HEFS

Graphics Generator Product Installation Guide

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Change History

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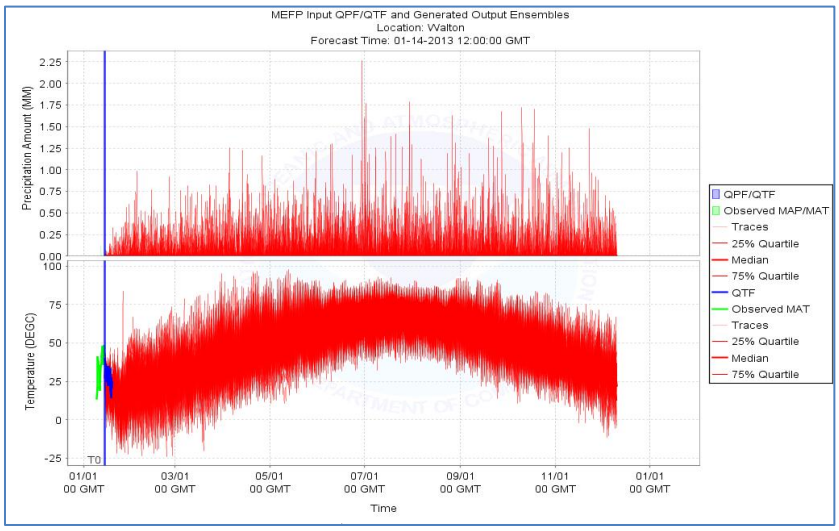
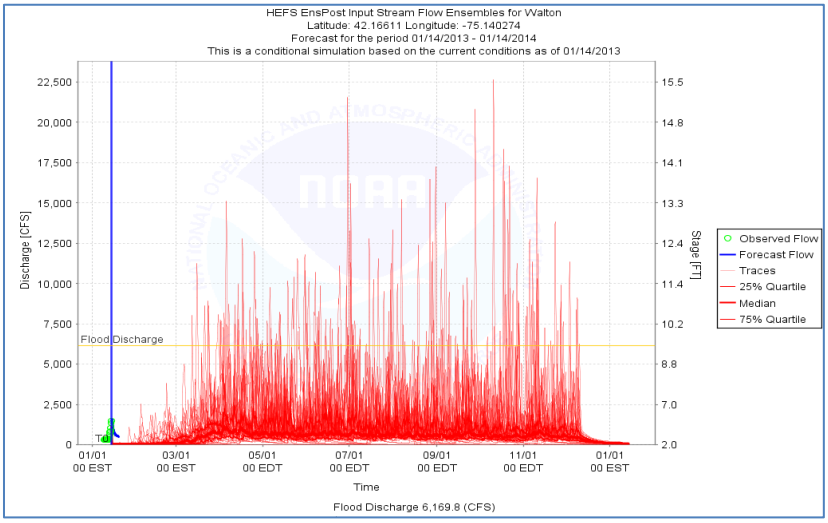
1 Overview

Delivered with the HEFS release of the MEFP and HEFS EnsPost software are pre-configured Graphics Generator products designed to display the following (a screen capture is included for each product):

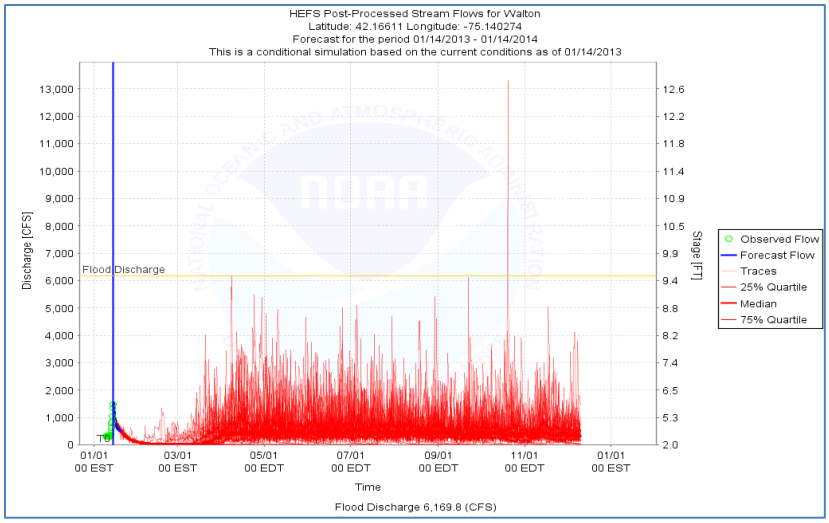
- *MEFP Results*: MEFP generated forecast ensembles of 6-hour FMAP and FMAT time series.



- *HEFS EnsPost Input*: Streamflow ensembles that are input to the HEFS EnsPost. If HEFS EnsPost is not used, the products can be used to display any streamflow ensemble. Also displayed is an observed time series and single-valued (operational) forecast time series.



- *HEFS EnsPost Output*: Streamflow ensembles that are post-processed and output by the HEFS EnsPost. Also displayed is an observed time series and single-valued (operational) forecast time series.



Installing the Graphics Generator HEFS products requires adding and updating FEWS configuration files, and using the FEWS GUI to finalize changes and verify the installation is successful. This guide provides instructions for the following:

- Installing the products for display in the CHPS interface
- Setting up automated workflows for outputting the HEFS products to files
- Adding MEFP Results products for additional catchments
- Turning off products for HEFS components that are not used

The instructions provided below refer to the *Graphics Generator Installation Guide* and *Graphics Generator AHPS Products Installation Guide* as needed. They can be acquired with the latest release of CHPS. Be sure to have a copy on hand when following the instructions below.

In cases where a configuration file is new and generic (valid for all RFCs), the file is included in the release-package and added directly to the configuration. For cases where a configuration change contains text that is specific to an RFC (new or existing file) a description of the text and/or a sample file is provided.

1.1 *Notation*

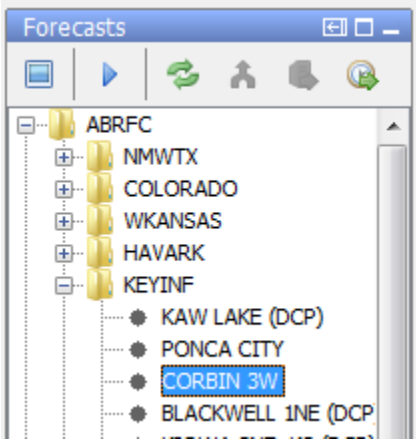
Within this document, the following notation is used:

- All graphical interface components are **Capitalized and in Bold**.
- All XML snippets are in this font.
- All command line entries are in this font.

- All important terms defined in Section 1.2 are *italicized* throughout the document.

1.2 *Terminology*

- *active forecast segment*: The current active segment, as selected in the **Forecasts Panel** of the CHPS interface and identified by the segment id set in the configuration file <*configuration file*>/RegionConfigFiles/Topology.xml. For example, for ABRFC, the active forecast segment in this case is CBNK1 (Corbin 3W):



- *identity mapping*: An id-mapping that maps one locationId onto itself; for example

  <location external="WALN6DEL" internal="WALN6DEL"/>

  Such mappings may be necessary for Graphics Generator to acquire needed time series; see Section 2.4.2.
- *installation stand-alone*: The stand-alone in which Graphics Generator will be installed, setup in Step 1.4.
- *installation segments*: The ids of the segments for which HEFS is to execute and products are to be generated.
- *thresholdId*: Short-hand for the levelThresholdId defined for a threshold value in <*configuration_dir*>/RegionConfigFiles/ThresholdValueSets.xml.

1.3 *Directories of Note*

The following directories will be referred to in the instructions provided below:

- <*region_dir*>: The *installation stand-alone* region home directory, typically "##rfc_sa".
- <*configuration_dir*>: The stand-alone Config directory, typically <*region_dir*>/Config.
- <*tar_root_dir*>: The directory where the HEFS release package was untarred.

- <*products_dir*>: The directory selected to hold HEFS products output by Graphics Generator, including image files, during testing in the *installation stand-alone*; see Section 2.2.

1.4 *Pre-installation Steps*

1. Acquire the *Graphics Generator Installation Guide*, *Graphics Generator AHPS Products Installation Guide*, and *Graphics Generator Tips and Troubleshooting Guide* from the most recent CHPS release.

2. Install the HEFS release as described in the *HEFS Install Notes*, if not already installed.

3. Create an *installation stand-alone* for initial installation of the HEFS Graphics Generator products. It should be created from an operational stand-alone that includes all desired HEFS components, MEFP and/or EnsPost, configured for the *installation segments*. In addition to HEFS components, the stand-alone must include:

   - Graphics Generator components configured to appear in the CHPS interface. See the *Graphics Generator Installation Guide*.
   - A localDataStore containing data necessary for the products to display. If the HEFS Graphics Generator products for the MEFP, MEFP-based streamflow forecasts, and/or EnsPost are to be displayed, then the localDataStore must contain, respectively, MEFP generated forecast ensembles, MEFP-based generated streamflow ensembles, and/or EnsPost post-processed streamflow ensembles.

   Configuration changes made here will later be ported to an OC for synchronization to the central server, but only after installation is successful on a stand-alone.

