downstream: J-Outlet PRP AREA 4A

Route: Muskingum Cunge

Channel: Triangular

Length: 4101

Energy Slope: 0.57

Mannings n: 0.065

Side Slope: 100

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: E LEM-5

Last Modified Date: 24 May 2016

Last Modified Time: 16:45:46

Canvas X: 2278338.1019354495

Canvas Y: 1.4929845768419808E7

Area: 0.66

Downstream: J-Outlet E LEM-5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 3.3

Curve Number: 61.4

Transform: SCS

Lag: 72.7

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-4

Last Modified Date: 24 May 2016

Last Modified Time: 16:45:37

Canvas X: 2277588.2166751563

Canvas Y: 1.4931195611998918E7

Area: 0.656

Downstream: R-E LEM-5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 72.8

Transform: SCS

Lag: 57.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R-E LEM-5

Last Modified Date: 12 May 2016

Last Modified Time: 20:52:11

Canvas X: 2274021.048763214

Canvas Y: 1.4923121554817667E7

From Canvas X: 2273723.1326585426

From Canvas Y: 1.4927035089101758E7

Downstream: J-Outlet E LEM-5

Route: Muskingum Cunge

Channel: Triangular

Length: 3962

Energy Slope: 0.0087

Mannings n: 0.04

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J-Outlet E LEM-5

Last Modified Date: 12 May 2016

Last Modified Time: 20:52:11

Canvas X: 2274021.048763214

Canvas Y: 1.4923121554817667E7

Label X: 1.0

Label Y: 0.0

Downstream: R-Matterhornblvd

End:

Reach: R-Matterhornblvd

Last Modified Date: 24 May 2016

Last Modified Time: 17:07:56

Canvas X: 2273430.105693537

Canvas Y: 1.4916588914448101E7

From Canvas X: 2274021.048763214

From Canvas Y: 1.4923121554817667E7

Downstream: J-Outlet PRP AREA 4A

Route: Muskingum Cunge

Channel: Trapezoid

Length: 7276

Energy Slope: 0.0116

Mannings n: 0.04

Bottom Width: 2

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-4A

Last Modified Date: 24 May 2016

Last Modified Time: 16:48:11

Canvas X: 2274389.9511119183

Canvas Y: 1.491851230074035E7

Area: 0.13

Downstream: J-Outlet PRP AREA 4A

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 84.6

Transform: SCS

Lag: 33.4

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet PRP AREA 4A

Last Modified Date: 24 May 2016

Last Modified Time: 17:07:56

Canvas X: 2273430.105693537

Canvas Y: 1.4916588914448101E7

Downstream: R-PRP AREA4B

End:

Reach: R-PRP AREA4B

Last Modified Date: 24 May 2016

Last Modified Time: 17:07:56

Canvas X: 2273856.5786147285

Canvas Y: 1.4915060719813831E7

From Canvas X: 2273430.105693537

From Canvas Y: 1.4916588914448101E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Triangular

Length: 1743

Energy Slope: 0.0037

Mannings n: 0.05

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-2

Last Modified Date: 23 May 2016

Last Modified Time: 19:35:15

Canvas X: 2278370.0836973414

Canvas Y: 1.4916908769138994E7

Area: 0.302

Downstream: R- LAG HEP-2 OUTFLOW

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 69.75

Transform: SCS

Lag: 20.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- LAG HEP-2 OUTFLOW

Last Modified Date: 16 May 2016

Last Modified Time: 23:46:12

Canvas X: 2273856.5786147285

Canvas Y: 1.4915060719813831E7

From Canvas X: 2275867.78636594

From Canvas Y: 1.4915355092474103E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Triangular

Length: 2042

Energy Slope: 0.0041

Mannings n: 0.04

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-1

Last Modified Date: 24 May 2016

Last Modified Time: 16:47:32

Canvas X: 2276178.0428233175

Canvas Y: 1.491454326687329E7

Area: 0.24

Downstream: R-LAG HEP-1 TO OUT

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 75

Transform: SCS

Lag: 21.08

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R-LAG HEP-1 TO OUT

Last Modified Date: 16 May 2016

Last Modified Time: 23:46:12

Canvas X: 2273856.5786147285

Canvas Y: 1.4915060719813831E7

From Canvas X: 2275156.9517351785

From Canvas Y: 1.4914797369705657E7

Downstream: O-SwanLake2

Route: Lag

Lag: 9

Channel Loss: None

End:

Subbasin: E LEM-11

Last Modified Date: 13 May 2016

Last Modified Time: 17:37:11

Canvas X: 2278930.109581284

Canvas Y: 1.4914072993284354E7

Area: 0.22

Downstream: J-Outlet E LEM 11

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 7.3

Curve Number: 59.8

Transform: SCS

Lag: 33.92

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet E LEM 11

Last Modified Date: 12 May 2016

Last Modified Time: 22:07:21

Canvas X: 2277765.918390753

Canvas Y: 1.491515020971595E7

Downstream: R-Nectar St

End:

Reach: R-Nectar St

Last Modified Date: 16 May 2016

Last Modified Time: 23:46:12

Canvas X: 2273856.5786147285

Canvas Y: 1.4915060719813831E7

From Canvas X: 2277765.918390753

From Canvas Y: 1.491515020971595E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Triangular

Length: 3941

Energy Slope: 0.0046

Mannings n: 0.07

Side Slope: 10

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-4B

Last Modified Date: 24 May 2016

Last Modified Time: 16:48:21

Canvas X: 2275491.391479297

Canvas Y: 1.4916837690318797E7

Area: 0.199

Downstream: O-SwanLake2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 86.2

Transform: SCS

Lag: 51.67

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: O-SwanLake2

Last Modified Date: 23 May 2016

Last Modified Time: 23:03:58

Canvas X: 2273856.5786147285

Canvas Y: 1.4915060719813831E7

Downstream: Swan Lake

End:

Subbasin: E LEM-2

Last Modified Date: 13 May 2016

Last Modified Time: 17:31:29

Canvas X: 2270294.8438745127

Canvas Y: 1.4930229397276394E7

Area: 0.76

Downstream: J-E LEM 2 AND 3

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 61.9

Transform: SCS

Lag: 46.7

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-3

Last Modified Date: 12 May 2016

Last Modified Time: 21:01:38

Canvas X: 2272489.5583227505

Canvas Y: 1.493398701443777E7

Area: 0.76

Downstream: R- E LEM2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 1

Curve Number: 66.4

Transform: SCS

Lag: 64.4

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- E LEM2

Description: Reach carrying flow from E LEM-3 outlet to HEP-34Channel

Last Modified Date: 12 May 2016

Last Modified Time: 20:36:34

Canvas X: 2271857.746587652

Canvas Y: 1.4925374422890896E7

From Canvas X: 2273487.1557992226

From Canvas Y: 1.4927436124342272E7

Downstream: J-E LEM 2 AND 3

Route: Muskingum Cunge

Channel: Triangular

Length: 3047

Energy Slope: 0.0088

Mannings n: 0.065

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J-E LEM 2 AND 3

Last Modified Date: 12 May 2016

Last Modified Time: 20:38:05

Canvas X: 2271857.746587652

Canvas Y: 1.4925374422890896E7

Downstream: R-HEP34 Channel

End:

Reach: R-HEP34 Channel

Description: Channel through HEP 3 and 4 develpments

Last Modified Date: 12 May 2016

Last Modified Time: 20:40:18

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

From Canvas X: 2271857.746587652

From Canvas Y: 1.4925374422890896E7

Downstream: O-SwanLake1

Route: Muskingum Cunge

Channel: Trapezoid

Length: 7431

Energy Slope: 0.0075

Mannings n: 0.065

Bottom Width: 4

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-34

Last Modified Date: 24 May 2016

Last Modified Time: 15:56:17

Canvas X: 2272655.8245688295

Canvas Y: 1.4924676104657367E7

Area: 1.14

Downstream: O-SwanLake1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 71.9

Transform: SCS

Lag: 26.02

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-1

Last Modified Date: 24 May 2016

Last Modified Time: 16:45:17

Canvas X: 2268395.4688152373

Canvas Y: 1.4924410402931456E7

Area: 0.41

Downstream: R- E LEM-01 TO OUT

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 74.6

Transform: SCS

Lag: 49.13

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- E LEM-01 TO OUT

Last Modified Date: 16 May 2016

Last Modified Time: 20:47:20

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

From Canvas X: 2268918.445796485

From Canvas Y: 1.491894380586345E7

Downstream: O-SwanLake1

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1089

Energy Slope: 0.0121

Mannings n: 0.045

Bottom Width: 2

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Junction: O-SwanLake1

Description: Northern most outlet to Swan Lake

Last Modified Date: 16 May 2016

Last Modified Time: 20:47:20

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

Downstream: Swan Lake

End:

Subbasin: PR AREA-3

Last Modified Date: 24 May 2016

Last Modified Time: 16:48:02

Canvas X: 2274937.4213418798

Canvas Y: 1.4913834340312468E7

Area: 0.10

Downstream: O-SwanLake3

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 85.9

Transform: SCS

Lag: 35.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: O-SwanLake3

Last Modified Date: 12 May 2016

Last Modified Time: 22:22:22

Canvas X: 2274193.2081083483

Canvas Y: 1.491248551920764E7

Downstream: Swan Lake

End:

Sink: Swan Lake

Last Modified Date: 16 May 2016

Last Modified Time: 20:48:12

Canvas X: 2269554.856306129

Canvas Y: 1.4915673362966668E7

End:

Basin Schematic Properties:

Last View N: 1.4934785092418948E7

Last View S: 1.4912039869955389E7

Last View W: 2268016.8642411563

Last View E: 2293023.5717755426

Maximum View N: 1.4934785092418948E7

Maximum View S: 1.4912039869955389E7

Maximum View W: 2268016.8642411563

Maximum View E: 2293023.5717755426

Extent Method: Elements

Buffer: 5

Draw Icons: Yes

Draw Icon Labels: Name

Draw Map Objects: No

Draw Gridlines: No

Draw Flow Direction: No

Fix Element Locations: No

Fix Hydrologic Order: No

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\Working\Shapefiles\AREA6\HMS\A6_routing.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\Working\Shapefiles\AREA6\HMS\A6_flowpath.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\ShapeFiles\Area3456\Area456Basins.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

End:

Basin: Area3456_PRP

Last Modified Date: 17 May 2016

Last Modified Time: 00:03:52

Version: 4.1

Filepath Separator: \

Unit System: English

Missing Flow To Zero: No

Enable Flow Ratio: No

Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No

End:

Subbasin: E LEM-9

Last Modified Date: 16 May 2016

Last Modified Time: 21:21:17

Canvas X: 2288371.6711880965

Canvas Y: 1.4911056440928426E7

Area: 1.96

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 77.1

Transform: SCS

Lag: 106.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-8

Last Modified Date: 20 May 2016

Last Modified Time: 21:45:41

Canvas X: 2291519.6654340867

Canvas Y: 1.4918756818464158E7

Area: 1.66

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 76.2

Transform: SCS

Lag: 116.3

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-7

Last Modified Date: 16 May 2016

Last Modified Time: 21:21:02

Canvas X: 2282333.1091771415

Canvas Y: 1.4927404168164324E7

Area: 1.58

Downstream: J-E LEM-7 and 8

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 61.6

Transform: SCS

Lag: 89.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-E LEM-7 and 8

Last Modified Date: 17 May 2016

Last Modified Time: 00:04:05

Canvas X: 2283497.2677890547

Canvas Y: 1.4920354947548063E7

Downstream: R-Lag Reach E LEM-10

End:

Reach: R-Lag Reach E LEM-10

Last Modified Date: 23 May 2016

Last Modified Time: 22:31:39

Canvas X: 2279329.6477700225

Canvas Y: 1.491815264849247E7

From Canvas X: 2283497.2677890547

From Canvas Y: 1.4920354947548063E7

Downstream: J-Outlet E LEM-10

Route: Muskingum

Muskingum K: 3.6

Muskingum x: 0.01

Muskingum Steps: 1

Channel Loss: None

End:

Subbasin: E LEM-10

Last Modified Date: 20 May 2016

Last Modified Time: 21:46:27

Canvas X: 2282935.554836932

Canvas Y: 1.491802347842594E7

Area: 0.78

Downstream: J-Outlet E LEM-10

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 65.8

Transform: SCS

Lag: 153.87

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet E LEM-10

Last Modified Date: 23 May 2016

Last Modified Time: 22:31:39

Canvas X: 2279329.6477700225

Canvas Y: 1.491815264849247E7

Downstream: R-PRP AREA6

End:

Reach: R-PRP AREA6

Last Modified Date: 23 May 2016

Last Modified Time: 22:31:39

Canvas X: 2276308.797911581

Canvas Y: 1.4917903872621775E7

From Canvas X: 2279329.6477700225

From Canvas Y: 1.491815264849247E7

Downstream: J-NW Corner HEP-02

Route: Muskingum Cunge

Channel: Trapezoid

Length: 3657

Energy Slope: 0.00702

Mannings n: 0.05

Bottom Width: 12

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: E LEM-6

Last Modified Date: 20 May 2016

Last Modified Time: 21:45:35

Canvas X: 2279471.80541042

Canvas Y: 1.492853015624147E7

Area: 0.91

Downstream: J-E LEM-06 OUTLET

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 60.8

Transform: SCS

Lag: 53.6

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-E LEM-06 OUTLET

Last Modified Date: 16 May 2016

Last Modified Time: 23:28:06

Canvas X: 2278050.2290064474

Canvas Y: 1.492337694177707E7

Downstream: R-Flow Thru Area6

End:

Reach: R-Flow Thru Area6

Last Modified Date: 23 May 2016

Last Modified Time: 22:28:08

Canvas X: 2276308.797911581

Canvas Y: 1.4917903872621775E7

From Canvas X: 2278050.2290064474

From Canvas Y: 1.492337694177707E7

Downstream: J-NW Corner HEP-02

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1283

Energy Slope: 0.015

Mannings n: 0.05

Bottom Width: 6

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-6C

Last Modified Date: 24 May 2016

Last Modified Time: 17:37:12

Canvas X: 2278725.4777983343

Canvas Y: 1.4921919825962998E7

Area: 0.256

Downstream: J-NW Corner HEP-02

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 40

Curve Number: 43.8

Transform: SCS

Lag: 29.12

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-NW Corner HEP-02

Last Modified Date: 23 May 2016

Last Modified Time: 22:28:08

Canvas X: 2276308.797911581

Canvas Y: 1.4917903872621775E7

Downstream: R-prp AREA 6 TO OUT

End:

Reach: R-prp AREA 6 TO OUT

Last Modified Date: 23 May 2016

Last Modified Time: 22:28:08

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2276308.797911581

From Canvas Y: 1.4917903872621775E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 4639

Energy Slope: 0.0048

Mannings n: 0.05

Bottom Width: 15

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: E LEM-5

Last Modified Date: 24 May 2016

Last Modified Time: 17:28:27

Canvas X: 2278338.1019354495

Canvas Y: 1.4929845768419808E7

Area: 0.66

Downstream: J-Outlet E LEM-5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 3.3

Curve Number: 61.4

Transform: SCS

Lag: 72.7

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-4

Last Modified Date: 24 May 2016

Last Modified Time: 17:28:18

Canvas X: 2277788.3805500316

Canvas Y: 1.493136807379481E7

Area: 0.656

Downstream: R-E LEM-5

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 72.8

Transform: SCS

Lag: 57.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R-E LEM-5

Last Modified Date: 12 May 2016

Last Modified Time: 20:52:11

Canvas X: 2274021.048763214

Canvas Y: 1.4923121554817667E7

From Canvas X: 2273723.1326585426

From Canvas Y: 1.4927035089101758E7

Downstream: J-Outlet E LEM-5

Route: Muskingum Cunge

Channel: Triangular

Length: 3962

Energy Slope: 0.0087

Mannings n: 0.04

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J-Outlet E LEM-5

Last Modified Date: 12 May 2016

Last Modified Time: 20:52:11

Canvas X: 2274021.048763214

Canvas Y: 1.4923121554817667E7

Label X: 1.0

Label Y: 0.0

Downstream: R-Matterhornblvd

End:

Reach: R-Matterhornblvd

Last Modified Date: 23 May 2016

Last Modified Time: 22:20:52

Canvas X: 2273394.566283438

Canvas Y: 1.49166955326784E7

From Canvas X: 2274021.048763214

From Canvas Y: 1.4923121554817667E7

Downstream: J-Outlet PRP AREA 4A

Route: Muskingum Cunge

Channel: Trapezoid

Length: 7276

Energy Slope: 0.0116

Mannings n: 0.04

Bottom Width: 8

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-4A

Last Modified Date: 24 May 2016

Last Modified Time: 17:45:23

Canvas X: 2274283.0515359202

Canvas Y: 1.4918365884953067E7

Area: 0.13

Downstream: J-Outlet PRP AREA 4A

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 40

Curve Number: 84.6

Transform: SCS

Lag: 18.6

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet PRP AREA 4A

Last Modified Date: 23 May 2016

Last Modified Time: 22:09:01

Canvas X: 2273394.566283438

Canvas Y: 1.49166955326784E7

Downstream: R-PRP AREA4B

End:

Reach: R-PRP AREA4B

Last Modified Date: 23 May 2016

Last Modified Time: 18:47:38

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2273394.566283438

From Canvas Y: 1.49166955326784E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Triangular

