Linking LSPC to WASP Spreadsheet Utility

Harpeth River water quality model

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Overview of linking data to WASP

Use LSPC to generate .OUT files

Calculate TN & TP subspecies based on monitoring data

Populate Excel utility w/ subspecies ratios

Determine routing of subbasins/PS to WASP segment

Identify whether RO vs. PERO is used

Add & rename segments in WASP

Populate Excel utility w/ LSPC subbasin and parameter info

Extract & reformat LSPC data using Excel utility

Import LSPC, PS, and weather data into WRDB

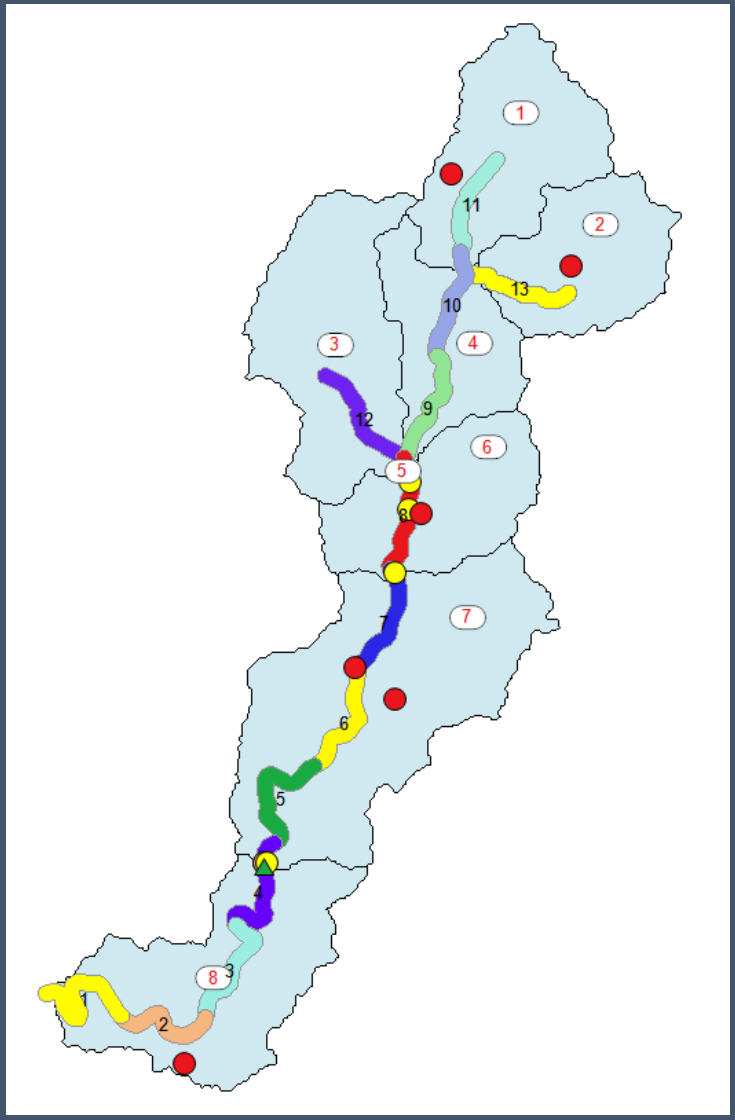
Process point source and weather data

Map WRDB to WASP

Map flowpaths to WASP segments

Map boundaries to WASP segments

Linking LSPC to WASP



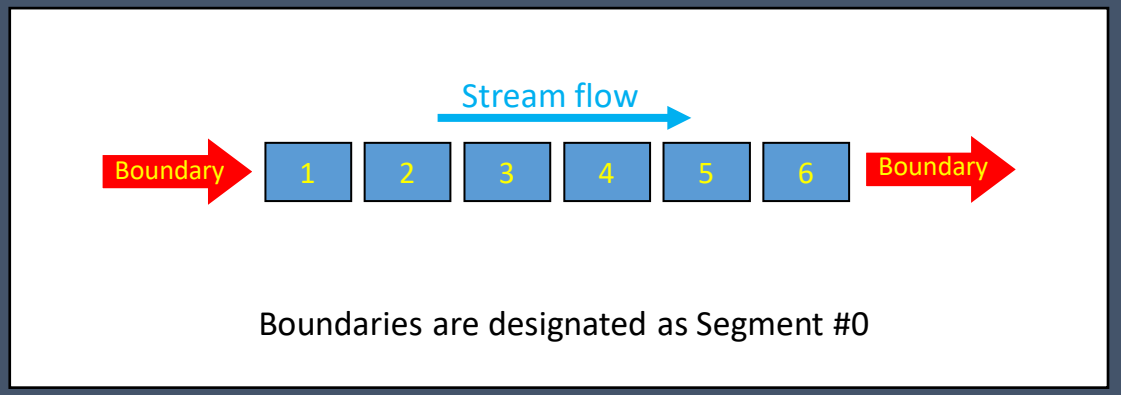
- Single LSPC subbasin may encompass multiple WASP segments
- Single WASP segment may span several LSPC subbasins
- WASP segments also have to capture point source discharges
- LSPC subbasins are manually mapped to WASP segments
  - Flows
  - Boundaries/loads