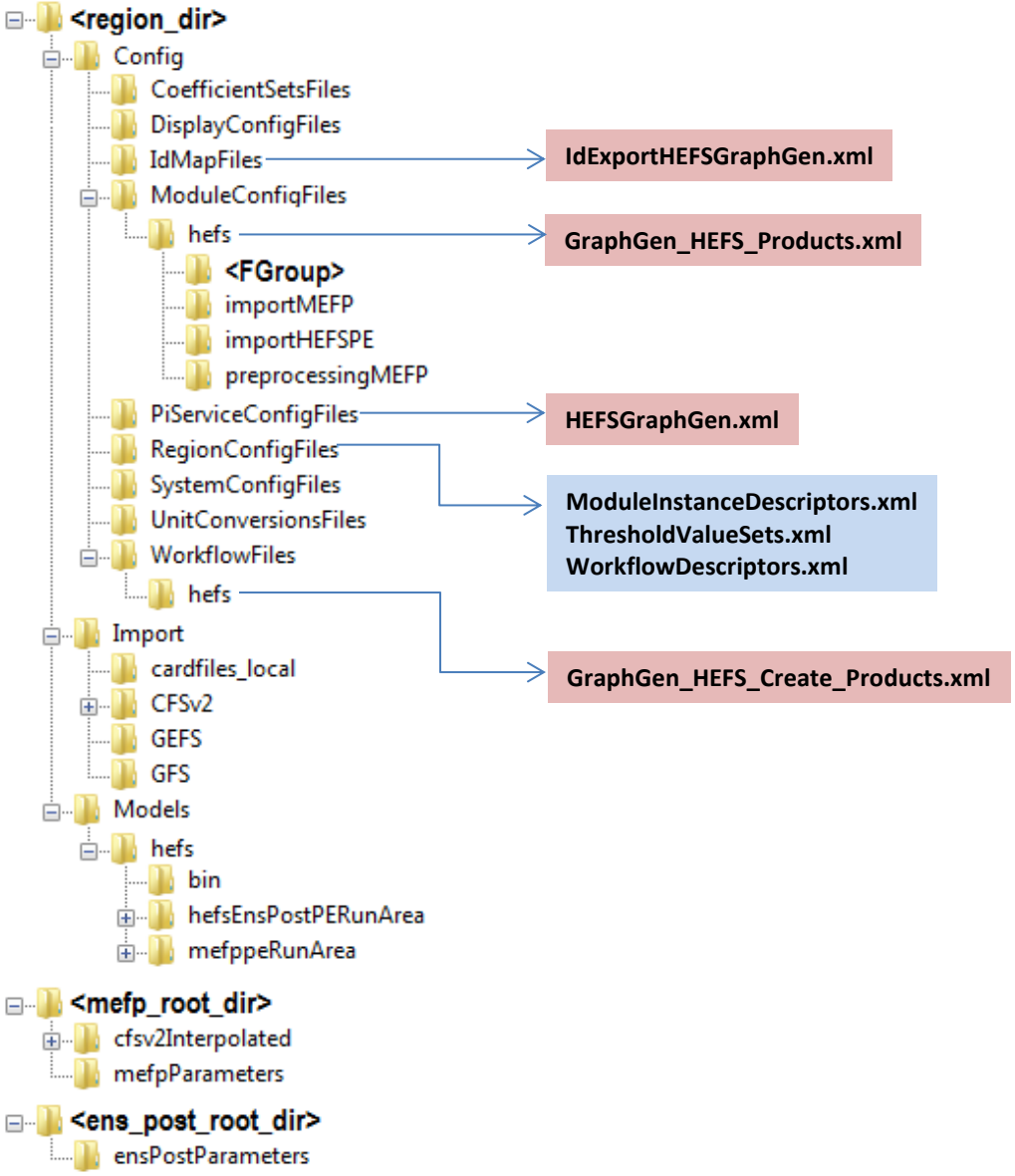
1.5 *Affected Configuration Files*

The diagram in Figure 1 summarizes all configuration files created or modified by the installation steps provided in this document. The directory structure shown includes all directories affected by any HEFS component. Files with a light red background are new for this release, while those with a light blue background are specific to each RFC and require editing. Note the following:

- The directory "**<FGroup>**" was renamed during installation of the MEFP data ingest components to match the first forecast group for which MEFP will execute.
- The directory corresponding to **<mefp_root_dir>** is used by the MEFP and MEFPPE and will not be used herein.
- The directory corresponding to **<ens_post_root_dir>** is used by the EnsPost and EnsPostPE application and will not be used herein.

- The directories shown under **<region_dir>**/Import were created during installation of the HEFS components and will not be used herein.

Figure 1: Configuration files created or modified during installation.



2 Configuring HEFS Products

This section provides general instructions for installing HEFS products provided in this release.

2.1 *Copy New Files and Directories (Required)*

Action: Execute the following command to copy *all* new files and directories that are necessary for generating the HEFS products into the *installation stand-alone* directory structure

```
cd <tar_root_dir>/graphgen
cp –r Config <region_dir>/.
```

2.2 *Create Installation <products_dir> (Required)*

Action: Create the installation testing HEFS products directory:

```
mkdir <region_dir>/Export/products
```

Description: The directory created above will store Graphics Generator generated products created during testing within the *installation stand-alone*. It is referred to below as *<products_dir>*.

2.3 *Modify SA Global Properties (Required)*

Action: Modify the file

<region_dir>/sa_global.properties

Add the following properties:

```
HEFS_PRODUCTS_DIR=%REGION_HOME%/Export/products
```

2.4 *Configuration File Changes*

Described below are changes that must be made to the configuration files in order for the Graphics Generator HEFS products to be generated.

2.4.1 Modify File Added in Step 2.1: HEFSGraphGen.xml (Required)

Action: Modify the PI-service queries (if needed) defined in the file

<*configuration_dir*>/PiServiceConfigFiles/HEFSGraphGen.xml

so that the ensembles used to generate the HEFS graphics generator products can be acquired via the FEWS PI-service. The default file contents are provided below.

Description: The HEFS products are constructed using time series and ensembles returned by the following queries defined in HEFSGraphGen.xml (listed by their <id> XML element):

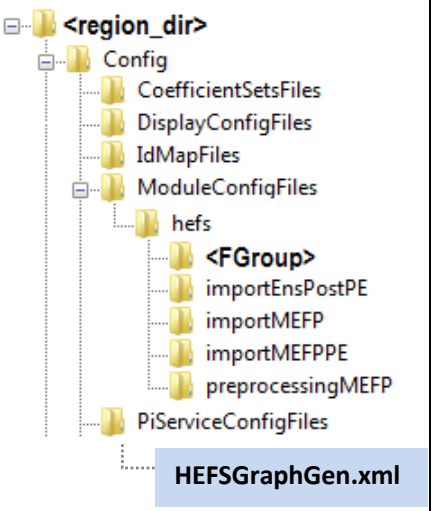
TIPS (read these before proceeding):

- The query id below is the value of the id XML element within the timeSeries XML element defined within the HEFSGraphGen.xml file.
- Location sets "Catchments_HEFS" and "Gages_HEFS" mentioned below should have been defined when configuring MEFP and EnsPost. See the *MEFP Configuration Guide: Data Ingest* and *EnsPostPE Configuration Guide*, respectively. It may be necessary to copy the definition of the Gages_HEFS location set from the *parameter estimation standalone* used in configuring the EnsPostPE to the *installation standalone* used here.
- Module instance sets "EnsPost_Input" and "EnsPost_Output" mentioned below should have been defined when configuring the EnsPost. See the *EnsPost Configuration Guide*.
- All queries for observed data are optional and should be included only if a frame of reference is desired and an appropriate time series exists.
- If the RFC QPF or RFC QTF forecast sources are used, then the queries with ids "MEFP QPF INPUT" and "MEFP QTF INPUT" should be specified appropriately (see below). If not, then they are optional and should be defined only if an appropriate time series exists and if the user would like to see QPF and QTF as a frame of reference when display MEFP output.
- It may be necessary in some cases to define multiple timeSeriesSet XML elements within the timeSeries XML elements specifying the PI-service queries. This is always true if a query must return time series for multiple parameters, such as SQIN and QINE for streamflow queries, or must return time series with different time steps (such as 6-hour and 1-hour time steps). See Sections 2.1.1 and 2.1.2 of the *Graphics Generator Tips and Troubleshooting Guide* for tips related to including multiple timeSeriesSet XML elements inside a single query and making use of module instance sets and location sets, if additional sets are needed.
- Note the locationIds of the time series returned within the four "FLOW" queries. If the locationIds are not identical to the segment ids of the segments involved, then an id-mapping (see Section 2.4.2 for specific condition) or modifying the defaultLocationId setting (see Section 2.5) may be needed.
- Forecast (simulated forecasting) time series can only be acquired from the FEWS PI-service if the workflow that generates the time series is approved.

