HI-RUN version 2.0

A Step-by-Step Example

Project Example

Project Identification and Location

State Route 13 Widening, Milepost 15.5
TDA 1 to be analyzed in this example
Located west of Olympia, WA

Existing roadway area: 24.8 acres
Proposed roadway area: 31.1 acres (6.3 additional acres)

Note: This is a hypothetical example; it does not reference a real highway project.

Project Example

Existing treatment
Biofiltration swale (sized for 4.3 acres)

Incidental Infiltration:
Due to sufficient separation between the base of the media filter drain and the seasonal high water table elevation, the media filter drains will achieve approximately 60 percent infiltration on an annual runoff volume basis.

Proposed treatment
Media filter drain (previously referred to as ecology embankments) sized for 6.3 new acres.
Existing biofiltration swale remains (sized for 4.3 acres).

Outfall
All runoff in the TDA discharges through a single outfall (only one subbasin).

The biofiltration swale is not expected to have substantial incidental infiltration.

Detention
Detention is planned for this TDA to meet the *Highway Runoff Manual* flow control requirements

Project Example

Receiving Water Information – Chinook Creek

ESA-listed fish species present in the project receiving water includes Puget Sound Chinook salmon. An analysis will be performed to evaluate the potential water quality effects of highway runoff on rearing Chinook salmon in the months of August and September.

Background water quality data from a site upstream of the project outfall is available from a previous watershed assessment effort. The median values for DCu and DZn are 0.002 and 0.003 mg/L, respectively.

Receiving water quality indicators are properly functioning.

Note: This is a hypothetical example; it does not reference a real receiving water.

Translating Project Information into HI-RUN

The project information described in slides 2-4 is summarized in the *ESA Stormwater Design Checklist* – which is completed by the project designer and provided to the project biologist to use for inputs to the HI-RUN model. The checklist is available on the WSDOT BA Stormwater Guidance Web page:

http://www.wsdot.wa.gov/Environment/Biology/BA/BAguidance.htm#Stormwater

Endangered Species Act

Stormwater Design Checklist

For Western Washington

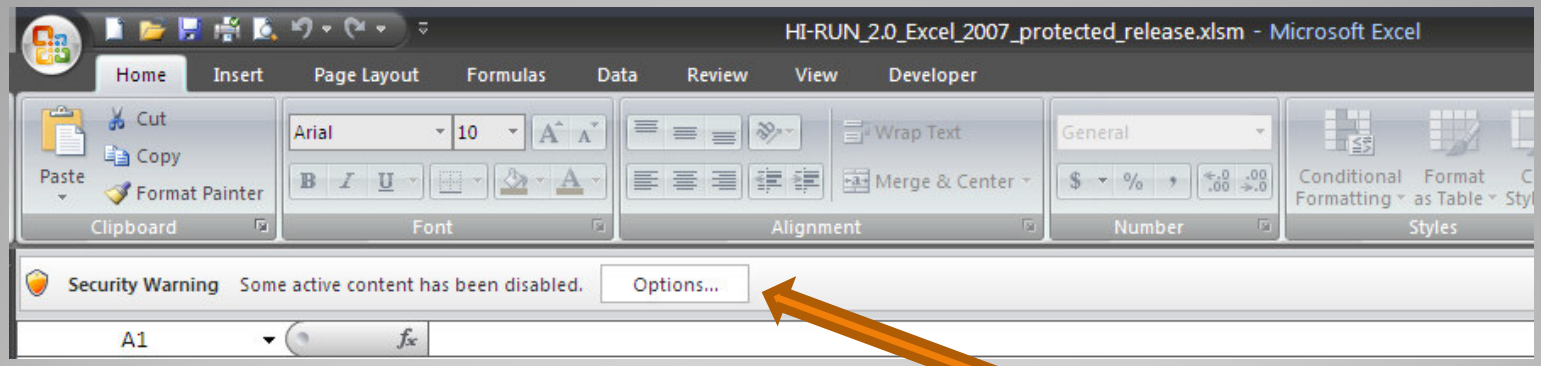
Inputs for HI-RUN Model End-of-Pipe Loading Subroutine

Baseline (i.e., Pre-Project) Stormwater Facilities

Treatment Type	*Level of Infiltration[a]*	*Subbasin 1 Impervious Area (acres)*	*Subbasin 2 Impervious Area (acres)*	*Subbasin 3 Impervious Area (acres)*	*Subbasin 4 Impervious Area (acres)*	*Subbasin 5 Impervious Area (acres)*
□ Basic OR	0%					
□ Phosphorus	20%					
(Check one)	40%					
	60%					
	80%					
Enhanced	0%					
	20%					
	40%					
	60%					
	80%					
None						
Infiltration BMP	100%					

[a] Level of infiltration relates to the amount of incidental infiltration that can be expected, expressed as a percentage of annual [illegible] volume. If no incidental infiltration can be assumed, enter area in the row corresponding to "0%"

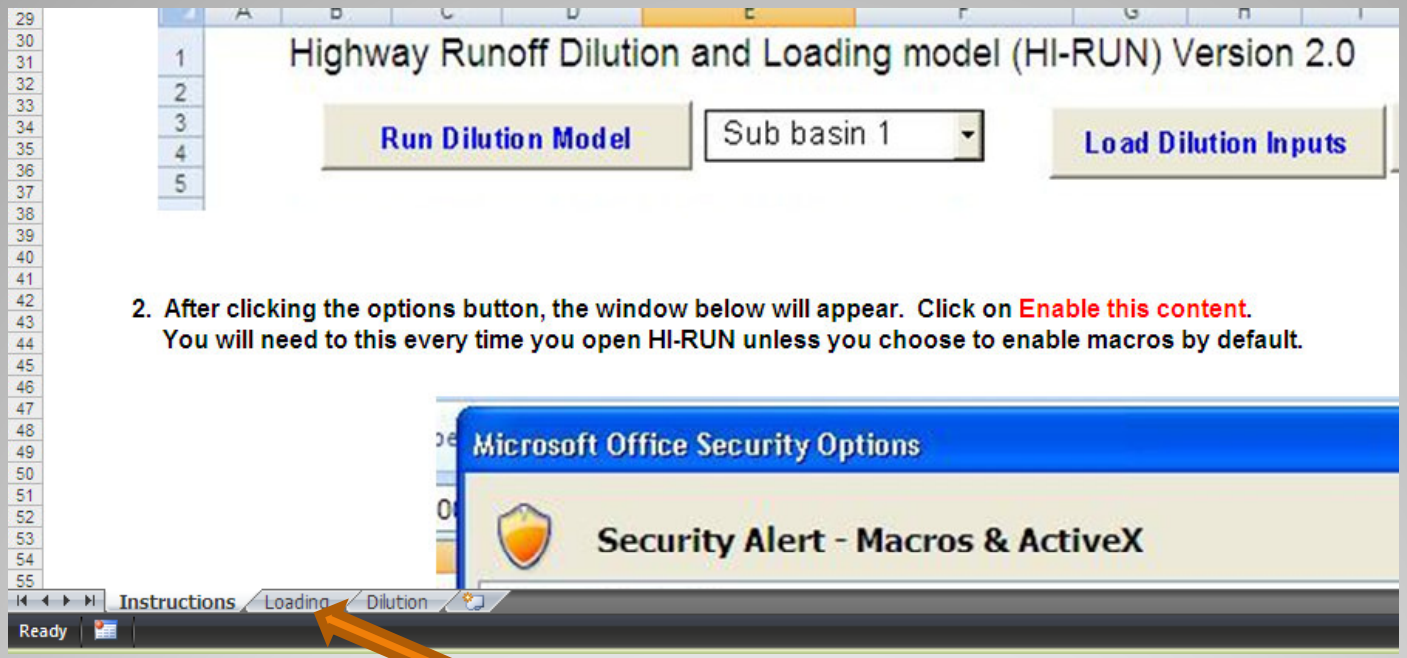
Project Example



If macros are disabled on your computer, you will not be able to enter input values or run the HI-RUN model.

To enable macros, click the "Options" button on the Security Warning banner at the top of the sheet. Then select "Enable this content" in the Microsoft Office Security Options window.

Starting HI-RUN

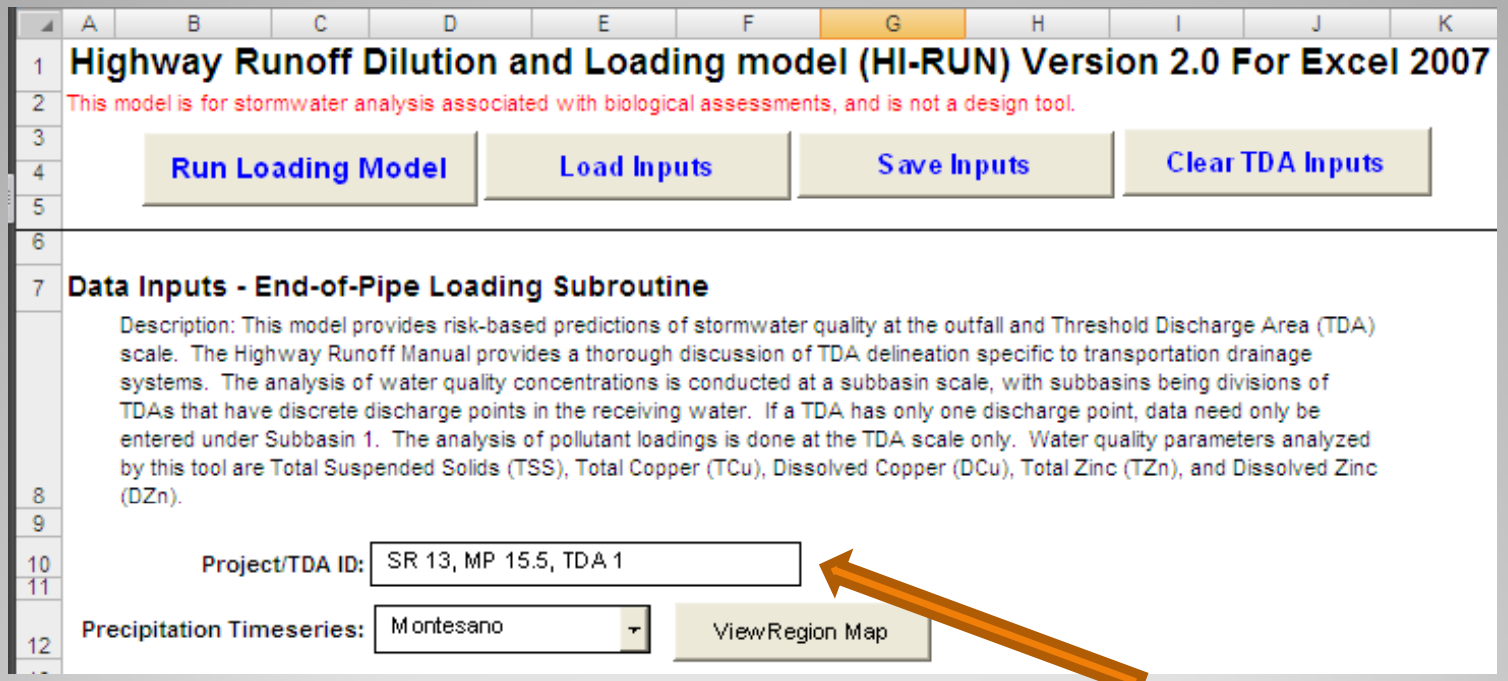


Once you have enabled the macros, you're ready to start running the model. Select the "Loading" tab at the bottom of the screen to start the End-of-Pipe Loading Subroutine