Length: 1743

Energy Slope: 0.0037

Mannings n: 0.05

Side Slope: 3

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-6BB

Last Modified Date: 24 May 2016

Last Modified Time: 17:35:34

Canvas X: 2276202.1796812834

Canvas Y: 1.492223968065389E7

Area: 0.446

Downstream: J-PRP AREA-6 outlet

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 35

Curve Number: 48.7

Transform: SCS

Lag: 29.13

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: PR AREA-6A

Last Modified Date: 24 May 2016

Last Modified Time: 17:35:23

Canvas X: 2274679.695266001

Canvas Y: 1.4922042183716862E7

Area: 0.288

Downstream: J-PRP AREA-6 outlet

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 40

Curve Number: 69.6

Transform: SCS

Lag: 29.59

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-PRP AREA-6 outlet

Last Modified Date: 17 May 2016

Last Modified Time: 00:03:18

Canvas X: 2275278.155018701

Canvas Y: 1.491822372731267E7

Downstream: R-Rd Through 4A and 4B

End:

Reach: R-Rd Through 4A and 4B

Last Modified Date: 23 May 2016

Last Modified Time: 22:21:47

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2275278.155018701

From Canvas Y: 1.491822372731267E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 3846

Energy Slope: 0.0043

Mannings n: 0.05

Bottom Width: 4

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-2

Last Modified Date: 23 May 2016

Last Modified Time: 18:38:28

Canvas X: 2278370.0836973414

Canvas Y: 1.4916908769138994E7

Area: 0.302

Downstream: R- LAG HEP-2 OUTFLOW

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 69.75

Transform: SCS

Lag: 20.8

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- LAG HEP-2 OUTFLOW

Last Modified Date: 23 May 2016

Last Modified Time: 22:21:16

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2275780.443720231

From Canvas Y: 1.4915617120411228E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Trapezoid

Length: 2042

Energy Slope: 0.0041

Mannings n: 0.04

Bottom Width: 4

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-1

Last Modified Date: 16 May 2016

Last Modified Time: 20:44:32

Canvas X: 2276178.0428233175

Canvas Y: 1.491454326687329E7

Area: 0.24

Downstream: R-LAG HEP-1 TO OUT

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 75

Transform: SCS

Lag: 21.08

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R-LAG HEP-1 TO OUT

Last Modified Date: 23 May 2016

Last Modified Time: 18:47:38

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2275156.9517351785

From Canvas Y: 1.4914797369705657E7

Downstream: O-SwanLake2

Route: Lag

Lag: 9

Channel Loss: None

End:

Subbasin: E LEM-11

Last Modified Date: 13 May 2016

Last Modified Time: 17:37:11

Canvas X: 2278930.109581284

Canvas Y: 1.4914072993284354E7

Area: 0.22

Downstream: J-Outlet E LEM 11

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 7.3

Curve Number: 59.8

Transform: SCS

Lag: 33.92

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: J-Outlet E LEM 11

Last Modified Date: 12 May 2016

Last Modified Time: 22:07:21

Canvas X: 2277765.918390753

Canvas Y: 1.491515020971595E7

Downstream: R-Nectar St

End:

Reach: R-Nectar St

Last Modified Date: 23 May 2016

Last Modified Time: 18:47:38

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

From Canvas X: 2277765.918390753

From Canvas Y: 1.491515020971595E7

Downstream: O-SwanLake2

Route: Muskingum Cunge

Channel: Triangular

Length: 3941

Energy Slope: 0.0046

Mannings n: 0.07

Side Slope: 10

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: PR AREA-4B

Last Modified Date: 17 May 2016

Last Modified Time: 00:17:02

Canvas X: 2275598.009709595

Canvas Y: 1.491609136270671E7

Area: 0.199

Downstream: O-SwanLake2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 40

Curve Number: 86.2

Transform: SCS

Lag: 20

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: O-SwanLake2

Last Modified Date: 23 May 2016

Last Modified Time: 22:09:01

Canvas X: 2273892.118024828

Canvas Y: 1.4915131798634028E7

Downstream: Swan Lake

End:

Subbasin: E LEM-2

Last Modified Date: 13 May 2016

Last Modified Time: 17:31:29

Canvas X: 2270294.8438745127

Canvas Y: 1.4930229397276394E7

Area: 0.76

Downstream: J-E LEM 2 AND 3

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 61.9

Transform: SCS

Lag: 46.7

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-3

Last Modified Date: 12 May 2016

Last Modified Time: 21:01:38

Canvas X: 2272489.5583227505

Canvas Y: 1.493398701443777E7

Area: 0.76

Downstream: R- E LEM2

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 1

Curve Number: 66.4

Transform: SCS

Lag: 64.4

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- E LEM2

Description: Reach carrying flow from E LEM-3 outlet to HEP-34Channel

Last Modified Date: 12 May 2016

Last Modified Time: 20:36:34

Canvas X: 2271857.746587652

Canvas Y: 1.4925374422890896E7

From Canvas X: 2273487.1557992226

From Canvas Y: 1.4927436124342272E7

Downstream: J-E LEM 2 AND 3

Route: Muskingum Cunge

Channel: Triangular

Length: 3047

Energy Slope: 0.0088

Mannings n: 0.065

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Junction: J-E LEM 2 AND 3

Last Modified Date: 12 May 2016

Last Modified Time: 20:38:05

Canvas X: 2271857.746587652

Canvas Y: 1.4925374422890896E7

Downstream: R-HEP34 Channel

End:

Reach: R-HEP34 Channel

Description: Channel through HEP 3 and 4 develpments

Last Modified Date: 12 May 2016

Last Modified Time: 20:40:18

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

From Canvas X: 2271857.746587652

From Canvas Y: 1.4925374422890896E7

Downstream: O-SwanLake1

Route: Muskingum Cunge

Channel: Trapezoid

Length: 7431

Energy Slope: 0.0075

Mannings n: 0.065

Bottom Width: 4

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Subbasin: HEP-34

Last Modified Date: 23 May 2016

Last Modified Time: 18:35:59

Canvas X: 2272655.8245688295

Canvas Y: 1.4924676104657367E7

Area: 1.14

Downstream: O-SwanLake1

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 20

Curve Number: 71.9

Transform: SCS

Lag: 26.02

Unitgraph Type: STANDARD

Baseflow: None

End:

Subbasin: E LEM-1

Last Modified Date: 24 May 2016

Last Modified Time: 17:28:06

Canvas X: 2268395.4688152373

Canvas Y: 1.4924410402931456E7

Area: 0.41

Downstream: R- E LEM-01 TO OUT

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 74.6

Transform: SCS

Lag: 49.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Reach: R- E LEM-01 TO OUT

Last Modified Date: 16 May 2016

Last Modified Time: 20:47:20

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

From Canvas X: 2268918.445796485

From Canvas Y: 1.491894380586345E7

Downstream: O-SwanLake1

Route: Muskingum Cunge

Channel: Trapezoid

Length: 1089

Energy Slope: 0.0121

Mannings n: 0.045

Bottom Width: 2

Side Slope: 2

Use Variable Time Step: No

Channel Loss: None

End:

Junction: O-SwanLake1

Description: Northern most outlet to Swan Lake

Last Modified Date: 16 May 2016

Last Modified Time: 20:47:20

Canvas X: 2270195.0841268655

Canvas Y: 1.4918524253552455E7

Downstream: Swan Lake

End:

Subbasin: PR AREA-3

Last Modified Date: 24 May 2016

Last Modified Time: 17:29:19

Canvas X: 2274937.4213418798

Canvas Y: 1.4913834340312468E7

Area: 0.10

Downstream: O-SwanLake3

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS

Percent Impervious Area: 0.0

Curve Number: 85.9

Transform: SCS

Lag: 35.1

Unitgraph Type: STANDARD

Baseflow: None

End:

Junction: O-SwanLake3

Last Modified Date: 12 May 2016

Last Modified Time: 22:22:22

Canvas X: 2274193.2081083483

Canvas Y: 1.491248551920764E7

Downstream: Swan Lake

End:

Sink: Swan Lake

Last Modified Date: 3 June 2016

Last Modified Time: 18:11:43

Canvas X: 2269840.6252735066

Canvas Y: 1.4915664889785519E7

End:

Basin Schematic Properties:

Last View N: 1.4934785092418948E7

Last View S: 1.4912039869955389E7

Last View W: 2268016.8642411563

Last View E: 2293023.5717755426

Maximum View N: 1.4934785092418948E7

Maximum View S: 1.4912039869955389E7

Maximum View W: 2268016.8642411563

Maximum View E: 2293023.5717755426

Extent Method: Elements

Buffer: 5

Draw Icons: Yes

Draw Icon Labels: Name

Draw Map Objects: No

Draw Gridlines: No

Draw Flow Direction: No

Fix Element Locations: No

Fix Hydrologic Order: No

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\Working\Shapefiles\AREA6\HMS\A6_routing.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\Working\Shapefiles\AREA6\HMS\A6_flowpath.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

Map: hec.map.aishape.AiShapeMap

Map File Name: R:\Reno Projects\LansingLemmonValley\GIS\ShapeFiles\Area3456\Area456Basins.shp

Minimum Scale: -2147483648

Maximum Scale: 2147483647

Map Shown: Yes

End:

Precipitation Data:

Precip Method Parameters: Frequency Based Hypothetical

Last Modified Date: 22 January 2016
Last Modified Time: 19:12:11
Exceedence Frequency: 20.000
Single Hypothetical Storm Size: Yes
Convert From Annual Series: No
Convert to Annual Series: No
Uniform Depth Duration Curve: Yes
Storm Size:
Total Duration: 1440
Time Interval: 5
Percent of Duration Before Peak Rainfall: 50
Depth: 0.17200
Depth: 0.32500
Depth: 0.54100
Depth: 0.68500
Depth: 0.81200
Depth: 1.1800
Depth: 1.6600
Depth: 2.2200

Precip Method Parameters: Frequency Based Hypothetical

Last Modified Date: 6 January 2016
Last Modified Time: 18:41:49
Single Hypothetical Storm Size: Yes
Convert From Annual Series: No
Convert to Annual Series: Yes
Uniform Depth Duration Curve: Yes
Storm Size:
Total Duration: 14400
Time Interval: 5
Percent of Duration Before Peak Rainfall: 50
Depth: 0.43200
Depth: 0.65700
Depth: 1.3600
Depth: 1.4400
Depth: 1.5200
Depth: 1.9200
Depth: 2.8100
Depth: 4.0800
Depth: 5.3300
Depth: 6.1700
Depth: 8.4800
Depth: 9.4900

End:

NOAA Atlas 14, Volume 1, Version 5
Location name: Reno, Nevada, US*
Latitude: 39.6547°, Longitude: -119.8258°
Elevation: 4916 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.104 (0.087-0.120)	0.129 (0.107-0.150)	0.172 (0.145-0.203)	0.214 (0.180-0.254)	0.285 (0.236-0.344)	0.351 (0.283-0.431)	0.432 (0.339-0.539)	0.531 (0.402-0.677)	0.693 (0.498-0.914)	0.845 (0.582-1.14)
10-min	0.158 (0.132-0.182)	0.197 (0.164-0.228)	0.262 (0.221-0.309)	0.325 (0.274-0.387)	0.433 (0.358-0.523)	0.534 (0.431-0.656)	0.657 (0.516-0.821)	0.807 (0.611-1.03)	1.05 (0.758-1.39)	1.29 (0.887-1.73)
15-min	0.196 (0.164-0.226)	0.244 (0.203-0.283)	0.325 (0.273-0.383)	0.403 (0.340-0.479)	0.537 (0.444-0.649)	0.663 (0.535-0.814)	0.814 (0.639-1.02)	1.00 (0.758-1.28)	1.31 (0.940-1.72)	1.59 (1.10-2.15)
30-min	0.263 (0.221-0.304)	0.328 (0.273-0.381)	0.437 (0.368-0.516)	0.543 (0.458-0.646)	0.723 (0.598-0.874)	0.892 (0.720-1.10)	1.10 (0.861-1.37)	1.35 (1.02-1.72)	1.76 (1.27-2.32)	2.15 (1.48-2.89)
60-min	0.326 (0.273-0.376)	0.406 (0.338-0.472)	0.541 (0.456-0.638)	0.672 (0.566-0.799)	0.895 (0.740-1.08)	1.10 (0.891-1.36)	1.36 (1.07-1.70)	1.67 (1.26-2.13)	2.18 (1.57-2.87)	2.66 (1.83-3.58)
2-hr	0.430 (0.380-0.495)	0.534 (0.474-0.616)	0.685 (0.600-0.790)	0.818 (0.709-0.944)	1.03 (0.868-1.19)	1.22 (1.00-1.43)	1.44 (1.16-1.71)	1.73 (1.36-2.15)	2.30 (1.70-2.90)	2.81 (2.01-3.62)
3-hr	0.524 (0.469-0.593)	0.650 (0.586-0.741)	0.812 (0.728-0.923)	0.948 (0.841-1.08)	1.14 (0.998-1.31)	1.31 (1.13-1.52)	1.52 (1.29-1.78)	1.82 (1.50-2.16)	2.33 (1.87-2.93)	2.82 (2.21-3.65)
6-hr	0.767 (0.692-0.859)	0.956 (0.861-1.07)	1.18 (1.06-1.32)	1.35 (1.20-1.52)	1.58 (1.39-1.78)	1.74 (1.52-1.99)	1.92 (1.65-2.20)	2.14 (1.81-2.48)	2.58 (2.15-3.04)	3.03 (2.48-3.69)
12-hr	1.06 (0.950-1.18)	1.32 (1.19-1.48)	1.66 (1.48-1.85)	1.92 (1.71-2.15)	2.27 (2.00-2.56)	2.54 (2.22-2.88)	2.81 (2.43-3.23)	3.09 (2.62-3.58)	3.46 (2.87-4.08)	3.78 (3.08-4.53)
24-hr	1.38 (1.24-1.55)	1.74 (1.56-1.95)	2.22 (1.99-2.49)	2.62 (2.33-2.94)	3.17 (2.80-3.57)	3.61 (3.16-4.08)	4.08 (3.53-4.65)	4.57 (3.91-5.24)	5.24 (4.41-6.09)	5.79 (4.78-6.79)
2-day	1.69 (1.50-1.93)	2.15 (1.90-2.45)	2.79 (2.46-3.18)	3.32 (2.92-3.79)	4.07 (3.54-4.67)	4.68 (4.03-5.40)	5.33 (4.53-6.20)	6.03 (5.05-7.08)	7.01 (5.74-8.36)	7.81 (6.27-9.46)
3-day	1.87 (1.65-2.13)	2.38 (2.10-2.72)	3.13 (2.75-3.58)	3.75 (3.28-4.30)	4.65 (4.02-5.34)	5.38 (4.60-6.22)	6.17 (5.20-7.18)	7.01 (5.83-8.24)	8.22 (6.68-9.81)	9.21 (7.35-11.1)
4-day	2.04 (1.79-2.34)	2.61 (2.29-2.99)	3.47 (3.04-3.98)	4.19 (3.65-4.81)	5.22 (4.50-6.02)	6.07 (5.17-7.04)	7.00 (5.88-8.16)	7.99 (6.61-9.40)	9.43 (7.62-11.3)	10.6 (8.42-12.8)
7-day	2.42 (2.10-2.81)	3.11 (2.70-3.62)	4.18 (3.62-4.87)	5.06 (4.36-5.90)	6.33 (5.39-7.40)	7.36 (6.21-8.66)	8.48 (7.07-10.1)	9.68 (7.95-11.6)	11.4 (9.16-13.8)	12.8 (10.1-15.8)
10-day	2.75 (2.39-3.19)	3.56 (3.09-4.12)	4.79 (4.14-5.55)	5.77 (4.98-6.70)	7.16 (6.12-8.35)	8.29 (7.01-9.71)	9.49 (7.94-11.2)	10.8 (8.87-12.8)	12.5 (10.1-15.1)	14.0 (11.1-17.1)
20-day	3.53 (3.08-4.08)	4.57 (3.98-5.29)	6.13 (5.33-7.09)	7.34 (6.36-8.48)	8.97 (7.71-10.4)	10.2 (8.74-11.9)	11.5 (9.75-13.5)	12.9 (10.8-15.3)	14.9 (12.2-17.8)	16.5 (13.3-19.9)
30-day	4.18 (3.64-4.85)	5.41 (4.72-6.28)	7.26 (6.31-8.40)	8.67 (7.51-10.0)	10.6 (9.10-12.2)	12.0 (10.3-14.0)	13.5 (11.5-15.8)	15.1 (12.6-17.8)	17.3 (14.3-20.6)	19.1 (15.6-22.9)
45-day	5.05 (4.41-5.76)	6.55 (5.71-7.46)	8.75 (7.61-9.96)	10.4 (9.01-11.8)	12.5 (10.8-14.3)	14.2 (12.2-16.3)	15.9 (13.5-18.3)	17.5 (14.8-20.3)	20.0 (16.6-23.4)	21.9 (18.0-25.9)
60-day	5.82 (5.05-6.65)	7.57 (6.58-8.65)	10.1 (8.76-11.5)	11.9 (10.3-13.6)	14.2 (12.2-16.2)	15.9 (13.6-18.2)	17.5 (14.9-20.2)	19.2 (16.2-22.2)	21.4 (17.9-25.0)	23.1 (19.1-27.2)

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

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

Please refer to NOAA Atlas 14 document for more information.