Query Id	Recommended Value	Description

MEFP OBS PRECIP TS	RFC-specific. May be able to use the output from a MergeMAP or MergeMAPX module.	Observed precipitation (MAP) data that is displayed on the MEFP Results product as a reference. May make use of location set "Catchments_HEFS". This time series is optional, but recommended.
MEFP QPF INPUT	RFC-specific. If RFC QPF forecast source is used, should be set to the RFC time series exported for use as input to MEFP within the module configuration file <*fgroup*>_MEFP_FMAP_Forecast.xml. See *MEFP Configuration Guide: Forecast Components*.	Forecast precipitation (FMAP) data that is displayed on the MEFP Results product as a reference. May make use of location set "Catchments_HEFS". This time series is optional, but should be included if the MEFP is executed using the RFC QPF as a forecast source.
MEFP OBS TEMP TS	RFC-specific. May be able to use the output from a MergeMAT.	Observed temperature (MAT) data that is displayed on the MEFP Results product as a reference. May make use of location set "Catchments_HEFS". This time series is optional, but recommended.
MEFP QTF INPUT	RFC-specific. If RFC QTF forecast source is used, should be set to FMAT specified as input to the transformation module configuration file MEFP_RFC_MAT_6to24.xml. See the *MEFP Configuration Guide: Forecast Components*.	Forecast temperature (FMAT) data that is displayed on the MEFP Results product as a reference. May make use of location set "Catchments_HEFS". This time series is optional, but should be included if the MEFP is executed using the RFC QTF as a forecast source.
MEFP MAP RAW OUTPUT	See the value used in the delivered HEFSGraphGen.xml file.	<u>Do not modify the default timeSeriesSet provided in the delivered HEFSGraphGen.xml.</u> The 6-hour FMAP forecast ensemble output by the MEFP.
MEFP MAT RAW OUTPUT	See the value used in the delivered HEFSGraphGen.xml file.	<u>Do not modify the default timeSeriesSet provided in the delivered HEFSGraphGen.xml.</u> The 6-hour FMAT forecast ensemble output by transforming defined in the module configuration file MEFP_FMAT_Forecast.xml.
OBSERVED FLOW	RFC-specific.	Observed streamflow that corresponds to the time series specified for OPERATIONAL FLOW OUTPUT, below (i.e., has the same time step and units). May make use of location set "Gages_HEFS". May use a module instance set, or require creating a new one. This will <u>not necessarily</u> be the observed streamflow defined as the first timeSeriesSet specified in the exportTimeSeriesActivity within the EnsPost module configuration
OPERATIONAL FLOW FORECAST	RFC-specific. Same as the <u>ensemble</u> (second) timeSeriesSet specified in the exportTimeSeriesActivity within the EnsPost module configuration file but using the ensembleId "main".	The single-valued, operational forecast or simulation corresponding to the ensemble that is input to EnsPost. Should make use of the module instance set "EnsPost_Input" and location set "Gages_HEFS".

FLOW RAW OUTPUT	RFC-specific. Same as the ensemble (second) timeSeriesSet specified in the exportTimeSeriesActivity within the EnsPost module configuration file, which should use ensembleId "MEFP".	The ensemble that is to be post-processed by EnsPost. Should make use of the module instance set "EnsPost_Input" and location set "Gages_HEFS". May require defining new location set if the existing one does not specify the correct locationIds.
FLOW ENSPOST OUTPUT	The same timeSeriesSet specified in the importTimeSeriesActivity within the EnsPost module configuration file, but read only.	The ensemble that is output from EnsPost. Should make use of the module instance set "EnsPost_Output" and location set "Gages_HEFS". May require defining new location set if the existing one does not specify the correct locationIds.

Standard Location: *<configuration_dir>*/**PiServiceConfigFiles/**	**Contents:** ***HEFSGraphGen.xml***
	<?xml version="1.0" encoding="UTF-8"?> <fewsPiServiceConfig xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.wldelft.nl/fews http://fews.wldelft.nl/schemas/version1.0/fewsPiServiceConfig.xsd"> <general> <exportIdMap>IdExportHEFSGraphGen</exportIdMap> </general> <!-- Most queries used by the HEFS Graphics Generator products are configured in this file. The only queries not configured herein are contained within the standard PI-service configuration file delivered with Graphics Generator and used for the AHPS products: GraphGen.xml.--> <!-- Returns the observed precipitation as a frame of reference for the output from MEFP --> <timeSeries> <id>MEFP OBS PRECIP TS</id> <timeSeriesSet> <moduleInstanceSetId>SNOW17_Forecast</moduleInstanceSetId> <valueType>scalar</valueType> <parameterId>RAIM</parameterId> <locationSetId>Catchments_HEFS</locationSetId> <timeSeriesType>simulated forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <relativeViewPeriod unit="hour" start="-240" startOverrulable="true" end="0"/> <readWriteMode>read only</readWriteMode> <ensembleId>QPF</ensembleId> <ensembleMemberIndex>1</ensembleMemberIndex> </timeSeriesSet> </timeSeries> <!-- Returns the forecast precipitation that is input to the MEFP for operational runs (the RFC QPF/QTF forecast source). --> <timeSeries> <id>MEFP QPF INPUT</id> <timeSeriesSet>

Standard Location: <*configuration_dir*>**/PiServiceConfigFiles/**	**Contents:** ***HEFSGraphGen.xml***
	<moduleInstanceId>ABRFC_QPF_TS_PreProcessing_Forecast</moduleInstanceId> <valueType>scalar</valueType> <parameterId>FMAP</parameterId> <qualifierId>QPF12</qualifierId> <locationSetId>Catchments_HEFS</locationSetId> <timeSeriesType>simulated forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <relativeViewPeriod unit="hour" start="0" startOverrulable="true" end="240" endOverrulable="true"/> <readWriteMode>read only</readWriteMode> <ensembleId>main</ensembleId> </timeSeriesSet> </timeSeries> <!-- Returns the observed temperature as a frame of reference for the output from MEFP --> <timeSeries> <id>MEFP OBS TEMP TS</id> <timeSeriesSet> <moduleInstanceId>MAT_PreProcessing_QTE</moduleInstanceId> <valueType>scalar</valueType> <parameterId>MAT</parameterId> <locationSetId>Catchments_HEFS</locationSetId> <timeSeriesType>external historical</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <relativeViewPeriod unit="hour" start="-240" startOverrulable="true" end="0"/> <readWriteMode>read only</readWriteMode> <ensembleId>main</ensembleId> </timeSeriesSet> </timeSeries> <!-- Returns the forecast temperature that is input to the MEFP for operational runs (the RFC QPF/QTF forecast source). --> <timeSeries> <id>MEFP QTF INPUT</id> <timeSeriesSet> <moduleInstanceId>FMAT_PreProcessing_QTF</moduleInstanceId> <valueType>scalar</valueType> <parameterId>FMAT</parameterId> <locationSetId>Catchments_HEFS</locationSetId> <timeSeriesType>external forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <relativeViewPeriod unit="hour" start="0" startOverrulable="true" end="240" endOverrulable="true"/> <readWriteMode>read only</readWriteMode> <ensembleId>main</ensembleId> </timeSeriesSet> </timeSeries> <!-- Returns the precipitation ensemble output by the MEFP. --> <timeSeries>

Standard Location: <*configuration_dir*>**/PiServiceConfigFiles/**	**Contents:** ***HEFSGraphGen.xml***

```
      <id>MEFP MAP RAW OUTPUT</id>
      <timeSeriesSet>
         <moduleInstanceSetId>ALL_MEFP_Forecasts</moduleInstanceSetId>
         <valueType>scalar</valueType>
         <parameterId>FMAP</parameterId>
         <locationSetId>Catchments_HEFS</locationSetId>
         <timeSeriesType>external forecasting</timeSeriesType>
         <timeStep unit="hour" multiplier="6"/>
         <readWriteMode>read only</readWriteMode>
         <ensembleId>MEFP</ensembleId>
      </timeSeriesSet>
   </timeSeries>

   <!-- Returns the temperature ensemble output by the MEFP. -->
   <timeSeries>
      <id>MEFP MAT RAW OUTPUT</id>
      <timeSeriesSet>
         <moduleInstanceSetId>ALL_MEFP_Forecasts</moduleInstanceSetId>
         <valueType>scalar</valueType>
         <parameterId>FMAT</parameterId>
         <locationSetId>Catchments_HEFS</locationSetId>
         <timeSeriesType>external forecasting</timeSeriesType>
         <timeStep unit="hour" multiplier="6"/>
         <readWriteMode>read only</readWriteMode>
         <ensembleId>MEFP</ensembleId>
      </timeSeriesSet>
   </timeSeries>

   <!-- Returns the observed time series that
       corresponds to the OPERATIONAL FLOW TS specified
       below.  If no such observed time series exist,
       leave this unchanged, but note that the observed
       time series will not be displayed on streamflow
       products and a warning message will be generated.-->
   <timeSeries>
      <id>OBSERVED FLOW</id>
      <timeSeriesSet>
         <moduleInstanceSetId>EnsPost_Input</moduleInstanceSetId>
         <valueType>scalar</valueType>
         <parameterId>QINE</parameterId>
         <locationSetId>Gages_HEFS</locationSetId>
         <timeSeriesType>simulated forecasting</timeSeriesType>
         <timeStep unit="hour" multiplier="6"/>
         <readWriteMode>read only</readWriteMode>
         <ensembleId>main</ensembleId>
       </timeSeriesSet>
   </timeSeries>

   <!-- Returns the operational (single-valued) forecast
       or simulated time series that corresponds to the
       FLOW RAW OUTPUT below.  This should use the same
       timeSeriesSet as FLOW RAW OUTPUT, but with
       ensembleId "main".-->
   <timeSeries>
```

Standard Location: <*configuration_dir*>**/PiServiceConfigFiles/**	**Contents:** ***HEFSGraphGen.xml***
	<id>OPERATIONAL FLOW OUTPUT</id> <timeSeriesSet> <moduleInstanceSetId>EnsPost_Input</moduleInstanceSetId> <valueType>scalar</valueType> <parameterId>QINE</parameterId> <locationSetId>Gages_HEFS</locationSetId> <timeSeriesType>simulated forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <readWriteMode>read only</readWriteMode> <ensembleId>main</ensembleId> </timeSeriesSet> </timeSeries> <!-- Returns the flow ensemble before ensemble post-processing. If the post-processor is not applied, this can be any flow ensemble you wish to display in the product. --> <timeSeries> <id>FLOW RAW OUTPUT</id> <timeSeriesSet> <moduleInstanceSetId>EnsPost_Input</moduleInstanceSetId> <valueType>scalar</valueType> <parameterId>QINE</parameterId> <locationSetId>Gages_HEFS</locationSetId> <timeSeriesType>simulated forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <readWriteMode>read only</readWriteMode> <ensembleId>MEFP</ensembleId> </timeSeriesSet> </timeSeries> <!-- Returns the HFES EnsPost post-processed flow ensemble. --> <timeSeries> <id>FLOW ENSPOST OUTPUT</id> <timeSeriesSet> <moduleInstanceSetId>EnsPost_Output</moduleInstanceSetId> <valueType>scalar</valueType> <parameterId>SQIN</parameterId> <locationSetId>Gages_HEFS</locationSetId> <timeSeriesType>simulated forecasting</timeSeriesType> <timeStep unit="hour" multiplier="6"/> <readWriteMode>read only</readWriteMode> <ensembleId>HEFSENSPOST</ensembleId> </timeSeriesSet> </timeSeries> </fewsPiServiceConfig>

2.4.2 Modify File Added in Step 2.1: IdExportHEFSGraphGen.xml (Optional)

Perform this step only if necessary due to the locationIds of time series defined within the HEFSGraphGen.xml PI-service configuration file; see condition below.