Starting HI-RUN

End-of-Pipe Loading Subroutine

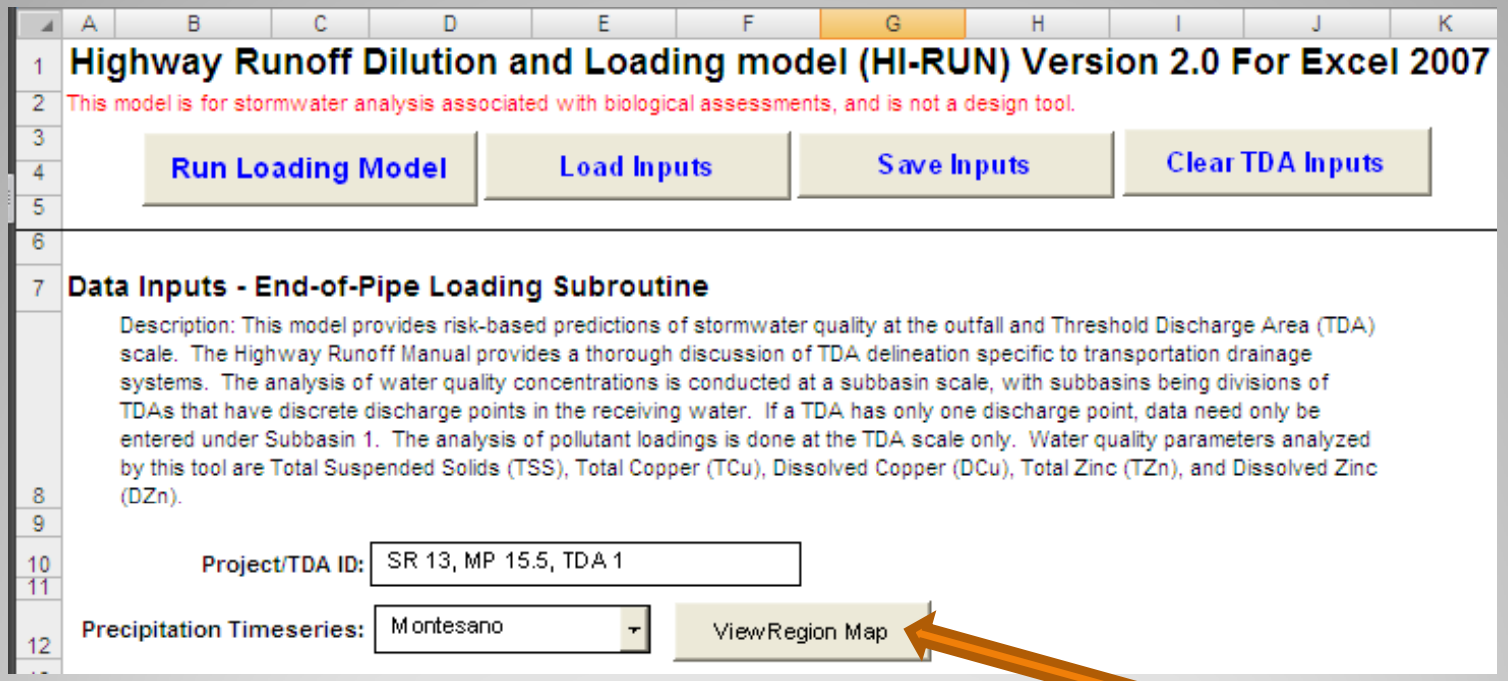
A Step-by-Step Example



Enter identifying information about the project and threshold discharge area that you are analyzing. Highway number, milepost, and TDA identifier are sufficient.

Step 1 – Project TDA/ID

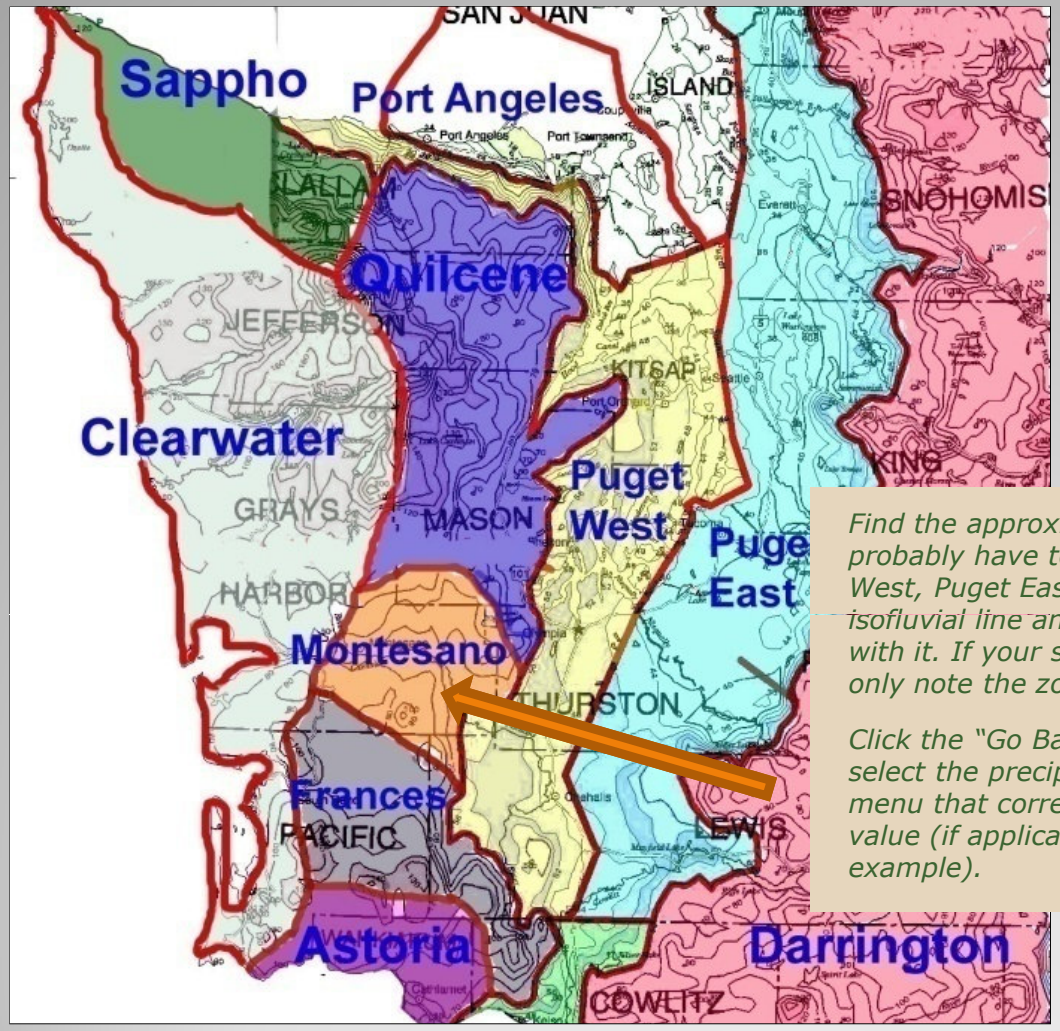
End-of-Pipe Loading Subroutine



Select the precipitation time series associated with your site from the dropdown menu. If you do not know which time series is appropriate, click the "View Region Map" button.