What is a boundary?

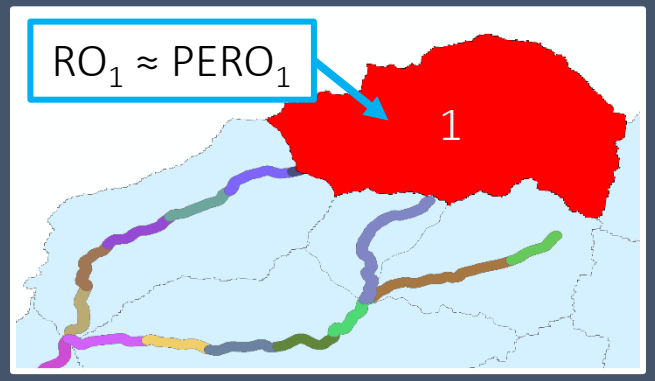
Any exchange of water from:

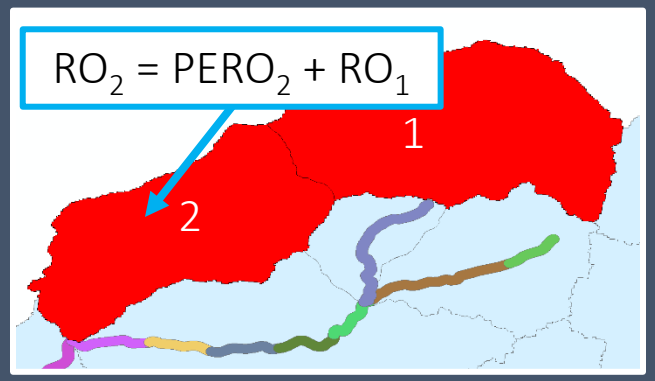
1. Outside model network into the model (e.g., LSPC runoff; point source)

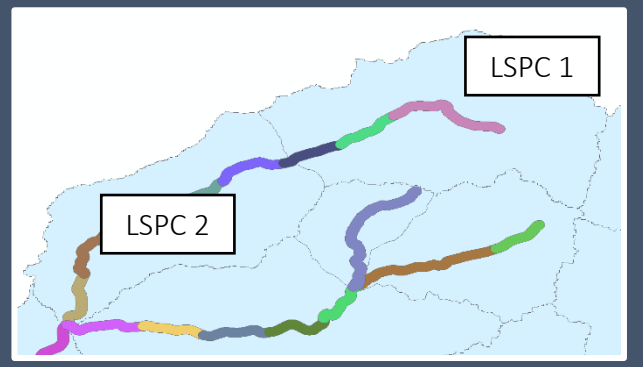
2. Inside model network to the outside (e.g., water withdrawal; outlet)