Action: Modify the file

<*configuration_dir*>/IdMapFiles/IdExportHEFSGraphGen.xml

to define id-mappings necessary for the display of the HEFS products. Details are below.

Description: The file is a standard id-mapping applied to the output from the PI-service queries defined in HEFSGraphGen.xml.

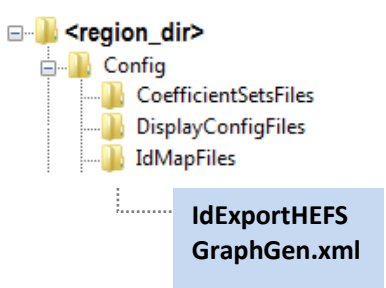
All Graphics Generator HEFS products are designed to expect all time series to have the same locationId and for that to match the segment id for streamflow products or the MEFP catchment id for the MEFP Results product.

Therefore, id-mapping changes may be necessary if the following condition is met for at least one of the catchments or segments for which products are to be constructed:

- *The time series returned by the PI-service for one catchment or segment, for all queries, and for the same type of data, either meteorological forcings (precipitation/temperature) or streamflow, can contain time series with more than one locationId.*

Most often, this condition will only be met for streamflow queries. For example, this condition is true if the queries with ids "OBSERVED FLOW" and "OPERATIONAL FLOW FORECAST" are both to be displayed and return time series for the same segment that have different locationIds. Usually for precipitation or temperature queries, the time series returned for a catchment have locationIds that match the MEFP catchment id.

If the condition is met, id-mappings should be defined to map the returned locationIds to the appropriate segment id (for streamflow) or catchment id (for precipitation and temperature). The following example displays id-mappings defined for MARFC for two segments, WALN6DEL and CNNN6DEL, in order to produce HEFS products (as well as other products):

Standard Location: <*configuration_dir*>/**IdMapFiles**	**Contents:** ***IdExportHEFSGraphGen.xml***
	<?xml version="1.0" encoding="UTF-8"?> <idMap …"> <!-- Map all WALN6 output to the segment id, WALN6DEL --> <location external="WALN6DEL" internal="WALN6TOT"/> <location external="WALN6DEL" internal="WALN6PPP"/> <location external="WALN6DEL" internal="WALN6DEL"/> <!--identity map--> <location external="WALN6DEL" internal="WALN6"/> <!-- Map all CNNN6 output to the segment id, CNNN6DEL --> <location external="CNNN6DEL" internal="CNNN6TOT"/> <location external="CNNN6DEL" internal="CNNN6PPP"/>

Standard Location: <*configuration_dir*>**/IdMapFiles**	**Contents:** ***IdExportHEFSGraphGen.xml***
	<location external="CNNN6DEL" internal="CNNN6TIF"/> <location external="CNNN6DEL" internal="CNNN6DEL"/> <!--identity map--> <location external="CNNN6DEL" internal="CNNN6"/> <enableOneToOneMapping/> </idMap>

In both cases, multiple locationIds for streamflow data are mapped to the segment id. Nothing needs to be done for the precipitation and temperature, since all precipitation and temperature time series have the same locationId for all catchments for each segment (in this case, WALN6DEL and CNNN6DEL both include only one catchment and that catchment has the same locationId as the segmentId).

NOTE: Any mapping for a given external id must include an *identity mapping*, which maps the id onto itself. For example

<location external="WALN6DEL" internal="WALN6DEL"/>

NOTE: For streamflow, if the time series returned by the PI-service always have the same locationId (therefore, not satisfying the above condition), but that locationId does not match the segment id defined in Topology.xml, an id-mapping can be used (do not leave out the identity mapping!). However, it may be preferable to use tools available via the **GraphGen Tree Panel** to modify the settings for the segment; see Section 6.1.1 of the *Graphics Generator AHPS Products Installation Guide* delivered with CHPS.

2.4.3 Modify Existing File: ThresholdValueSets.xml (Optional)

If thresholds are not to be displayed on the HEFS streamflow products, skip this step. See the **NOTE** *below for a description of the warning message will be displayed if this step is skipped.*

Action: Modify the file

<*configuration_dir*>/RegionConfigFiles/ThresholdValueSets.xml

as needed to define thresholds that can be displayed in the HEFS products. The HEFS products make use of the same thresholds used for the AHPS products. See Section 2.1.3 of the *Graphics Generator AHPS Products Installation Guide* for how to modify the ThresholdValueSets.xml file and troubleshooting tips related to the thresholds.

NOTE: If thresholds are not available when generating a product, a warning will be displayed during product generation in the CHPS **Logs Panel** when generated via the Graphics Generator FEWS plug-in components or the diagnostics (diag.xml) file created when generated via the GraphGenModelAdapter. The output products will still be generated. This warning message will be displayed if this step was skipped.

2.5 *Complete HEFS Product Configuration (Required)*

Action: Use the Graphics Generator components to complete the installation of the HEFS products. General steps that must be performed are described below. For a detailed description of how to perform these steps, see Section 2.3 of the *Graphics Generator AHPS Products Installation Guide*.

The steps are as follows:

1. Start CHPS.

2. Set the FEWS PI-service port number; see Section 2.3 of the *Graphics Generator Tips and Troubleshooting Guide*.

3. Use **Product and Template Manager Dialog** to import products from the file

   <*tar_root_dir*>/graphgen/installFiles/hefsInstallationImport.xml

   The **Product and Template Manager Dialog** is opened by clicking on the **Manage Products Button**, , in the toolbar of the **GraphGen Tree Panel**. See the description below for a list of the products included in this release.
4. Use the **Modify Settings Dialog** to import settings from the file

   <*tar_root_dir*>/graphgen/installFiles/hefsSettingsImport.xml

   <u>Do not discard existing settings</u> (i.e., click **Yes** when the **Keep Existing Settings? Dialog** opens)! The **Modify Settings Dialog** is opened by clicking on the **Change Default Settings Button**, , in the toolbar of the **GraphGen Tree Panel.**

5. Override the settings as needed for any segments for which products are to be displayed. See the description below for the settings that must be specified.
6. Create additional "MEFP Results" products as needed. This is required if any segments for which products are to be created includes more than one catchment. See Section 6.1.1 herein for instructions on how to do so.

Description: The Graphics Generator templates and products delivered with this release of HEFS are as follows:

- Templates
  - EnsPost Fcst Flow/Stage TS
  - EnsPost Obs Flow/Stage Input
  - HEFS Quartile Spread

    - HEFS Spaghetti
    - MEFP Obs Precip TS
    - MEFP Obs Temp TS
    - MEFP QPF Input
    - MEFP QTF Input
- Products
    - HEFS EnsPost Input
    - HEFS EnsPost Output
    - MEFP Results

The streamflow products, HEFS EnsPost Input and HEFS EnsPost Output, make use of the default, predefined argument used by Graphics Generator: defaultLocationId. For a segment, this argument defines the locationId that is expected in all time series returned by the FEWS PI-service. By default, the defaultLocationId is set to the segment id of the forecast segment. See Section 6.1.1 of the *Graphics Generator AHPS Products Installation Guide* for instructions on when and how to override its value.

The MEFP Results product, which displays MEFP output by catchment, makes use of HEFS-specific argument mefpCatchment#, described below. They do not use the defaultLocationId. See below and Section 6.1.1 for instructions on how to set its value.

The following arguments are specific for the HEFS products and must be set in Step 4 above (using the **Modify Settings Dialog**):

Argument Name	Recommended Value	Description
hefsDisplayTimeZone	RFC-dependent. Valid time zones include EST (no accounting for daylight savings time), EST/EDT (accounts for daylight savings time), CST, CST/CDT, MST, MST/MDT, PST, PST/PDT, AST, AST/AKDT, and GMT. A more general time zone is Etc/GMT <+/–> # where # is the number of hours shifted from GMT and <+/-> indicates the directory. For example “Etc/GMT – 5” is equivalent to EST.	The time zone assumed for the time axes and labels of the HEFS products. This should be set to the same value as the ahpsDisplayTimeZone argument if the AHPS products have already been installed.

hefsFloodingThresholdId	RFC-dependent, but typically "MINOR" or "FS".	*If threshold is not to be displayed on the HEFS products, do not modify this argument. Instead, see Section 6.2.1 of Graphics Generator AHPS Products Installation Guide for instructions on removing the threshold from the products*. The id of the threshold defined in the ThresholdValueSets.xml configuration file (see Section 2.4.3) that corresponds to the flood level displayed on streamflow products. This should be set to the same value as the ahpsMinorFloodingThresholdId argument if the AHPS products have already been installed. This id may need to vary from segment-to-segment depending on data types.
mefpCatchment#	@overrideActiveSegmentId@ (defaults to *active forecast segment* id) Only use the default if the locationId of the FMAP/FMAT ensembles output by MEFP to be displayed in the product is identical to the segment id. In all other cases, set the mefpCatchment# argument value to the appropriate locationId for the FMAP/FMAT ensembles output from MEFP (which should both have the same locationId).	The locationId of time series of FMAP and FMAT acquired by Graphics Generator via the FEWS PI-service for <u>one</u> catchment. It is the locationId of time series returned by the temperature and precipitation queries setup in the HEFSGraphGen.xml; see Section 2.4.1. The # indicates the catchment number for a given catchment within the active segment. For example, if the segment includes only a single catchment, define the argument "mefpCatchment1". If it includes two catchments, then two arguments should be defined: "mefpCatchment1" and "mefpCatchment 2". And so on. By default, only a single "MEFP Results" product is provided for displaying the results for one catchment within a Segment (displaying products for argument "mefpCatchment1"). See Section 6.1.1 for instructions on creating additional MEFP Results products.

