

DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 5.6.0

TUTORIAL # 4 UPDATING NSTPS VALUES FOR CHANNEL

ROUTING



KVL Consultants, Inc.

UPDATING NSTPS VALUES FOR CHANNEL ROUTING

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UPDATING NSTPS VALUES FOR CHANNEL ROUTING DATE UPDATED: APRIL 27, 2018

1.0 INTRODUCTION

This tutorial document is developed to guide users in evaluating the NSTPS parameter (HEC-1 RS card's first field) for channel flow routing in HEC-1 using DDMSW. The input data file is an existing HEC-1 input file where normal-depth storage routing methodology is used. The implemented tool within the DDMSW program creates an updated HEC-1 input file that includes a refined set of NSTPS values updated from two successive model runs.

NSTPS is normally evaluated from flow and reach characteristics of the project area. It is usually estimated by the following relation (HEC, 1998).

NSTPS = [Channel Reach Length / Average Flow Velocity] / Time Interval (1)

It can also be estimated by:

Normally, the determination of the refined values of NSTPS can be made from several runs of the HEC-1 model, until the values converge. There are rare occasions, however, when NSTPS do not converge (i.e., values swing back and forth between iterations). In these cases, the modeler should look into the matter and use engineering judgment to select appropriate values of NSTPS adequate for his/her modeling purposes. One possible solution is to manually use Manning's equation to estimate the channel flow velocity and then estimate NSTPS by Equation (1) above. The manually estimated NSTPS can then be entered into an HEC-1 input file for the channel routings whose NSTPS values do not converge, users can execute the tool within DDMSW twice (i.e., three (3) model iterative runs in each execution). Here, the second-time model execution (i.e., three more iterative model runs) provides refined NSTPS values for the HEC-1 input file. This process of executing the model twice will shed light if there is any instability in the NSTPS values.

The program is based on two assumptions. The first assumption is that normaldepth channel routings are defined by RS cards with FLOW as a keyword in Field 2. It should be mentioned that there might be some exceptions to this assumption due to many combinations of routing parameters though this assumption is valid for most cases. Users should check to make sure that the intended channel routings are defined by RS card with FLOW as a keyword in Field 2. The second assumption is that all ID's in KK cards are unique. Users should check to make sure that there are no duplicate (**ID's in**) KK cards. It is the users' responsibility to check and accept the final results.

For purposes of illustration, this tutorial will use KVLEXAMPLE1.DAT. After completing the tutorial, the user should test the tool using his or her project data.

2.0 OPEN THE PROJECT

After launching the DDMSW program, open an existing project ('File => Select **Project**'). Select **KVLExAMPLE1** from the project list. Press 'OK' to close the **SELECT PROJECT** form. [Note: Please use the DDMSW project file 'KVLExample1.zip' that is bundled along with the tutorial document for this tutorial. To use the attached project data, delete first the 'KVLExample1' project in DDMSW and once it is deleted, to import the 'KVLExample1.zip' into DDMSW (File → Project Management → Import].

| Ŀi | st | | Details | |
|-------------------|------------|-------|---|---|
| Look for | | | | |
| Reference 🔺 | Date | ID | Title | |
| BANKPROTECTIONFCD | 01/01/2012 | 00049 | River Mechanics Example - Bank Protection | - |
| BRIDGEPIERFCD | 01/01/2012 | 00053 | River Mechanics Example - Bridge Pier | - |
| DUMMY1 | 03/16/2018 | 00048 | | - |
| EXAMPLE1 | 01/01/2010 | 00054 | Clark, Green Ampt, Single, 6 Hour | _ |
| EXAMPLE1_TEST | 03/16/2018 | 00077 | Clark, Green Ampt, Single, 6 Hour | |
| EXAMPLE2 | 01/01/2010 | 00055 | S-Graph, Green-Ampt, Single, 24 Hour | |
| EXAMPLE3 | 01/01/2010 | 00056 | S-Graph, Green-Ampt, Multiple, 6 Hour | = |
| EXAMPLE3_TEST | 03/19/2018 | 00084 | S-Graph, Green-Ampt, Mulitple, 6 Hour | |
| EXAMPLE4 | 01/01/2010 | 00057 | Clark, Init and Uniform, Single, 6 Hour | |
| | 01/01/2011 | 00088 | Example 1 HEC-1 tutorial project | |
| KVLEXAMPLE12 | 01/10/2014 | 00070 | Street Drainage Example | |
| KVLEXAMPLE2 | 04/11/2018 | 00086 | Example 2 Using Shape Files and NOAA 14 | |
| KVLEXAMPLE3 | 01/01/2011 | 00061 | Example 3 Rational Method tutorial project | |
| KVLEXAMPLE3A | 04/13/2018 | 00087 | Example Project of the Rational Method Tutorial | _ |
| KVLEXAMPLE5 | 01/01/2011 | 00063 | HEC-1 Tutorial - Clark Unit Hydrograph | _ |
| KVLEXAMPLE5_TEST | 03/26/2018 | 00083 | HEC-1 Tutorial - Clark Unit Hydrograph | - |
| • | | | | • |

