PRELIMINARY DRAINAGE REPORT FOR THE

IRON EAGLE PRELIMINARY PLAT

MONROE, WASHINGTON

HARMSEN & ASSOCIATES INC

CIVIL ENGINEERING / LAND SURVEYING

Anticipate / Understand / Guide / Deliver

ISLAND COUNTY
840 SE 8th Ave., Ste. 102
Oak Harbor, WA 98277
(360) 675-5973

SNOHOMISH COUNTY
16778 146th St. SE, Ste. 104
Monroe, WA 98272
(360) 794-7811

SKAGIT COUNTY
603 South First Street
Mt Vernon, WA 98273
(360) 336-9199

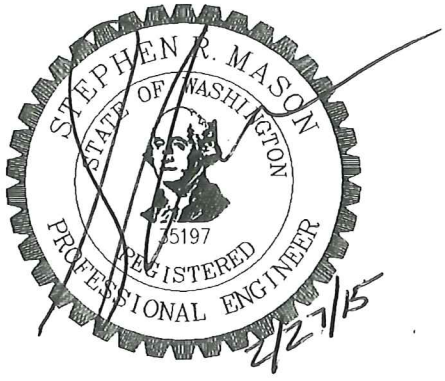
www.HarmsenInc.com

PRELIMINARY DRAINAGE REPORT FOR

IRON EAGLE PRELIMINARY PLAT

CITY OF MONROE, WASHINGTON

FEBRUARY 20, 2015



HARMSEN & ASSOCIATES INC

SNOHOMISH COUNTY
16778 146th Street SE, Suite 104 | PO Box 516
Monroe, Washington 98272
tel: 360. 794.7811 | fax: 360.805.9732

ISLAND COUNTY
840 SE 8th Avenue, Suite 102
Oak Harbor, Washington 98277
tel: 360. 675.5973 | fax: 360.675.7255

SKAGIT COUNTY
603 South First Street
Mount Vernon, Washington 98273
tel: 360. 336.9199 | fax: 360.982.2637

www.HarmsenInc.com

MR 1: STORMWATER SITE PLAN REPORT

PROJECT OVERVIEW & EXECUTIVE SUMMARY

DRAINAGE PLAN DESCRIPTION

This Preliminary Drainage Report has been prepared for the Preliminary Plat of Iron Eagle. The site is located at 16691 Currie Road, see Figure 1: Vicinity Map. The proposed development is to formally plat the 6.67 acre property into 34 single family lots, see Figure 3: Developed Conditions. The site is within the Lords Lake regional detention facility drainage basin. This facility provides flow control, but not runoff treatment which is to be provided by the individual properties as they developed.

METHODOLOGY

The drainage calculations for the site have been prepared based on the requirements of the 2005 Department of Ecology Manual.

DRAINAGE BASINS

The drainage basin that has been evaluated consists of the entire subject property.

DOWNSTREAM ANALYSIS

See Downstream Analysis on page 5 of this report.

UPSTREAM ANALYSIS

See Upstream Analysis on page 5 of this report.

CONVEYANCE CALCULATIONS

Conveyance calculations will be prepared as part of the construction permit submittal.

CONSTRUCTION WATER QUALITY

A Conceptual Storm Water Pollution Prevention Plan (SWPPP) has been prepared for the preliminary plat review. A final SWPPP will be prepared as part of the construction permit submittal. See Section 2 of this report for more information.

OPERATIONS AND MAINTENANCE

An Operations and Maintenance Manual will be prepared as part of the construction permit submittal.

RUNOFF TREATMENT BMP'S

Lords Lake regional detention facility provides for flow control, but not runoff treatment. With more than 5,000 sf of new impervious surface subject to vehicular traffic, Iron Eagle will need to provide for provide a runoff treatment facility. The proposed facility is a biofiltration swale.

STREAM BANK EROSION CONTROL BMP'S

The site is within the Lords Lake regional detention facility drainage basin. As such, onsite flow control is not required.

EXISTING CONDITIONS SUMMARY

DESCRIPTION

The site is located at 16691 Currie Road, see Figure 1: Vicinity Map. Past development on the property was as a golf driving range with a two story building and paved parking lot. The majority of the site is lawn, being the old driving range itself. The site has subsequently had several other uses and is now vacant. All the existing improvements will be removed. There are no wetlands or other critical areas on the site.

The topography of the site shows that it slopes slightly from Currie Road, along the south property line north into the parking lot. The driving range itself is very flat.

There are two drainage ditches near the southwest property corner. A 48" CMP culvert discharges to the northwest about 100 feet from the property corner. It extends to the west property line, and then bends to the west between the Currie Road Apartments and the Plat of Lords Lake. A second ditch is located adjacent to the west property line and flowing to the north it connects to the previously mentioned ditch.

The site is bounded to the west by the Plat of Lords Lake, by the Currie Road Apartments to the southwest, by a large wetland tract to the north and access panhandle to the east owned the City of Monroe.