Step 2 – Precipitation Time Series

End-of-Pipe Loading Subroutine

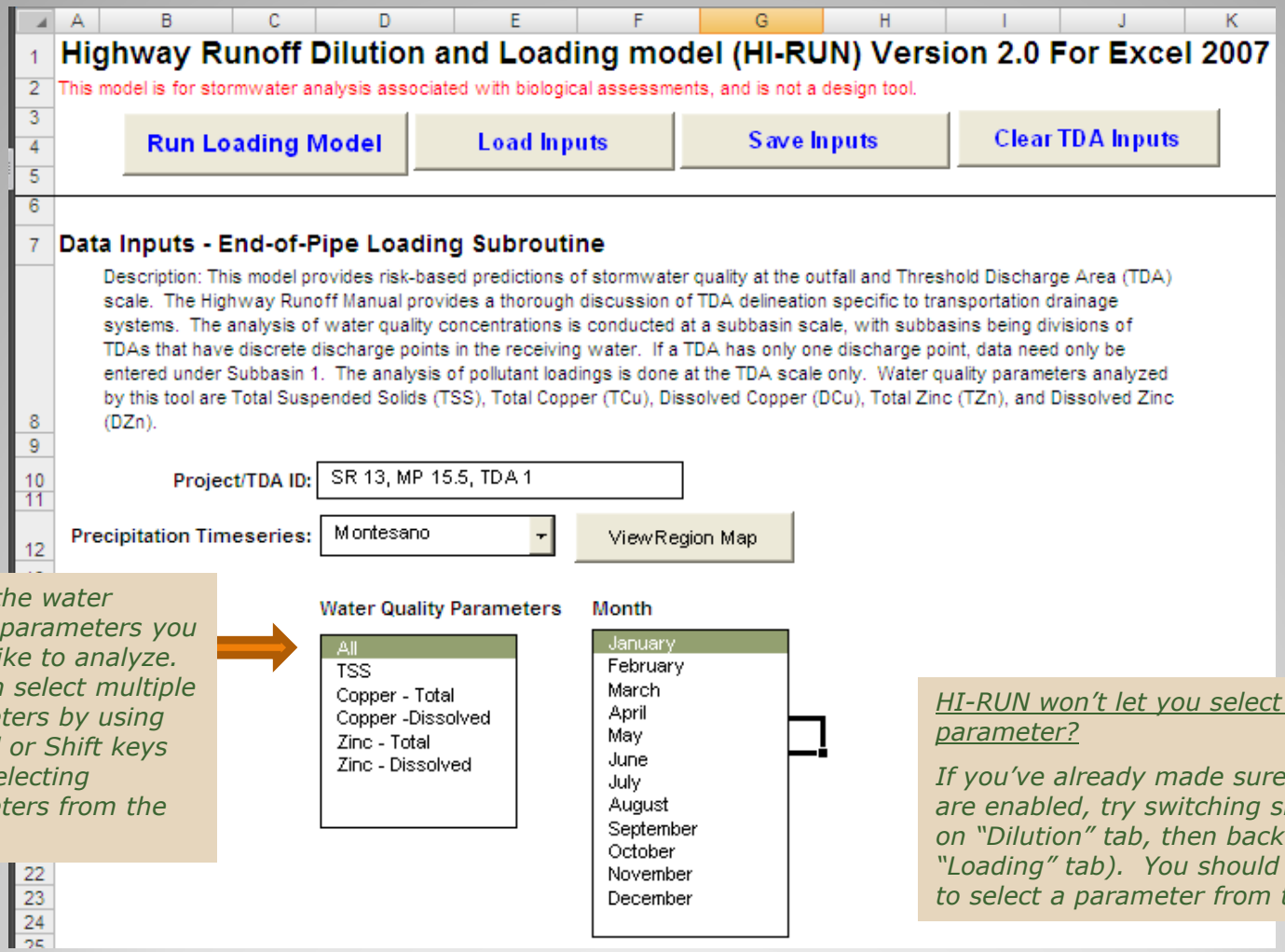


Find the approximate project location on the map (you'll probably have to zoom in). If your project is in the Puget West, Puget East, or Vancouver zones, find the closest isofluvial line and note the precipitation value associated with it. If your site lies outside of those zones, you need only note the zone that it is located in.

Click the "Go Back to Data Input Sheet" button and select the precipitation time series from the dropdown menu that corresponds to the zone and precipitation value (if applicable) from the map (Montesano in this example).

Step 2 – Precipitation Time Series

End-of-Pipe Loading Subroutine



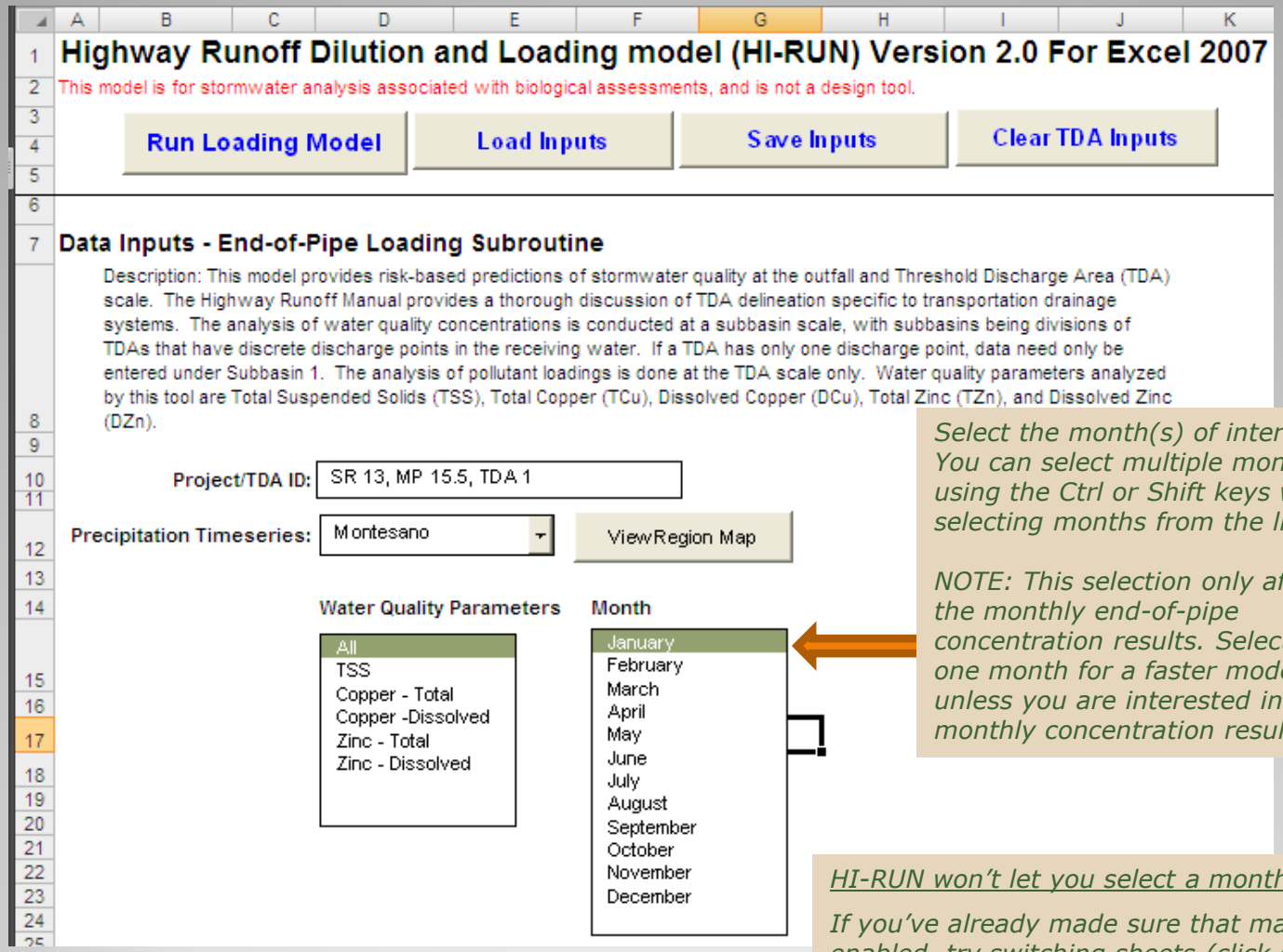
Select the water quality parameters you would like to analyze. You can select multiple parameters by using the Ctrl or Shift keys while selecting parameters from the list.

HI-RUN won't let you select a parameter?

If you've already made sure that macros are enabled, try switching sheets (click on "Dilution" tab, then back on "Loading" tab). You should then be able to select a parameter from the list.

Step 3 – Water Quality Parameters

End-of-Pipe Loading Subroutine



Select the month(s) of interest. You can select multiple months by using the Ctrl or Shift keys while selecting months from the list.

NOTE: This selection only affects the monthly end-of-pipe concentration results. Select only one month for a faster model run unless you are interested in the monthly concentration results .

HI-RUN won't let you select a month?

If you've already made sure that macros are enabled, try switching sheets (click on "Dilution" tab, then back on "Loading" tab). You should then be able to select a month from the list.

Step 4 – Months

End-of-Pipe Loading Subroutine

Incidental infiltration is the estimated portion of annual runoff volume that is infiltrated during the runoff treatment process.

*Enter impervious drainage area that is applied in the **pre-project** condition.*

HI-RUN can evaluate up to 5 subbasins within a given TDA (areas with different discharge points)

TDA Information - Baseline Conditions							
		Subbasin Area (acres)					TDA Impervious Area (acres)
Treatment Type	Level of Incidental Infiltration (%)	1	2	3	4	5	
Basic	0	4.3					4.3
	20						0
	40						0
	60						0
	80						0
Enhanced	0						0
	20						0
	40						0
	60						0
	80						0
Infiltration BMP	100						0
None	0	20.5					20.5
Total		*24.8*	*0*	*0*	*0*	*0*	*24.8*

Runoff from 4.3 acres of the project area impervious surface is treated with a basic treatment BMP (as defined in the Highway Runoff Manual).

Infiltration BMP indicates infiltration ponds, trenches, etc. that are designed to infiltrate all or most runoff routed to them.

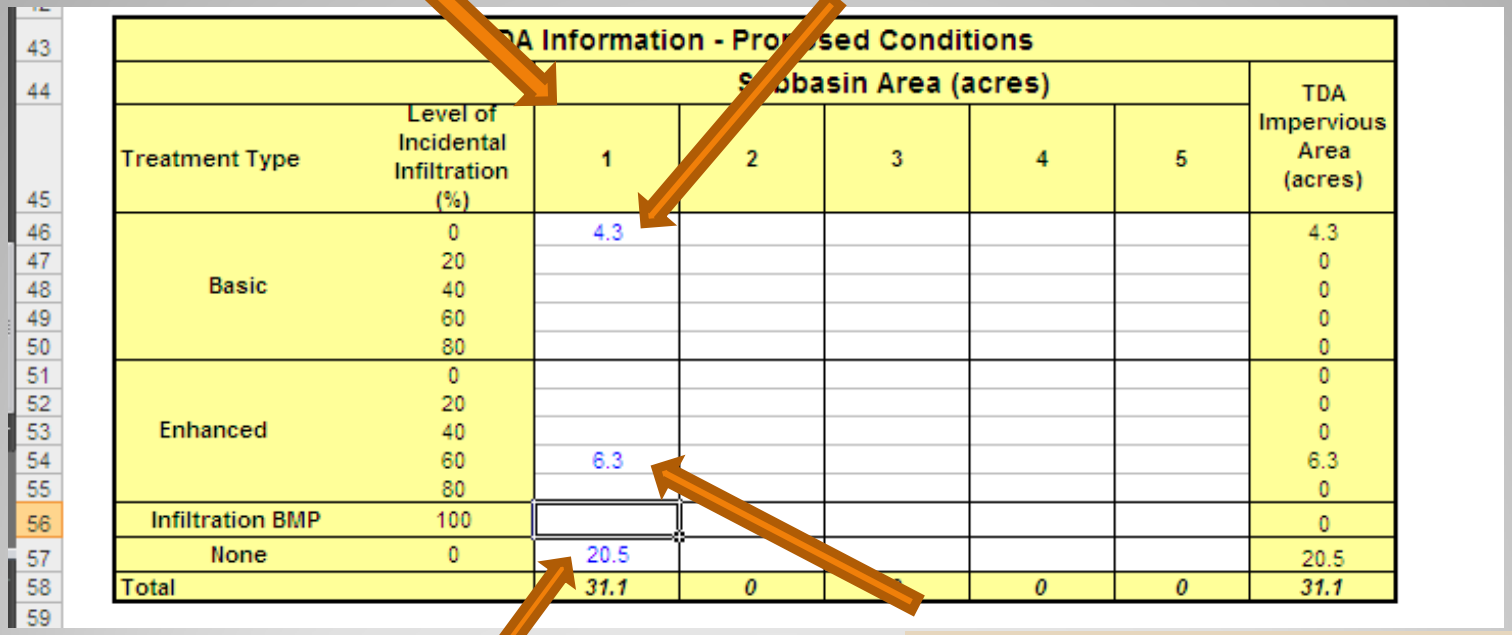
Runoff from 20.5 acres of the project area impervious surface is discharged with no treatment.