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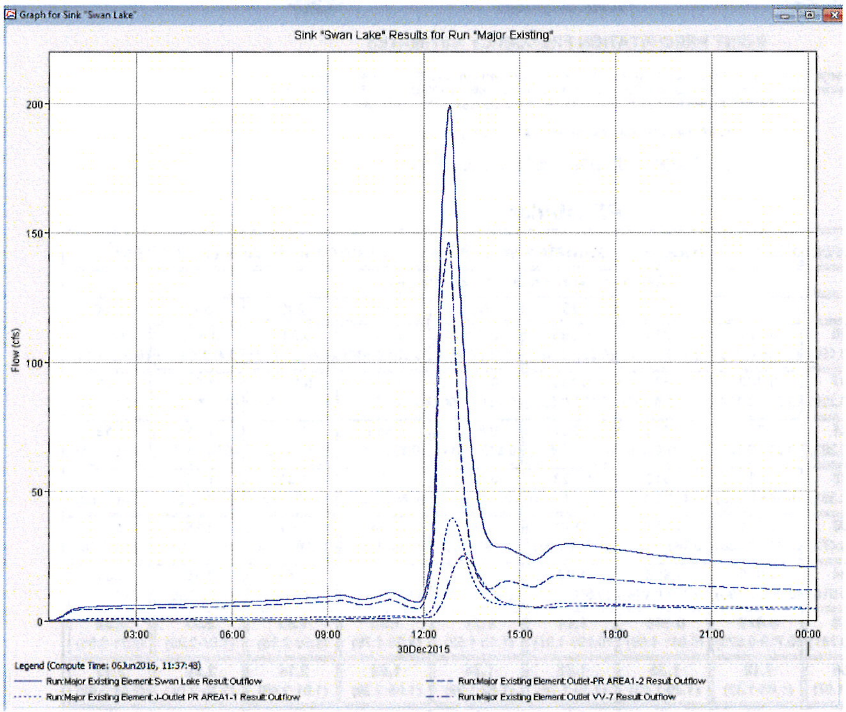
Output Hydrographs/Tables:

Area 1



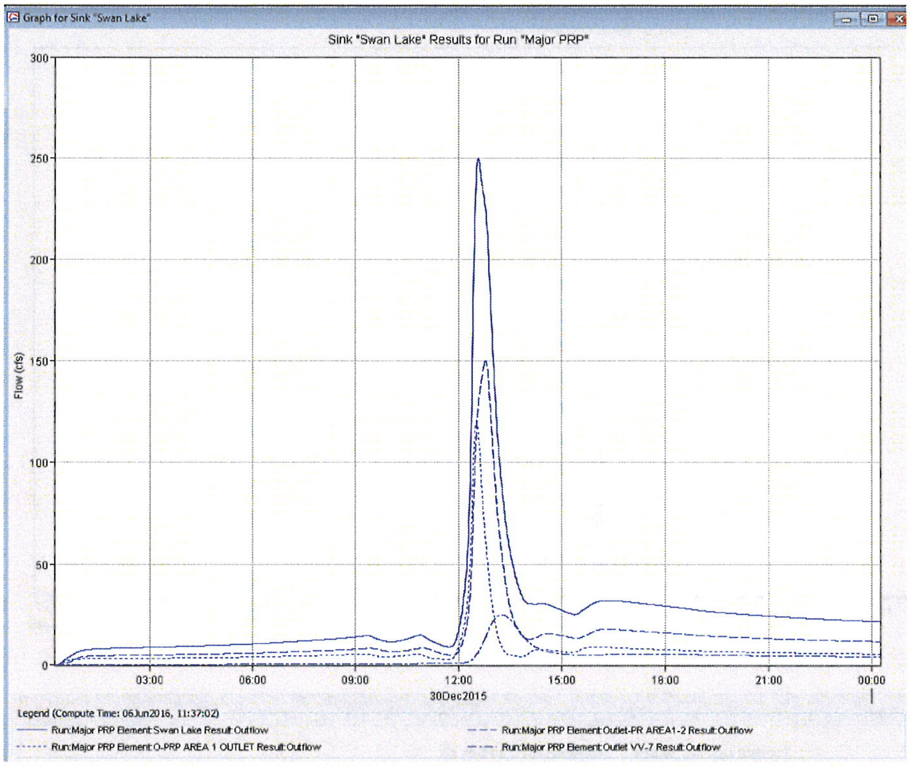
Global Summary Results for Run "Major Existing"

Project: Lansing_Area1 Simulation Run: Major Existing

Start of Run: 30Dec2015, 00:15 Basin Model: AREA1_EX
End of Run: 31Dec2015, 00:15 Meteorologic Model: 100yr24hrEX
Compute Time: 06Jun2016, 11:37:48 Control Specifications: Control 24 hr

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
VV-5	0.04	39.8	30Dec2015, 12:29	4.8
VV-2	0.023	23.4	30Dec2015, 12:29	2.7
R-Patrician Dr Gutter	0.023	22.8	30Dec2015, 12:35	2.7
J-VV-5 Outlet	0.063	60.0	30Dec2015, 12:32	7.5
R-overland Park	0.063	60.0	30Dec2015, 12:47	7.4
LVP-2	0.023	30.6	30Dec2015, 12:26	3.2
LVP-1	0.016	16.0	30Dec2015, 12:27	1.7
VV-9	0.008	11.1	30Dec2015, 12:22	1.0
J-SD Outlet Park	0.110	75.2	30Dec2015, 12:45	13.3
R PR AREA1-1 Channel	0.110	74.4	30Dec2015, 12:49	13.3
VV-1	0.065	54.7	30Dec2015, 12:32	7.2
J Fleetwood Dr SD Inlet	0.065	54.7	30Dec2015, 12:32	7.2
R Fleetwood Dr SD	0.065	52.4	30Dec2015, 12:35	7.2
J SD outlet 1	0.065	52.4	30Dec2015, 12:35	7.2
VV-8	0.02	24.2	30Dec2015, 12:25	2.4
SD outlet1	0.085	66.7	30Dec2015, 12:39	9.5
PR AREA1-2	0.076	18.4	30Dec2015, 13:03	4.4
Outlet-PR AREA1-2	0.271	146.1	30Dec2015, 12:46	27.2
PR AREA1-1	0.091	27.0	30Dec2015, 12:55	5.7
VV-3	0.018	16.9	30Dec2015, 12:31	2.1
R- VV3 Lag thru PRArea1-1	0.018	8.3	30Dec2015, 12:47	2.1
VV-6	0.012	13.3	30Dec2015, 12:27	1.4
R VV-6 Lag thru PR Area1-1	0.012	5.2	30Dec2015, 12:43	1.4
J-Outlet PR AREA1-1	0.121	39.8	30Dec2015, 12:53	9.2
VV-7	0.11	25.0	30Dec2015, 13:15	7.3
Outlet VV-7	0.11	25.0	30Dec2015, 13:15	7.3
Swan Lake	0.502	199.2	30Dec2015, 12:48	43.6
NV-1	0.042	45.6	30Dec2015, 12:30	5.8
NV-1 Outlet	0.042	45.6	30Dec2015, 12:30	5.8



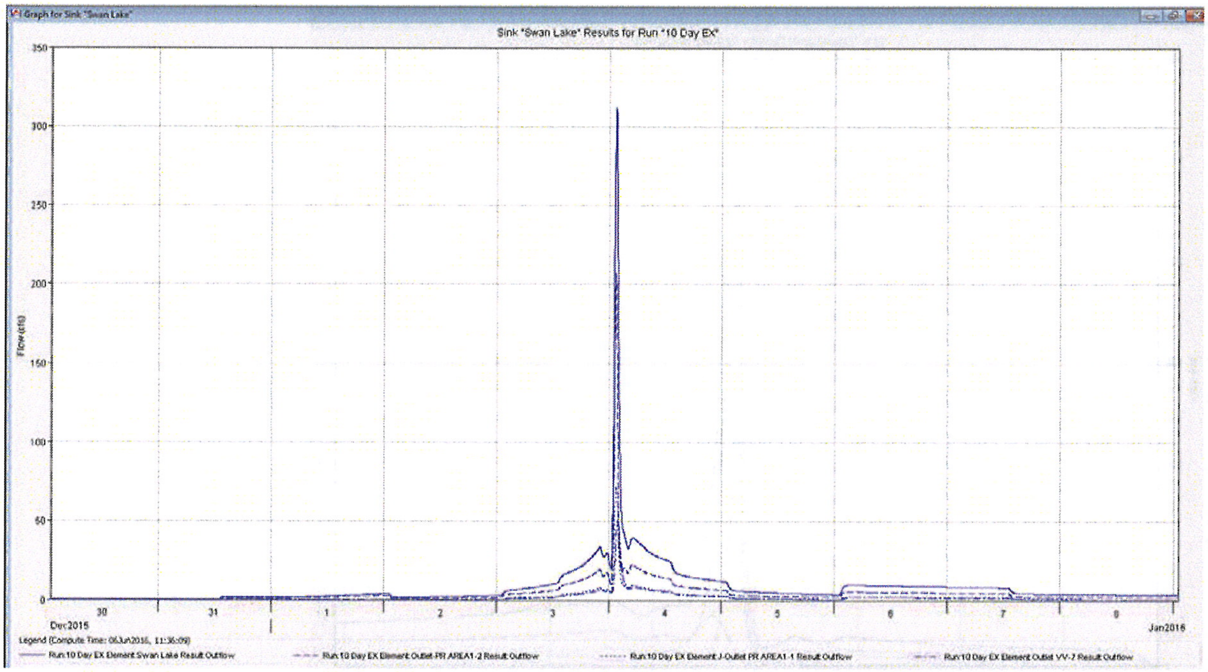
Global Summary Results for Run "Major PRP"

Project: Lansing_Area1 Simulation Run: Major PRP

Start of Run: 30Dec2015, 00:15 Basin Model: Area1_PRP
End of Run: 31Dec2015, 00:15 Meteorologic Model: 100 yr 24 hr PRP
Compute Time: 06Jun2016, 11:37:02 Control Specifications: Control 24 hr

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
VV-5	0.04	39.8	30Dec2015, 12:29	4.8
VV-2	0.023	23.4	30Dec2015, 12:29	2.7
R-Patrician Dr Gutter	0.023	22.8	30Dec2015, 12:35	2.7
J-VV-5 Outlet	0.063	60.0	30Dec2015, 12:32	7.5
R-overland Park	0.063	60.0	30Dec2015, 12:47	7.4
LVP-2	0.023	29.6	30Dec2015, 12:26	3.2
LVP-1	0.016	16.0	30Dec2015, 12:27	1.7
VV-9	0.008	11.1	30Dec2015, 12:22	1.0
J-SD Outlet Park	0.110	75.9	30Dec2015, 12:45	13.3
R PR AREA1-1 Channel	0.110	75.0	30Dec2015, 12:48	13.3
VV-1	0.065	54.7	30Dec2015, 12:32	7.2
J Fleetwood Dr SD Inlet	0.065	54.7	30Dec2015, 12:32	7.2
R Fleetwood Dr SD	0.065	52.4	30Dec2015, 12:35	7.2
J SD outlet 1	0.065	52.4	30Dec2015, 12:35	7.2
VV-8	0.02	24.2	30Dec2015, 12:25	2.4
SD outlet1	0.085	66.7	30Dec2015, 12:39	9.5
PR AREA1-2	0.076	21.9	30Dec2015, 13:03	5.4
Outlet-PR AREA1-2	0.271	150.0	30Dec2015, 12:46	28.1
PRP PH-1A	0.03	32.4	30Dec2015, 12:27	3.6
VV-6	0.012	13.3	30Dec2015, 12:27	1.4
R VV-6 Lag thru PR Area1-1	0.012	13.2	30Dec2015, 12:29	1.4
J-PRP PH-1A OUTLET	0.042	45.3	30Dec2015, 12:28	5.0
R-CHANNEL THRU PRP PH-1B	0.042	44.5	30Dec2015, 12:32	5.0
PRP PH-1B	0.039	39.5	30Dec2015, 12:29	4.7
J-Outlet PR AREA1-1	0.081	82.7	30Dec2015, 12:30	9.7
PRP PH-2	0.022	32.6	30Dec2015, 12:26	3.6
VV-3	0.018	16.9	30Dec2015, 12:31	2.1
R- VV3 thru PRArea1-1	0.018	16.4	30Dec2015, 12:40	2.1
J-PRP PH-2 Outlet	0.040	37.3	30Dec2015, 12:28	5.7
O-PRP AREA 1 OUTLET	0.121	119.8	30Dec2015, 12:30	15.3
VV-7	0.11	25.0	30Dec2015, 13:15	7.3
Outlet VV-7	0.11	25.0	30Dec2015, 13:15	7.3
Swan Lake	0.502	250.1	30Dec2015, 12:34	50.7
NV-1	0.042	45.6	30Dec2015, 12:30	5.8
NV-1 Outlet	0.042	45.6	30Dec2015, 12:30	5.8



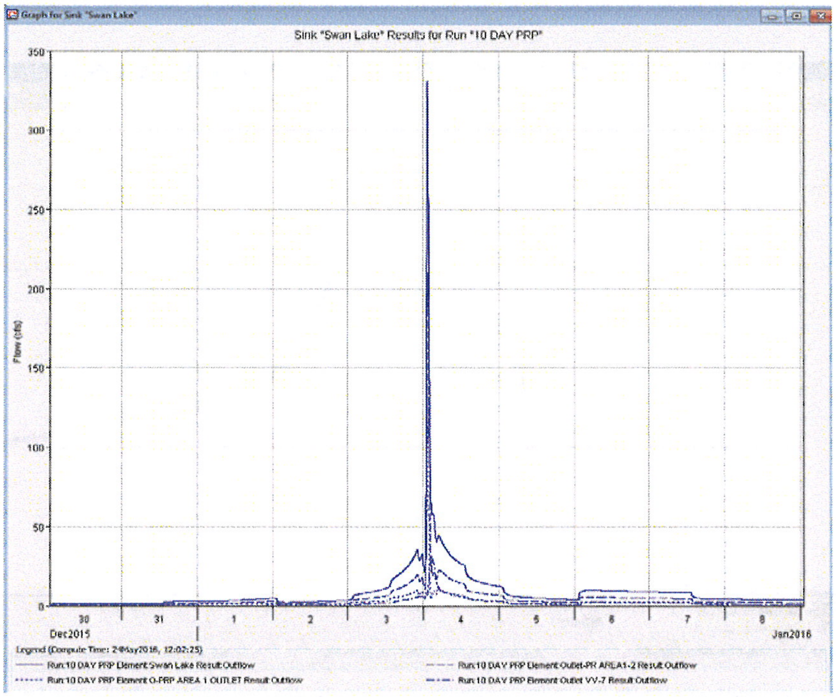
Global Summary Results for Run "10 Day EX"

Project: Lansing_Area1 Simulation Run: 10 Day EX

Start of Run: 30Dec2015, 01:00 Basin Model: AREA1_EX
End of Run: 09Jan2016, 01:00 Meteorologic Model: 100 yr 10 day EX
Compute Time: 06Jun2016, 11:36:09 Control Specifications: Control 10 day

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

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
VV-5	0.04		31Dec1969, 16:00	0.0
VV-2	0.023		31Dec1969, 16:00	0.0
R-Patrician Dr Gutter	0.023		31Dec1969, 16:00	0.0
J-VV-5 Outlet	0.063		31Dec1969, 16:00	0.0
R-overland Park	0.063		31Dec1969, 16:00	0.0
LVP-2	0.023		31Dec1969, 16:00	0.0
LVP-1	0.016		31Dec1969, 16:00	0.0
VV-9	0.008		31Dec1969, 16:00	0.0
J-SD Outlet Park	0.110		31Dec1969, 16:00	0.0
R PR AREA1-1 Channel	0.110		31Dec1969, 16:00	0.0
VV-1	0.065		31Dec1969, 16:00	0.0
J Fleetwood Dr SD Inlet	0.065		31Dec1969, 16:00	0.0
R Fleetwood Dr SD	0.065		31Dec1969, 16:00	0.0
J SD outlet 1	0.065		31Dec1969, 16:00	0.0
VV-8	0.02		31Dec1969, 16:00	0.0
SD outlet1	0.085		31Dec1969, 16:00	0.0
PR AREA1-2	0.076		31Dec1969, 16:00	0.0
Outlet-PR AREA1-2	0.271		31Dec1969, 16:00	0.0
PR AREA1-1	0.091		31Dec1969, 16:00	0.0
VV-3	0.018		31Dec1969, 16:00	0.0
R- VV3 Lag thru PRArea1-1	0.018		31Dec1969, 16:00	0.0
VV-6	0.012		31Dec1969, 16:00	0.0
R VV-6 Lag thru PR Area1-1	0.012		31Dec1969, 16:00	0.0
J-Outlet PR AREA1-1	0.121		31Dec1969, 16:00	0.0
VV-7	0.11		31Dec1969, 16:00	0.0
Outlet VV-7	0.11		31Dec1969, 16:00	0.0
Swan Lake	0.502		31Dec1969, 16:00	0.0
NV-1	0.042		31Dec1969, 16:00	0.0
NV-1 Outlet	0.042		31Dec1969, 16:00	0.0



Global Summary Results for Run "10 DAY PRP"