3.0 ENTER INITIAL NSTPS VALUES

Go to the Routing Menu ('*Hydrology* → *HEC-1* → *Routing*').

| KVL Co | nsultants, Inc KVLEX | |
|-----------|---------------------------|--|
| File Edit | Hydrology Hydraulics | River Mechanics Maps Tools Admin Submittals Help |
| 00 | <u>R</u> ainfall | |
| | Soils | |
| | Soil <u>D</u> efaults | |
| | Land Use | |
| | Land <u>U</u> se Defaults | |
| | Major Basins | |
| | Sub <u>B</u> asins | |
| | Manual S- <u>G</u> raph | |
| | HEC-1 | ▶ <u>M</u> odel |
| | Land Use Impacts | <u>N</u> etwork |
| | | Data |
| | | Import HEC-1 File |
| | | Elow Summary |
| | | Import Runoff Summary |
| | | View Output |
| | | Schematic |
| | | Graphs |
| | | Graph <u>H</u> ydrographs |
| | | Diversions |
| | | Routing |

On the **HEC-1 ROUTING DATA** form, check the custom check boxes to the right of the '**Steps**' field for all the return periods. This allows you to enter an initial step value into the current routing card. Enter initial step values into the '**Steps**' field. Now, uncheck the custom check boxes and press '**Save'**. Repeat for every routing card or record. When finished, press '**OK**' to close the **HEC-1 ROUTING DATA** form.

| Look for Route D10105 Normal Depth 010110 < | HEC-1 Ro | outing Data - MB: 01 | | | | | | | | | • 🛛 |
|---|----------------|----------------------|---|---------|--------------------------|----------------|--------|-------|----------|---|-----|
| Station Elevation Model NSTPS Custon LOB N 0.035 1 510.0 99.70 2 Year V 1 Chan N 0.038 2 1510.0 94.10 5 Year V 1 1 ROB N 0.035 LB 1585.0 93.60 10 Year V 1 1 Length 4224.0 4. 1596.0 92.20 25 Year V 1 1 Slope 0.0012 5 1600.0 92.20 50 Year V 1 1 Max Elev 99.70 RB 1612.0 93.60 100 Year V 1 1 Robustor R2262.0 99.70 0 100 Year V 1 1 | ID 🔺 010105 | Type Normal Depth | | Major E | Basin ID 0 Route ID 0 | 10105 IORMA | | | | | |
| Chan N 0.038 2. 1510.0 94.10 5 Year V 1 N 0.035 LB 1585.0 93.60 10 Year V 1 Length 4224.0 4. 1596.0 92.20 25 Year V 1 Slope 0.0012 5. 1600.0 92.20 25 Year V 1 Max Elev 99.70 RB 1612.0 93.60 100 Year V 1 7. 1662.0 94.90 Custom 2 8 2262.0 99.70 1 | | | _ | | |]]] | | | Model | | |
| Length 4224.0 4. 1596.0 92.20 25 Year ♥ 1 Slope 0.0012 5. 1600.0 92.20 50 Year ♥ 1 Max Elev 99.70 RB 1612.0 93.60 100 Year ♥ 1 7. 1662.0 94.90 Custom 8 2262.0 99.70 | | | - | Chan N | 0.038 | 2. | 1510.0 | 94.10 | 5 Year 🔽 | 1 | |
| ▲ Max Elev 99.70 RB 1612.0 93.60 100 Year ✓ 1 7. 1662.0 94.90 Custom 8 2262.0 99.70 | | | _ | | | | | | | | |
| 7. 1662.0 94.90 Custom | | | * | | | - | | | | | |
| LEGER Undate NSTRE from HEC 1 | | | | | | - | | | | | |
| | | | - | Allaf | | | | | | | |

4.0 UPDATE THE MODEL

On the **HEC-1 DATA** form (*'Hydrology* → *HEC-1* → *Data'*), press the *'Update'* button.