Step 5 – Baseline Conditions

End-of-Pipe Loading Subroutine

*Enter impervious drainage area, separated by the kind of runoff treatment that will be applied in the **post-project** condition.*

Runoff from 4.3 acres of the project area impervious surface is treated with a basic treatment BMP (as defined in the Highway Runoff Manual) .



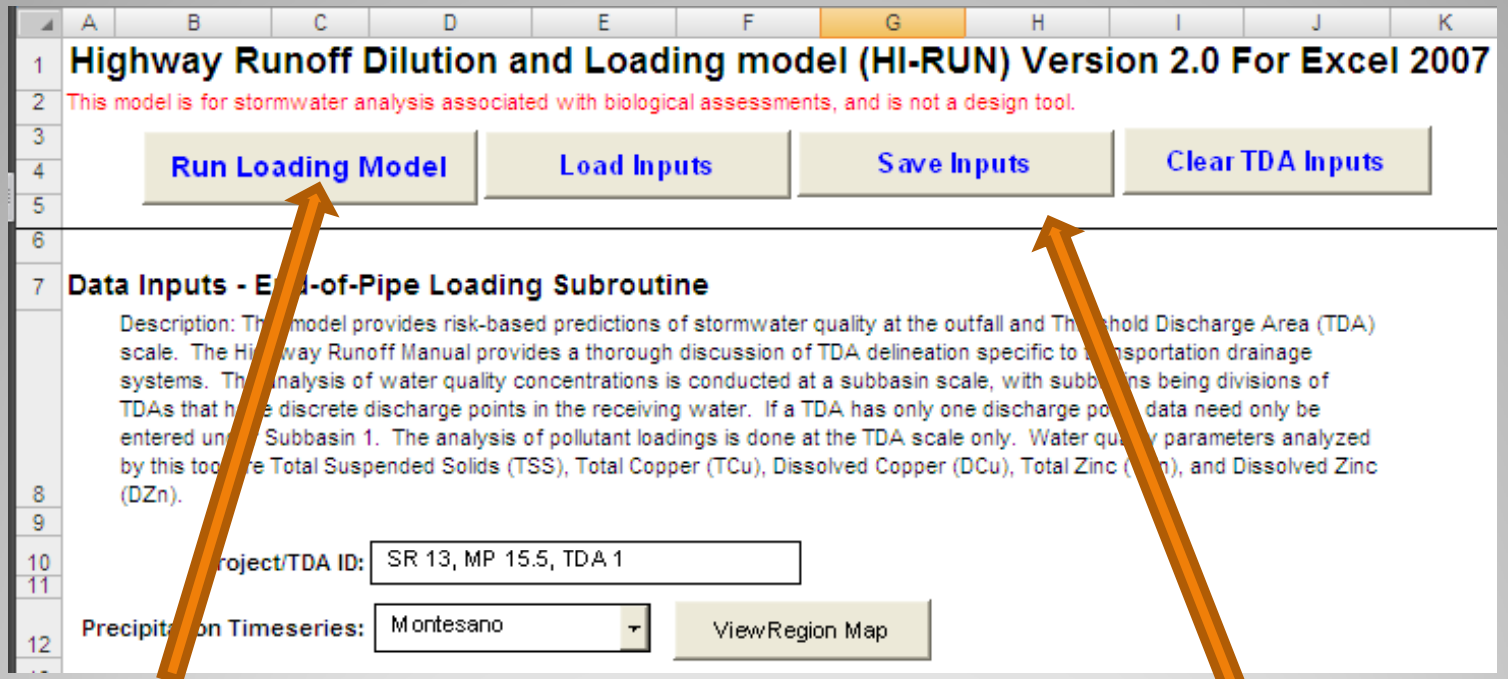
TDA Information - Proposed Conditions							
		Subbasin Area (acres)					TDA Impervious Area (acres)
Treatment Type	Level of Incidental Infiltration (%)	1	2	3	4	5	
Basic	0	4.3					4.3
	20						0
	40						0
	60						0
	80						0
Enhanced	0						0
	20						0
	40						0
	60	6.3					6.3
	80						0
Infiltration BMP	100						0
None	0	20.5					20.5
Total		*31.1*	*0*		*0*	*0*	*31.1*

Runoff from 20.5 acres of the project area impervious surface is discharged with no treatment.

Runoff from 6.3 acres of the project area impervious surface is treated with an enhanced treatment BMP (as defined in the Highway Runoff Manual). This BMP also infiltrates approximately 60% of the annual runoff volume.

Step 6 – Proposed Conditions

End-of-Pipe Loading Subroutine

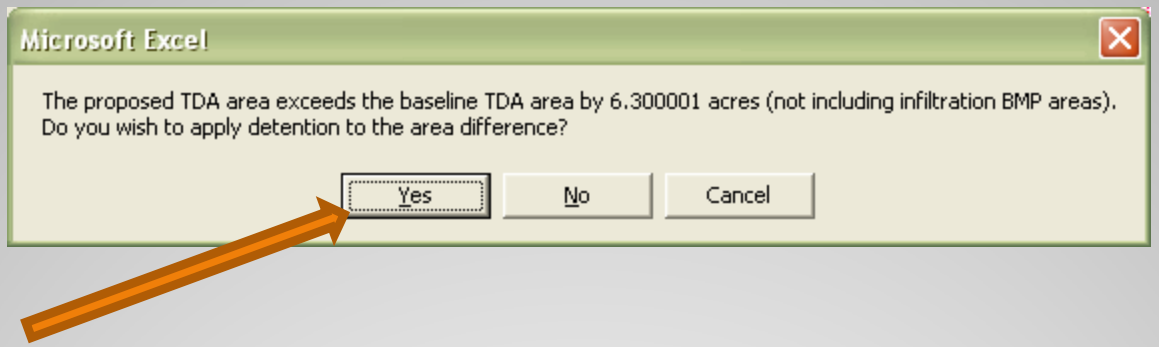


Click this button when your inputs have been entered.

You can also save your inputs for future model runs.

Step 7 – Run End-of-Pipe Loading Subroutine

End-of-Pipe Loading Subroutine

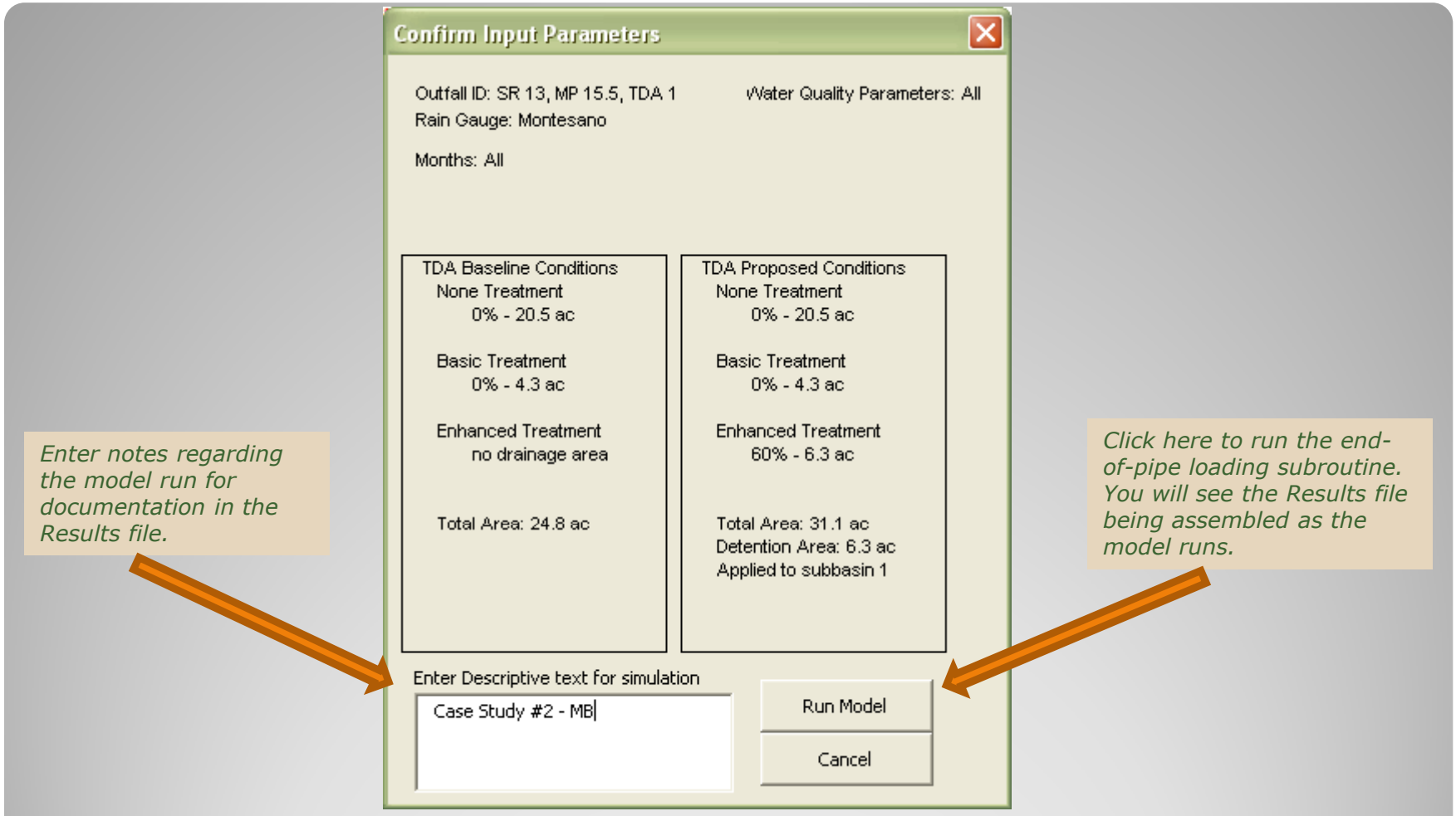


Indicate here whether the project will implement detention to control flows from increased impervious area.

Note: Detention does not affect the annual pollutant load estimates in the End-of-Pipe Loading Subroutine, but it does affect the pollutant concentration results.