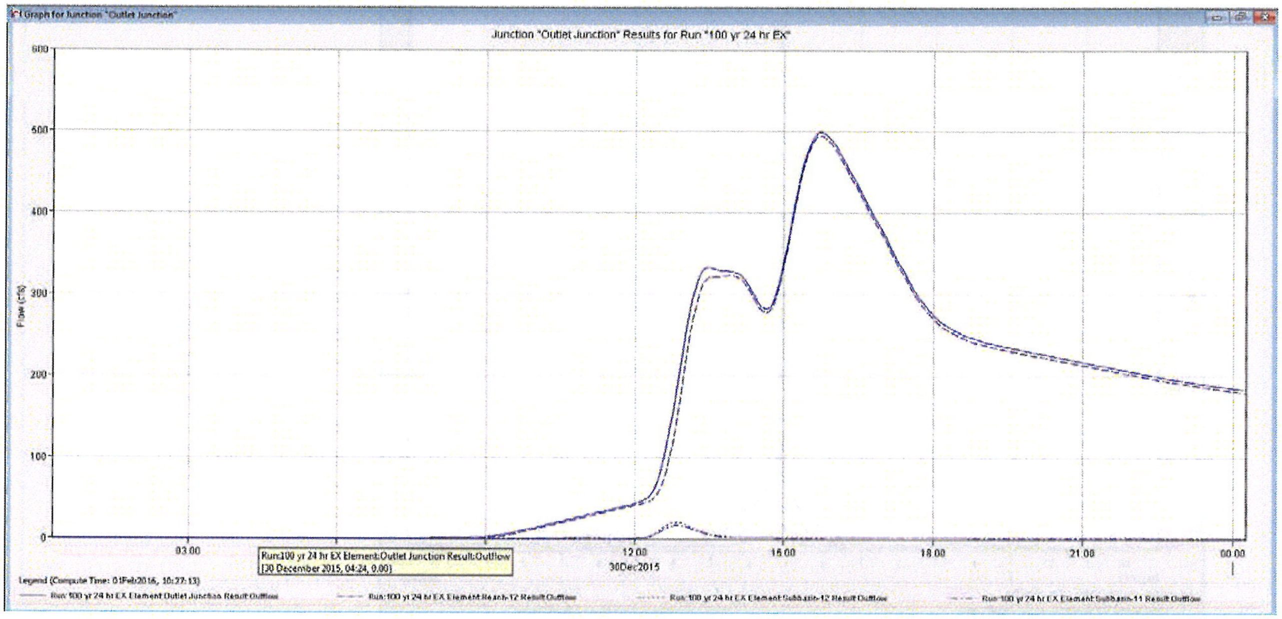
Project: Lansing_Area1 Simulation Run: 10 DAY PRP

Start of Run: 30Dec2015, 01:00 Basin Model: Area1_PRP
End of Run: 09Jan2016, 01:00 Meteorologic Model: 100YR 10dayPRP
Compute Time: 24May2016, 12:02:25 Control Specifications: Control 10 day

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
VV-5	0.04	48.9	04Jan2016, 01:13	14.7
VV-2	0.023	28.8	04Jan2016, 01:13	8.4
R-Patrician Dr Gutter	0.023	28.1	04Jan2016, 01:19	8.4
J-VV-5 Outlet	0.063	74.6	04Jan2016, 01:16	23.1
R-overland Park	0.063	74.6	04Jan2016, 01:31	23.1
LVP-2	0.023	33.2	04Jan2016, 01:11	9.0
LVP-1	0.016	21.1	04Jan2016, 01:11	5.6
VV-9	0.008	14.1	04Jan2016, 01:07	2.9
J-SD Outlet Park	0.110	98.9	04Jan2016, 01:29	40.6
R PR AREA1-1 Channel	0.110	98.1	04Jan2016, 01:32	40.6
VV-1	0.065	71.0	04Jan2016, 01:16	23.1
J Fleetwood Dr SD Inlet	0.065	71.0	04Jan2016, 01:16	23.1
R Fleetwood Dr SD	0.065	68.0	04Jan2016, 01:19	23.0
J SD outlet 1	0.065	68.0	04Jan2016, 01:19	23.0
VV-8	0.02	29.9	04Jan2016, 01:09	7.3
SD outlet1	0.085	86.4	04Jan2016, 01:23	30.3
PR AREA1-2	0.076	41.4	04Jan2016, 01:46	22.7
Outlet-PR AREA1-2	0.271	209.9	04Jan2016, 01:30	93.7
PRP PH-1A	0.03	39.7	04Jan2016, 01:11	11.0
VV-6	0.012	16.4	04Jan2016, 01:11	4.4
R VV-6 Lag thru PR Area1-1	0.012	16.2	04Jan2016, 01:14	4.4
J-PRP PH-1A OUTLET	0.042	55.6	04Jan2016, 01:12	15.4
R-CHANNEL THRU PRP PH-1B	0.042	54.6	04Jan2016, 01:16	15.4
PRP PH-1B	0.039	48.6	04Jan2016, 01:13	14.3
J-Outlet PR AREA1-1	0.081	102.0	04Jan2016, 01:15	29.7
PRP PH-2	0.022	33.4	04Jan2016, 01:11	9.4
VV-3	0.018	20.8	04Jan2016, 01:15	6.6
R- VV3 thru PRArea1-1	0.018	20.4	04Jan2016, 01:24	6.6
J-PRP PH-2 Outlet	0.040	42.8	04Jan2016, 01:13	16.0
O-PRP AREA 1 OUTLET	0.121	144.5	04Jan2016, 01:15	45.7
VV-7	0.11	31.3	04Jan2016, 02:41	32.2
Outlet VV-7	0.11	31.3	04Jan2016, 02:41	32.2
Swan Lake	0.502	330.7	04Jan2016, 01:18	171.5
NV-1	0.042	51.5	04Jan2016, 01:15	16.5
NV-1 Outlet	0.042	51.5	04Jan2016, 01:15	16.5

Area 2



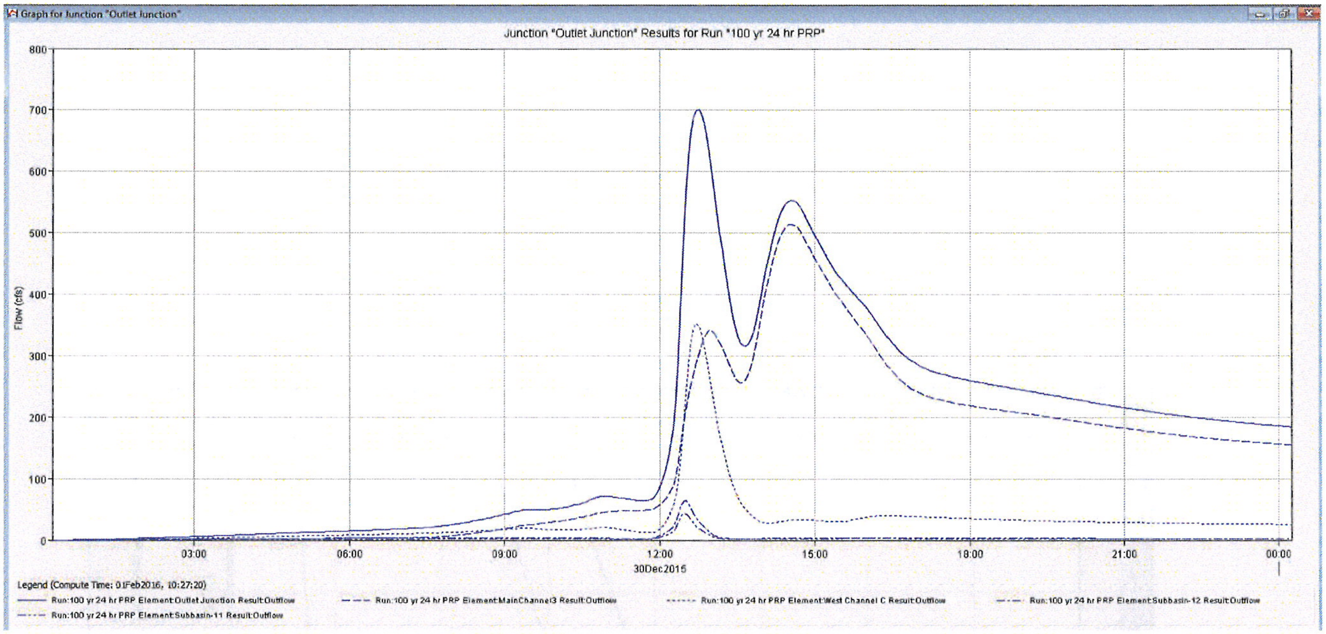
Global Summary Results for Run "100 yr 24 hr EX"

Project: Lansing_IndPark_01Feb2016   Simulation Run: 100 yr 24 hr EX

Start of Run: 30Dec2015, 00:15   Basin Model: North LV existing
End of Run: 31Dec2015, 00:15   Meteorologic Model: 100 yr 24 hr EX
Compute Time: 01Feb2016, 10:27:13   Control Specifications: Control 24 hr

Show Elements: All Elements   Volume Units: IN (•) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin-2	1.5	255.4	30Dec2015, 14:06	112.3
Subbasin-1	0.72	276.2	30Dec2015, 13:09	69.6
Junction-1-2	2.22	435.3	30Dec2015, 13:24	181.9
Reach3	2.22	435.3	30Dec2015, 14:30	172.3
Subbasin-3	0.49	194.3	30Dec2015, 13:03	43.9
Junction-3	2.71	469.1	30Dec2015, 14:30	216.2
Reach-9	2.71	469.1	30Dec2015, 15:30	205.2
Subbasin-5a	0.26	81.8	30Dec2015, 13:09	20.8
Subbasin-6	0.25	123.8	30Dec2015, 12:45	20.4
Reach-7	0.25	123.2	30Dec2015, 13:12	20.0
Subbasin-4a	0.164	43.4	30Dec2015, 13:06	10.7
Subbasin-8	0.097	21.9	30Dec2015, 12:45	4.1
Subbasin-5b	0.07	30.3	30Dec2015, 12:51	5.7
Subbasin-9	0.062	6.5	30Dec2015, 13:33	2.5
Subbasin-10	0.058	6.6	30Dec2015, 13:42	2.7
Subbasin-7	0.038	17.3	30Dec2015, 12:54	3.4
Subbasin-4b	0.036	13.9	30Dec2015, 12:45	2.4
Junction-7-8-9	3.745	517.3	30Dec2015, 15:27	277.5
Reach-12	3.745	494.6	30Dec2015, 15:45	271.1
Subbasin-12	0.038	20.7	30Dec2015, 12:51	3.8
Subbasin-11	0.03	17.1	30Dec2015, 12:51	3.2
Outlet Junction	3.813	498.9	30Dec2015, 15:45	278.1
Outlet	3.813	498.9	30Dec2015, 15:45	278.1



Global Summary Results for Run "100 yr 24 hr PRP"

Project: LansingArea2_Final_07Jun2016 Simulation Run: 100 yr 24 hr PRP

Start of Run: 30Dec2015, 00:15
End of Run: 31Dec2015, 00:15
Compute Time: 07Jul2016, 11:34:28

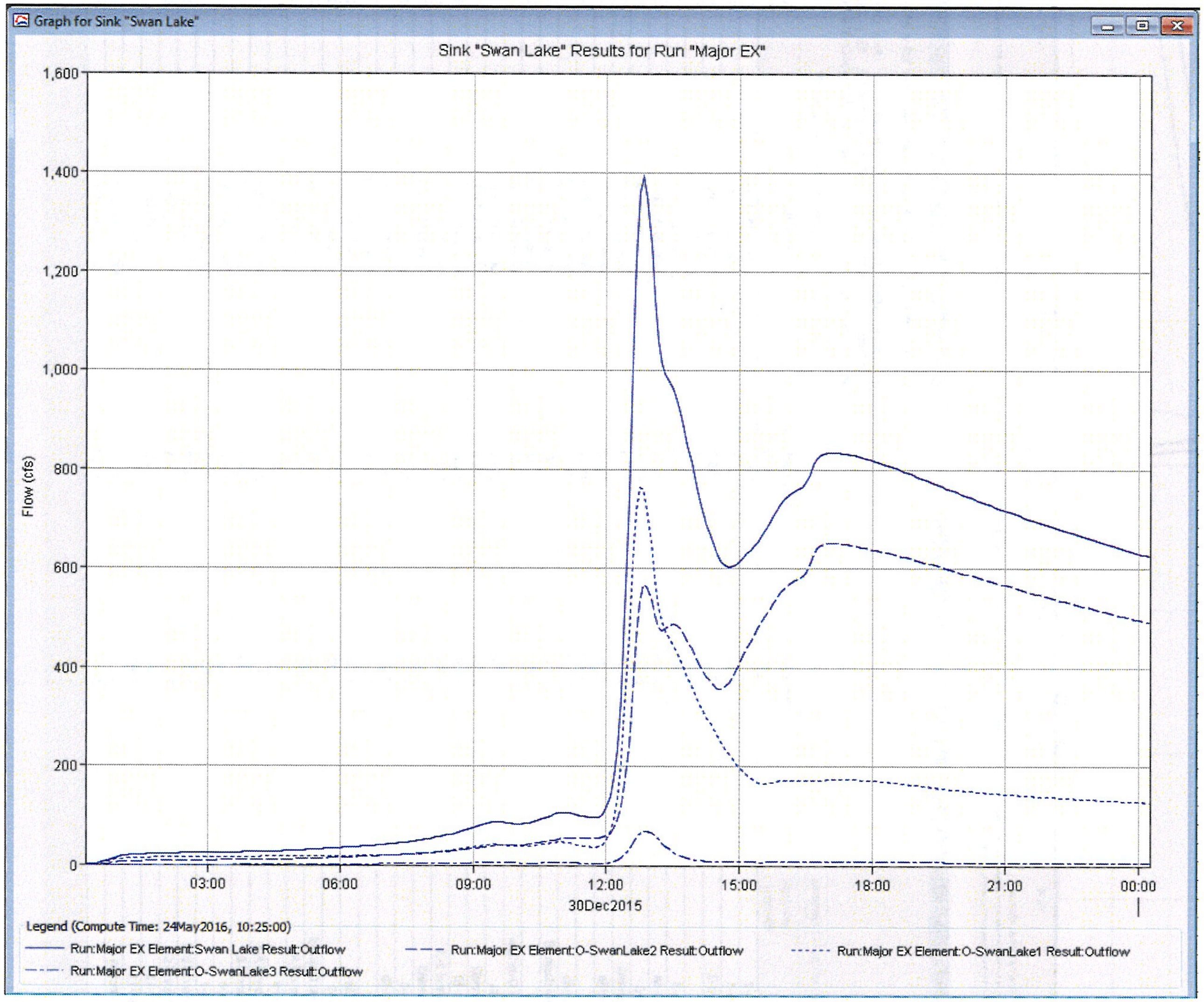
Basin Model: Area 2 proposed
Meteorologic Model: 100 yr 24 hr PRP
Control Specifications: Control 24 hr

Show Elements: All Elements

Volume Units: IN (●) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Subbasin-2	1.5	255.4	30Dec2015, 14:06	112.3
Subbasin-1	0.72	276.2	30Dec2015, 13:09	69.6
Junction-1-2	2.22	435.3	30Dec2015, 13:24	181.9
Reach3	2.22	435.3	30Dec2015, 14:30	172.3
Subbasin-3	0.49	194.3	30Dec2015, 13:03	43.9
Subbasin-4a	0.164	78.2	30Dec2015, 12:45	13.0
Junction-3	2.874	477.6	30Dec2015, 14:30	229.2
MainChannel1	2.874	477.4	30Dec2015, 14:30	228.8
Subbasin-5a	0.26	144.2	30Dec2015, 12:39	21.3
Ditch2	0.26	142.9	30Dec2015, 12:42	21.3
Subbasin-4b	0.036	20.3	30Dec2015, 12:30	2.4
Detention Basin 4B	0.296	36.0	30Dec2015, 13:21	23.0
Lateral 1	0.296	36.0	30Dec2015, 13:24	22.9
Det Basin Overflow	0.0	0.0	30Dec2015, 00:15	0.0
OutletLat1	3.170	509.2	30Dec2015, 14:30	251.7
MainChannel2	3.170	508.8	30Dec2015, 14:33	251.3
Subbasin-10	0.058	91.8	30Dec2015, 12:30	10.5
MainChannel 2-3	3.228	513.9	30Dec2015, 14:30	261.8
MainChannel3	3.228	513.8	30Dec2015, 14:33	261.5
Subbasin-6	0.25	125.2	30Dec2015, 12:45	20.7
Subbasin-5b	0.07	53.3	30Dec2015, 12:30	5.8
Ditch3A	0.07	52.4	30Dec2015, 12:33	5.8
Junction 5b-6	0.32	162.5	30Dec2015, 12:39	26.5
Ditch 3A-2	0.32	161.9	30Dec2015, 12:42	26.5
Inlet West Channel	0.32	161.9	30Dec2015, 12:42	26.5
West Channel A	0.32	159.3	30Dec2015, 12:45	26.4
Subbasin-8	0.097	120.7	30Dec2015, 12:33	15.8
West Channel A-B	0.417	261.8	30Dec2015, 12:39	42.2
West Channel B	0.417	254.3	30Dec2015, 12:42	42.0
Subbasin-9	0.062	88.9	30Dec2015, 12:33	12.4
Subbasin-7	0.038	53.7	30Dec2015, 12:30	5.9
West Channel B-C	0.517	362.9	30Dec2015, 12:39	60.3
West Channel C	0.517	355.5	30Dec2015, 12:42	60.1
Subbasin-12	0.038	63.8	30Dec2015, 12:30	7.7
Subbasin-11	0.03	43.6	30Dec2015, 12:27	4.6
Outlet Junction	3.813	702.7	30Dec2015, 12:45	333.9
Outlet	3.813	702.7	30Dec2015, 12:45	333.9

Areas 3-6


Graph for Sink "Swan Lake"
Sink "Swan Lake" Results for Run "Major EX"
Flow (cfs)
1,600
1,400
1,200
1,000
800
600
400
200
0
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
30Dec2015
Legend (Compute Time: 24May2016, 10:25:00)
Run:Major EX Element:Swan Lake Result:Outflow
Run:Major EX Element:O-SwanLake2 Result:Outflow
Run:Major EX Element:O-SwanLake1 Result:Outflow
Run:Major EX Element:O-SwanLake3 Result:Outflow