LSPC flow outputs: RO vs. PERO



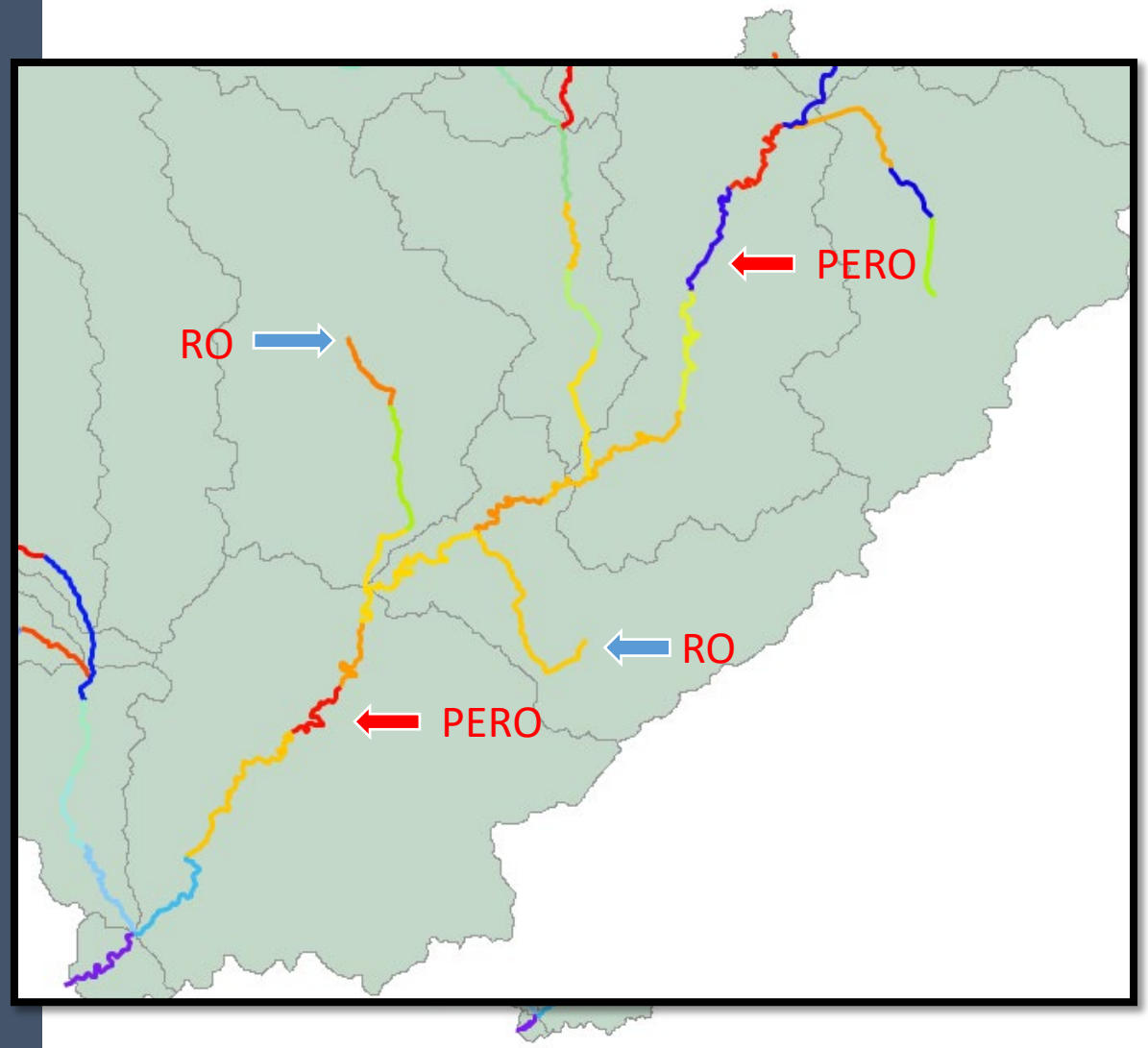




- LSPC generates two flow types for each subbasin:
  - PERO – terrestrial sheetflow for a given subbasin
    - acre-in/day
  - RO – cumulative instream flow
    - ft^3/s
    - Sum of terrestrial sheetflow for that subbasin AND instream flows from upstream subbasin(s)