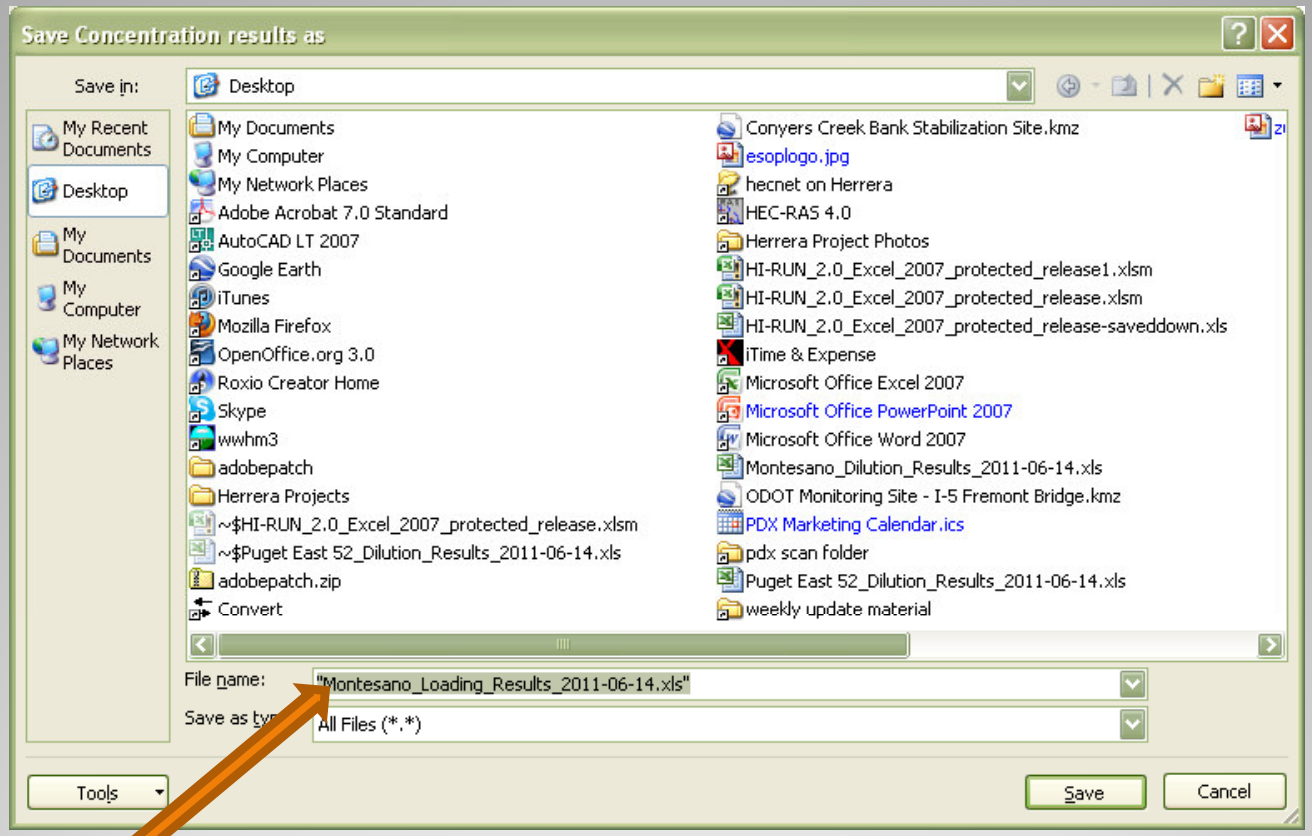
Step 7 – Run End-of-Pipe Loading Subroutine

End-of-Pipe Loading Subroutine



Step 7 – Run End-of-Pipe Loading Subroutine

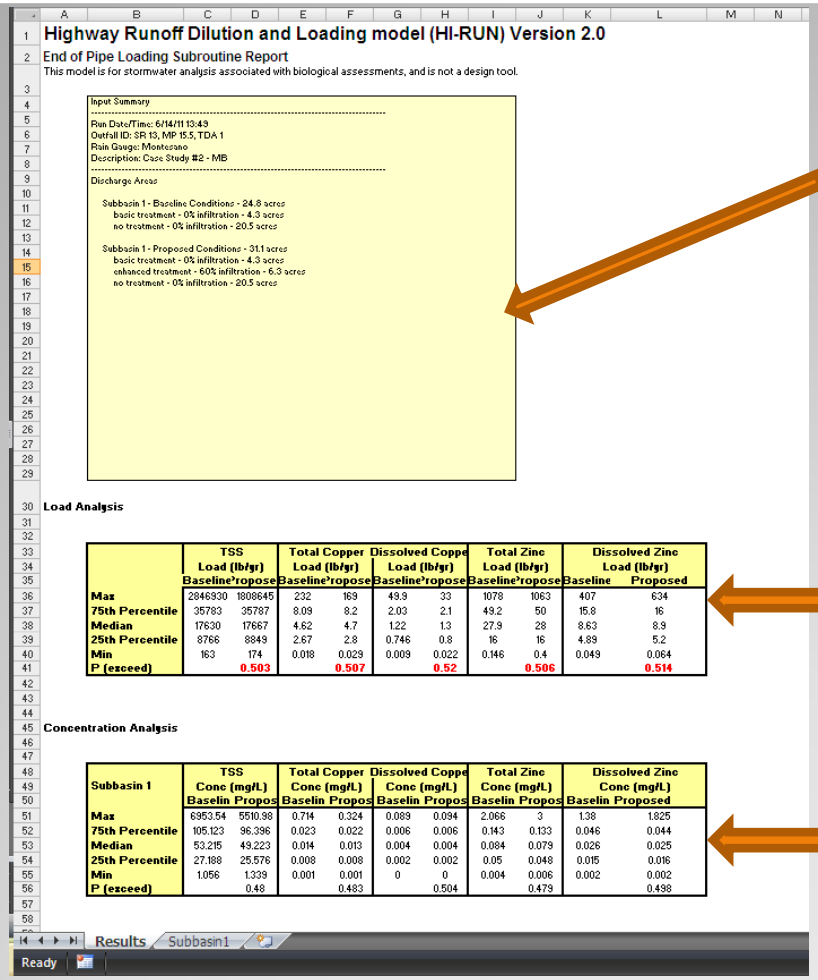
End-of-Pipe Loading Subroutine



Save your results for your records.

Step 7 – Run End-of-Pipe Loading Subroutine

End-of-Pipe Loading Subroutine



Highway Runoff Dilution and Loading model (HI-RUN) Version 2.0

End of Pipe Loading Subroutine Report

This model is for stormwater analysis associated with biological assessments, and is not a design tool.

Input Summary

Run Date/Time: 6/14/11 10:43
Outfall ID: SR 13, MP 15.5, TDA 1
Rain Gauge: Montesano
Description: Case Study #2 - MB

Discharge Areas

Subbasin 1 - Baseline Conditions - 24.8 acres
basic treatment - 0% infiltration - 4.3 acres
no treatment - 0% infiltration - 20.5 acres

Subbasin 1 - Proposed Conditions - 31.1 acres
basic treatment - 0% infiltration - 4.3 acres
enhanced treatment - 60% infiltration - 6.3 acres
no treatment - 0% infiltration - 20.5 acres

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	2846930	1808645	232	169	49.9	33	1078	1063	407	634
75th Percentile	35783	35787	8.09	8.2	2.03	2.1	49.2	50	15.8	16
Median	17630	17667	4.62	4.7	1.22	1.3	27.9	28	8.63	8.9
25th Percentile	8766	8849	2.67	2.8	0.746	0.8	16	16	4.89	5.2
Min	163	174	0.018	0.029	0.009	0.022	0.146	0.4	0.049	0.064
P (exceed)		0.503		0.507		0.52		0.506		0.514

Concentration Analysis

Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	6953.54	5510.98	0.714	0.324	0.089	0.094	2.066	3	1.38	1.825
75th Percentile	105.123	96.396	0.023	0.022	0.006	0.006	0.143	0.133	0.046	0.044
Median	53.215	49.223	0.014	0.013	0.004	0.004	0.084	0.079	0.026	0.025
25th Percentile	27.188	25.576	0.008	0.008	0.002	0.002	0.05	0.048	0.015	0.016
Min	1.056	1.339	0.001	0.001	0	0	0.004	0.006	0.002	0.002
P (exceed)		0.48		0.483		0.504		0.479		0.498

Results | Subbasin1

Ready

This box summarizes the inputs that were used.

This box summarizes load statistics

This box summarizes concentration statistics.

Step 8 – Interpreting End-of-Pipe Loading Subroutine Results

End-of-Pipe Loading Subroutine

Load Analysis

	TSS Load (lb/yr)		Total Copper Load (lb/yr)		Dissolved Copper Load (lb/yr)		Total Zinc Load (lb/yr)		Dissolved Zinc Load (lb/yr)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	2846930	1808645	232	169	49.9	33	1078	1063	407	634
75th Percentile	35783	35787	8.09	8.2	2.03	2.1	49.2	50	15.8	16
Median	17630	17667	4.62	4.7	1.22	1.3	27.9	28	8.63	8.9
25th Percentile	8766	8849	2.67	2.8	0.746	0.8	16	16	4.89	5.2
Min	163	174	0.018	0.029	0.009	0.022	0.146	0.4	0.049	0.064
P (exceed)		0.503		0.507		0.52		0.506		0.514

Concentration Analysis

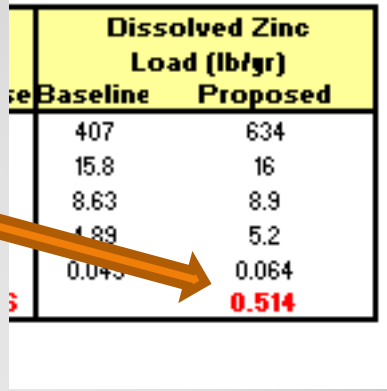
Subbasin 1	TSS Conc (mg/L)		Total Copper Conc (mg/L)		Dissolved Copper Conc (mg/L)		Total Zinc Conc (mg/L)		Dissolved Zinc Conc (mg/L)	
	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed	Baseline	Proposed
Max	6953.54	5510.98	0.714	0.324	0.089	0.094	2.066	3	1.38	1.825
75th Percentile	105.123	96.396	0.023	0.022	0.006	0.006	0.143	0.133	0.046	0.044
Median	53.215	49.223	0.014	0.013	0.004	0.004	0.084	0.079	0.026	0.025
25th Percentile	27.188	25.576	0.008	0.008	0.002	0.002	0.05	0.048	0.015	0.016
Min	1.056	1.339	0.001	0.001	0	0	0.004	0.006	0.002	0.002
P (exceed)		0.48		0.483		0.504		0.479		0.498

Annual Load statistics: Max, Min, Median, 25th and 75th percentiles for proposed and baseline and P(exceed).