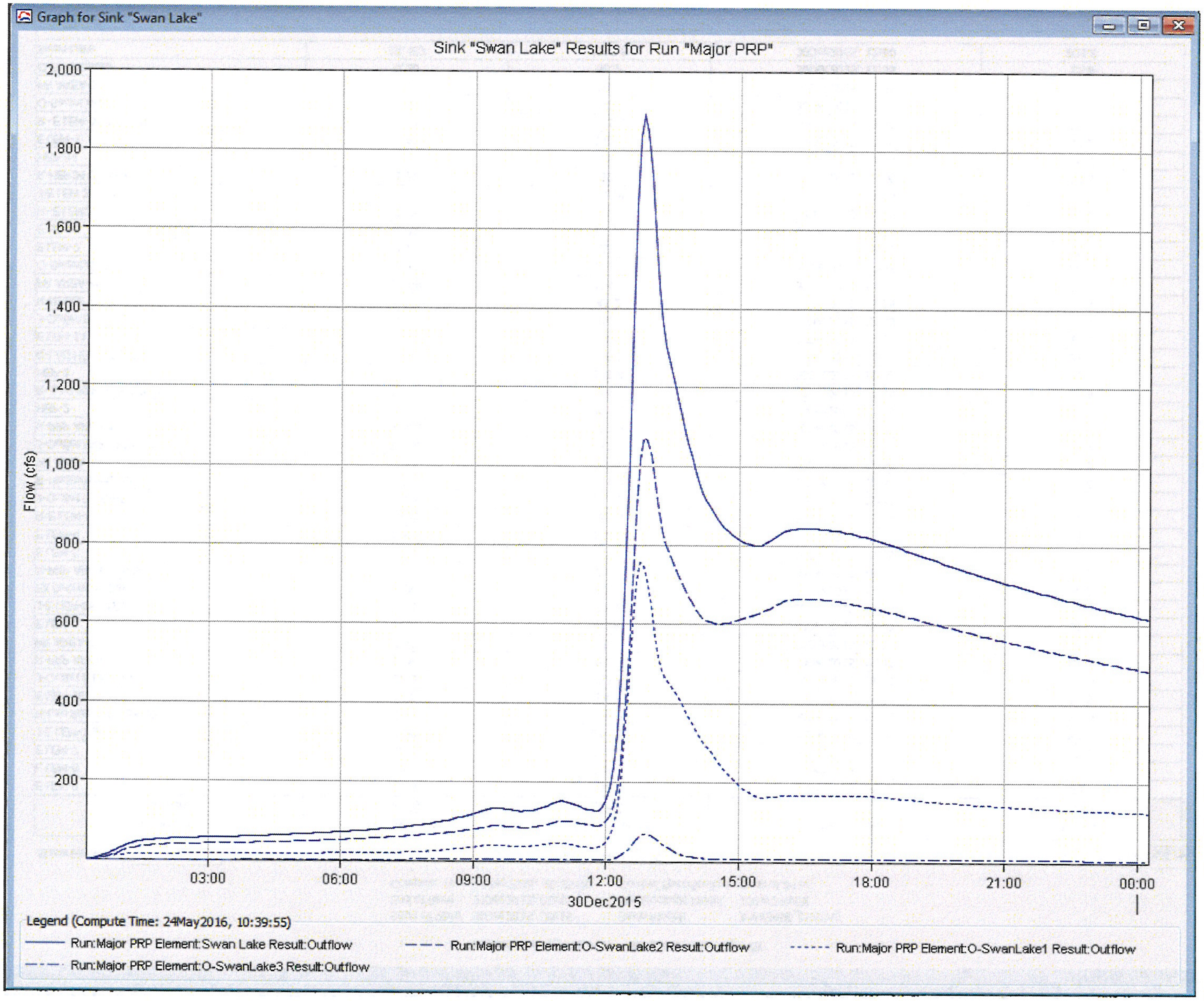
Global Summary Results for Run "Major EX"

Project: Lansing_Area3456 Simulation Run: Major EX

Start of Run: 30Dec2015, 00:15 Basin Model: Area3456_Existing
End of Run: 31Dec2015, 00:15 Meteorologic Model: 100yr24hrEX
Compute Time: 24May2016, 10:25:00 Control Specifications: Control 24 hr

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
E LEM-9	1.96	407.9	30Dec2015, 14:05	181.4
E LEM-8	1.66	308.8	30Dec2015, 14:20	146.4
E LEM-7	1.58	145.1	30Dec2015, 13:55	68.1
J-E LEM-7 and 8	5.20	854.1	30Dec2015, 14:10	396.0
R-Lag Reach E LEM-10	5.20	394.7	30Dec2015, 16:15	310.9
E LEM-10	0.78	65.1	30Dec2015, 15:05	39.5
J-Outlet E LEM-10	5.98	452.4	30Dec2015, 15:55	350.4
R-PRP AREA6	5.98	452.0	30Dec2015, 16:45	320.6
PR AREA-6	0.99	93.5	30Dec2015, 12:50	26.2
E LEM-6	0.91	88.9	30Dec2015, 13:40	38.1
J-E LEM-06 OUTLET	0.91	88.9	30Dec2015, 13:40	38.1
EX Detention Basin	1.90	62.7	30Dec2015, 17:40	42.2
R-PRP AREA6 Outlet	1.90	62.7	30Dec2015, 18:35	37.2
E LEM-5	0.66	80.6	30Dec2015, 13:35	32.5
E LEM-4	0.656	183.2	30Dec2015, 13:20	53.1
R-E LEM-5	0.656	182.4	30Dec2015, 13:30	52.5
J-Outlet E LEM-5	1.316	262.2	30Dec2015, 13:30	85.0
R-Matterhornblvd	1.316	261.2	30Dec2015, 13:45	83.6
PR AREA-4A	0.13	87.9	30Dec2015, 12:50	17.2
J-Outlet PRP AREA 4A	9.326	587.4	30Dec2015, 17:05	458.6
R-PRP AREA4B	9.326	587.2	30Dec2015, 17:10	454.1
HEP-2	0.302	191.2	30Dec2015, 12:40	30.8
R- LAG HEP-2 OUTFLOW	0.302	184.6	30Dec2015, 12:45	30.6
HEP-1	0.24	178.8	30Dec2015, 12:40	28.2
R-LAG HEP-1 TO OUT	0.24	176.8	30Dec2015, 12:50	28.0
E LEM-11	0.22	49.2	30Dec2015, 12:55	12.0
J-Outlet E LEM 11	0.22	49.2	30Dec2015, 12:55	12.0
R-Nectar St	0.22	46.2	30Dec2015, 13:35	11.4
PR AREA-4B	0.199	104.6	30Dec2015, 13:10	27.4
O-SwanLake2	10.287	651.7	30Dec2015, 17:05	551.5
E LEM-2	0.76	123.1	30Dec2015, 13:10	35.4
E LEM-3	0.76	137.4	30Dec2015, 13:25	45.9
R- E LEM2	0.76	136.5	30Dec2015, 13:35	45.2
J-E LEM 2 AND 3	1.52	235.8	30Dec2015, 13:25	80.7
R-HEP34 Channel	1.52	232.8	30Dec2015, 13:50	77.8
HEP-34	1.14	674.8	30Dec2015, 12:45	122.6
E LEM-1	0.41	142.1	30Dec2015, 13:10	36.2
R- E LEM-01 TO OUT	0.41	141.4	30Dec2015, 13:10	36.1
O-SwanLake1	3.07	762.8	30Dec2015, 12:45	236.5
PR AREA-3	0.10	68.7	30Dec2015, 12:55	13.8
O-SwanLake3	0.10	68.7	30Dec2015, 12:55	13.8
Swan Lake	13.457	1393.8	30Dec2015, 12:50	801.8



Graph for Sink "Swan Lake"
Sink "Swan Lake" Results for Run "Major PRP"
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
Flow (cfs)
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
30Dec2015
Legend (Compute Time: 24May2016, 10:39:55)
Run:Major PRP Element:Swan Lake Result:Outflow
Run:Major PRP Element:O-SwanLake2 Result:Outflow
Run:Major PRP Element:O-SwanLake1 Result:Outflow
Run:Major PRP Element:O-SwanLake3 Result:Outflow

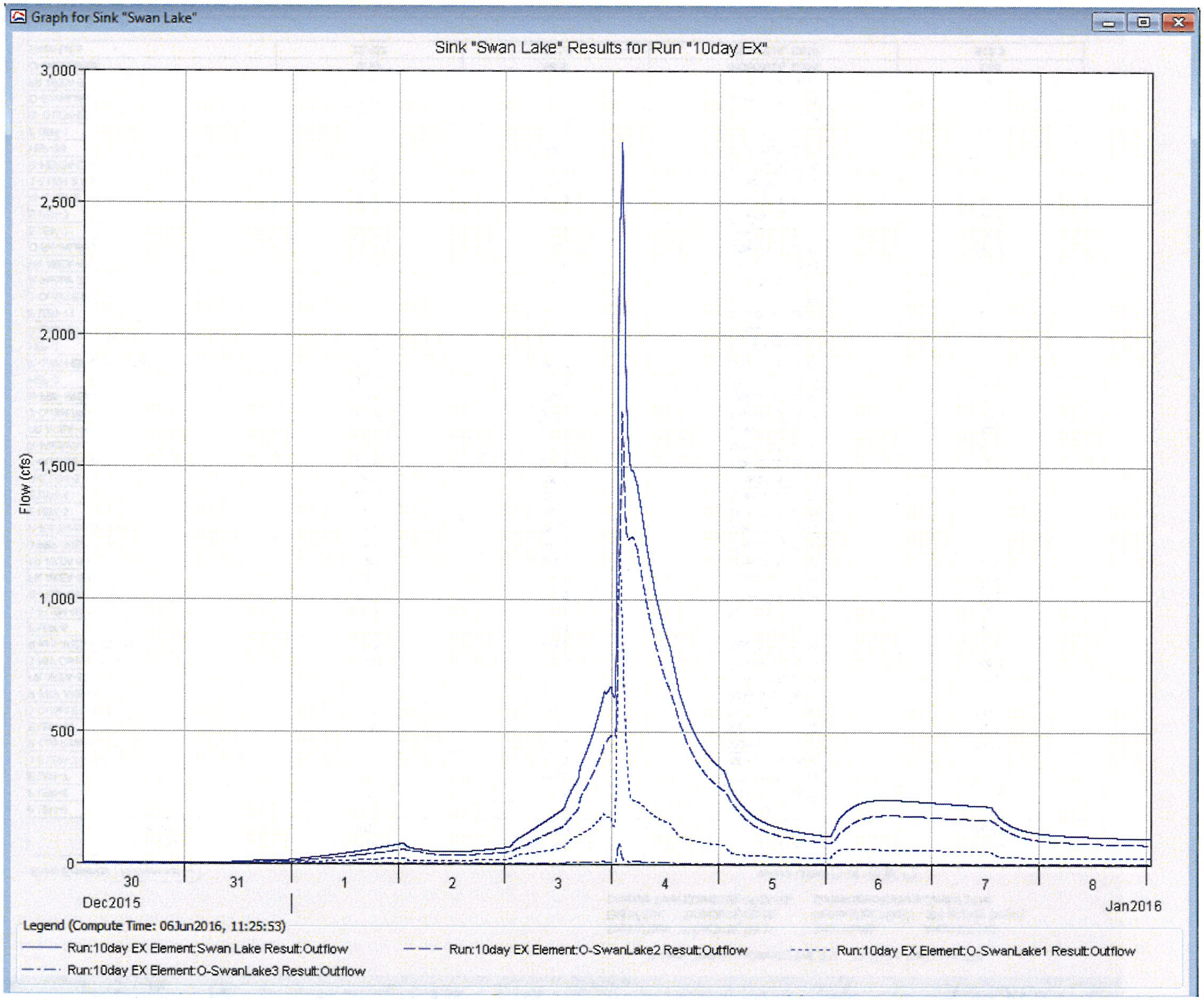
Global Summary Results for Run "Major PRP"

Project: LansingArea3thru6_Final_07J Simulation Run: Major PRP

Start of Run: 30Dec2015, 00:15 Basin Model: Area3456_PRP
End of Run: 31Dec2015, 00:15 Meteorologic Model: 100 yr 24 hr (Major)
Compute Time: 13Jun2016, 09:56:55 Control Specifications: Control 24 hr

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
E LEM-9	1.96	402.8	30Dec2015, 14:05	177.7
E LEM-8	1.66	304.6	30Dec2015, 14:20	143.4
E LEM-7	1.58	141.0	30Dec2015, 13:55	66.1
J-E LEM-7 and 8	5.20	840.9	30Dec2015, 14:10	387.1
R-Lag Reach E LEM-10	5.20	387.2	30Dec2015, 16:15	303.9
E LEM-10	0.78	63.5	30Dec2015, 15:05	38.5
J-Outlet E LEM-10	5.98	443.5	30Dec2015, 15:55	342.4
R-PRP AREA6	5.98	443.4	30Dec2015, 16:05	337.0
PR AREA-6C	0.256	104.8	30Dec2015, 12:45	23.2
J-NW Corner HEP-02	6.236	454.8	30Dec2015, 16:10	360.1
R-prp AREA 6 TO OUT	6.236	454.6	30Dec2015, 16:20	351.9
E LEM-6	0.91	116.0	30Dec2015, 13:15	38.1
J-E LEM-06 OUTLET	0.91	116.0	30Dec2015, 13:15	38.1
R-Flow Thru Area6	0.91	115.9	30Dec2015, 13:20	37.9
PR AREA-6BB	0.446	165.0	30Dec2015, 12:50	38.0
PR AREA-6A	0.288	181.3	30Dec2015, 12:50	36.8
J-PRP AREA-6 outlet	1.644	404.3	30Dec2015, 12:50	112.7
R-Rd Through 4A and 4B	1.644	395.6	30Dec2015, 13:05	111.2
E LEM-5	0.66	78.7	30Dec2015, 13:35	31.6
E LEM-4	0.656	180.8	30Dec2015, 13:20	51.9
R-E LEM-5	0.656	180.0	30Dec2015, 13:30	51.3
J-Outlet E LEM-5	1.316	257.9	30Dec2015, 13:30	83.0
R-Matterhornblvd	1.316	256.9	30Dec2015, 13:45	81.6
PR AREA-4A	0.13	144.1	30Dec2015, 12:35	21.4
J-Outlet PRP AREA 4A	1.446	264.8	30Dec2015, 13:45	103.0
R-PRP AREA4B	1.446	262.9	30Dec2015, 13:50	102.1
HEP-2	0.302	189.3	30Dec2015, 12:40	30.2
R- LAG HEP-2 OUTFLOW	0.302	182.4	30Dec2015, 12:45	30.0
HEP-1	0.24	177.3	30Dec2015, 12:40	27.7
R-LAG HEP-1 TO OUT	0.24	175.3	30Dec2015, 12:50	27.5
E LEM-11	0.22	48.2	30Dec2015, 12:55	11.7
J-Outlet E LEM 11	0.22	48.2	30Dec2015, 12:55	11.7
R-Nectar St	0.22	45.2	30Dec2015, 13:35	11.1
PR AREA-4B	0.199	217.0	30Dec2015, 12:40	33.7
O-SwanLake2	10.287	1083.2	30Dec2015, 12:50	667.5
E LEM-2	0.76	120.0	30Dec2015, 13:10	34.4
E LEM-3	0.76	134.8	30Dec2015, 13:25	44.7
R- E LEM2	0.76	133.9	30Dec2015, 13:35	44.1
J-E LEM 2 AND 3	1.52	230.7	30Dec2015, 13:25	78.5
R-HEP34 Channel	1.52	227.9	30Dec2015, 13:50	75.6
HEP-34	1.14	668.7	30Dec2015, 12:45	120.3
E LEM-1	0.41	140.5	30Dec2015, 13:10	35.5
R- E LEM-01 TO OUT	0.41	139.7	30Dec2015, 13:10	35.4
O-SwanLake1	3.07	754.4	30Dec2015, 12:45	231.3
PR AREA-3	0.10	68.3	30Dec2015, 12:55	13.6
O-SwanLake3	0.10	68.3	30Dec2015, 12:55	13.6
Swan Lake	13.457	1901.6	30Dec2015, 12:50	912.3


Graph for Sink "Swan Lake"
Sink "Swan Lake" Results for Run "10day EX"
Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
30
31
1
2
3
4
5
6
7
8
Dec2015
Jan2016
Legend (Compute Time: 06Jun2016, 11:25:53)
Run:10day EX Element:Swan Lake Result:Outflow
Run:10day EX Element:O-SwanLake2 Result:Outflow
Run:10day EX Element:O-SwanLake1 Result:Outflow
Run:10day EX Element:O-SwanLake3 Result:Outflow

Global Summary Results for Run "10day EX"