CURRENT BASIN SUMMARY

The 6.67 acre site currently contains 6.67 acres including the building (0.15 ac), parking (0.40 ac), lawn (5.62 ac) and landscaping (0.5 ac). The runoff rates for this basin are as follows:

Storm Event	Runoff Rate
2 Year	0.76 cfs
10 Year	1.64 cfs
100 Year	3.22 cfs

SOILS DESCRIPTION

Onsite soils exploration has been performed by GeoTest and is documented in their report dated December 9, 2014, provided under separate cover. Typically, there is a 4" to 8" thick layer of topsoil. The subsoil to a depth of 18" to 30" is stiff, gray and tan, wet, sandy silt. The substratum to a depth of 60 inches or more is medium dense to dense, tan, wet to saturated, very gravelly, sand to very sandy gravel with trace cobbles. Rapid ground water seepage was noted at 4.5 to 5.5 feet.

UPSTREAM ANALYSIS

The only significant upstream flow that impacts the property is from the previously mentions drainage ditches near the southwest corner. We have been informed that it is permissible to re-route and enclose these ditches in a storm system to minimize their impact to the site. The sizing of the culverts will be done as part of the construction permit submittal.

DOWNSTREAM ANALYSIS

Stormwater leaves the site as sheetflow towards the north, entering the City owned property. A drainage ditch conveys the runoff to the north for 1,200 feet until it intersects a large drainage ditch to the north of the Plat of Lords Lake. This ditch then conveys the flow about 325 feet to a piped storm system that conveys runoff southwest 450 feet to Lords Lake regional detention facility. See Figure 4: Downstream Map. With implementation of the proposed BMPs, there should be not significant adverse impact from the proposed construction.

MR 2: SWPPP NARRATIVE

A Storm Water Pollution Prevention Plan (SWPPP) will be prepared for this project as part of the construction permit submittal. The site is very flat and is not anticipated to present any specific erosion control concerns. The 12 Required Elements are addressed as follows:

Element #1: Mark Clearing Limits
The construction plans delineate the clearing limits and they will be marked in the field prior to construction.
BMP C101, Preserving Natural Vegetation

Element #2: Establish Construction Access
Construction access will be taken from the existing access from Currie Road. A rock stabilized construction access will be installed at that point.
BMP C105, Stabilized Construction Entrance

Element #3: Control Flow Rates
The site is within the Lords Lake regional detention facility drainage basin. As such, onsite flow control is not required. A temporary sediment pond will be used to prevent the transport of sediment from the construction site.
BMP C241, Temporary Sediment Pond

Element #4: Install Sediment Controls
Sediment controls and their installation will be addressed and located on the project plans to be prepared for construction permitting. They will include the following BMPs:
BMP C105, Stabilized Construction Entrance
BMP C233, Silt Fence
BMP C241, Temporary Sediment Pond

Element #5: Stabilize Soils
Bests Management Practices (BMP's) will be used to control sediment transport during construction and will be addressed and located on the project plans to be prepared for construction permitting. The following BMPs are applicable:
BMP C120, Temporary & Permanent Seeding
BMP C121, Mulching
BMP C123, Plastic Covering
BMP C125, Topsoiling

Element #6: Protect Slopes
New slopes within the project will be limited to a maximum of 3 horizontal to 1 vertical. There are no natural steep sloped areas on the site.

Element #7: Protect Drain Inlets
The are no existing storm drain inlets in the work areas on the site. As new inlets are installed, they will be protected with filter inserts.
BMP C220, Storm Drain Inlet Protection

Element #8: Stabilize Channels and Outlets
Temporary drainage swales may be incorporated into the SWPPP. They will be stabilized using the following BMPs:
BMP C207, Check Dams
BMP C201 Grass Lined Channels

Element #9: Control of Pollutants
The control of typical construction pollutants will be addressed in the final drainage report and plans to be prepared for construction permitting. Items that will be addressed include the following:

- Appropriate handling of all pollutants, including waste materials and demolition debris.
- Cover, containment, and protection for all chemicals, liquid products, petroleum products, etc.
- Maintenance, repair and refueling of heavy equipment and vehicles.
- Application of agricultural chemicals, including fertilizers and pesticides.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources.

Element #10: Control De-Watering
Dewatering is expected to be necessary during utility sinatallation. The final SWPPP will address use of a settling pond as a discharge point for dewatering.

Element #11: Maintain BMP's
Notes for the maintenance of erosion control facilities will be included on the construction plans to be prepared for permitting.

Element #12: Manage the Project
The project will be subject to seasonal work limitations, site inspection and monitoring as required by the City of Monroe. Erosion control monitoring and supervision will be managed by a certified CESCL.

MR 3: WATER POLLUTION SOURCE CONTROL

As residential plat, the applicable source control BMPs would be temporary storage of garbage in sealed garbage cans to prevent wastes mixing with storm water and appropriate maintenance of the stormwater system. Street sweeping will be performed at the direction of the City of Monroe.