These tables summarize annual pollutant loads and concentrations at the project outfall.

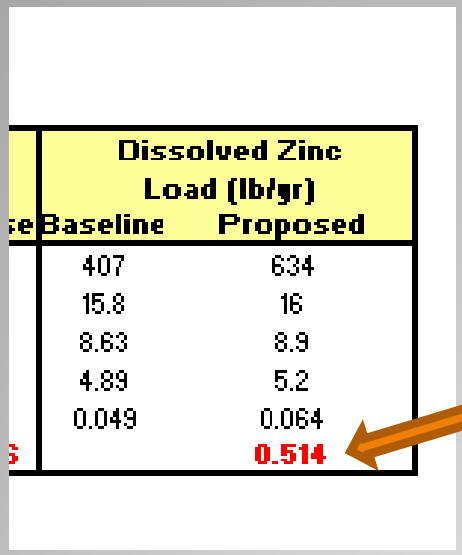
Concentration statistics: Max, Min, Median, 25th and 75th percentiles for proposed and baseline and P(exceed).

The key data point to note here is the P(exceed) value for dissolved zinc load (0.514).



Step 8 – Interpreting End-of-Pipe Loading Subroutine Results

End-of-Pipe Loading Subroutine



What does the P(exceed) value mean?

It is the estimated probability that the parameter (annual load of zinc in the dissolved phase in this example) will be greater with the proposed project than in the baseline condition.

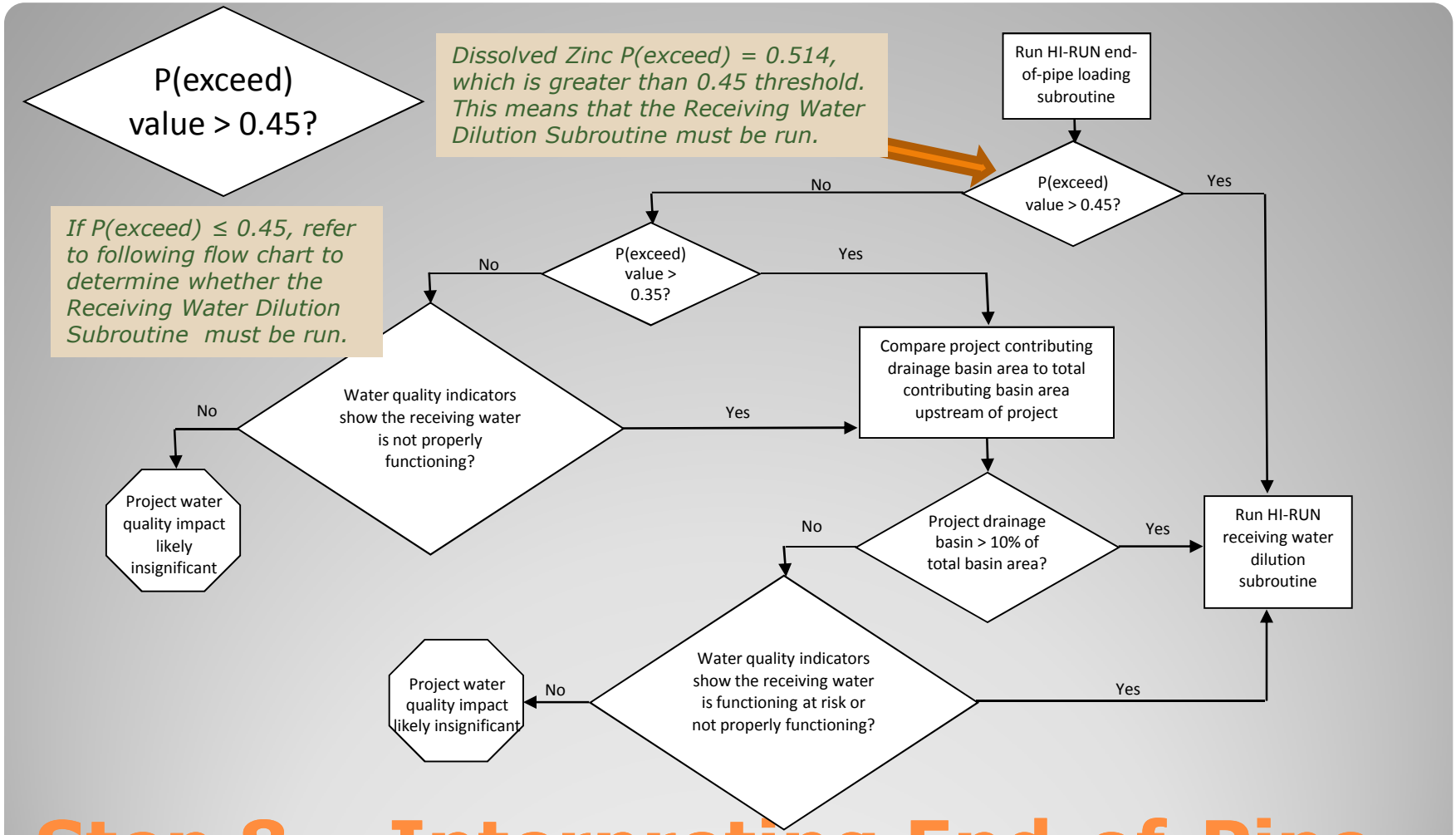
If a TDA has a P(exceed) value of 0.5, there is a 50% probability that the load with the proposed project will be greater than in the baseline condition(an increase in pollutant loading) and a 50% probability that it will be less (a decrease in pollutant loading).

*If a TDA has a **P(exceed) value < 0.5, there is a greater chance that pollutant loading will decrease** with the proposed project.*

*If a TDA has **a P(exceed) value > 0.5, there is a greater chance that pollutant loading will increase** with the proposed project.*