Override these settings as needed for each segment for which products are to be generated. Follow the instructions provided in Section 2.3 of the *Graphics Generator AHPS Products Installation Guide* to override the settings for each segment.

2.6 *Verify HEFS Product Configuration (Required)*

Action: Use CHPS and the Graphics Generator components to verify the installation of the HEFS products. General steps that must be performed are described below.

For a detailed description of how to perform these steps, see Section 2.4 in the *Graphics Generator AHPS Products Installation Guide*, which pertains to verifying the AHPS products installation.

The steps are as follows:

1. Start CHPS.

2. Set the FEWS PI-service port number; see Section 2.3 of the *Graphics Generator Tips and Troubleshooting Guide*.

3. Use the CHPS **Manual Forecast Dialog** to execute the HEFS workflows (if not already executed). This may include running the MEFP_Forecast workflow and associated streamflow and EnsPost workflows, which may be forecast group specific.

4. Select an active forecast segment from the CHPS **Forecasts Panel**. Be sure to click on the **View Mode Button** to switch to view mode; otherwise CHPS will execute the segment's operational forecasts when the segment is selected.

5. Use the CHPS **Database Viewer** to confirm that ensembles were created.

6. Open the **GraphGen Thumbnails Panel**. The HEFS Graphics Generator products listed in Section 2.5 should be displayed as thumbnails (templates will not be displayed).

7. Use the **GraphGen Viewer Panel** to confirm that the products are displayed correctly, comparing results with those shown in the **Database Viewer** as needed.

Description: Verifying HEFS product configuration requires generating products and viewing them, which, in turn, requires that the needed time series and ensembles are generated.

3 Setting Up Automated Graphics Generator Workflows

This section provides instructions for setting up scheduled tasks in CHPS to execute workflows that generate the HEFS products output files.

The steps in Section 3.1 of the *Graphics Generator Installation Guide* must be performed before completing these steps.

3.1 *Configuration File Changes (All Steps Required)*

Described below are changes that must be made to the configuration files in order for a workflow to be constructed that generates the Graphics Generator products, using HEFS products as an example. In the diagram below, the affected files are colored green:

3.1.1 Modify File Added in Step 2.1: GraphGen_HEFS_Products.xml

Action: Modify the file

<*configuration_dir*>/ModuleConfigFiles/hefs/GraphGen_HEFS_Products.xml

Replace *segmentId#* with the *installation segments* (one line must be added per segment).

Description: The module generates all HEFS products for all segments for which products are to be generated. The default file provided with the release is for ABRFC, with the line that contains *segmentId#* being as follows (it is highlighted in the example provided below):

```
<string key="products.CBNK1" value="MEFP Results*;HEFS EnsPost*"/>
```

This line must be changed to reflect the correct segment id replacing "CBNK1". One line with the same value must then be included for each segment for which products will be generated.

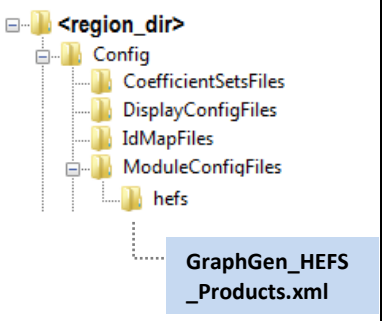
NOTE: The HEFS products are currently configured to generate the following output files (product id – file created under baseOutputDir):

- <*segmentId*>.HEFS.EnsPost.Input.png – one per segment displaying streamflow ensembles that would typically be input to EnsPost (if EnsPost is installed)
- <*segmentId*>.HEFS.EnsPost.Output.png – one per segment displaying output from HEFS EnsPost
- <*mefpCatchmentId*>.HEFS.MEFP.png – one per catchment within each segment, displaying the 6-hour FMAP and FMAT output of the MEFP workflow.

NOTE: The configuration depends upon the global properties piServiceBackendRFCIdentifier, piServiceHostName, and piServicePortNumber being defined; see Section 3.1.2 of the *Graphics Generator Installation Guide*.

NOTE: The configuration depends upon the global property HEFS_PRODUCTS_DIR being defined. See Section 2.3 for instructions to define the testing property and Section 4.2 for the central property.

Standard Location: <*configuration_dir*>**/ModuleConfigFiles/hefs/**	**Contents:** ***GraphGen_HEFS_Products.xml***

Standard Location: *<configuration_dir>*/**ModuleConfigFiles/hefs/**	**Contents:** ***GraphGen_HEFS_Products.xml***
	<?xml version="1.0" encoding="UTF-8"?> <generalAdapterRun xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.wldelft.nl/fews http://chps1/schemas/generalAdapterRun.xsd"> <general> <description>Generate HEFS Products for All HEFS Locations</description> <rootDir>%TEMP_DIR%</rootDir> <workDir>%ROOT_DIR%/work</workDir> <exportDir>%ROOT_DIR%/input</exportDir> <exportDataSetDir>%ROOT_DIR%</exportDataSetDir> <importDir>%ROOT_DIR%/output</importDir> <dumpFileDir>$GA_DUMPFILEDIR$</dumpFileDir> <dumpDir>%ROOT_DIR%</dumpDir> <diagnosticFile>%ROOT_DIR%/output/diag.xml</diagnosticFile> </general> <activities> <startUpActivities> <makeDir> <dir>%ROOT_DIR%/output</dir> </makeDir> </startUpActivities> <exportActivities> <exportRunFileActivity> <exportFile>%ROOT_DIR%/run_info.xml</exportFile> <properties> <string key="piServiceBackendRFCIdentifier" value="$piServiceBackendRFCIdentifier$"/> <string key="piServiceHostName" value="$piServiceHostName$"/> <string key="piServicePortNumber" value="$piServicePortNumber$"/> <string key="baseOutputDir" value="$HEFS_PRODUCTS_DIR$"/> <string key="products.*segmentId#*" value="MEFP Results.*;HEFS EnsPost.*"/> </properties> </exportRunFileActivity> </exportActivities> <executeActivities> <executeActivity> <command>

3.1.2 Modify Existing File: ModuleInstanceDescriptors.xml

Action: Define new module instance descriptors in the file

<*configuration_dir*>/RegionConfigFiles/ModuleInstanceDescriptors.xml

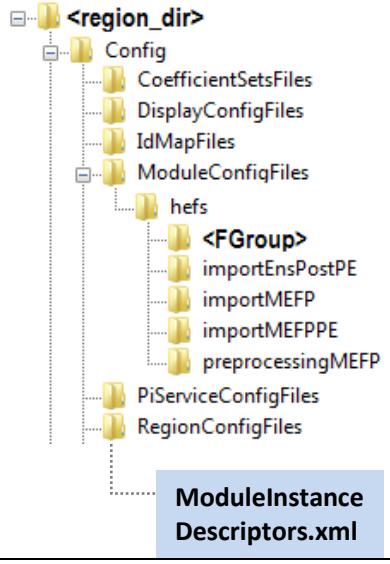
See the example below for text to add immediately before the closing "</moduleInstanceDescriptors>" at the end of the file. A sample is provided here:

<*tar_root_dir*>/graphgen/samples/Config/RegionConfigFiles/ModuleInstanceDescriptors.xml

Description: Modified to add modules to generate the HEFS Graphics Generator products.

NOTE: The module instance group defined below with the id "GraphicsGenerator" may have already been added as part of installing the AHPS products (see the *Graphics Generator AHPS Products Installation Guide*). If so, then add the descriptor added below to that module instance group.

NOTE: The added module is the one modified in Step 3.1.1 that executes the GraphGenModelAdapter to generate the HEFS products.