Subbasin 1: Use RO flows Subbasin 2: Use PERO flows

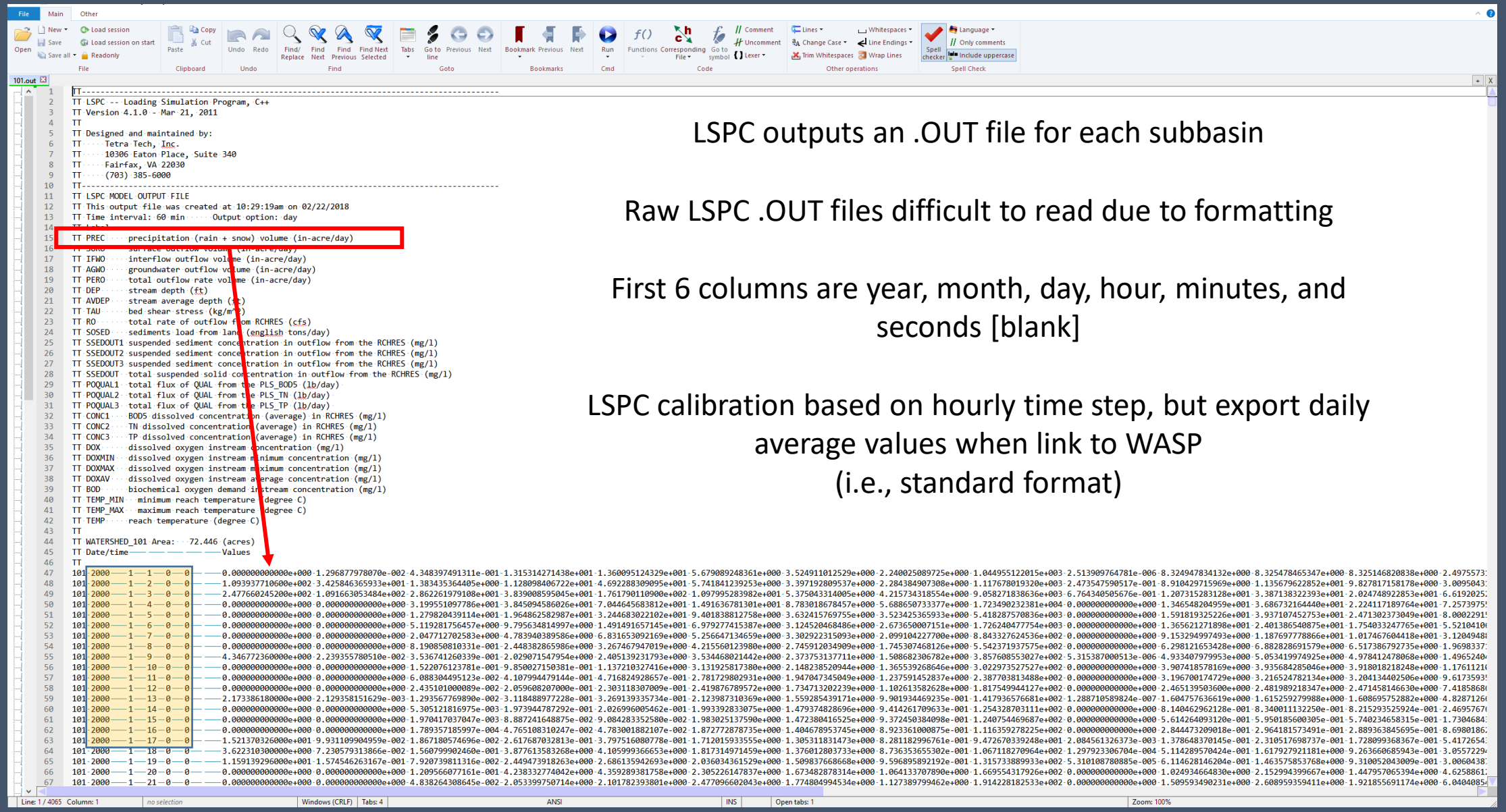
Linking LSPC to WASP: RO vs. PERO



- Headwater ROs typically routed to most upstream WASP segment in that subbasin
- PEROs typically routed to midpoint WASP segment in that subbasin
  - Calibration stations or PS may affect this
- Can use RO instead of PERO if need to merge two LSPC headwaters
  - Too few WASP segments
  - Improve model run times

Processing LSPC output

LSPC to WASP: Standard .OUT format



Linking LSPC to WASP: Subspecies partitioning

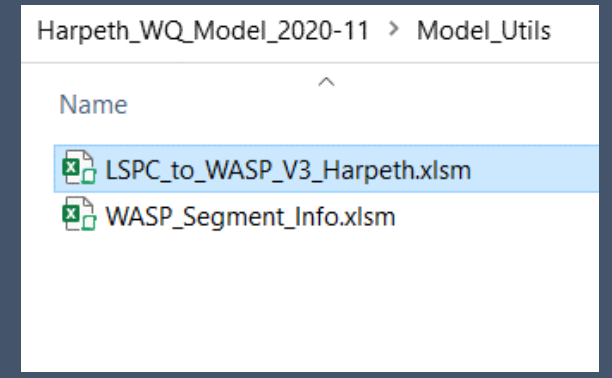
- LSPC WQ parameters linked into WASP as boundary concentrations
  - Nutrients, DO, CBOD, inorganic sediment, and water temperature
- Typically, only output TN and TP from LSPC
- WASP needs NH_3, NO_2/NO_3, OrgN, PO_4, and OrgP
- Can partition LSPC TN and TP based on assumptions
  - Use ambient monitoring data to calculate subspecies composition of LSPC runoff
  - Use WRDB and Excel to calculate subspecies composition