Step 8 – Interpreting End-of-Pipe Loading Subroutine Results

End-of-Pipe Loading Subroutine

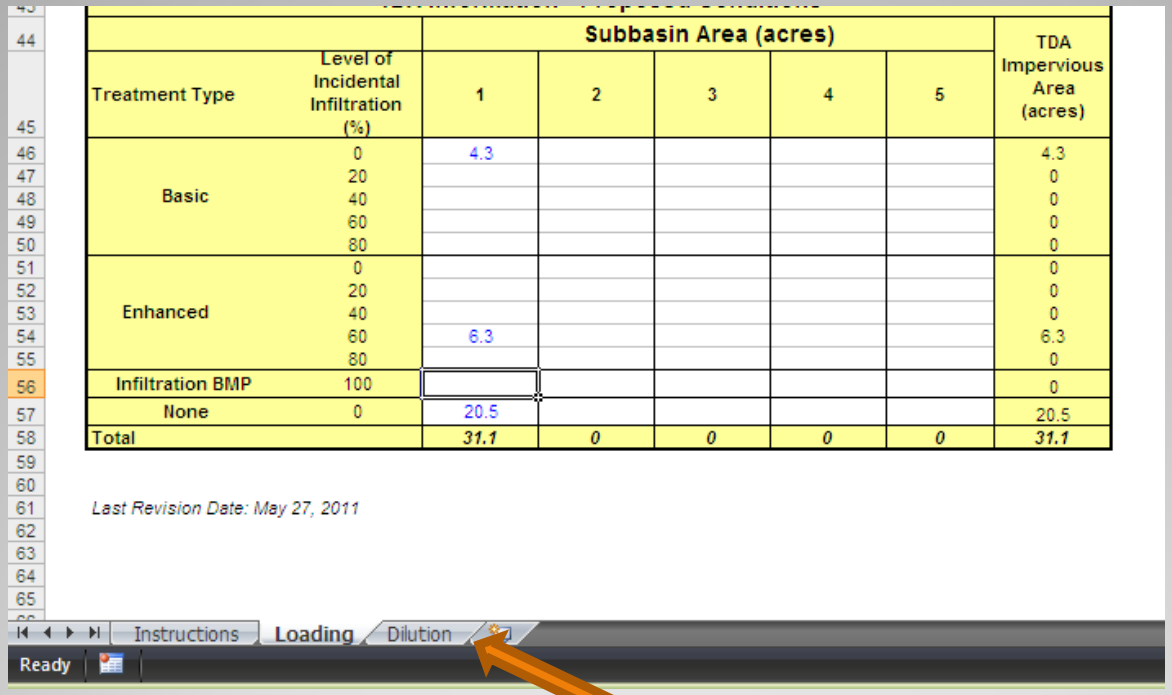


Step 8 – Interpreting End-of-Pipe Loading Subroutine Results

End-of-Pipe Loading Subroutine

Receiving Water Dilution Subroutine

A Step-by-Step Example



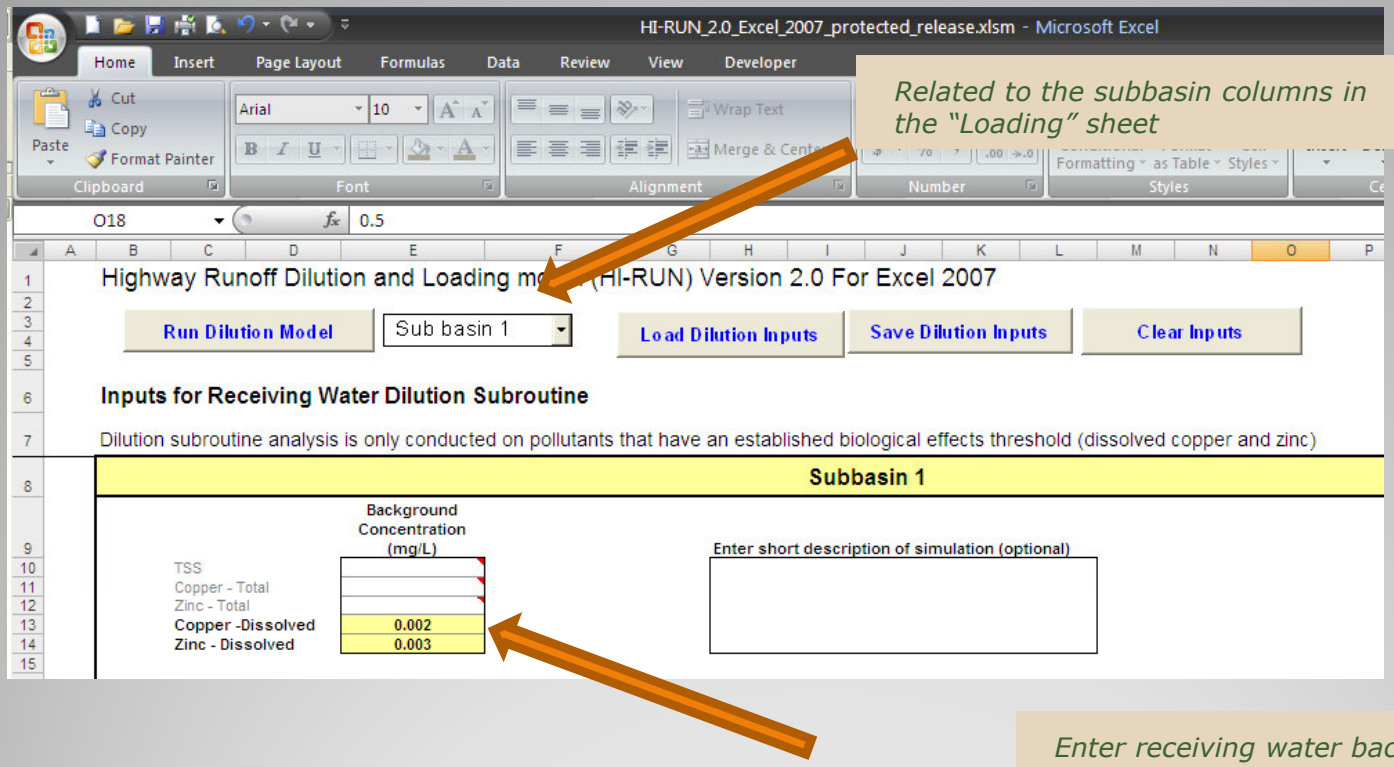
Treatment Type	Level of Incidental Infiltration (%)	Subbasin Area (acres) 1	2	3	4	5	TDA Impervious Area (acres)
Basic	0	4.3					4.3
	20						0
	40						0
	60						0
	80						0
Enhanced	0						0
	20						0
	40						0
	60	6.3					6.3
	80						0
Infiltration BMP	100						0
None	0	20.5					20.5
Total		*31.1*	*0*	*0*	*0*	*0*	*31.1*

Last Revision Date: May 27, 2011

To begin running the Receiving Water Dilution Subroutine, click on the "Dilution" tab at the bottom of the sheet

Running the Receiving Water Dilution Subroutine

Receiving Water Dilution Subroutine



Enter receiving water background concentrations for dissolved copper and dissolved zinc.

Note: the receiving water dilution subroutine will analyze only dissolved copper and zinc, regardless of parameters selected on the "Loading" sheet.

Step 1 – Background Concentrations

Receiving Water Dilution Subroutine

Inputs for Receiving Water Dilution Subroutine

Dilution subroutine analysis is only conducted on pollutants that have an established biological effects threshold (dissolved copper and zinc)

Subbasin 1

	Background Concentration (mg/L)
TSS	
Copper - Total	
Zinc - Total	
Copper -Dissolved	**0.002**
Zinc - Dissolved	**0.003**

Enter short description of simulation (optional)

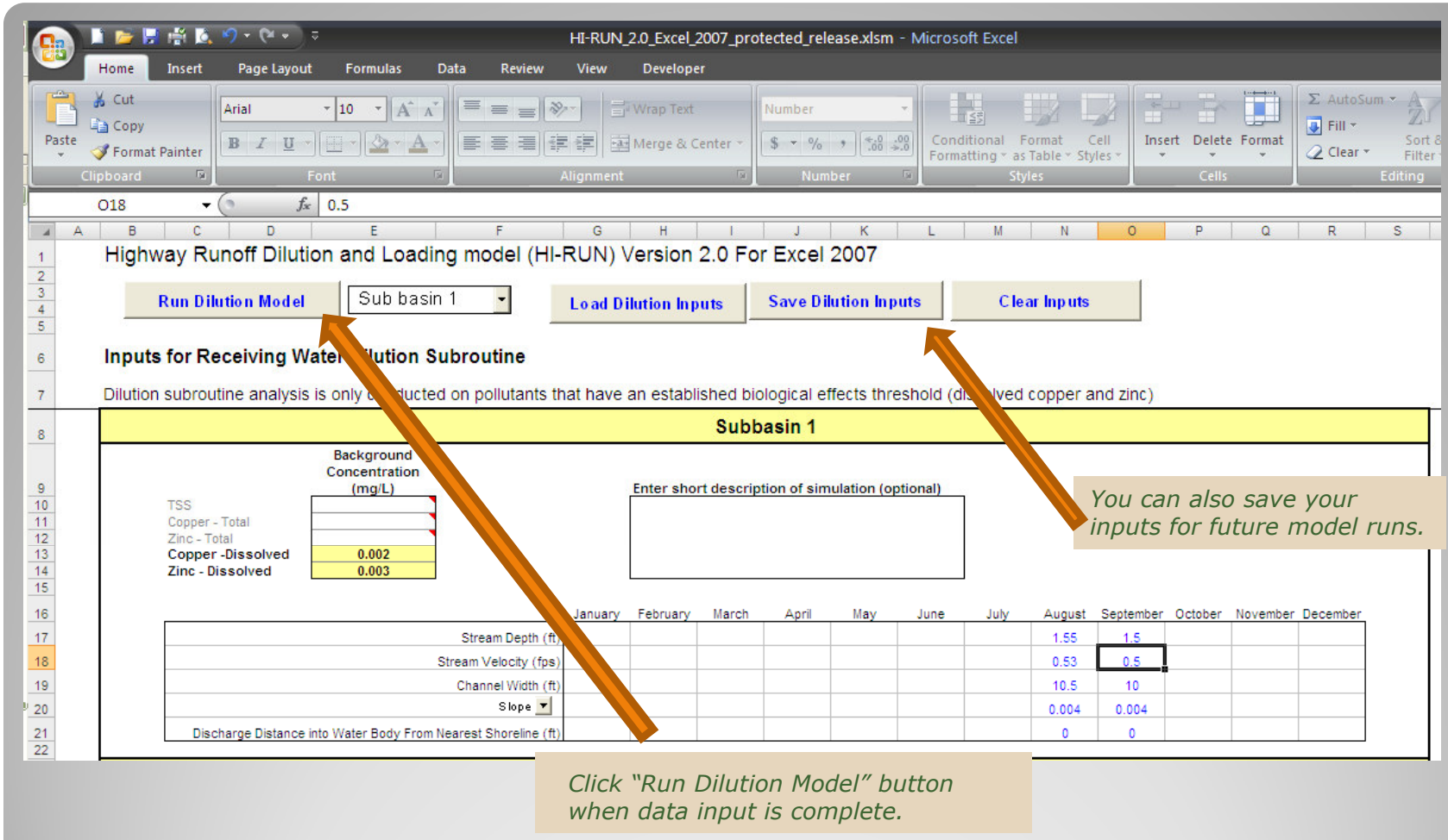
	January	February	March	April	May	June	July	August	September	October	November	December
Stream Depth (ft)								1.55	1.5			
Stream Velocity (fps)								0.53	0.5			
Channel Width (ft)								10.5	10			
Slope								0.004	0.004			
Discharge Distance into Water Body From Nearest Shoreline (ft)								0	0			

Enter depth, velocity, width, slope (or channel roughness), for each month of interest, and the outfall distance from the bank.

Note: The receiving water dilution subroutine will analyze all months with characteristic data entered, NOT the months selected in the "Loading" sheet.

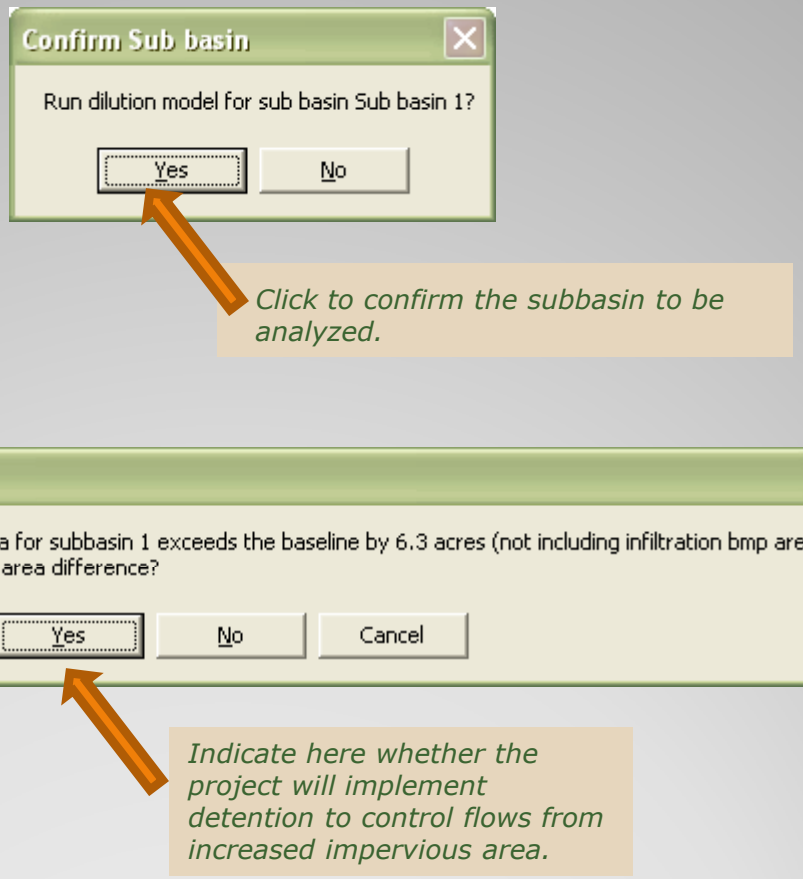
Steps 2-6 – Receiving Water Characteristics

Receiving Water Dilution Subroutine



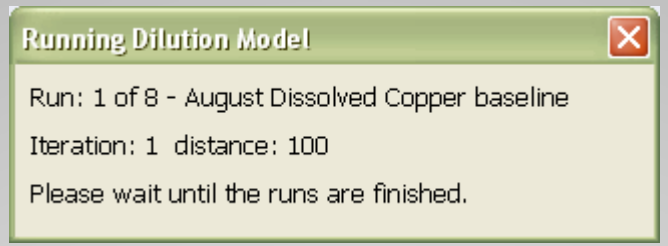
Step 7 – Run Receiving Water Dilution Subroutine