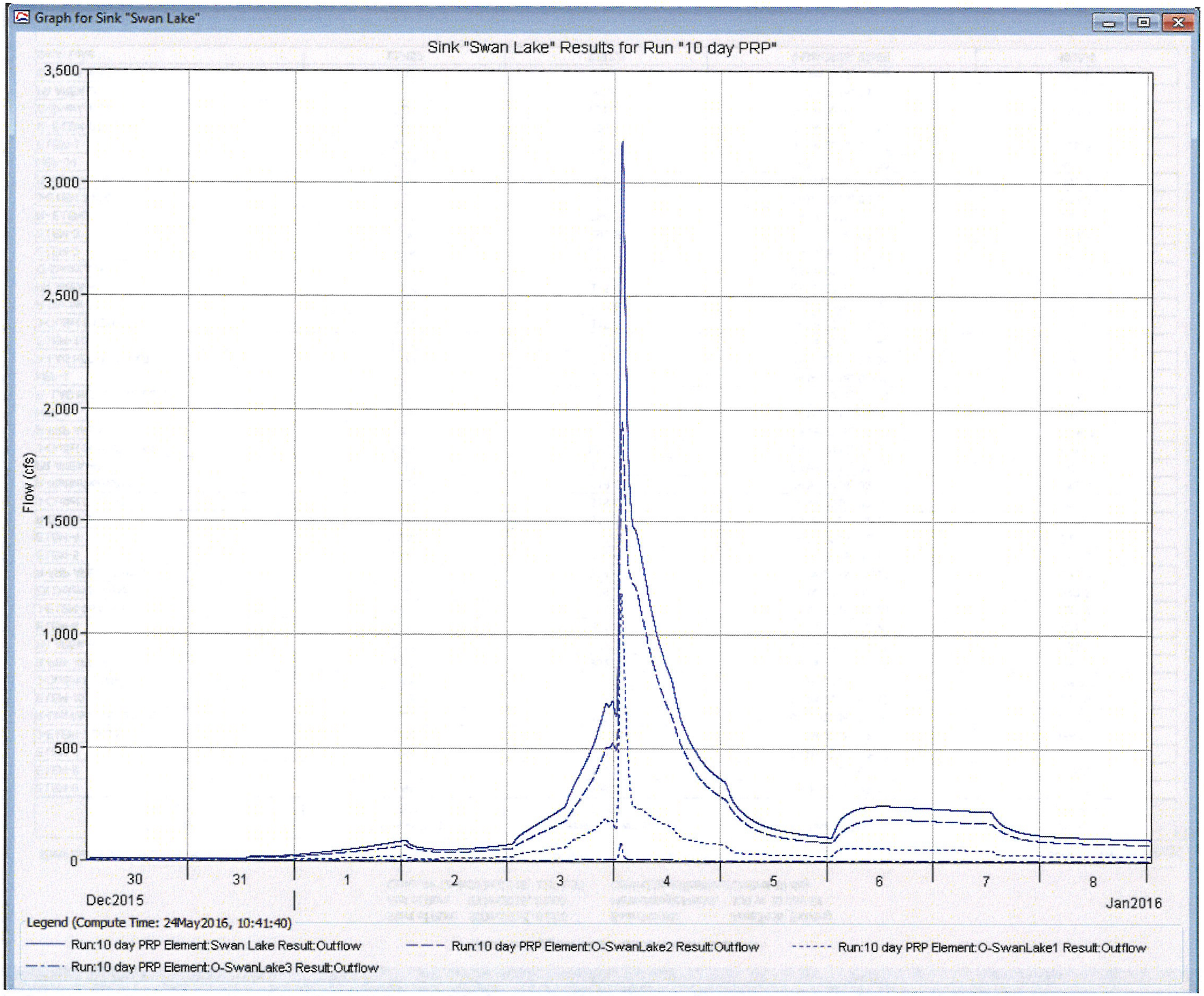
Project: Lansing_Area3456 Simulation Run: 10day EX

Start of Run: 30Dec2015, 01:00
End of Run: 09Jan2016, 01:00
Compute Time: 06Jun2016, 11:25:53

Basin Model: Area3456_Existing
Meteorologic Model: 100 yr 10 day EX
Control Specifications: Control 10 day

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
E LEM-9	1.96	628.8	04Jan2016, 02:45	693.1
E LEM-8	1.66	490.0	04Jan2016, 02:55	576.9
E LEM-7	1.58	410.0	04Jan2016, 02:35	393.2
J-E LEM-7 and 8	5.20	1511.0	04Jan2016, 02:45	1663.3
R-Lag Reach E LEM-10	5.20	762.9	04Jan2016, 04:20	1651.7
E LEM-10	0.78	151.5	04Jan2016, 03:35	216.0
J-Outlet E LEM-10	5.98	903.7	04Jan2016, 04:10	1867.7
R-PRP AREA6	5.98	902.7	04Jan2016, 04:55	1863.5
PR AREA-6	0.99	477.2	04Jan2016, 01:25	192.5
E LEM-6	0.91	261.6	04Jan2016, 02:20	221.8
J-E LEM-06 OUTLET	0.91	261.6	04Jan2016, 02:20	221.8
EX Detention Basin	1.90	576.3	04Jan2016, 01:35	392.6
R-PRP AREA6 Outlet	1.90	554.4	04Jan2016, 02:05	391.7
E LEM-5	0.66	206.4	04Jan2016, 02:15	169.2
E LEM-4	0.656	312.1	04Jan2016, 02:00	213.7
R-E LEM-5	0.656	311.3	04Jan2016, 02:10	213.6
J-Outlet E LEM-5	1.316	516.0	04Jan2016, 02:10	382.8
R-Matterhornblvd	1.316	514.6	04Jan2016, 02:25	382.6
PR AREA-4A	0.13	106.0	04Jan2016, 01:35	52.7
J-Outlet PRP AREA 4A	9.326	1397.8	04Jan2016, 02:15	2690.5
R-PRP AREA4B	9.326	1392.7	04Jan2016, 02:20	2689.8
HEP-2	0.302	269.9	04Jan2016, 01:25	104.4
R- LAG HEP-2 OUTFLOW	0.302	264.0	04Jan2016, 01:30	104.3
HEP-1	0.24	230.1	04Jan2016, 01:25	89.8
R-LAG HEP-1 TO OUT	0.24	227.6	04Jan2016, 01:35	89.8
E LEM-11	0.22	115.0	04Jan2016, 01:40	56.6
J-Outlet E LEM 11	0.22	115.0	04Jan2016, 01:40	56.6
R-Nectar St	0.22	109.6	04Jan2016, 02:10	56.4
PR AREA-4B	0.199	125.0	04Jan2016, 01:55	82.7
O-SwanLake2	10.287	1706.0	04Jan2016, 02:10	3023.0
E LEM-2	0.76	325.5	04Jan2016, 01:50	191.2
E LEM-3	0.76	291.8	04Jan2016, 02:10	216.1
R- E LEM2	0.76	290.7	04Jan2016, 02:15	216.0
J-E LEM 2 AND 3	1.52	567.5	04Jan2016, 02:00	407.2
R-HEP34 Channel	1.52	560.7	04Jan2016, 02:20	406.7
HEP-34	1.14	936.7	04Jan2016, 01:30	407.0
E LEM-1	0.41	226.2	04Jan2016, 01:55	138.6
R- E LEM-01 TO OUT	0.41	226.1	04Jan2016, 01:55	138.6
O-SwanLake1	3.07	1183.5	04Jan2016, 01:35	952.3
PR AREA-3	0.10	80.6	04Jan2016, 01:40	41.4
O-SwanLake3	0.10	80.6	04Jan2016, 01:40	41.4
Swan Lake	13.457	2727.0	04Jan2016, 02:05	4016.6


Graph for Sink "Swan Lake"
Sink "Swan Lake" Results for Run "10 day PRP"
Flow (cfs)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
30
31
1
2
3
4
5
6
7
8
Dec2015
Jan2016
Legend (Compute Time: 24May2016, 10:41:40)
Run:10 day PRP Element:Swan Lake Result:Outflow
Run:10 day PRP Element:O-SwanLake2 Result:Outflow
Run:10 day PRP Element:O-SwanLake1 Result:Outflow
Run:10 day PRP Element:O-SwanLake3 Result:Outflow

Global Summary Results for Run "10 day PRP"

Project: Lansing_Area3456 Simulation Run: 10 day PRP

Start of Run: 30Dec2015, 01:00 Basin Model: Area3456_PRP
End of Run: 09Jan2016, 01:00 Meteorologic Model: 100yr 10 Day PRP
Compute Time: 24May2016, 10:41:40 Control Specifications: Control 10 day

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

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
E LEM-8	1.66	490.0	04Jan2016, 02:55	576.9
E LEM-7	1.58	410.0	04Jan2016, 02:35	393.2
J-E LEM-7 and 8	5.20	1511.0	04Jan2016, 02:45	1663.3
R-Lag Reach E LEM-10	5.20	762.9	04Jan2016, 04:20	1651.7
E LEM-10	0.78	151.5	04Jan2016, 03:35	216.0
J-Outlet E LEM-10	5.98	903.7	04Jan2016, 04:10	1867.7
R-PRP AREA6	5.98	903.4	04Jan2016, 04:20	1866.9
E LEM-6	0.91	341.9	04Jan2016, 02:00	222.0
J-E LEM-06 OUTLET	0.91	341.9	04Jan2016, 02:00	222.0
R-Flow Thru Area6	0.91	341.8	04Jan2016, 02:00	222.0
PR AREA-6C	0.256	138.7	04Jan2016, 01:35	71.6
J-NW Corner HEP-02	7.146	973.0	04Jan2016, 04:10	2160.5
R-prp AREA 6 TO OUT	7.146	972.7	04Jan2016, 04:25	2159.1
E LEM-5	0.66	206.4	04Jan2016, 02:15	169.2
E LEM-4	0.656	312.1	04Jan2016, 02:00	213.7
R-E LEM-5	0.656	311.3	04Jan2016, 02:10	213.6
J-Outlet E LEM-5	1.316	516.0	04Jan2016, 02:10	382.8
R-Matterhornblvd	1.316	514.5	04Jan2016, 02:25	382.6
PR AREA-4A	0.13	149.7	04Jan2016, 01:20	57.9
J-Outlet PRP AREA 4A	1.446	524.1	04Jan2016, 02:25	440.5
R-PRP AREA4B	1.446	521.2	04Jan2016, 02:30	440.3
PR AREA-6BB	0.446	251.1	04Jan2016, 01:35	125.8
PR AREA-6A	0.288	229.3	04Jan2016, 01:35	110.9
J-PRP AREA-6 outlet	0.734	480.4	04Jan2016, 01:35	236.7
R-Rd Through 4A and 4B	0.734	467.8	04Jan2016, 01:45	236.5
HEP-2	0.302	269.9	04Jan2016, 01:25	104.4
R- LAG HEP-2 OUTFLOW	0.302	263.5	04Jan2016, 01:30	104.3
HEP-1	0.24	230.1	04Jan2016, 01:25	89.8
R-LAG HEP-1 TO OUT	0.24	227.6	04Jan2016, 01:35	89.8
E LEM-11	0.22	115.0	04Jan2016, 01:40	56.6
J-Outlet E LEM 11	0.22	115.0	04Jan2016, 01:40	56.6
R-Nectar St	0.22	109.6	04Jan2016, 02:10	56.4
PR AREA-4B	0.199	222.4	04Jan2016, 01:25	89.9
O-SwanLake2	10.287	1940.0	04Jan2016, 01:45	3176.4
E LEM-2	0.76	325.5	04Jan2016, 01:50	191.2
E LEM-3	0.76	291.8	04Jan2016, 02:10	216.1
R- E LEM2	0.76	290.7	04Jan2016, 02:15	216.0
J-E LEM 2 AND 3	1.52	567.5	04Jan2016, 02:00	407.2
R-HEP34 Channel	1.52	560.7	04Jan2016, 02:20	406.7
HEP-34	1.14	936.7	04Jan2016, 01:30	407.0
E LEM-1	0.41	226.3	04Jan2016, 01:55	138.6
R- E LEM-01 TO OUT	0.41	226.2	04Jan2016, 01:55	138.6
O-SwanLake1	3.07	1183.6	04Jan2016, 01:35	952.3
PR AREA-3	0.10	80.6	04Jan2016, 01:40	41.4
O-SwanLake3	0.10	80.6	04Jan2016, 01:40	41.4
Swan Lake	13.457	3185.3	04Jan2016, 01:40	4170.1

A.2 Street and Drainage Facility Calculations

Area 1

Conveyance Channels

Title	Description	Assumed Manning's n	Assumned slope (ft/ft)	Base Width (ft)	Major Storm Discharge (cfs)	Maximum flow depth (ft)	Peak Velocity (ft/s)	Minimum freeboard required (ft)
SD Outlet 1 (West of PH-3)	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0100	2.00	53.50	2.10	4.11	0.76
SD Outlet Park (channel to East of PH-3	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0067	2.00	75.00	2.65	3.88	0.73
VV-6 Outlet	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0065	2.00	13.3	1.20	2.52	0.60
PH1A-outlet	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0065	2.00	45.30	2.20	3.22	0.66
North Conveyance Channel	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0065	2.00	44.50	2.20	3.16	0.66
North Channel DS of PH1B outlet	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0030	2.00	82.70	3.32	2.88	0.63
North Channel Full Combined	Trapezoidal Channel, 2:1 side slopes, earthen/rock lined	0.040	0.0068	2.00	119.80	3.25	4.34	0.79

Strom Drain Pipes

Title	Description	Assumed Manning's n	Assumned slope (ft/ft)	Minor storm discharge (cfs)	Pipe Diameter (in)	Minor Velocity (ft/s)
SD outlet Park (Minor)	RCP pipe, 24" diameter	0.013	0.0100	20.70	24.00	7.22
Offsite Flows from VV-6	RCP pipe, 18" diameter	0.013	0.0065	3.80	18.00	4.81
VV-6Offsite w PRP PH1A	RCP pipe, 24" diameter	0.013	0.0065	12.80	24.00	5.82
PH1-B on Site	RCP pipe, 24" diameter	0.013	0.0069	11.20	24.00	6.00
VV-3 Offsite	RCP pipe, 18" diameter	0.013	0.0068	4.80	18.00	4.91
VV-3 Offsite w PRP PH2	RCP pipe, 24" diameter	0.013	0.0068	12.40	24.00	5.95
VV-9 Outlet	RCP pipe, 18" diameter	0.013	0.0050	3.10	18.00	4.21

Area 2

Summary of Drainage Infrastructure Calculations

Title	Description	Assumed Mannings n[1]	Slope	base width (ft)	100-year (Major Storm) Discharge (cfs)	Maximum Flow Depth (ft)	Flow Area (ft2)	Peak Velocity (ft/s)	Minimum Freeboard Required (ft) 1 ft minimum	5-year (minor storm) Discharge (cfs)	Flow Area (ft2)	Minor Velocity (ft/s)
Main Channel	Trapezoidal Channel, 3:1 Side Slopes, Rock lined	0.03	0.2%	15	513	4.22	116.7	4.4	0.8	116	40.66	2.85
West Channel	Trapezoidal Channel, 3:1 Side Slopes, Rock lined	0.03	0.2%	20	353	3.36	101.1	3.5	0.7	88	39.68	2.22
Lateral 1	RCP 24" Diameter	0.013	1.0%	N/A	36	2	4.9	7.3	1.3	8	81.8	0.10
V-Ditch 1	V-Ditch, 3:1 Side Slopes, RockLined	0.033	0.5%	N/A	80	2.7	17.1	4.7	0.8	11	8.22	1.34
V-Ditch 2	V-Ditch, 3:1 Side Slopes, RockLined	0.033	0.5%	N/A	145	3.35	21.2	6.8	1.2	22	10.75	2.05
V-Ditch 3	V-Ditch, 3:1 Side Slopes, RockLined	0.033	1.0%	N/A	160	3.05	19.3	8.3	1.6	24	9.49	2.53
Gutter 3B	Street Flow, 2% cross slope	0.013	0.7%	N/A	120	0.59	13.1	5.4*	N/A	39	5.42	1.73*
Gutter 3C	Street Flow, 2% cross slope	0.013	0.4%	N/A	89	0.58	12.6	4.1*	N/A	35	4.32	1.42*

*Value represents velocity times depth (V*D) in ft^2/s

[1] Values assumed from Table 802 (TMRDM)

Areas 3-6

			Minor Storm	Major Storm	Conceptual Runoff Conveyance (sized for Major Storm)					
Outlet Point	Code	Drainage Area (mi²)	Q_5 PRP (cfs)	Q_{100} PRP (cfs)	Channel Shape	side slope, z	b (ft)	depth[1] (ft)	velocity[2] (ft/s)	slope[3] (ft/ft)
Offsite Matterhorn Blvd.	OS-MH	1.3	35.4	256.9	Trapezoidal	2	6	5	4.6	0.005
Offsite Basin E LEM-06	OS-6	0.9	6.9	116	Trapezoidal	2	4	3.5	5.7	0.015
Offsite Basin E LEM-10	OS-10	6.0	118.4	443.5	Trapezoidal	3	12	4.5	5.5	0.007
Offsite Basin HEP-02	OS-H2	0.3	42.6	189.3	Trapezoidal	2	4	4.5	4.3	0.005
Combined Runoff Area 4A	RO-A4A	1.4	50.1	264.8	Trapezoidal	2	8	4.75	4.6	0.005
Combined Runoff Area 6A/B	RO-A6AB	1.6	118.9	404.3	Trapezoidal[4]	2	2	4.6	4.0	0.004
Combined Runoff Area 6C	RO-A6C	6.2	129.5	454.8	Trapezoidal	3	15	4.75	4.8	0.005

Discharge to Swan Lake

Drainage Area (mi²)	Q_{100} EX (cfs)	Q_{100} PRP (cfs)
13.5	1393.8	1901.6

Runoff Volume at Swan Lake (AF)

10-day Existing	10 day Proposed	Increase
4016.6	4170.1	153.5

[1] Includes required freeboard

[2] Assumed manning's n of 0.04

[3] Assumed proposed slope matches EG

[4] Assumed flow is split on both sides of roadway (i.e., channel sized for half of flow)