MR 4: PRESERVATION OF NATURAL DRAINAGE

The current drainage from the majority of the site is to the north as sheetflow towards the north, entering the City owned property and drainage ditches. In the developed condition, runoff will be discharged to the ditch beginning near the northwest property corner. Thus the natural drainage will be maintained.

MR 5: ON-SITE STORMWATER MANAGMENT

The proposed development is to formally plat the 6.67 acre property into 34 single family lots, see Figure 3: Developed Conditions. The site is within the Lords Lake regional detention facility drainage basin. This facility provides flow control, but not runoff treatment.

DEVELOPED BASIN SUMMARY

The developed site drainage basin contains 6.67 acres including the roadway (1.15 ac), driveways (0.33 ac), roofs (2.03 ac), planter strip and yards (3.16 ac). The runoff rates for this basin are as follows:

Storm Event	Runoff Rate
2 Year	1.55 cfs
10 Year	2.65 cfs
100 Year	4.30 cfs

See WWHM3 output in Appendix B for more information.

FLOW CONTROL BMPs

The proposed flow control BMP will be reconditioned soil around the future residences and open space per BMP T5.13.

MR 6: RUNOFF TREATMENT REQUIREMENTS

The site is within the Lords Lake regional detention facility drainage basin. This facility provides flow control, but not runoff treatment. That was to be provided by the individual properties as