Receiving Water Dilution Subroutine



Step 7 – Run Receiving Water Dilution Subroutine

Receiving Water Dilution Subroutine

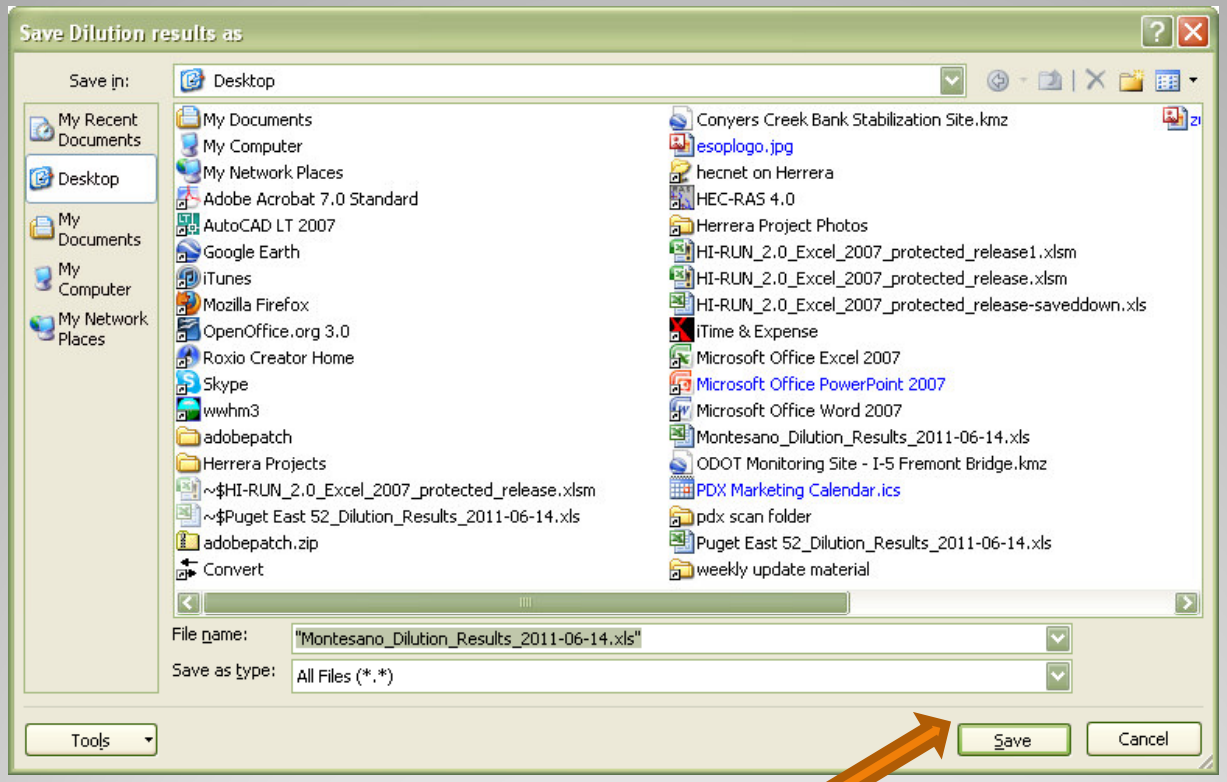


The receiving water dilution subroutine will conduct multiple iterations for each combination of baseline/proposed conditions and parameters.

This window shows progress as the Results file is generated in the background.

Step 7 – Run Receiving Water Dilution Subroutine

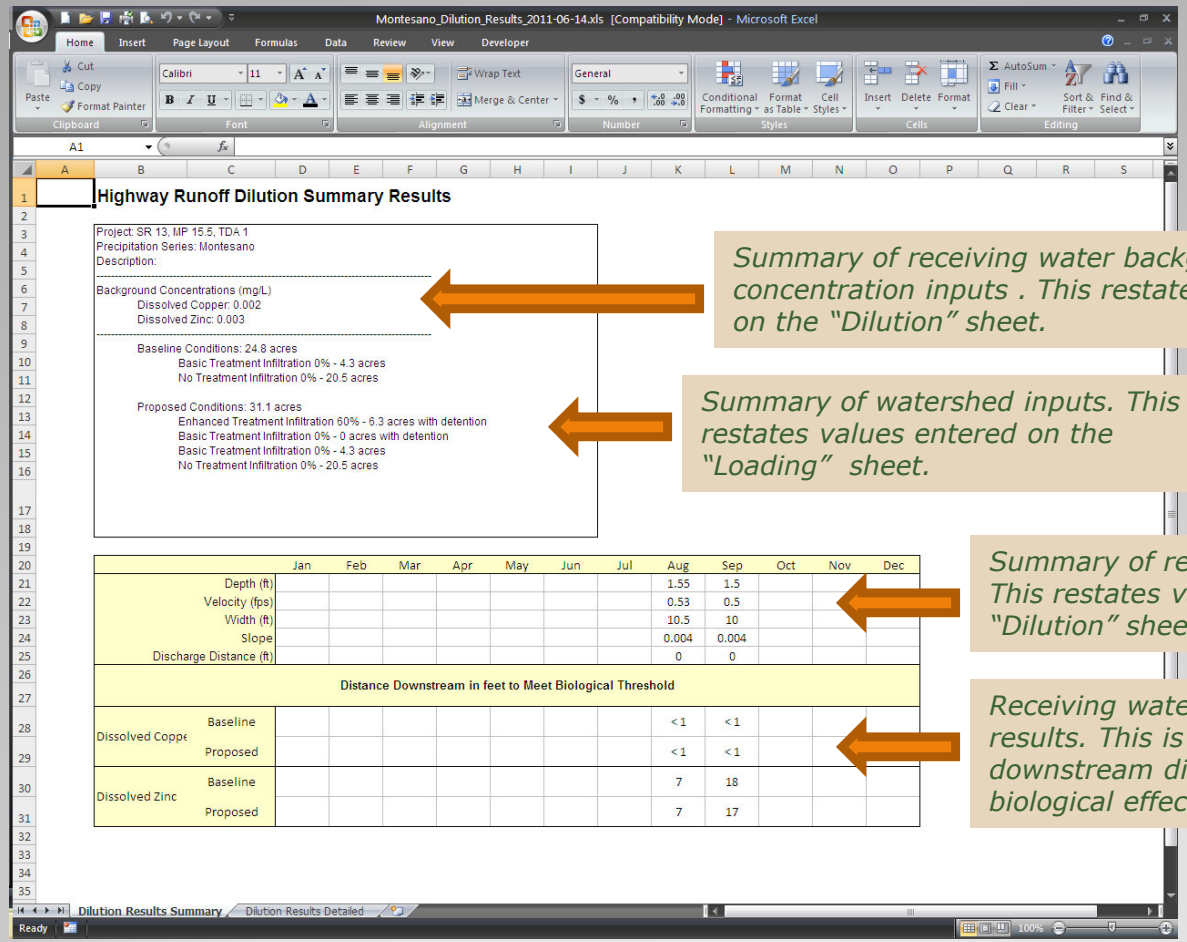
Receiving Water Dilution Subroutine



When the analysis is complete, you will be prompted to save your results.

Step 7 – Run Receiving Water Dilution Subroutine

Receiving Water Dilution Subroutine



Summary of receiving water background concentration inputs . This restates values entered on the "Dilution" sheet.

Summary of watershed inputs. This restates values entered on the "Loading" sheet.

Summary of receiving water inputs. This restates values entered on the "Dilution" sheet.

Receiving water dilution subroutine results. This is a summary of predicted downstream distances to meet biological effects thresholds.

Step 8 – Interpreting Receiving Water Dilution Subroutine Results

Receiving Water Dilution Subroutine

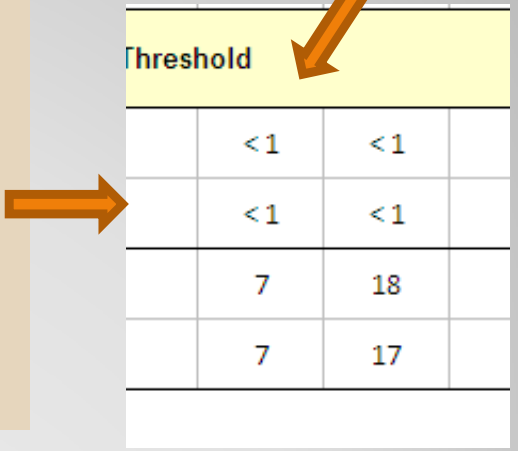
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Depth (ft)								1.55	1.5			
Velocity (fps)								0.53	0.5			
Width (ft)								10.5	10			
Slope								0.004	0.004			
Discharge Distance (ft)								0	0			
Distance Downstream in feet to Meet Biological Threshold												
Dissolved Copper – Baseline								<1	<1			
Dissolved Copper – Proposed								<1	<1			
Dissolved Zinc – Baseline								7	18			
Dissolved Zinc – Proposed								7	17			

"<1" results indicate nearly instantaneous dilution to below the biological effects threshold upon discharge to the receiving water.

If a result of ">1,000" is generated, it suggests that the receiving water does not have the capacity to dilute project discharge to below the biological effects threshold.

Dissolved zinc results for September indicate the greatest distance from the outfall within which the biological effects threshold is predicted to be exceeded.

The lower value under proposed conditions (17 feet vs. 18 feet) suggests that the project will result in slightly reduced impacts (compared to the baseline [existing] condition).



Step 8 – Interpreting Receiving Water Dilution Subroutine Results

Receiving Water Dilution Subroutine

- What do these results mean for fish?
  - Copper concentrations are diluted nearly instantaneously to background levels in both August and September under pre- and post project conditions.
  - Project will result in no change in zinc levels in August
  - Project will result in slight improvement in zinc levels in September.
  - Fish within 0 to 7 feet (August) and 0 to 17 feet (September) of the outfall could be exposed to zinc concentrations exceeding the biological threshold.

Threshold			
	<1	<1	
	<1	<1	
	7	18	
	7	17	

Step 8 – Interpreting Receiving Water Dilution Subroutine Results

- Considerations for the BA
  - What species or life stages are potentially present in August and September?
  - What habitat is present between 0 and 17 feet of the outfall?
  - How would fish use habitat in this area during this time of year?
  - How frequently are discharges from storm events expected to occur during these months?

- Purpose of the BA
  - Identify the potential for exposure
  - Characterize what the exposure will be like and quantify the extent of exposure (duration, area, frequency, etc.)

Step 8 – Interpreting Receiving Water Dilution Subroutine Results