Standard Location: *<configuration_dir>*/**RegionConfigFiles/**	**Contents:** ***ModuleInstanceDescriptors.xml***
	<?xml version="1.0" encoding="UTF-8"?> <moduleInstanceDescriptor xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.wldelft.nl/fews http://chps1/schemas/moduleInstanceDescriptors.xsd" version="1.0"> … **<!-- ADDED FOR HEFS - GRAPHGEN ========== -->** **<moduleInstanceGroup id="GraphicsGenerator">** **<moduleInstanceDescriptor id="GraphGen_HEFS_Products">** **<moduleId>GeneralAdapter</moduleId>** **</moduleInstanceDescriptor>** **</moduleInstanceGroup>** **<!-- END OF HEFS - GRAPHGEN ========== -->** </moduleInstanceDescriptors>

3.1.3 Modify Existing File: WorkflowDescriptors.xml

Action: Define new workflow descriptors in the file

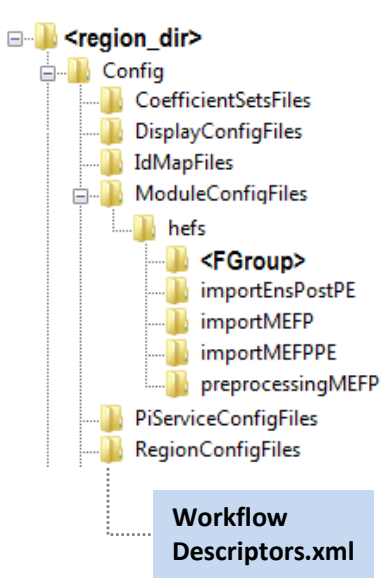
<configuration_dir>/RegionConfigFiles/WorkflowDescriptors.xml

See the example below for text to add immediately before the closing "</workflowDescriptors>" at the end of the file. A sample is provided here:

<tar_root_dir>/graphgen/samples/Config/RegionConfigFiles/WorkflowDescriptors.xml

Description: The added workflow is used to execute the GraphGen module created previously. The name of the workflow is GraphGen_HEFS_Create_Products and the workflow configuration file was put in place in Section 2.1.

NOTE: Before you modify your WorkflowDescriptors.xml, it is advised that you first make a backup copy.

Standard Location: *<configuration_dir>*/**RegionConfigFiles/**	**Contents:** ***WorkflowDescriptors.xml***
	<?xml version="1.0" encoding="UTF-8"?> <workflowDescriptors xmlns="http://www.wldelft.nl/fews" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.wldelft.nl/fews http://chps1/schemas/workflowDescriptors.xsd" version="1.0"> **…** **<!-- ADDED FOR HEFS - GRAPHGEN ========== -->** **<workflowDescriptor id="GraphGen_HEFS_Create_Products"** **name="GraphGen HEFS Create Products" forecast="true" visible="true">** **<description>Create GraphGen Products</description>** **</workflowDescriptor>** **<!-- END OF HEFS - GRAPHGEN ========== -->** </workflowDescriptors>

3.2 *Test the Changes*

This testing is done in the *installation stand-alone*.

Action: Modify the file

<*configuration_dir*>/ModuleConfigFiles/hefs/GraphGen_HEFS_Products.xml

Comment out the lines that define the piService* run file properties, highlighted below:

```
        <exportRunFileActivity>
           <exportFile>%ROOT_DIR%/run_info.xml</exportFile>
           <properties>
<!--              <string key="piServiceBackendRFCIdentifier" value="$piServiceBackendRFCIdentifier$"/>
              <string key="piServiceHostName" value="$piServiceHostName$"/>
              <string key="piServicePortNumber" value="$piServicePortNumber$"/> -->
…
           </properties>
        </exportRunFileActivity>
```

These lines force the GraphicsGeneratorModelAdapter to run using the backend PI-service. By commenting them out, the adapter will use the PI-service connection established when running the *installation stand-alone*.

Action: Start CHPS. Execute the workflow GraphGen_Create_HEFS_Products created in Section 3.1 via the CHPS interface **Manual Forecast Dialog** as normal (start CHPS, set the PI-service port number, open the panel, show all workflows, select the workflow, and click **Run**). If executed successfully, the HEFS product files will be created in the *installation stand-alone* products directory (i.e., <*products_dir*>) specified by the baseOutputDir run file property (see Section 3.1.1). The images will appear similar to those shown in Section 1.

If not successful, examine the **Logs Panel** of the CHPS interface and check the trouble shooting in Section 6 of the *Graphics Generator AHPS Products Installation Guide* and check the *Graphics Generator Tips and Troubleshooting Guide*.

4 Synchronizing Changes to the Central Server

Synchronize (upload) the changes made to the configuration and Graphics Generator products and settings to the central server. General instructions are provided in the *Graphics Generator Installation Guide*.

4.1 *Create Central <products_dir> (Required)*

Action: Select an appropriate central HEFS products directory where HEFS product files created by Graphics Generator will be output when generated by a scheduled workflow.

NOTE: An appropriate central products output directory may have already been identified and created during installation of Graphics Generator; see Section 3.1.1 of the *Graphics Generator Installation Guide*. You may want to create an HEFS subdirectory of that directory and let that serve as the central HEFS products directory, denoted below as <*central products_dir*>.

Description: The directory must not be specific to the *installation stand-alone*. Rather, it must be a central shared directory as it will be referenced by all sessions of CHPS that are not stand-alones (e.g. Forecast Shell Servers – fss) and that execute the Graphics Generator to generate HEFS product files. For example, the directory referenced by $EXPORT_FOLDER$ or $EXPORT_DIR$ in the fss global properties file is a commonly used central directory for storing data generated by executing CHPS.

Action: Create the central HFS products directory if it does not yet exist:

mkdir <*central products_dir*>

4.2 *Modify FSS Global Properties (Required)*

Action: For each FSS##, open the following file for editing (replace ?? with the lower case 2-letter RFC abbreviation):

/awips/chps_local/fss/??rfc/FSS##/FewsShell/??rfc/fss_global.properties

Add the following properties:

HEFS_PRODUCTS_DIR=<*central products_dir*>
piServiceBackendRFCIdentifier=??rfc_pi
piServiceHostName=localHost
piServicePortNumber=<service_number>

NOTE: The piService* properties may already be defined as part of the standard Graphics Generator installation. No change should be needed. See Section 3.1.2 of the *GraphGen Installation Guide*.

4.3 *Synchronize Configuration Changes (Required)*

Action: Upload configuration changes to the central server. Use the FEWS configuration manager (cm) tool for installing the files in the central server (place the changes in the FEWS OC, validate, and synchronize/upload the changes).

Description: See Section 1.5 for the configuration files that must be uploaded.

NOTE: After making changes to the FEWS OC, you can repeat Section 2.6 to verify that the HEFS products are installed correctly in the OC. Start the OC and proceed to Step 1 in that Section.

4.4 *Synchronize Product Changes (Required)*

Action: Upload Graphics Generator products and settings to the central server. See Section 4 of the *Graphics Generator Installation Guide* for general instructions on uploading Graphics Generator products and settings to the central server. That section references the *Graphics Generator Tips and Troubleshooting Guide* for detailed instructions.

NOTE: The Graphics Generator products and settings are stored in CHPS database in the data sets table. This step does <u>not</u> require uploading any product or settings XML files.

5 Creating the Scheduled Task

In order to generate the HEFS product output (image files and ASCII tabular files), a scheduled task must be added. Perform the following action to do so:

Action: Create a scheduled task to execute the workflow GraphGen_Create_HEFS_Products. Use the FEWS admin interface provided by CHPS to add a workflow mapping and schedule the workflow to execute at an appropriate time. Make sure the workflow is executed after the ensemble workflows that yield the time series are completed and with a system time that matches those forecasts.

6 Tips and Trouble Shooting

For general trouble shooting and tips, see the *Graphics Generator Tips and Troubleshooting Guide*. Also, see Section 6 of the *Graphics Generator AHPS Products Installation Guide* for tips related to the AHPS products, which can be generalized and applied to the HEFS products as well (except for those dealing with probability plots, since there are no HEFS probability plots). HEFS specific tips and troubleshooting are provided below.

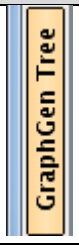
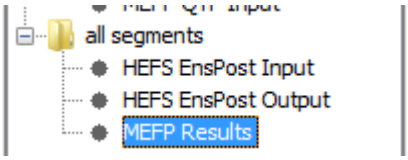
6.1 *Tips*