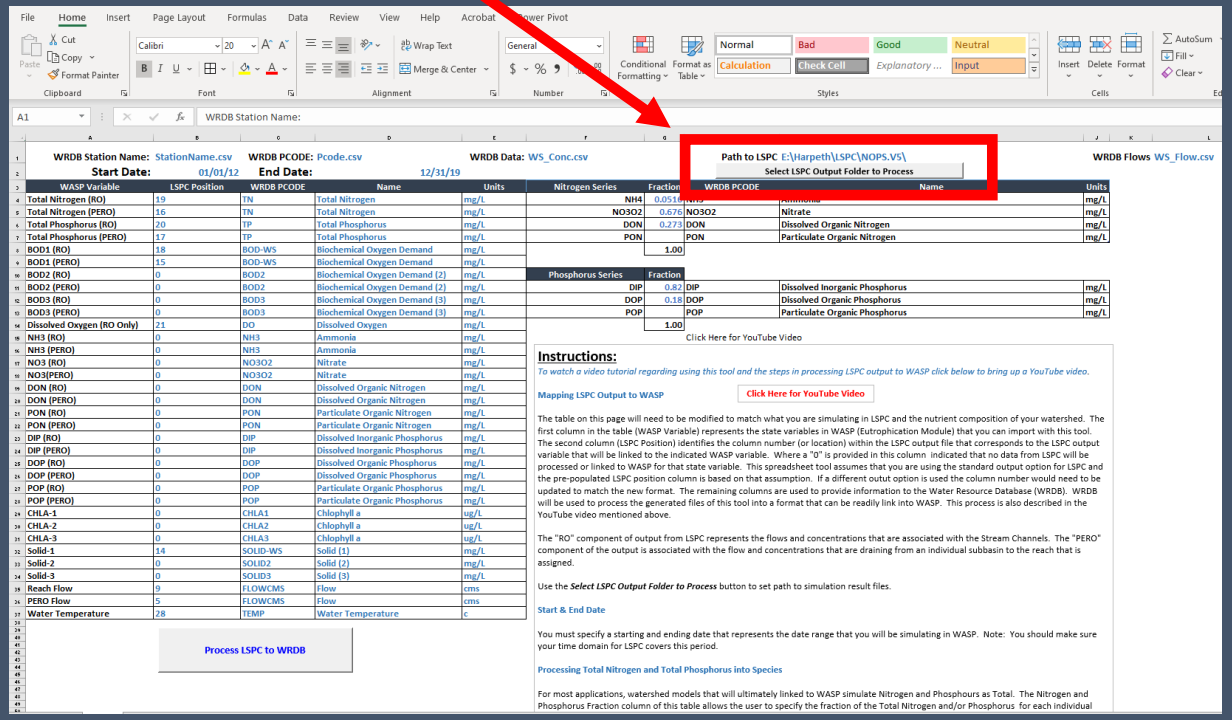
Linking LSPC to WASP: Unit conversion

- Need to convert units when linking LSPC output to WASP
- Units of LSPC flows:
  - RO – cubic feet per second
  - PERO – acre-in per day
- WASP needs flows in cubic meter per second
- WASP needs concentrations in mg/L and temperature in degree Celsius
  - RO concentrations directly reported in LSPC .OUT (mg/L)
  - PERO concentrations calculated from LSPC loads (lbs/day) and PERO flows (acre-in per day)

LSPC to WASP: Excel spreadsheet

- Excel utility can preprocess LSPC .OUT files for WASP
- Already preconfigured for Harpeth
  - Only need to update 'Path to LSPC' filepath argument
- Utility will
  - Extract parameters required by WASP
  - Partition TN and TP into subspecies
  - Apply appropriate unit conversions
    - Including RO vs PERO
  - Export WRDB-ready .csv files