APPENDIX A
FIGURES & BASIN MAPS

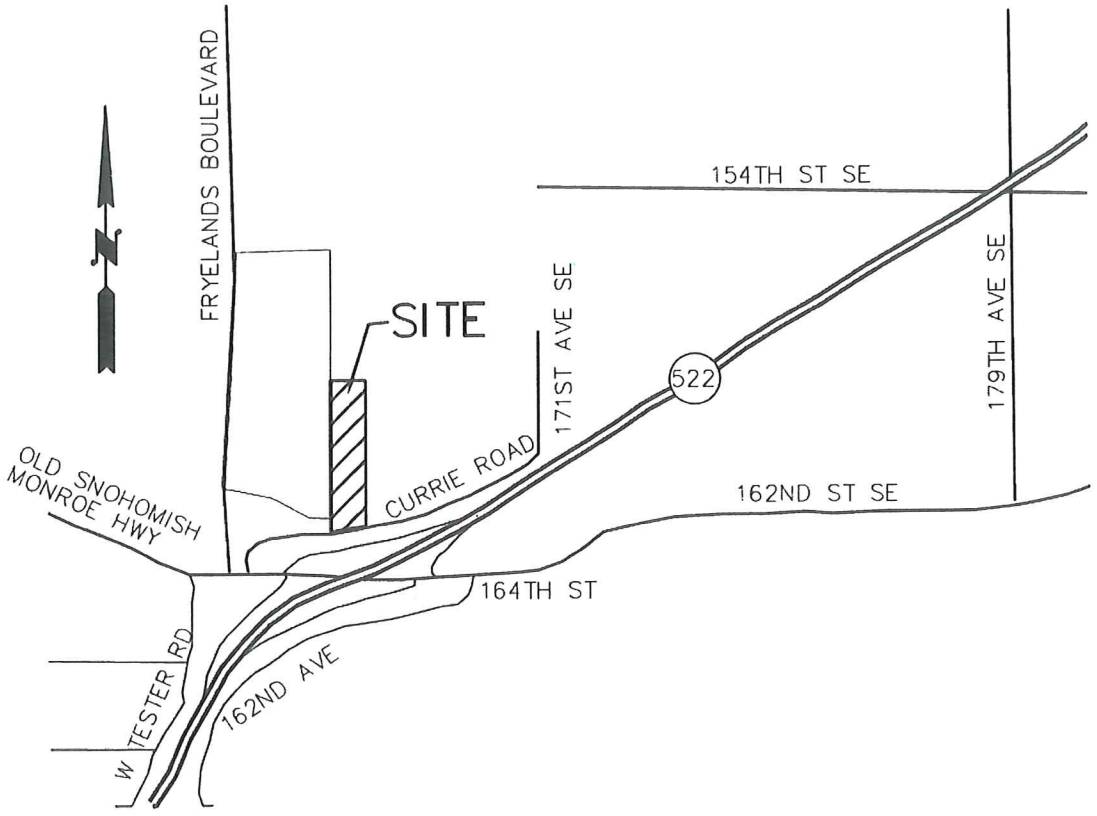


FIGURE 1: VICINITY MAP

FIGURE 2: EXISTING SITE MAP