| | | | <u>L</u> ist | | | | | | De | tails | | | |
|---------|--------|----------|--------------|----------|----------|----------|--------|-------|-------|-------|------|--------------------|-----|
| Fin | d Nex | + | | | | 1 | | | | - | | | |
| F0 | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | Sort | Special Code ID | 4 |
| ID | | KVL Cons | ultants, | Inc. | | | | | | | 10 | | [|
| ID | | VLEXAMP | LE1 - Ex | ample 1 | HEC-1 tu | torial p | roject | | | | 20 | | ſ |
| ID | | 100 YEAR | | | | | | | | | 30 | | ſ |
| ID | | 6 Hour | Storm | | | | | | | | 40 | | ſ |
| ID | | Unit Hyd | rograph: | Clark | | | | | | | 50 | | ſ |
| ID | | Storm: M | ultiple | | | | | | | | 60 | | ſ |
| ID | | 08/31/20 | 13 | | | | | | | | 70 | | ſ |
| ID | | This is | the HEC- | 1 tutori | al progr | am examp | le. | | | | 80 | | ſ |
| *D | IAGRAM | | | | | | | | | | 90 | | ſ |
| IT | 5 | 1JAN99 | 0 | 2000 | | | | | | | 100 | | ľ |
| 10 | 5 | | | | | | | | | | 110 | | ľ |
| IN | 15 | | | | | | | | | | 120 | | ľ |
| * | | | | | | | | | | | 130 | | |
| JD | 3.250 | 0.0001 | | | | | | | | | 140 | | ſ |
| PC | 0.000 | 0.008 | 0.016 | 0.025 | 0.033 | 0.041 | 0.050 | 0.058 | 0.066 | 0.074 | 150 | | ſ |
| PC ∢ | 0.087 | 0.099 | 0.118 | 0.138 | 0.216 | 0.377 | 0.834 | 0.911 | 0.931 | 0.950 | 160 | 4 | 1 - |
| | | | | | | | | | | | | | |

On the UPDATE HEC-1 DATA form, press 'Yes' to continue.



Select a return period. Press the 'OK' button for DDMSW to update the HEC-1

model with the latest parameters from the data entry menus, including the initial routing NSTPS values. Press '**OK**' to close the **HEC-1 DATA** form.

| _ | F2 KVL Cons (VLEXAMP 10 YEAR 6 Hour Unit Hyd Storm: M 08/31/20 | List F3 ultants, LE1 - Ex Storm rograph: ultiple 13 | F4 Inc. ample 1 Clark | F5 HEC-1 tu | F6 torial p | F7 roject | F8 | F9 | Ptails F10 | 10 20 30 | Special Code ID | |
|--|---|--|--------------------------------|----------------|----------------|--------------|-------|-------|---------------|----------------|--------------------|-----|
| ID F1 | F2 KVL Cons (VLEXAMP 10 YEAR 6 Hour Unit Hyd Storm: M 08/31/20 | ultants, LE1 - Ex Storm rograph: ultiple | Inc. ample 1 | | | | F8 | F9 | F10 | 10 20 30 | | Į |
| ID ID ID ID ID ID ID ID ID ID ID | KVL Cons VLEXAMP 10 YEAR 6 Hour Unit Hyd Storm: M 08/31/20 | ultants, LE1 - Ex Storm rograph: ultiple | Inc. ample 1 | | | | F8 | F9 | F10 | 10 20 30 | | Į |
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| ID ID ID ID ID ID | 10 YEAR 6 Hour Unit Hyd Storm: M 08/31/20 | Storm rograph: ultiple | | HEC-1 tu | torial p | roject | | | | 30 | | Ī |
| ID ID ID ID ID | 6 Hour Unit Hyd Storm: M 08/31/20 | rograph: ultiple | Clark | | | | | | | | | |
| ID ID ID ID | Unit Hyd Storm: M 08/31/20 | rograph: ultiple | Clark | | | | | | | | | |
| ID ID ID | Storm: M 08/31/20 | ultiple | Clark | | | | | | | 40 | | Ť |
| ID ID | 08/31/20 | | | | | | | | | 50 | | Ť |
| ID | | 13 | | | | | | | | 60 | | Ť |
| | | | | | | | | | | 70 | | Ť |
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| | | | | | | | | | | 90 | | Ť |
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| 10 5 | | | | | | | | | | | | 1 |
| IN 15 | | | | | | | | | | 120 | | Î. |
| * | | | | | | | | | | 130 | | Ť |
| ID 2.050 | 0.0001 | | | | | | | | | 140 | | t |
| PC 0.000 | 0.008 | 0.016 | 0.025 | 0.033 | 0.041 | 0.050 | 0.058 | 0.066 | 0.074 | 150 | | Ť |
| 0.087 | 0.099 | 0.118 | 0.138 | 0.216 | 0.377 | 0.834 | 0.911 | 0.931 | 0.950 | 160 | + | † • |