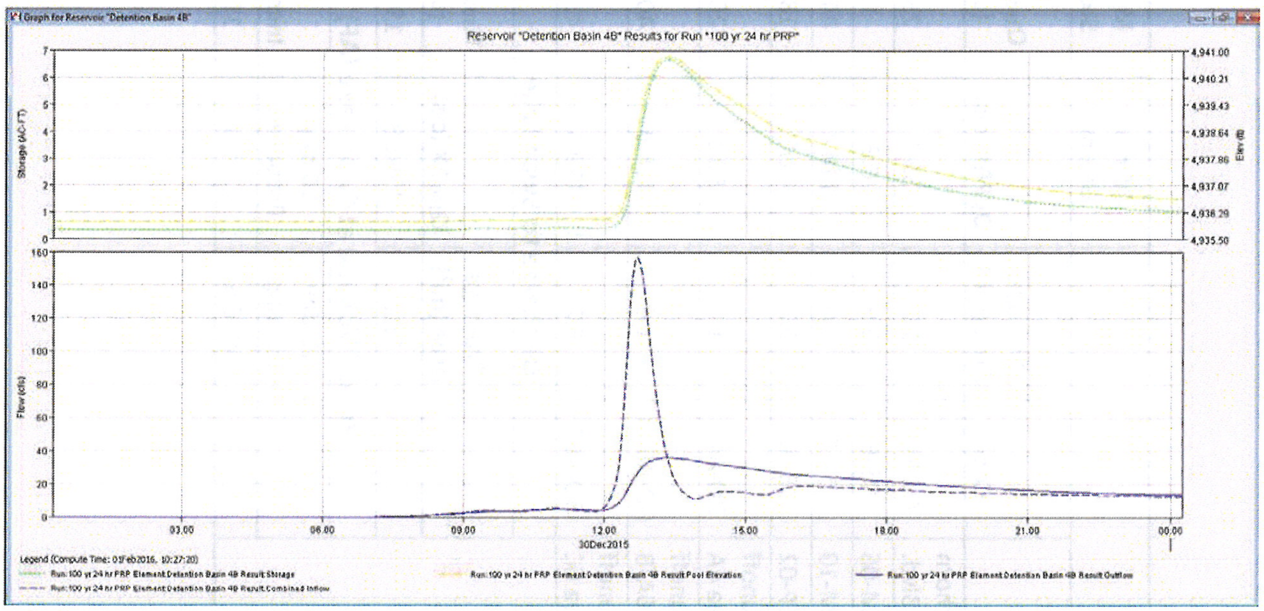
A.3 Detention Calculations (Area 2 proposed Basin)

Detention Basin Calculations

Assumptions: Inlet control, C=0.65, 24" RCP outlet, Bottom elevation=4935

Elevation (ft NAVD88)	Area (SF)	Storage Volume (Acre-ft)	Discharge[1] (cfs)	Velocity (ft/s)
4935	38208	0.00	0.00	0.00
4936	43166	1.87	16.39	5.22
4937	48744	2.99	23.18	7.38
4938	54076	4.23	28.38	9.03
4939	60253	5.61	32.77	10.43
4940	66864	7.15	36.64	11.66
4941	73710	8.84	40.14	12.78
4942	80803	10.69	43.36	13.80
4943	88256	12.72	46.35	14.75

[1]Calculated using equation 1302 (TMRDM 2009)



A.4 Referenced Tables/Charts (TMRDM 2009)

RUNOFF CURVE NUMBERS FOR URBAN AREAS[1]

Cover Type and Hydrologic Condition	Aver. % Impervious Area[2]	Runoff Curve Numbers: Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Fully developed urban area (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50 to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious only, no vegetation)[5]		77	86	91	94
Idle lands (CNs are determined using cover types similar to those Table 702 - 3 of 4)					

[1]Average runoff condition, and $I_a = 0.2S$

[2]The average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CNs for other combinations of conditions may be computed using figure 2-3 or 2-4 in TR-55 (SCS, 1986).

[3]CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

[4]Composite CNs for natural desert landscaping should be computed using figure 2-3 or 2-4 in TR-55 (SCS, 1986) based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CNs are assumed equivalent to desert shrub in poor hydrologic condition.

[5]Composite CNs to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 in TR-55 (SCS, 1986) based on the degree of development (impervious area percentage) and the CNs for the newly graded pervious areas.

RUNOFF CURVE NUMBERS FOR CULTIVATED AGRICULTURAL LANDS[1]

Cover type	Treatment[2]	Hydrologic condition[3]	Runoff Curve Numbers Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Fallow	Bare soil	-	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1]Average runoff condition, and $I_a = 0.2S$

[2]*Crop residue cover* applies only if residue is on at least 5% of the surface throughout the year.

[3]Hydrologic condition is based on combination of factors that affect infiltration and runoff, including: (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.
Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

RUNOFF CURVE NUMBERS FOR OTHER AGRICULTURAL LANDS[1]

Cover Type	Hydrologic Condition	Runoff Curve Numbers Soil Comp A	Soil Comp B	Soil Comp C	Soil Comp D
Pasture, grassland, or range – continuous forage for grazing[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow – continuous grass, protected from grazing and generally mowed for hay	-	30	58	71	78
Brush – brush-weed-grass mixture with brush the major element[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4]	48	65	73
Woods – grass combination (orchard or tree farm)[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30[4]	55	70	77
Farmsteads – buildings, lanes, driveways, and surrounding lots	-	59	74	82	86

[1]Average runoff condition, and $I_a = 0.2S$

[2]*Poor*: < 50% ground cover or heavily grazed with no mulch
Fair: 50 to 75% ground cover and not heavily grazed
Good: > 75% ground cover and lightly or only occasionally grazed

[3]*Poor*: < 50% ground cover
Fair: 50 to 75% ground cover
Good: >75% ground cover

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pasture.

[6]*Poor*: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

RUNOFF CURVE NUMBERS FOR ARID AND SEMIARID RANGELANDS[1]

Cover Description	Hydrologic Condition[2]	Runoff Curve Numbers: Soil Comp A[3]	Soil Comp B	Soil Comp C	Soil Comp D
Herbaceous – mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen – mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper – pinyon, juniper, or both; grass understory	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub – major plants include saltbrush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

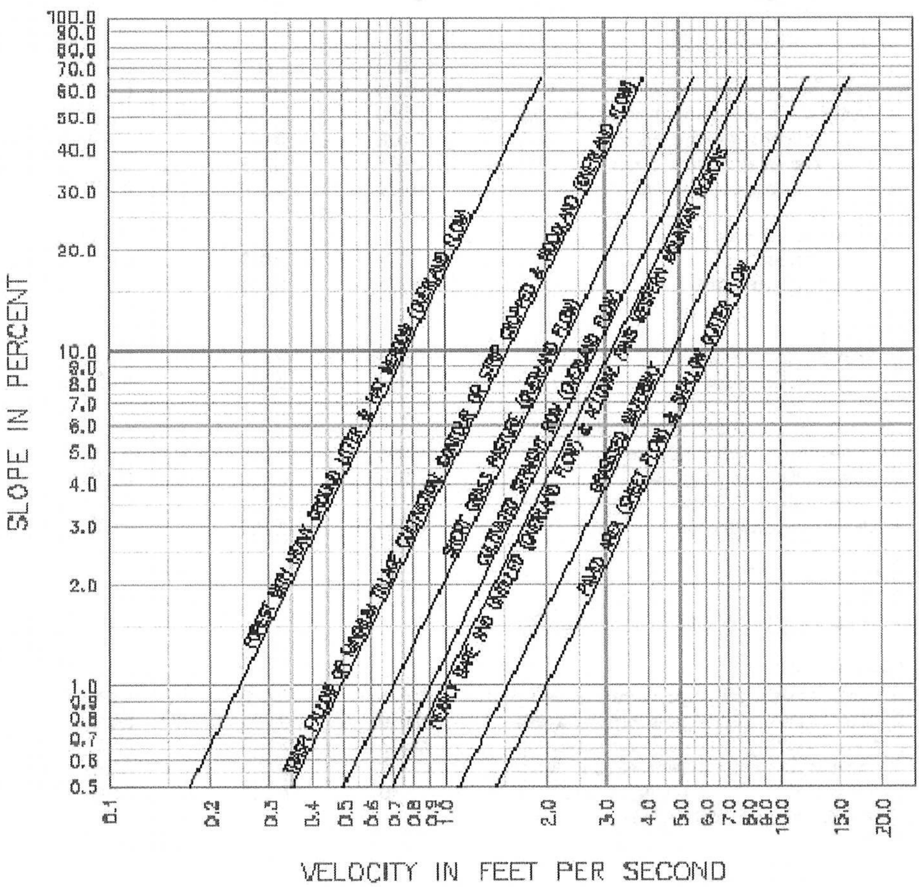
[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use Table 702 - 3 of 4.

[2]*Poor*: < 30% ground cover (litter, grass, and brush overstory)
Fair: 30 to 70% ground cover
Good: > 70% ground cover

[3]Curve numbers for group A have been developed only for desert shrub.

TRUCKEE MEADOWS REGIONAL DRAINAGE MANUAL

TRAVEL TIME VELOCITY



Version: April 30, 2009	REFERENCE: Soil Conservation Service, 1985 (Modified)	FIGURE 701
PLACES–CSI		

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

TYPE OF CHANNEL AND DESCRIPTION	MINIMUM	NORMAL	MAXIMUM
EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same as above, but highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
Minor Streams (top width at flood stage < 100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, but lower stages, and more ineffective slopes and sections	0.040	0.048	0.055

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

TYPE OF CHANNEL AND DESCRIPTION	MINIMUM	NORMAL	MAXIMUM
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravel, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.105	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.1200
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
Major Streams (top width at flood stage > 100 ft). The *n* value is less than that for minor streams of similar description, because banks offer less effective resistance			
a. Regular section with no boulders or brush	0.025	---	0.060
b. Irregular and rough section	0.035	---	0.100

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

TYPE OF CHANNEL AND DESCRIPTION	MINIMUM	NORMAL	MAXIMUM
LINED OR BUILT-UP CHANNELS			
a. Corrugated Metal	0.021	0.025	0.030
b. Concrete			
1. Trowel finish	0.011	0.013	0.015
2. Float finish	0.013	0.015	0.016
3. Finished, with gravel on bottom	0.015	0.017	0.020
4. Unfinished	0.014	0.017	0.020
5. Gunite, good section	0.016	0.019	0.023
6. Gunite, wavy section	0.018	0.022	0.025
7. On good excavated rock	0.017	0.020	---
8. On irregular excavated rock	0.022	0.027	---
c. Concrete bottom float finished with sides of:			
1. Dressed stone in mortar	0.015	0.017	0.020
2. Random stone in mortar	0.017	0.020	0.024
3. Cement rubble masonry, plastered	0.016	0.020	0.024
4. Cement rubble masonry	0.020	0.025	0.030
5. Dry rubble or riprap	0.020	0.030	0.035
d. Gravel bottom with sides of :			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0..023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
e. Asphalt			
1. Smooth	0.013	0.013	---
2. Rough	0.016	0.016	---
f. Grassed	0.030	0.040	0.050

MAXIMUM PERMISSIBLE MEAN CHANNEL VELOCITIES

MATERIAL/LINING	MAXIMUM PERMISSIBLE MEAN VELOCITY (ft/sec)
NATURAL AND IMPROVED UNLINED CHANNELS	
Fine sand, colloidal	1.50
Sandy Loam, noncolloidal	1.75
Silt Loam, noncolloidal	2.00
Alluvial Silts, noncolloidal	2.00
Ordinary Firm Loam	2.50
Volcanic Ash	2.50
Stiff Clay, very colloidal	3.75
Alluvial Silts, colloidal	3.75
Shales and Hardpans	6.00
Fine Gravel	2.50
Graded Loam to Cobbles when noncolloidal	3.75
Graded Silts to Cobbles when colloidal	4.00
Coarse Gravel, noncolloidal	4.00
Cobbles and Shingles	5.00
Sandy Silt	2.0
Silty Clay	2.5
Poor Sedimentary Rock	10
Sound Rock (Igneous or Hard Metamorphic)	20
FULLY LINED CHANNELS	
Unreinforced vegetation	5
Loose riprap	15
Grouted riprap	15
Gabions	15
Soil-Cement	15
Concrete	35

NOTES:

1. For composite-lined channels, use the lowest of the maximum mean velocities for the materials used in the composite lining.
2. Deviation from the above values is only allowed with appropriate engineering analysis and/or suitable agreements for maintenance responsibilities.
3. Maximum permissible velocities based upon non-clear water conditions.

APPENDIX C

FEMA CLOMR-F FORMS

DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

PROPERTY INFORMATION FORM

O.M.B. NO. 1660-0015
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this data collection is estimated to average 1.63 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and submitting the form. This collection is required to obtain or retain benefits. You are not required to respond to this collection of information unless a valid OMB control number is displayed on this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0015). **NOTE: Do not send your completed form to this address.**

This form may be completed by the property owner, property owner's agent, licensed land surveyor, or registered professional engineer to support a request for a Letter of Map Amendment (LOMA), Conditional Letter of Map Amendment (CLOMA), Letter of Map Revision Based on Fill (LOMR-F), or Conditional Letter of Map Revision Based on Fill (CLOMR-F) for existing or proposed, single or multiple lots/structures. In order to process your request, all information on this form must be completed ***in its entirety***, unless stated as optional. **Incomplete submissions will result in processing delays.** Please check the item below that describes your request:

☐ LOMA	A letter from DHS-FEMA stating that an existing structure or parcel of land that has not been elevated by fill (natural grade) would not be inundated by the base flood.
☐ CLOMA	A letter from DHS-FEMA stating that a proposed structure that is not to be elevated by fill (natural grade) would not be inundated by the base flood if built as proposed.
☐ LOMR-F	A letter from DHS-FEMA stating that an **existing** structure or parcel of land that has been **elevated by fill** would not be inundated by the base flood.
■ CLOMR-F	A letter from DHS-FEMA stating that a parcel of land or **proposed** structure that will be **elevated by fill** would not be inundated by the base flood if fill is placed on the parcel as proposed or the structure is built as proposed.

Fill is defined as material from any source (including the subject property) placed that raises the ground to or above the Base Flood Elevation (BFE). The common construction practice of removing unsuitable existing material (topsoil) and backfilling with select structural material is not considered the placement of fill if the practice does not alter the existing (natural grade) elevation, which is at or above the BFE. **Fill that is placed before the date of the first National Flood Insurance Program (NFIP) map showing the area in a Special Flood Hazard Area (SFHA) is considered natural grade.**

Has fill been placed on your property to raise ground that was previously below the BFE? ☐ Yes ■ No — If yes, when was fill placed? / (month/year)

Will fill be placed on your property to raise ground that is below the BFE? ■ Yes* ☐ No — If yes, when will fill be placed? / (month/year)

* If yes, Endangered Species Act (ESA) compliance must be documented to FEMA prior to issuance of the CLOMR-F determination (please refer page 4 to the MT-1 instructions).

1. Street Address of the Property (if request is for multiple structures or units, please attach additional sheet referencing each address and enter street names below):

   See Attached

2. Legal description of Property (Lot, Block, Subdivision or abbreviated description from the Deed):

3. Are you requesting that a flood zone determination be completed for (check one):

   ☐ Structures on the property? What are the dates of construction? _______________ (MM/YYYY)
   ☐ A portion of land within the bounds of the property? (A certified metes and bounds description and map of the area to be removed, certified by a licensed land surveyor or registered professional engineer, are **required**. For the preferred format of metes and bounds descriptions, please refer to the MT-1 Form 1 Instructions.)
   ☒ The entire legally recorded property?

4. Is this request for a (check one):
   ☐ Single structure
   ☐ Single lot
   ☐ Multiple structures (How many structures are involved in your request? List the number: _______)
   ☒ Multiple lots (How many lots are involved in your request? List the number: _______)

In addition to this form (MT-1 Form 1), please complete the checklist below. **ALL** requests must include one copy of the following:

- [x] Copy of the effective FIRM panel on which the structure and/or property location has been accurately plotted (property inadvertently located in the NFIP regulatory floodway will require Section B of MT-1 Form 3)

- [ ] Copy of the Subdivision Plat Map for the property **(with recordation data and stamp of the Recorder's Office)**

OR

- [ ] Copy of the Property Deed **(with recordation data and stamp of the Recorder's Office),** ***accompanied by*** a tax assessor's map or other certified map showing the surveyed location of the property relative to local streets and watercourses. The map should include at least one street intersection that is shown on the FIRM panel.

- [ ] Form 2 – Elevation Form. If the request is to remove the structure, and an Elevation Certificate has already been completed for this property, it may be submitted in lieu of Form 2. If the request is to remove the entire legally recorded property, or a portion thereof, the lowest lot elevation must be provided on Form 2.

- [x] Please include a map scale and North arrow on all maps submitted.

For LOMR-Fs and CLOMR-Fs, the following must be submitted in addition to the items listed above:

- [x] Form 3 – Community Acknowledgment Form

For CLOMR-Fs, the following must be submitted in addition to the items listed above:

- [x] Documented ESA compliance, which may include a copy of an Incidental Take Permit, an Incidental Take Statement, a "not likely to adversely affect" determination from the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), or an official letter from NMFS or USFWS concurring that the project has "No Effect" on proposed or listed species or designated critical habitat. Please refer to the MT-1 instructions for additional information.

Please do *not* submit original documents. Please retain a copy of all submitted documents for your records.

DHS-FEMA encourages the submission of all required data in a digital format (e.g. scanned documents and images on Compact Disc [CD]). Digital submissions help to further DHS-FEMA's Digital Vision and also may facilitate the processing of your request.