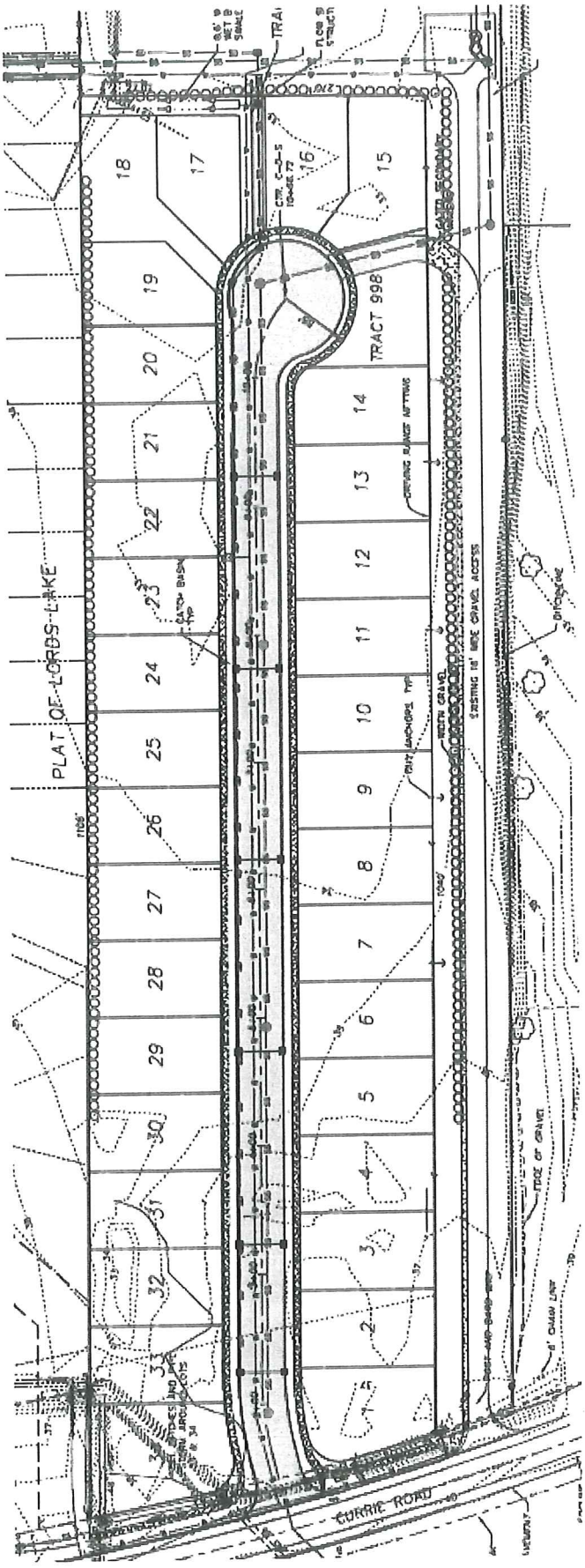
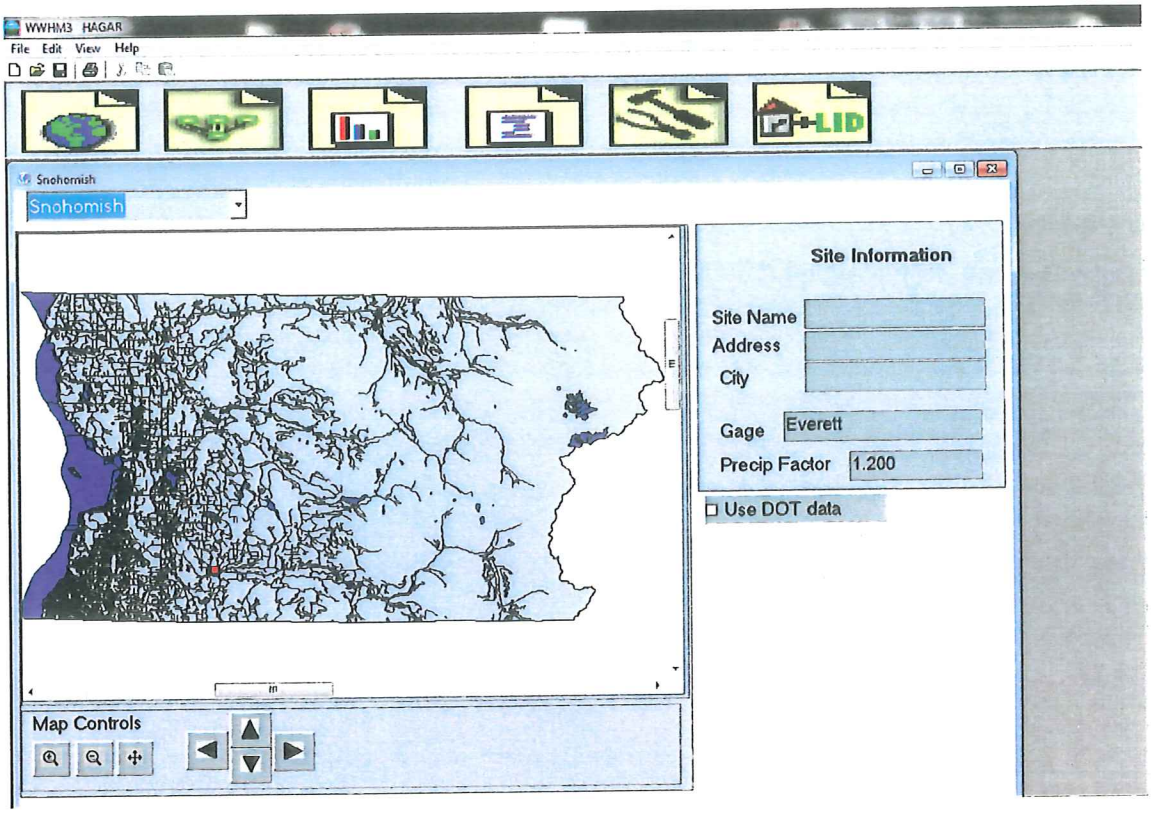
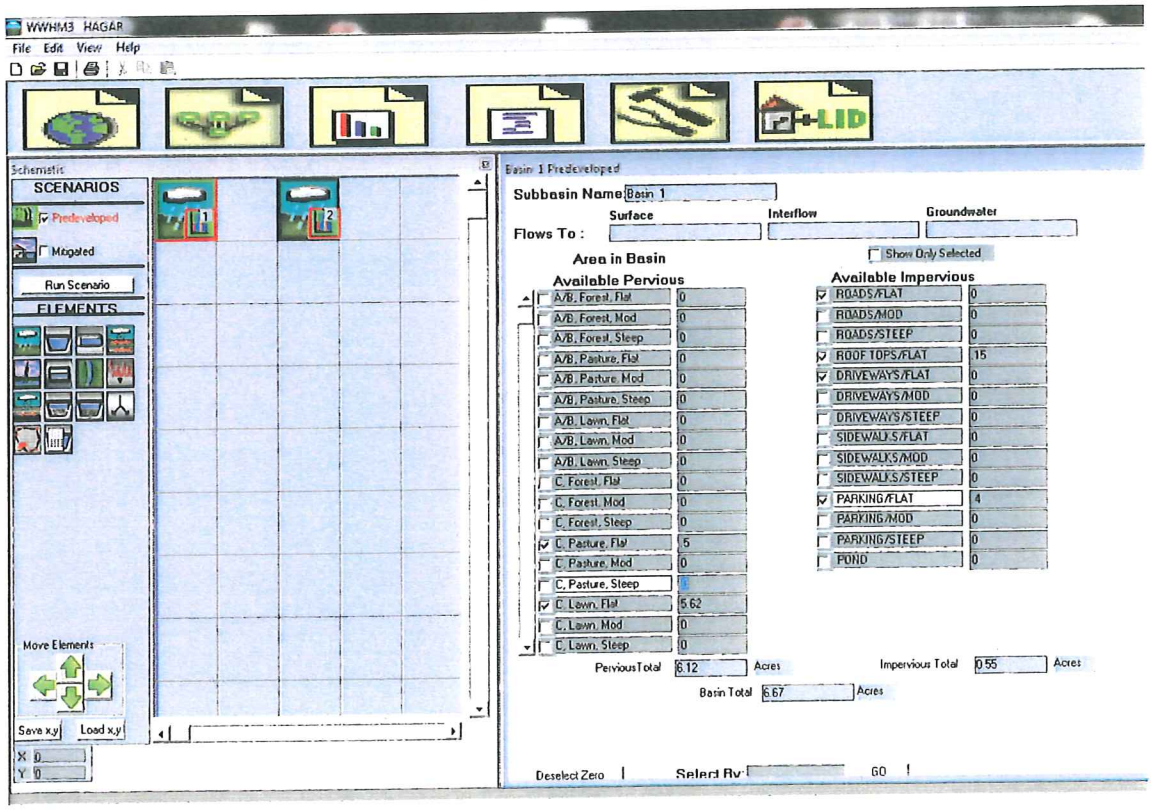