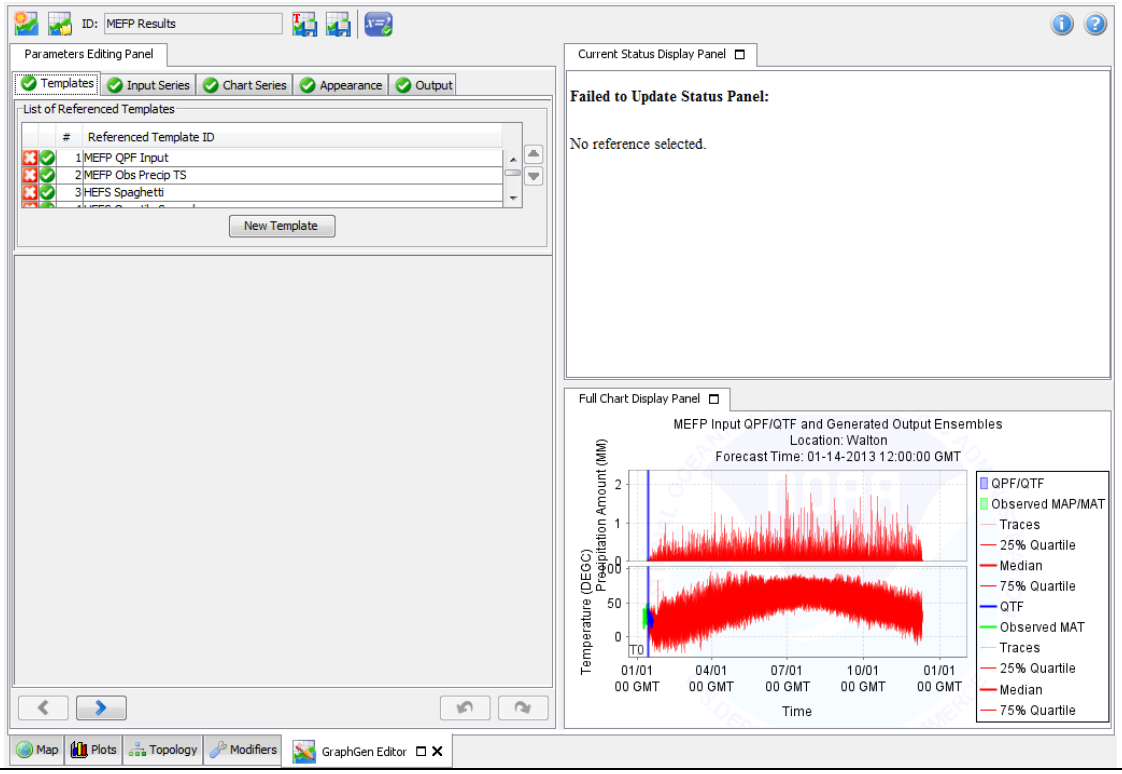
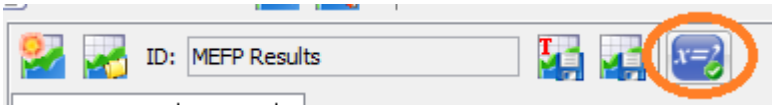
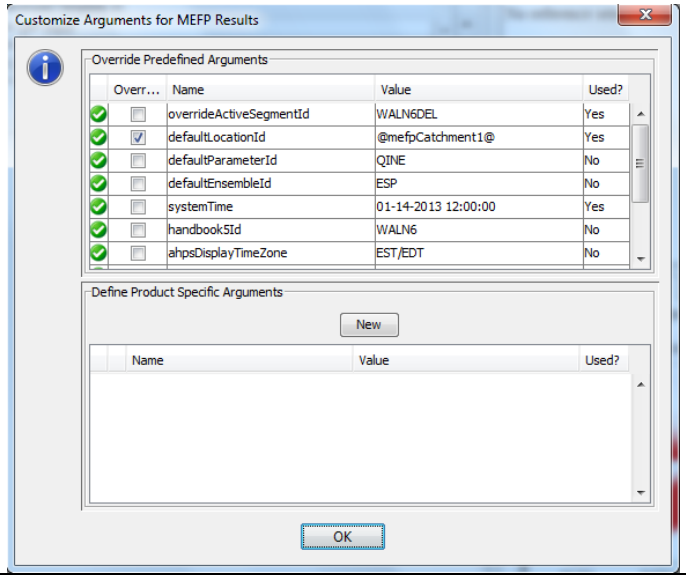
6.1.1 Adding MEFP Results Products for Additional Catchments

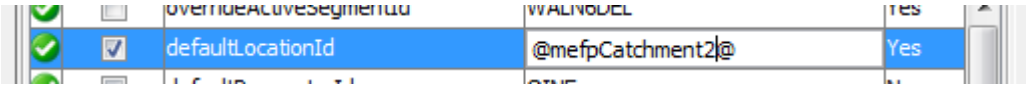
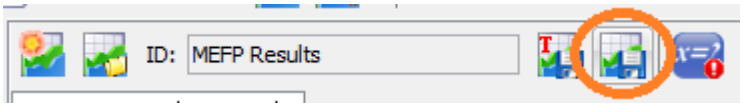
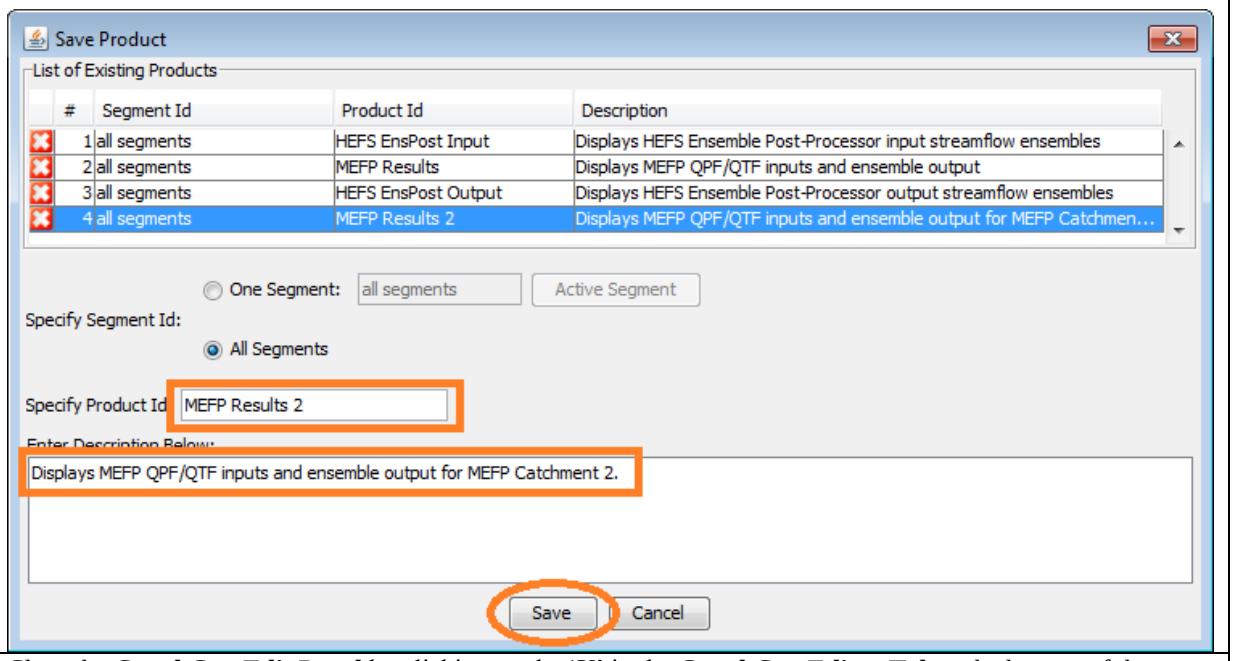
The release package includes only a single Graphics Generator product to display the output of the MEFP_Forecast workflow, therefore assuming only a single catchment exists per segment. In some cases, however, multiple catchments (e.g., an upper and a lower catchment) may exist for one forecast segment.

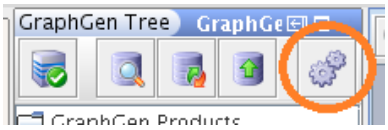
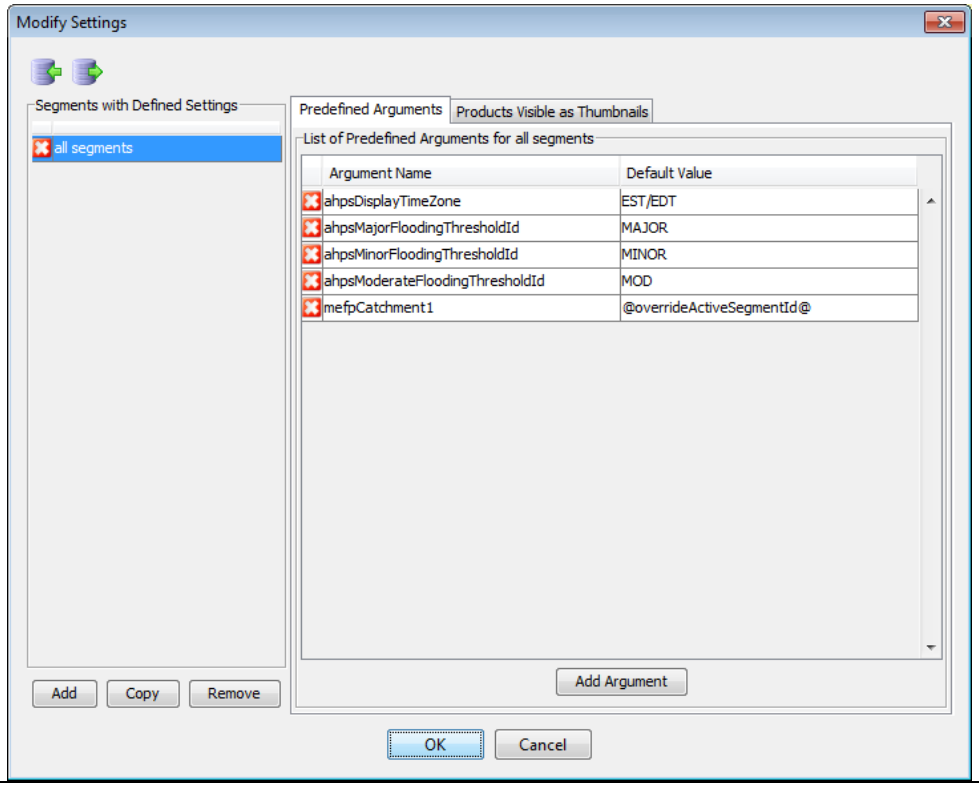
The instructions below describe how to create additional products to display the output for an additional catchment from the MEFP_Forecast workflow. The *catchment number* must be identified (1 for the first, default catchment; 2 for the next catchment; and so on). The locationId of the original catchment will be referred to as <*mefpCatchmentOrig*> below, while the locationId of the new catchment will be referred to as <*mefpCatchmentNew*>.