5.0 EXECUTE PROGRAM TO EVALUATE NSTPS VALUES

On the **HEC-1 ROUTING DATA** form ('Hydrology → HEC-1 → Routing'), click the "Update Steps from HEC-1' button.

| Loo | k for | | ⊂ Route | | | | | | | |
|--------|--------------|-----|----------------|-----------|-------|----------|-----------|--------------|---------|------|
| ID 🔺 | Туре | | Major B | asin ID 0 | 1 | | | | | |
| 010105 | Normal Depth | _ | | | 10105 | | | | | |
| 010110 | Normal Depth | _ | | | | | | | | |
| | | - 1 | | Type N | ORM/ | L DEPTH | | | | |
| | | - 1 | | | Chan | nel Loss | | | | |
| | | - 1 | | | | | | | | |
| | | | ⊺ Normal I | Donth | | | | | | |
| | | - 1 | Norman | behn | | Station | Elevation | Model NS | TDO C | tor |
| | | - 1 | LOBN | 0.035 | 1. | 510.0 | 99.70 | 2 Year 🔽 | 1 | |
| | | - 1 | Chan N | 0.038 | 2. | 1510.0 | 94.10 | 5 Year 🗸 | 1 | |
| | | | ROBN | | LB | | | | | |
| | | | | 0.035 | | 1585.0 | 93.60 | 10 Year 🔽 | 1 | |
| | | | Length | 4224.0 | 4. | 1596.0 | 92.20 | 25 Year 🔽 | 1 | |
| | | | Slope | 0.0012 | 5. | 1600.0 | 92.20 | 50 Year 🔽 | 1 | |
| | | | Max Elev | 99.70 | RB | 1612.0 | 93.60 | 100 Year 🔽 | 1 | |
| | | | | | 7. | 1662.0 | 94.90 | Custom 📃 | | |
| | | | | | 8. | 2262.0 | 99.70 | Update NSTPS | from U | EC 4 |
| | | - | | | | | | update NSTPS | ITOIN H | |

A pop-up message will appear stating that HEC-1 will run 3 times for each of the selected return periods. This will update the NSTPS routing values, only if the custom checkbox is unchecked. Press '**Yes'** to continue.

| Update Ro | uting NSTPS for Selected Return Periods |
|-----------|--|
| i | This will run the HEC-1 model 3 times for each of the selected Return Periods and update NSTPS routing values for records where Custom IS NOT Checked. Do you want to continue? |
| | Yes No |

After the last HEC-1 run is completed, the NSTPS values for the routing cards will be updated. Press **'OK'** to close the **HEC-1 ROUTING DATA** form.

| HEC-1 Ro | uting Data - MB: 01 | | | | | | | [| | |
|----------------|----------------------|---|---------------|------------|----------|----------------|----------------|------------|--------------|--------------|
| Lool | k for | | Route | | | | | | | |
| ID ▲ 010105 | Type Normal Depth | ^ | Major E | Basin ID 0 | 1 | 2 | | | | |
| 010110 | Normal Depth | | R | | 10105 | | | | | |
| | | - | | Type 1 | | L DEPTH | | | | |
| | | _ | | | Chan | nel Loss | | | | |
| | | - | | | | | | | | |
| | | _ | Normal | Depth — | | | | NSTPS | | |
| | | | | | _ | Station | Elevation | Model N | <u>ISTPS</u> | Custom |
| | | | LOB N | 0.035 | 1. | 510.0 | 99.70 | 2 Year 🔽 | 8 | |
| | | - | Chan N | 0.038 | 2. | 1510.0 | 94.10 | 5 Year 🔽 | 6 | |
| | | - | ROB N | 0.035 | LB | 1585.0 | 93.60 | 10 Year 🔽 | 6 | |
| | | | Length | 4224.0 | 4. | 1596.0 | 92.20 | 25 Year 📝 | 5 | |
| | | | Slope | 0.0012 | 5. | 1600.0 | 92.20 | 50 Year 🔽 | 5 | |
| | | | Max Elev | 99.70 | RB | 1612.0 | 93.60 | 100 Year 📝 | 5 | |
| | | | | | 7. | 1662.0 | 94.90 | Custom 📃 | | |
| | | | | | 8. | 2262.0 | 99.70 | Update NST | PS from H | EC-1 |
| | | Ŧ | | | _ | | | | | |
| | | | <u>Øl</u> nfo | Cop | <u>y</u> | P <u>r</u> int | <u>D</u> elete | Add MB | | <u>о</u> к : |

6.0 RUN THE MODEL

After all the NSTPS values have been determined and accepted, you can run the HEC-1 model to obtain your model results.