Incomplete submissions will result in processing delays. For additional information regarding this form, including where to obtain the supporting documents listed above, please refer to the MT-1 Form Instructions located at http://www.fema.gov/plan/prevent/fhm/dl_mt-1.shtm**.**

Processing Fee (see instructions for appropriate mailing address; or visit http://www.fema.gov/fhm/frm_fees.shtm for the most current fee schedule)

Revised fee schedules are published periodically, but no more than once annually, as noted in the **Federal Register**. Please note: single/multiple lot(s)/structure(s) LOMAs are fee exempt. The current review and processing fees are listed below:

Check the fee that applies to your request:

- [ ] $325 (single lot/structure LOMR-F following a CLOMR-F)
- [ ] $425 (single lot/structure LOMR-F)
- [ ] $500 (single lot/structure CLOMA or CLOMR-F)
- [ ] $700 (multiple lot/structure LOMR-F following a CLOMR-F, or multiple lot/structure CLOMA)
- [x] $800 (multiple lot/structure LOMR-F or CLOMR-F)

Please submit the Payment Information Form for remittance of applicable fees. Please make your check or money order payable to:

National Flood Insurance Program.

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Applicant's Name (required):

Company (if applicable):

Mailing Address (required):

Daytime Telephone No. (required):

E-Mail Address (optional): [ ] By checking here you may receive correspondence electronically at the email address provided):

Fax No. (optional):

Date (required)

Signature of Applicant (required)

DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY **ELEVATION FORM**	*O.M.B. NO. 1660-0015* *Expires February 28, 2014*

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this data collection is estimated to average 1.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and submitting the form. This collection is required to obtain or retain benefits. You are not required to respond to this collection of information unless a valid OMB control number is displayed on this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0015). **NOTE: Do not send your completed form to this address.**

This form must be completed for requests and must be completed and signed by a registered professional engineer or licensed land surveyor. **A DHS - FEMA National Flood Insurance Program (NFIP) Elevation Certificate may be submitted in lieu of this form for single structure requests.**

For requests to remove a structure on natural grade OR on engineered fill from the Special Flood Hazard Area (SFHA), submit the lowest adjacent grade (the lowest ground touching the structure), ***including an attached deck or garage***. For requests to remove an entire parcel of land from the SFHA, provide the lowest lot elevation; or, if the request involves an area described by metes and bounds, provide the lowest elevation within the metes and bounds description. All measurements are to be rounded to nearest tenth of a foot. In order to process your request, all information on this form must be completed ***in its entirety***. **Incomplete submissions will result in processing delays.**

1. NFIP Community Number: 320019 Property Name or Address:
2. Are the elevations listed below based on ☒ ***existing*** or ☐ ***proposed*** conditions? (Check one)
3. For the existing or proposed structures listed below, what are the types of construction? (check all that apply)
   ☐ crawl space ☐ slab on grade ☐ basement/enclosure ☐ other (explain) N/A
4. Has DHS - FEMA identified this area as subject to land subsidence or uplift? (see instructions) ☐ Yes ☒ No
   If yes, what is the date of the current re-leveling? / (month/year)
5. What is the elevation datum? ☐ NGVD 29 ☐ NAVD 88 ☐ Other (explain)
   If any of the elevations listed below were computed using a datum different than the datum used for the effective Flood Insurance Rate Map (FIRM) (e.g., NGVD 29 or NAVD 88), what was the conversion factor?
   Local Elevation +/- ft. = FIRM Datum
6. Please provide the Latitude and Longitude of the most upstream edge of the ***structure*** (in decimal degrees to the nearest fifth decimal place):
   Indicate Datum: ☐ WGS84 ☐ NAD83 ☐ NAD27 Lat. . Long. .
   Please provide the Latitude and Longitude of the most upstream edge of the ***property*** (in decimal degrees to the nearest fifth decimal place):
   Indicate Datum: ☐ WGS84 ☐ NAD83 ☐ NAD27 Lat. . Long. .

Address	Lot Number	Block Number	Lowest Lot Elevation*	Lowest Adjacent Grade To Structure	Base Flood Elevation	BFE Source

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name:	License No.:	Expiration Date:
Company Name:	Telephone No.:	
Email:	Fax No.	
Signature:	Date:	

Seal (optional)

* For requests involving a portion of property, include the lowest ground elevation within the metes and bounds description.
Please note: If the Lowest Adjacent Grade to Structure is the only elevation provided, a determination will be issued for the structure only.

Continued from Page 1.

Address	Lot Number	Block Number	Lowest Lot Elevation*	Lowest Adjacent Grade To Structure	Base Flood Elevation	BFE Source

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name:	License No.:	Expiration Date:
Company Name:	Telephone No.:	
Email:	Fax No.	
Signature:	Date:	

Seal (optional)

* For requests involving a portion of property, include the lowest ground elevation within the metes and bounds description.
Please note: If the Lowest Adjacent Grade to Structure is the only elevation provided, a determination will be issued for the structure only.

DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY **COMMUNITY ACKNOWLEDGMENT FORM**	*O.M.B. NO. 1660-0015* *Expires February 28, 2014*

PAPERWORK BURDEN DISCLOSURE NOTICE

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This form must be completed for requests involving the existing or proposed placement of fill (complete Section A) ***OR*** to provide acknowledgment of this request to remove a property from the SFHA which was previously located within the regulatory floodway (complete Section B).

This form must be completed and signed by the official responsible for floodplain management in the community. **The six digit NFIP community number and the subject property address must appear in the spaces provided below. Incomplete submissions will result in processing delays.** Please refer to the MT-1 instructions for additional information about this form.

Community Number: 320019 Property Name or Address: ______________________

A. REQUESTS INVOLVING THE PLACEMENT OF FILL

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision Based on Fill (LOMR-F) or Conditional LOMR-F request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a Conditional LOMR-F, will be obtained. For Conditional LOMR-F requests, the applicant has or will document Endangered Species Act (ESA) compliance to FEMA prior to issuance of the Conditional LOMR-F determination. For LOMR-F requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by DHS-FEMA, all analyses and documentation used to make this determination. For LOMR-F requests, we understand that this request is being forwarded to DHS-FEMA for a possible map revision.

Community Comments:

Community Official's Name and Title: (*Please Print or Type*)		Telephone No.:
Community Name:	Community Official's Signature: (required)	Date:

B. PROPERTY LOCATED WITHIN THE REGULATORY FLOODWAY

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this request for a LOMA. We understand that this request is being forwarded to DHS-FEMA to determine if this property has been inadvertently included in the regulatory floodway. We acknowledge that no fill on this property has been or will be placed within the designated regulatory floodway. We find that the completed or proposed project meets or is designed to meet all of the community floodplain management requirements.

Community Comments:

Community Official's Name and Title: (*Please Print or Type*)		Telephone No.:
Community Name:	Community Official's Signature (required):	Date:

DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

ELEVATION FORM

O.M.B. NO. 1660-0015
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this data collection is estimated to average 1.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and submitting the form. This collection is required to obtain or retain benefits. You are not required to respond to this collection of information unless a valid OMB control number is displayed on this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0015). **NOTE: Do not send your completed form to this address.**

This form must be completed for requests and must be completed and signed by a registered professional engineer or licensed land surveyor. **A DHS - FEMA National Flood Insurance Program (NFIP) Elevation Certificate may be submitted in lieu of this form for single structure requests.**

For requests to remove a structure on natural grade OR on engineered fill from the Special Flood Hazard Area (SFHA), submit the lowest adjacent grade (the lowest ground touching the structure), ***including an attached deck or garage***. For requests to remove an entire parcel of land from the SFHA, provide the lowest lot elevation; or, if the request involves an area described by metes and bounds, provide the lowest elevation within the metes and bounds description. All measurements are to be rounded to nearest tenth of a foot. In order to process your request, all information on this form must be completed ***in its entirety***. **Incomplete submissions will result in processing delays.**

1. NFIP Community Number: 320019 Property Name or Address:
2. Are the elevations listed below based on ☒ ***existing*** or ☐ ***proposed*** conditions? (Check one)
3. For the existing or proposed structures listed below, what are the types of construction? (check all that apply)
   ☐ crawl space ☐ slab on grade ☐ basement/enclosure ☐ other (explain) N/A
4. Has DHS - FEMA identified this area as subject to land subsidence or uplift? (see instructions) ☐ Yes ☐ No
   If yes, what is the date of the current re-leveling? / (month/year)
5. What is the elevation datum? ☐ NGVD 29 ☐ NAVD 88 ☐ Other (explain)
   If any of the elevations listed below were computed using a datum different than the datum used for the effective Flood Insurance Rate Map (FIRM) (e.g., NGVD 29 or NAVD 88), what was the conversion factor?
   Local Elevation +/- ft. = FIRM Datum
6. Please provide the Latitude and Longitude of the most upstream edge of the ***structure*** (in decimal degrees to the nearest fifth decimal place):
   Indicate Datum: ☐ WGS84 ☐ NAD83 ☐ NAD27 Lat. . Long. .
   Please provide the Latitude and Longitude of the most upstream edge of the ***property*** (in decimal degrees to the nearest fifth decimal place):
   Indicate Datum: ☐ WGS84 ☐ NAD83 ☐ NAD27 Lat. . Long. .

Address	Lot Number	Block Number	Lowest Lot Elevation*	Lowest Adjacent Grade To Structure	Base Flood Elevation	BFE Source

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name:	License No.:	Expiration Date:
Company Name:	Telephone No.:	
Email:	Fax No.	
Signature:	Date:	

Seal (optional)

* For requests involving a portion of property, include the lowest ground elevation within the metes and bounds description.
Please note: If the Lowest Adjacent Grade to Structure is the only elevation provided, a determination will be issued for the structure only.

Continued from Page 1.

Address	Lot Number	Block Number	Lowest Lot Elevation*	Lowest Adjacent Grade To Structure	Base Flood Elevation	BFE Source

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name:	License No.:	Expiration Date:
Company Name:	Telephone No.:	
Email:	Fax No.	
Signature:	Date:	

Seal (optional)

* For requests involving a portion of property, include the lowest ground elevation within the metes and bounds description.
Please note: If the Lowest Adjacent Grade to Structure is the only elevation provided, a determination will be issued for the structure only.

DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY **COMMUNITY ACKNOWLEDGMENT FORM**	***O.M.B. NO. 1660-0015*** ***Expires February 28, 2014***

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This form must be completed for requests involving the existing or proposed placement of fill (complete Section A) ***OR*** to provide acknowledgment of this request to remove a property from the SFHA which was previously located within the regulatory floodway (complete Section B).

This form must be completed and signed by the official responsible for floodplain management in the community. **The six digit NFIP community number and the subject property address must appear in the spaces provided below. Incomplete submissions will result in processing delays.** Please refer to the MT-1 instructions for additional information about this form.

Community Number: 320019 Property Name or Address: ____________________

A. REQUESTS INVOLVING THE PLACEMENT OF FILL

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision Based on Fill (LOMR-F) or Conditional LOMR-F request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a Conditional LOMR-F, will be obtained. For Conditional LOMR-F requests, the applicant has or will document Endangered Species Act (ESA) compliance to FEMA prior to issuance of the Conditional LOMR-F determination. For LOMR-F requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by DHS-FEMA, all analyses and documentation used to make this determination. For LOMR-F requests, we understand that this request is being forwarded to DHS-FEMA for a possible map revision.

Community Comments:

Community Official's Name and Title: (*Please Print or Type*)		Telephone No.:
Community Name:	Community Official's Signature: (required)	Date:

B. PROPERTY LOCATED WITHIN THE REGULATORY FLOODWAY

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this request for a LOMA. We understand that this request is being forwarded to DHS-FEMA to determine if this property has been inadvertently included in the regulatory floodway. We acknowledge that no fill on this property has been or will be placed within the designated regulatory floodway. We find that the completed or proposed project meets or is designed to meet all of the community floodplain management requirements.

Community Comments:

Community Official's Name and Title: (*Please Print or Type*)		Telephone No.:
Community Name:	Community Official's Signature (required):	Date:

FEDERAL EMERGENCY MANAGEMENT AGENCY

PAYMENT INFORMATION FORM

Community Name:

Project Identifier: Prado Ranch Development

THIS FORM MUST BE MAILED, ALONG WITH THE APPROPRIATE FEE, TO THE ADDRESS BELOW OR FAXED TO THE FAX NUMBER BELOW.

Please make check or money order payable to the National Flood Insurance Program.

Type of Request:

- [x] MT-1 application
- [ ] MT-2 application

LOMC Clearinghouse
847 South Pickett Street
Alexandria, VA 22304-4605
Attn.: LOMC Manager

- [ ] EDR application

FEMA Project Library
847 South Pickett Street
Alexandria, VA 22304-4605
FAX (703) 212-4090

Request No. (if known): ____________ **Check No.:** ____________ **Amount:** ______

☐ INITIAL FEE* ☐ FINAL FEE ☐ FEE BALANCE** ☐ MASTER CARD ☐ VISA ☐ CHECK ☐ MONEY ORDER

*Note: Check only for EDR and/or Alluvial Fan requests (as appropriate).

****Note: Check only if submitting a corrected fee for an ongoing request.**

COMPLETE THIS SECTION *ONLY* IF PAYING BY CREDIT CARD

CARD NUMBER EXP. DATE

1	2	3	4	–	5	6	7	8	–	9	10	11	12	–	13	14	15	16		Month	–	Year

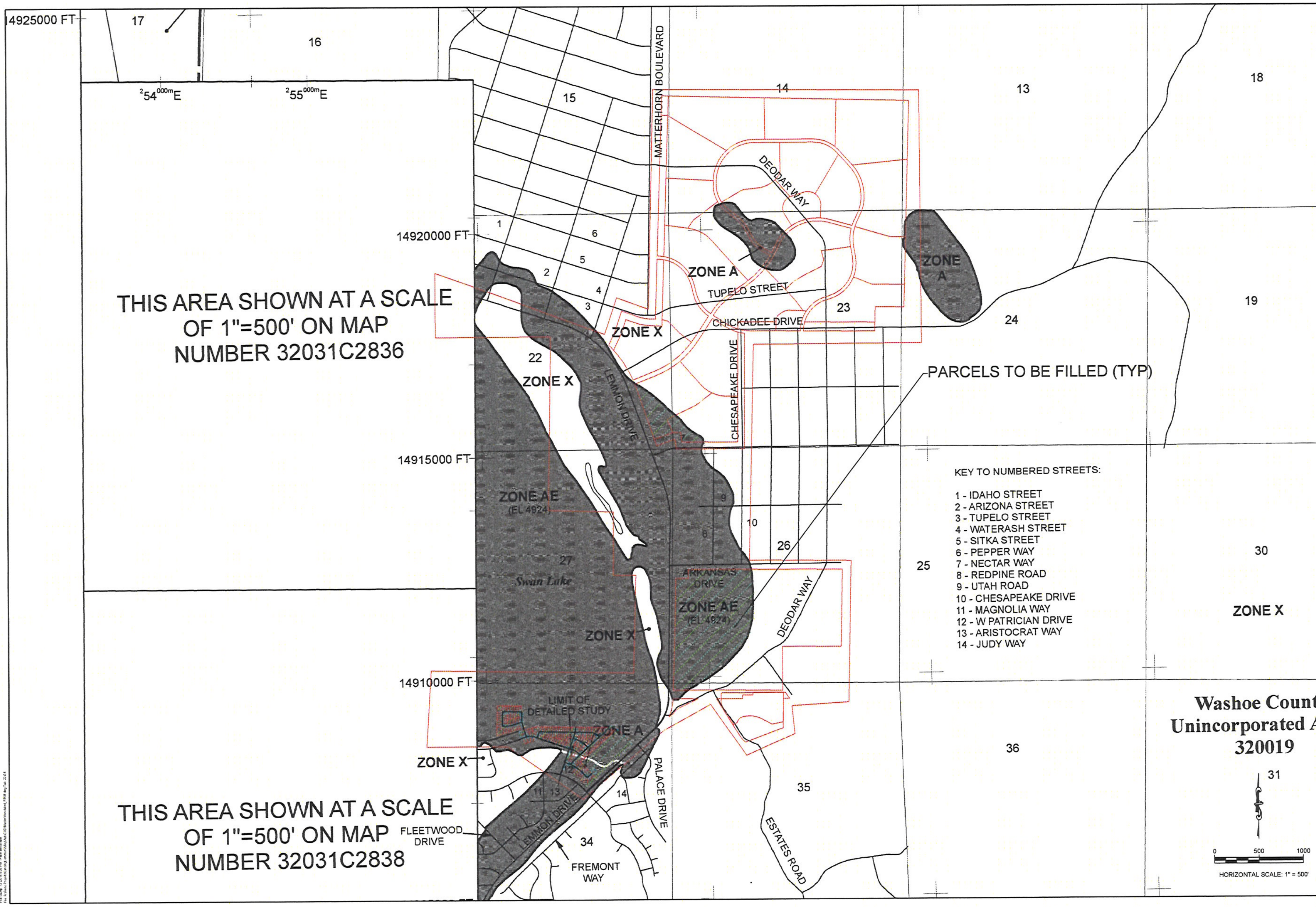
____________ Date

____________________________ Signature

NAME *(AS IT APPEARS ON CARD)*: ____________
(please print or type)

ADDRESS: ____________
(for your credit card receipt-please print or type) ____________

DAYTIME PHONE: ____________



DATE	REVISIONS	NO

SEAL

Cardno ENTRIX
5492 LONGLEY LN, STE B
RENO, NV 89511
(775) 828-4362

Annotated FIRM

Prado Ranch Development

Washoe County, NV

DATE:	July, 2016
DRAWN BY:	PB
CHECKED BY:	MG
SCALE:	AS SHOWN