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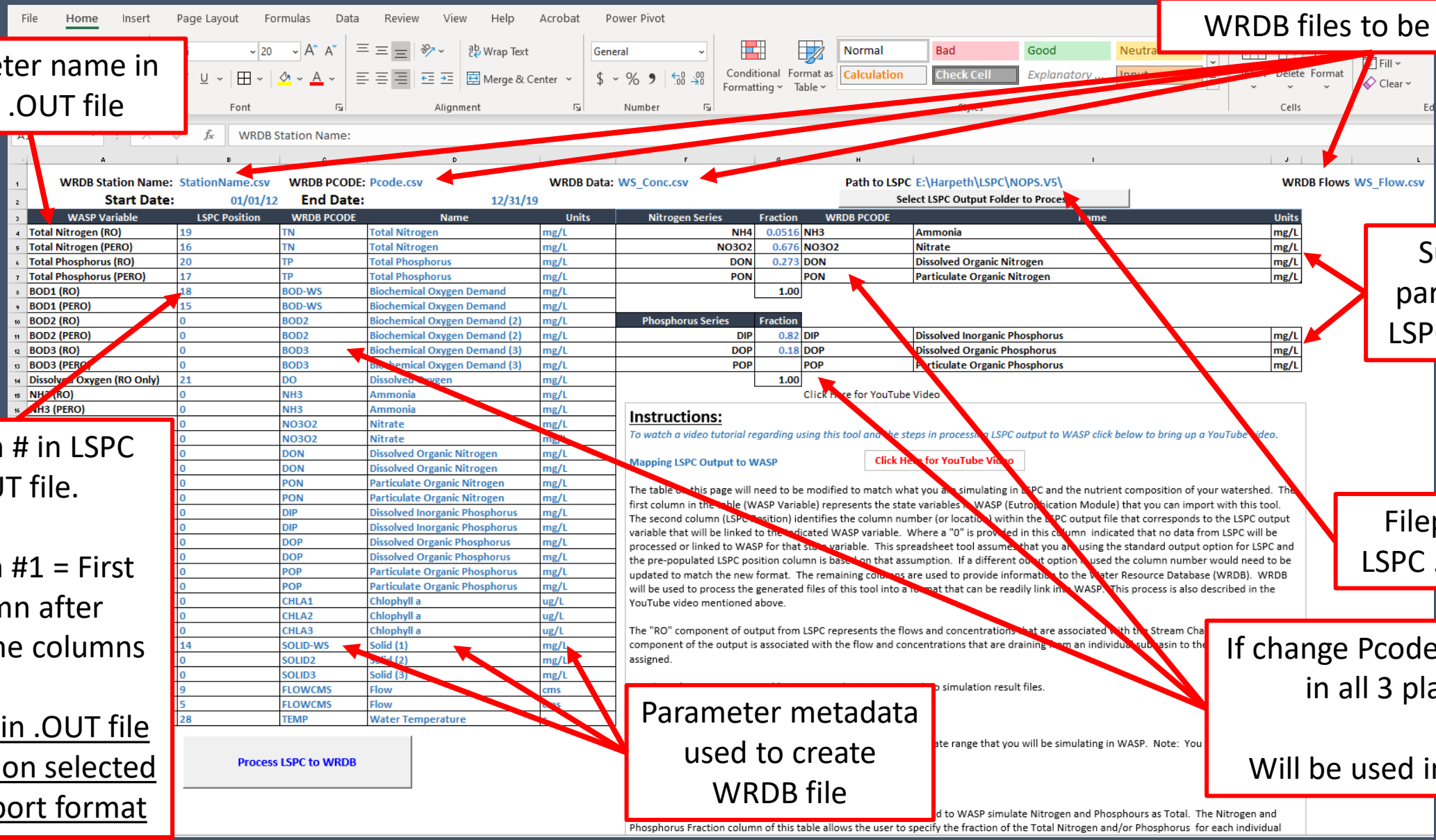
LSPC to WASP: Excel spreadsheet



WRDB Station Name: StationName.csv | WRDB PCODE: Pcode.csv | WRDB Data: WS_Conc.csv | Path to LSPC E:\Harpeth\LSPC\NOPS.V5\ | WRDB Flows WS_Flow.csv
Start Date: 01/01/12 | End Date: 12/31/19
Select LSPC Output Folder to Proces