FIGURE 3: DEVELOPED SITE MAP

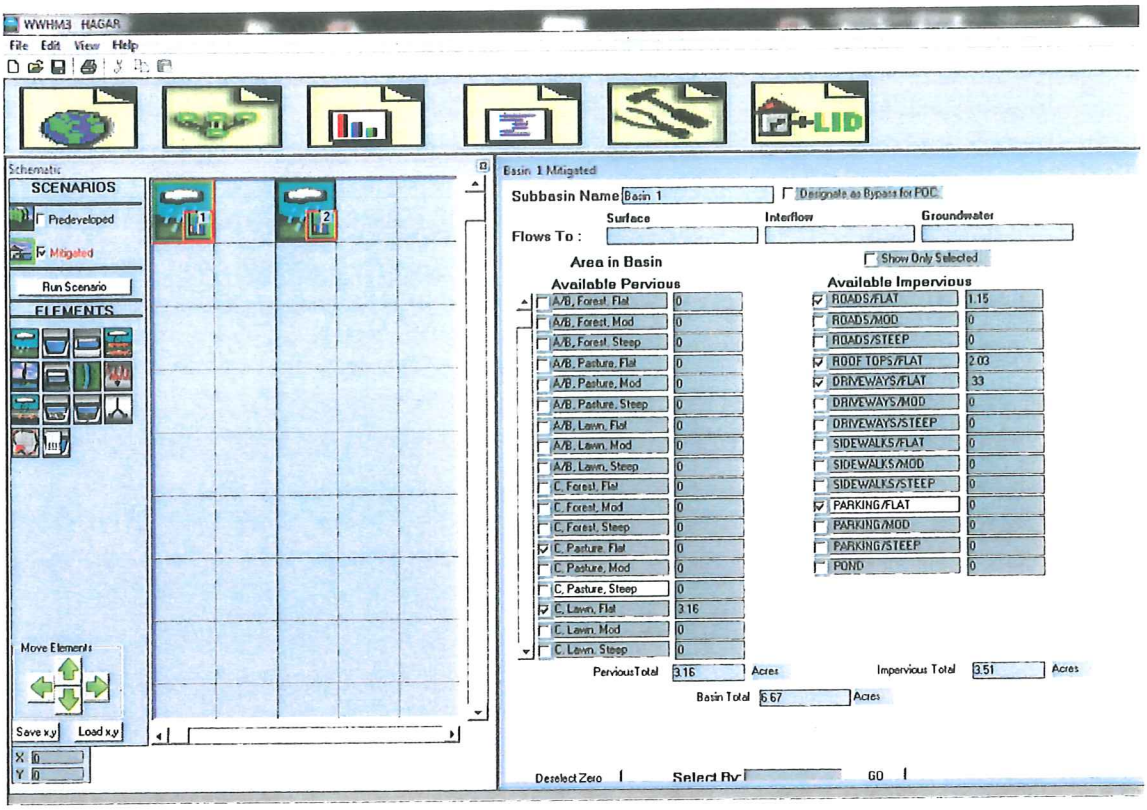
APPENDIX B
WWHM3 SCREEN SHOTS



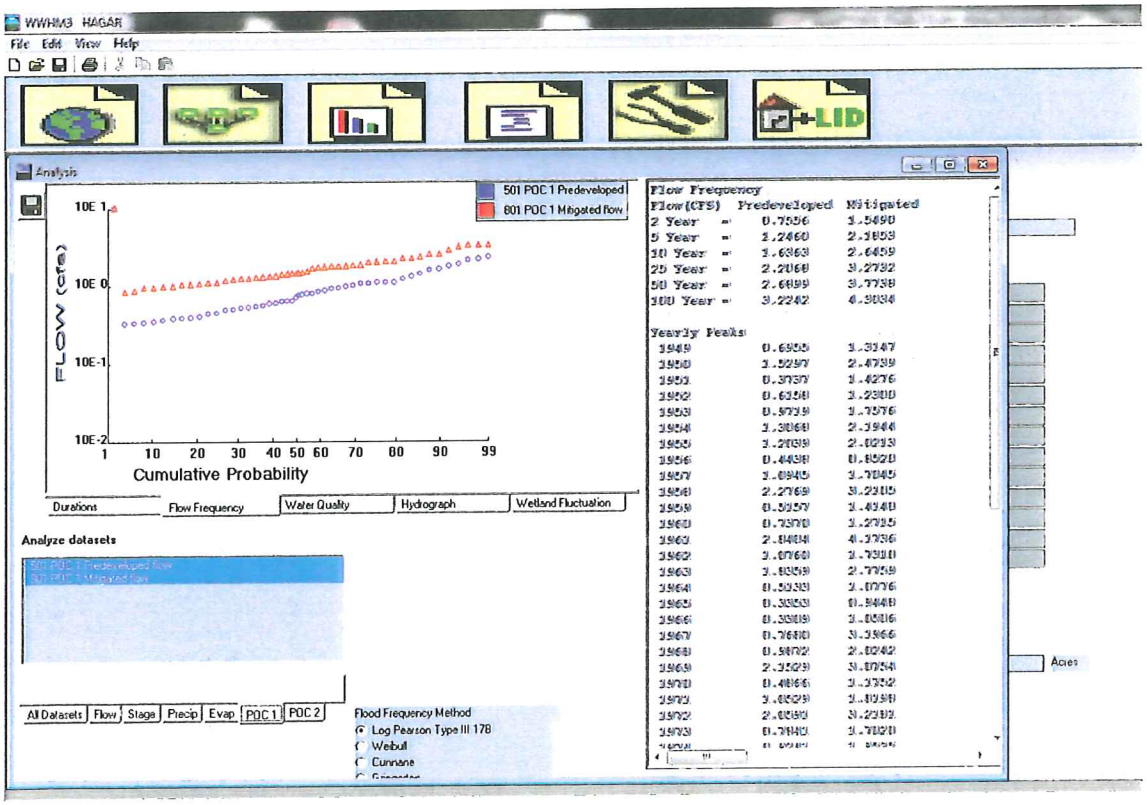
SITE LOCATION



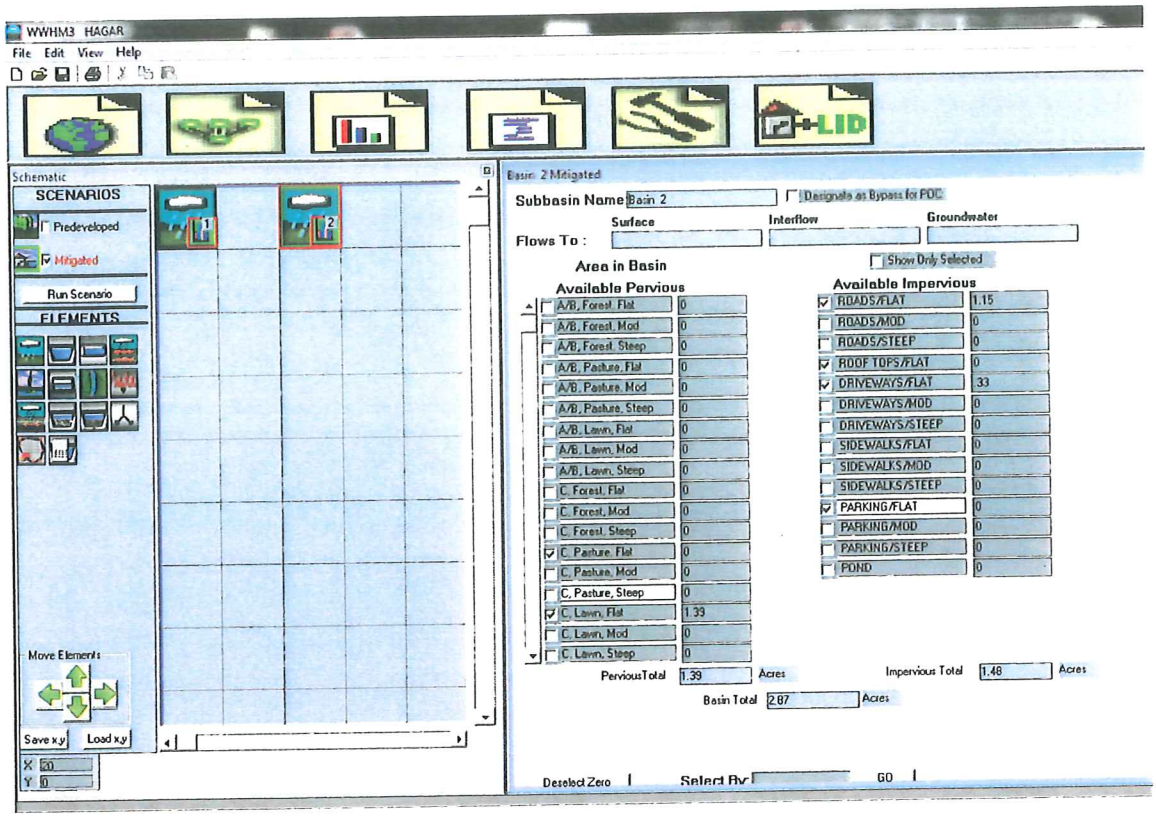
EXISTING BASIN



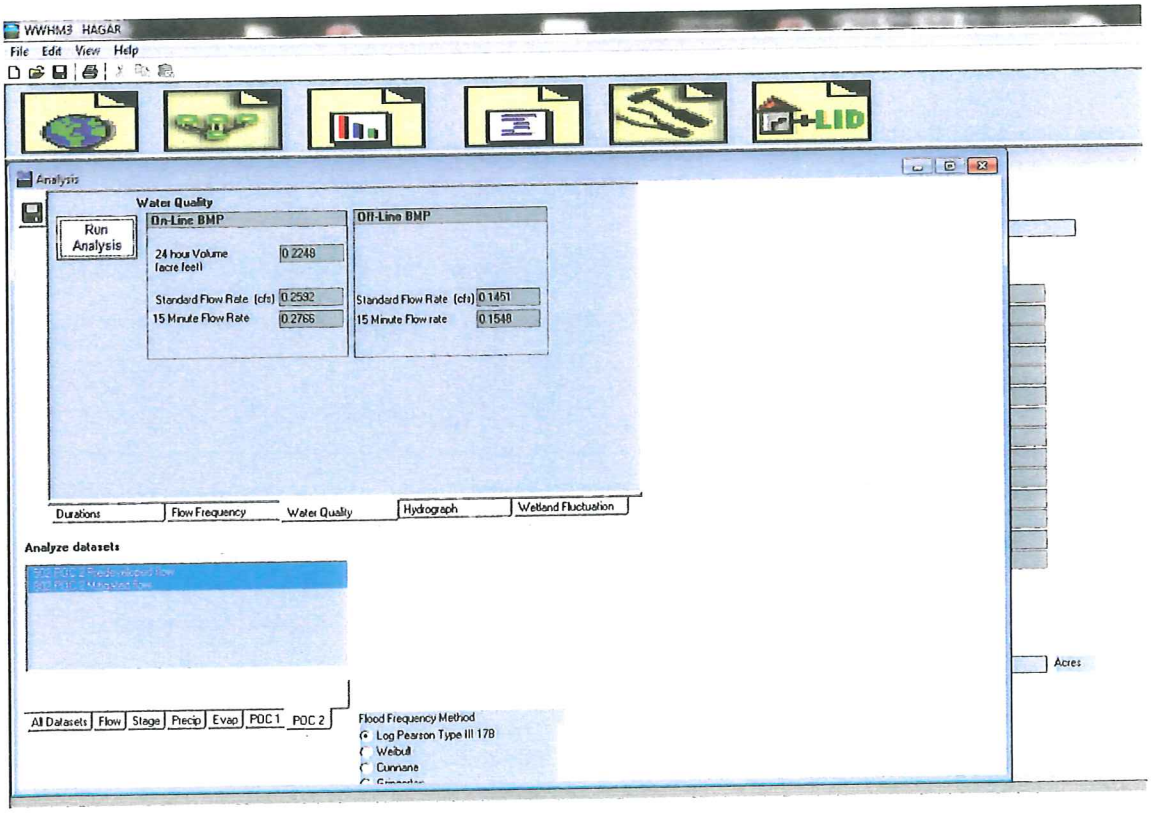
DEVELOPED BASIN



FLOW FREQUENCY ANALYSIS



TREATMENT BASIN



TREATMENT FLOW RATE

BIOFILTRATION SWALE CALCULATIONS

SIZING FOR BIOFILTRATION SWALES:

This spread sheet will assist in the sizing of bio-filtration swales using a trapezoidal shape. See Appendix AIII-6.1 of the DOE Manual.

P-1	15 minute flow rate:		0.53 cfs
	Peak rate 100-year storm:		1.00 cfs
P-2	Swale slope:		0.005 ft/ft
P-3	Grass type: Italian Rye	Rating:	3
D-1	Winter grass height:		5.00 in
	Design flow depth:		3.50 in
D-2	Mannings n:	0.24	
D-3	Base design on trapezoidal channel with Z =		3
D-4	Bottom width =		8.57 ft
D-4b	Top width =		10.32 ft
D-5	Cross-sectional area =		2.75 ft^2
D-6	Flow velocity =	V = Q/A =	0.19 ft/s < 1.0 ft/s ?

