HI-RUN version 2.0

A Step-by-Step 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.
Existing treatment
Biofiltration swale (sized for 4.3 acres)

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).

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
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.
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.
End-of-Pipe Loading Subroutine

A Step-by-Step Example
Step 1 – Project TDA/ID

End-of-Pipe Loading Subroutine

Enter identifying information about the project and threshold discharge area that you are analyzing. Highway number, milepost, and TDA identifier are sufficient.
Step 2 – Precipitation Time Series

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.
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 3 – Water Quality Parameters

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.
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.

If 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**

<table>
<thead>
<tr>
<th>Water Quality Parameters</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>January</td>
</tr>
<tr>
<td>Total Copper</td>
<td>February</td>
</tr>
<tr>
<td>Dissolved Copper</td>
<td>March</td>
</tr>
<tr>
<td>Total Zinc</td>
<td>April</td>
</tr>
<tr>
<td>Dissolved Zinc</td>
<td>May</td>
</tr>
<tr>
<td>TSS</td>
<td>June</td>
</tr>
<tr>
<td>Copper - Total</td>
<td>July</td>
</tr>
<tr>
<td>Zinc - Total</td>
<td>August</td>
</tr>
<tr>
<td>Copper - Dissolved</td>
<td>September</td>
</tr>
<tr>
<td>Zinc - Dissolved</td>
<td>October</td>
</tr>
<tr>
<td></td>
<td>November</td>
</tr>
<tr>
<td></td>
<td>December</td>
</tr>
</tbody>
</table>
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).

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).

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

### TDA Information - Baseline Conditions

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Level of Incidental Infiltration (%)</th>
<th>Subbasin Area (acres)</th>
<th>TDA Impervious Area (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>0 20 40 60 80</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Enhanced</td>
<td>0 20 40 60 80</td>
<td>0 0 0 0 0</td>
<td>0 0 0 0 0</td>
</tr>
<tr>
<td>Infiltration BMP</td>
<td>100</td>
<td>0 20.5</td>
<td>0 0 0 0 0</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
<td>Total - 24.8</td>
<td>Total - 24.8</td>
</tr>
</tbody>
</table>

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

**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).

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.

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

**Step 6 – Proposed Conditions**

*End-of-Pipe Loading Subroutine*
Step 7 – Run End-of-Pipe Loading Subroutine

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

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.
Enter notes regarding the model run for documentation in the Results file.

Click here to run the end-of-pipe loading subroutine. You will see the Results file being assembled as the model runs.

Step 7 – Run End-of-Pipe Loading Subroutine
Step 7 – Run End-of-Pipe Loading Subroutine

Save your results for your records.
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
These tables summarize annual pollutant loads and concentrations at the project outfall.

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

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**
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**

<table>
<thead>
<tr>
<th>Dissolved Zinc Load (lb/yr)</th>
<th>Baseline</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>407</td>
<td>634</td>
<td></td>
</tr>
<tr>
<td>15.8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8.63</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>4.89</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>0.043</td>
<td>0.064</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.514</strong></td>
<td></td>
</tr>
</tbody>
</table>
Step 8 – Interpreting End-of-Pipe Loading Subroutine Results

**End-of-Pipe Loading Subroutine**

Dissolved Zinc $P(\text{exceed}) = 0.514$, which is greater than 0.45 threshold. This means that the Receiving Water Dilution Subroutine must be run.

If $P(\text{exceed}) \leq 0.45$, refer to following flow chart to determine whether the Receiving Water Dilution Subroutine must be run.
Receiving Water
Dilution Subroutine

A Step-by-Step Example
To begin running the Receiving Water Dilution Subroutine, click on the “Dilution” tab at the bottom of the sheet.
Step 1 – Background Concentrations

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.
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

You can also save your inputs for future model runs.

Click “Run Dilution Model” button when data input is complete.
Click to confirm the subbasin to be analyzed.

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

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

Running Dilution Model

Run: 1 of 8 - August Dissolved Copper baseline
Iteration: 1 distance: 100
Please wait until the runs are finished.

Receiving Water Dilution Subroutine
Step 7 – Run Receiving Water Dilution Subroutine

*Receiving Water Dilution Subroutine*
Step 8 – Interpreting Receiving Water Dilution Subroutine Results

Receiving Water Dilution Subroutine

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

Summary of receiving water background concentration inputs. This restates values entered on the “Dilution” 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.
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).

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.

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

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.

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.)

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**Step 8 – Interpreting Receiving Water Dilution Subroutine Results**