To run the model, open the **Run HEC-1 ModeL** form ('*Hydrology* → *HEC-1* → *Model*') and check the following checkboxes: All the events in the '*Return*

Period', the '*Update HEC-1*' checkbox, and the '*Delete Prior Results*' checkbox. Finally, click the '*Run Model'* button to execute the program.

| Run HEC-1 Model - MB: 01 | |
|--|---|
| Return Period ↓ 2 Year ↓ 5 Year ↓ 10 Year ↓ 25 Year ↓ 50 Year ↓ 100 Year | Options Multiple Basins Major Basin 01 ✓ Update HEC-1 ✓ Delete Prior Results □ Select Custom Folder ─ Update Conveyance Flows |
| <u> Info</u> <u>S</u> chematic | O <u>u</u> tput <u>R</u> esults Run <u>M</u> odel <u>O</u> K |
| | ii. |

Click 'Yes' twice to continue.



Afterwards, you can view the model results by clicking the '*Results*' button on the Run HEC-1 Model form. Alternatively, you can also view the results from '*Hydrology* \rightarrow HEC-1 \rightarrow Flow Summary'.

| | ook for | | | | | | | | | _ |
|--------|---------|------------|-------|------|------|-------|-------|-------|--------|----|
| ID | Sort 🔺 | Туре | Area | 2 Yr | 5 Yr | 10 Yr | 25 Yr | 50 Yr | 100 Yr | · |
| 010105 | 10 | Hydrograph | 6.69 | 1742 | 3314 | 4520 | 6166 | 7445 | 8650 | |
| DT0105 | 20 | Diversion | 6.69 | 610 | 1160 | 1582 | 2158 | 2606 | 3028 | |
| 010105 | 30 | Hydrograph | 6.69 | 1132 | 2154 | 2938 | 4008 | 4839 | 5623 | _ |
| 010105 | 40 | Routed | 6.69 | 680 | 1426 | 2001 | 2803 | 3459 | 4094 | |
| 010110 | 50 | Hydrograph | 5.70 | 2631 | 4025 | 5051 | 6465 | 7569 | 8621 | |
| 010105 | 60 | Hydrograph | 6.69 | 610 | 1160 | 1582 | 2158 | 2606 | 3028 | _ |
| 010105 | 70 | Combined | 12.39 | 3171 | 5374 | 7100 | 9477 | 11355 | 13155 | |
| 010110 | 80 | Routed | 12.39 | 2033 | 3760 | 5078 | 6897 | 8393 | 9827 | |
| HYD001 | 90 | Hydrograph | 3.76 | 1941 | 2718 | 3883 | 5047 | 5824 | 7765 | |
| HYD001 | 100 | Combined | 16.15 | 2032 | 3760 | 5078 | 6895 | 8393 | 9820 | |
| ST0115 | 110 | Routed | 16.15 | 895 | 1196 | 1492 | 1867 | 2157 | 2545 | |
| | | | | | | | | | | - |
| | | | | | | | | | | _ |
| | | | | | | | | | | - |
| | | | | | | | | | | |
| • | 1 | III | | 1 | | 1 | 1 | 1 | 1 | ÷. |

7.0 Notes

- A. When you check the 'Custom' checkbox (3rd column) next to the 'Steps' field on the HEC-1 ROUTING DATA form ('Hydrology → HEC-1 → Routing'), the program will lock the entered values so they could not be changed even when the 'Update Steps from HEC-1' button is pressed. Only the ones that are unchecked will be updated by the program.
- B. If you receive 'Output file not found' messages after pressing the 'Update Steps from HEC-1' button, while on the HEC-1 ROUTING DATA form, check the model runs path ('File → Project Paths → Model Runs Path') to ensure that you have set the path for the project; otherwise, define the Model Runs Path by using the ellipse (...) button on the right side of the Model Runs Path textbox.
- C. To ensure that NSTPS values have reached stability, the tool may have to be executed more than once. To run the tool for the second or the third time, press the 'Update Steps from HEC-1' button after the first or second execution.
- D. Selecting the 'Custom' checkbox, under the 'Model' column (1st column) in the 'Steps' data group, will default the tool to run only for the '100 Year' event.