If velocity is less than 1.0 ft/s continue, otherwise repeat D-1 to D-6 until condition is met.

D-7 Calc length for 9min residence time = 103.94
Note minimum length is 100 feet

STABILITY CHECK

For swale designs where larger flows will be conveyed through bio-swale.
Check must be performed for highest expected flow with least vegetation.

SC-1	Estimate flow for largest storm event that bio-swale will receive. Adjust WWHM 100 year hourly flow to 100 year 15 minute flow by multiplying by 1.6	1.6
SC-2	Estimate vegetation cover based on 'fair' condition and 3" height of least coverage.	
SC-3	Estimate degree of retardence from Table 9.2 based on Low condition Establish Vmax	D 3 ft/s
SC-4	Select initial Manning's n (0.04 is a good initial choice):	0.039
SC-5	Refer to Figure 9.7 for first approximation of VR:	3.4 ft^2/s
SC-6	Compute hydraulic radius: R=VR/Vmax =	1.133333 ft

SC-7 Use Manning's Equation to solve for actual VR: 3.32 ft^2/s

SC-8 1-(SC-6/SC-8)= 0.02 < 0.05 ? If yes continue, otherwise select new n and re-run steps SC-5 to SC-9

SC-9 Compute actual velocity: V = VR/R = 2.93 ft/s< Vmax ? If so continue, if not repeat until it is less.

SC-10 Compute area for stability: A = Q/V = 0.34 ft^2

SC-11 Compare SC-11 with D-14: -2.41 If negative, design is acceptable, if positive recalc. channel dimensions using stability area. Use y from D-1.

Recalculated bottom width: 0.30 ft

SC-12 Calculate depth of flow at stability flow rate: 0.29 ft

SC-13 Take larger depth of SC-12 or D-1 and add 0.5': 0.79 ft
Calculate top width 13.32

SC-14 Recalculate hydraulic radius: 0.64 ft.

SC-15 Final capacity check on stability check design storm and maximum retardence.
Q= 1.646433 cfs > 100 year storm flow? Yes

If yes, continue, otherwise increase channel cross-section.

COMPLETION STEPS

CO-1 Multiply area for bio-swale by the following factor:

Swale Length	103.94 ft
Channel Depth	0.79 ft
Bottom width	8.57 ft

CO-2 If slope is greater than 2 percent, design log or rock check dams approximately every 50 ft.