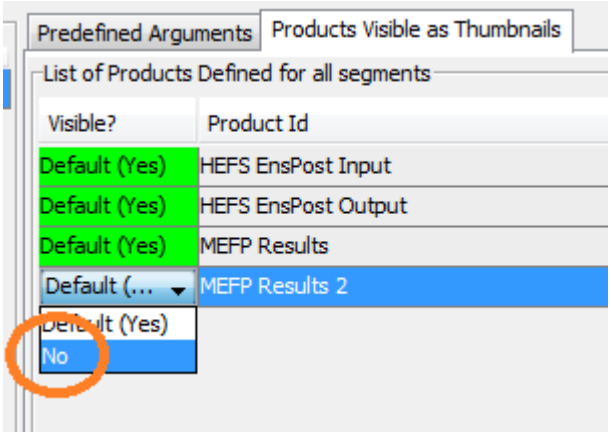
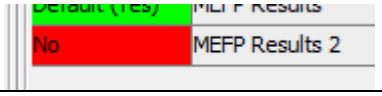
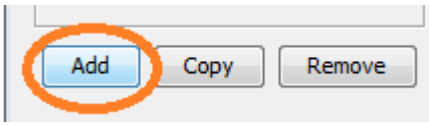
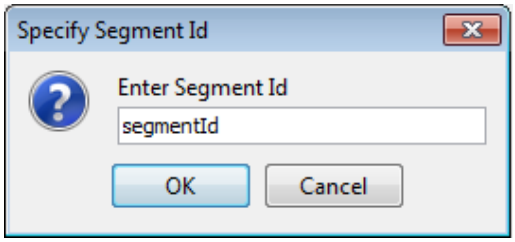
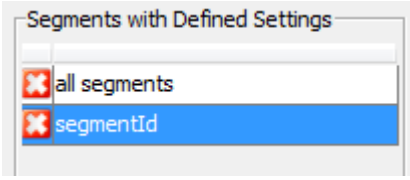
Before following the instructions below, start a CHPS session for which the localDataStore includes MEFP_Forecast workflow output for at least one segment with multiple catchments. If the changes are to be synchronized to the central server, be sure to start the CHPS session as an OC. Specify the PI-service port number and, in the CHPS **Forecasts Panel,** select the segment with multiple catchments to be the *active forecast segment* (see Section 1.2).

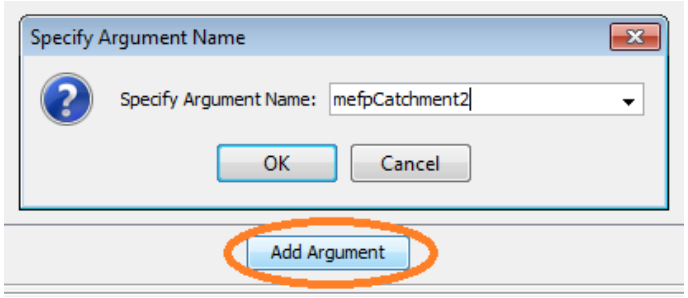
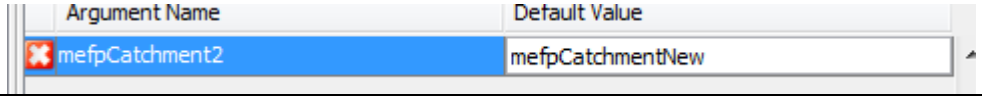
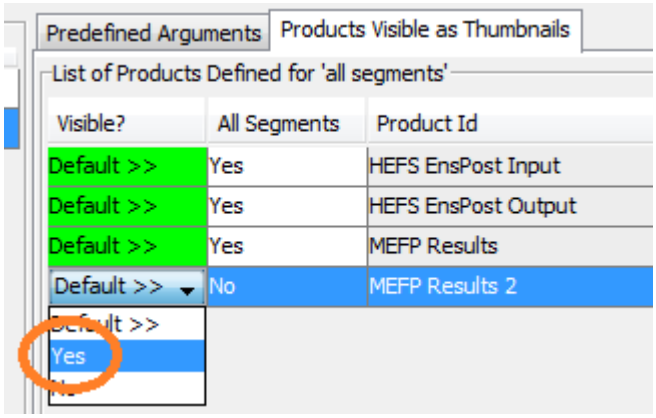
#	Action
1	Click on the  (tab) on the left to open the **GraphGen Tree Panel**.
2	Expand the “all segments” node in the tree and select “MEFP Results”: 

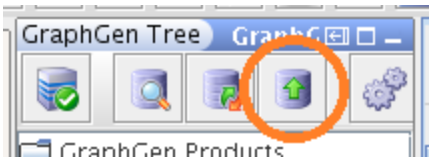
#	Action
3	Click on the **GraphGen Editor Button** to open the **GraphGen Editor Panel**: 
4	Click on the **Manage Product Arguments Button** in the toolbar of the editor  to open the **Customize Arguments Dialog**: 

#	Action
5	In the row for "defaultLocationId", click on the entry for the "Value" column and edit it, changing it to "@mefpCatchment#@" where # is the catchment number. For example (# is 2):  This will cause the product to have an error because of no "mefpCatchment2" predefined argument being defined yet for the active segment. This will be resolved later.
6	Save the product by clicking on the **Save as Product Button**:  In the **Save Product Dialog**, set the product id to be "MEFP Results #" (matching the # in the previous step), modify the description appropriately, and click **Save**: 
7	Close the **GraphGen Edit Panel** by clicking on the 'X' in the **GraphGen Editor Tab** at the bottom of the panel:

#	Action
8	Click on the **Change Default Settings Button**, , in the toolbar of the **GraphGen Tree Panel**:  The **Modify Settings Dialog** will open (the exact appearance of this panel will vary based on what settings have already been modified): 

#	Action
9	Make the **Products Visible as Thumbnails Panel** active. In the "Visible?" column for the row corresponding to "MEFP Results #", select "No" so that the product is not visible, by default, as a thumbnail:  After selecting no and clicking off of the row, the color for the "Visible?" column will be red: 
10	Click on the **Add Button** under the **Segments with Defined Settings List**  In the **Specify Segment Id Dialog** that opens, enter the active segment id (chosen before Step 1) and click **OK**:  The specified segment will be selected in the **Segments with Defined Settings List**:  Steps 11 – 13, below, modify the settings for the segment selected in this list. <u>Make sure that the appropriate segment is selected when performing steps 11 – 13</u>!

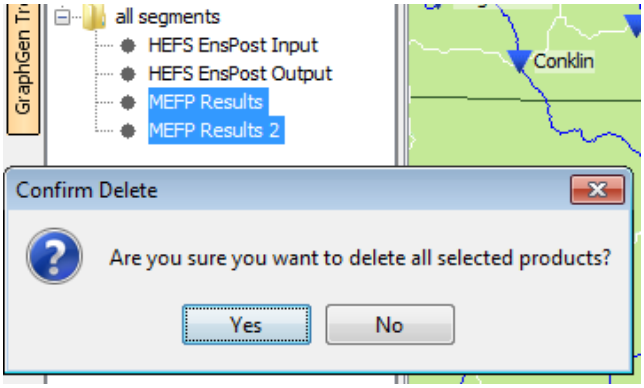
#	Action
11	Make the **Predefined Arguments Panel** active and click on the **Add Argument Button**. In the **Specify Argument Name Dialog** that opens, enter "mefpCatchment#" and click **OK** (using # as 2): 
12	In the **List of Predefined Arguments Table**, edit the "Default Value" column for the row for "mefpCatchment#" to be the <*mefpCatchmentNew*>: 
13	Make the **Products Visible as Thumbnails Panel** active. In the "Visible?" column for the row corresponding to "MEFP Results #", select "Yes" so that the product is visible, as a thumbnail for the segment:  After selecting no and clicking off of the row, the color for the "Visible?" column will be green:
14	REPEAT Steps 10 – 13 for <u>every</u> segment for which a product "MEFP Results #" is needed. See Step 10: <u>Make sure that the appropriate segment is selected when performing steps 11 – 13</u>!
15	When done modifying settings, click **OK** to save the changes.
16	Verify the changes for the active segment by opening the **GraphGen Thumbnails Panel**. The products with ids "MEFP Results" and "MEFP Results #" should be visible and drawn correctly for all segments for which Steps 10 – 13 were performed (as well as any other "MEFP Results #" already added).

#	Action
17	Make the change permanent by clicking on the **Upload Products Button** in the **GraphGen Tree Panel**:  When the confirmation dialog opens, click **Yes**.

6.1.2 Turning Off Products for MEFP or EnsPost

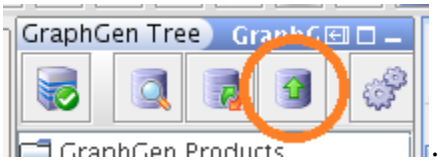
To turn off products for MEFP or EnsPost, identify the products to "turn off" and either (1) remove the product or (2) make the product not visible as a thumbnail. For MEFP, the products affected have ids that start with "MEFP Results". For EnsPost, the products affected have ids that start with "HEFS EnsPost".

To remove the affected products, open the **GraphGen Tree Panel**, expand the "all segments" node and select the appropriate products (press the <Ctrl> key while clicking to select multiple products). Press the <Delete> key and, when the **Confirm DeleteDialog** opens, click **Yes**:



To make the affected products not visible as a thumbnail, see Section 2.6 of the *Graphics Generator Tips and Troubleshooting Guide*. You will first need to make the product not visible by default, modifying the visibility for "all segments" to be "No". Then, if the visibility was overridden for any segments, set the visibility for those segments to be "Default…" so that it uses the "all segments" default visibility of "No".

After making any changes, as always, click on the **Upload Products Button** in the **GraphGen Tree Panel** to make the changes permanent:



Lastly, if the products are being generated for any segment as part of a GraphGenModelAdapter module (see Section 3.1.1), then modify the appropriate module configuration files removing all references to the product. For example, to remove MEFP products in the default GraphGen_HEFS_Products.xml module configuration file, change

```
<string key="products.CBNK1" value="MEFP Results.*;HEFS EnsPost.*"/>
```

to

```
<string key="products.CBNK1" value="HEFS EnsPost.*"/>.
```

6.2 *Troubleshooting*

See the *Graphics Generator Tips and Troubleshooting Guide* and the *Graphics Generator AHPS Product Installation Guide*.