WASP Variable	LSPC Position	WRDB PCODE	Name	Units
Total Nitrogen (RO)	19	TN	Total Nitrogen	mg/L
Total Nitrogen (PERO)	16	TN	Total Nitrogen	mg/L
Total Phosphorus (RO)	20	TP	Total Phosphorus	mg/L
Total Phosphorus (PERO)	17	TP	Total Phosphorus	mg/L
BOD1 (RO)	18	BOD-WS	Biochemical Oxygen Demand	mg/L
BOD1 (PERO)	15	BOD-WS	Biochemical Oxygen Demand	mg/L
BOD2 (RO)	0	BOD2	Biochemical Oxygen Demand (2)	mg/L
BOD2 (PERO)	0	BOD2	Biochemical Oxygen Demand (2)	mg/L
BOD3 (RO)	0	BOD3	Biochemical Oxygen Demand (3)	mg/L
BOD3 (PERO)	0	BOD3	Biochemical Oxygen Demand (3)	mg/L
Dissolved Oxygen (RO Only)	21	DO	Dissolved Oxygen	mg/L
NH3 (RO)	0	NH3	Ammonia	mg/L
NH3 (PERO)	0	NH3	Ammonia	mg/L
	0	NO3O2	Nitrate	mg/L
	0	NO3O2	Nitrate	mg/L
	0	DON	Dissolved Organic Nitrogen	mg/L
	0	DON	Dissolved Organic Nitrogen	mg/L
	0	PON	Particulate Organic Nitrogen	mg/L
	0	PON	Particulate Organic Nitrogen	mg/L
	0	DIP	Dissolved Inorganic Phosphorus	mg/L
	0	DIP	Dissolved Inorganic Phosphorus	mg/L
	0	DOP	Dissolved Organic Phosphorus	mg/L
	0	DOP	Dissolved Organic Phosphorus	mg/L
	0	POP	Particulate Organic Phosphorus	mg/L
	0	POP	Particulate Organic Phosphorus	mg/L
	0	CHLA1	Chlophyll a	ug/L
	0	CHLA2	Chlophyll a	ug/L
	0	CHLA3	Chlophyll a	ug/L
	14	SOLID-WS	Solid (1)	mg/L
	0	SOLID2	Solid (2)	mg/L
	0	SOLID3	Solid (3)	mg/L
	9	FLOWCMS	Flow	cms
	5	FLOWCMS	Flow	cms
	28	TEMP	Water Temperature	

Process LSPC to WRDB

Nitrogen Series	Fraction	WRDB PCODE	Name	Units
NH4	0.0516	NH3	Ammonia	mg/L
NO3O2	0.676	NO3O2	Nitrate	mg/L
DON	0.273	DON	Dissolved Organic Nitrogen	mg/L
PON		PON	Particulate Organic Nitrogen	mg/L
	1.00			

Phosphorus Series	Fraction			
DIP	0.82	DIP	Dissolved Inorganic Phosphorus	mg/L
DOP	0.18	DOP	Dissolved Organic Phosphorus	mg/L
POP		POP	Particulate Organic Phosphorus	mg/L
	1.00			

Click Here for YouTube Video

Instructions:

To watch a video tutorial regarding using this tool and the steps in processing LSPC output to WASP click below to bring up a YouTube video.

Mapping LSPC Output to WASP — Click Here for YouTube Video

The table on this page will need to be modified to match what you are simulating in LSPC and the nutrient composition of your watershed. The first column in the table (WASP Variable) represents the state variables in WASP (Eutrophication Module) that you can import with this tool. The second column (LSPC Position) identifies the column number (or location) within the LSPC output file that corresponds to the LSPC output variable that will be linked to the indicated WASP variable. Where a "0" is provided in this column indicated that no data from LSPC will be processed or linked to WASP for that state variable. This spreadsheet tool assumes that you are using the standard output option for LSPC and the pre-populated LSPC position column is based on that assumption. If a different output option is used the column number would need to be updated to match the new format. The remaining columns are used to provide information to the Water Resource Database (WRDB). WRDB will be used to process the generated files of this tool into a format that can be readily link into WASP. This process is also described in the YouTube video mentioned above.

The "RO" component of output from LSPC represents the flows and concentrations that are associated with the Stream Cha component of the output is associated with the flow and concentrations that are draining from an individual subbasin to the assigned.

o simulation result files.

ate range that you will be simulating in WASP. Note: You

d to WASP simulate Nitrogen and Phosphours as Total. The Nitrogen and Phosphorus Fraction column of this table allows the user to specify the fraction of the Total Nitrogen and/or Phosphorus for each individual

WRDB files to be created

Parameter name in LSPC .OUT file

Column # in LSPC .OUT file.

Column #1 = First column after date/time columns

Position in .OUT file depends on selected LSPC export format

Subspecies partitioning of LSPC TP and TN

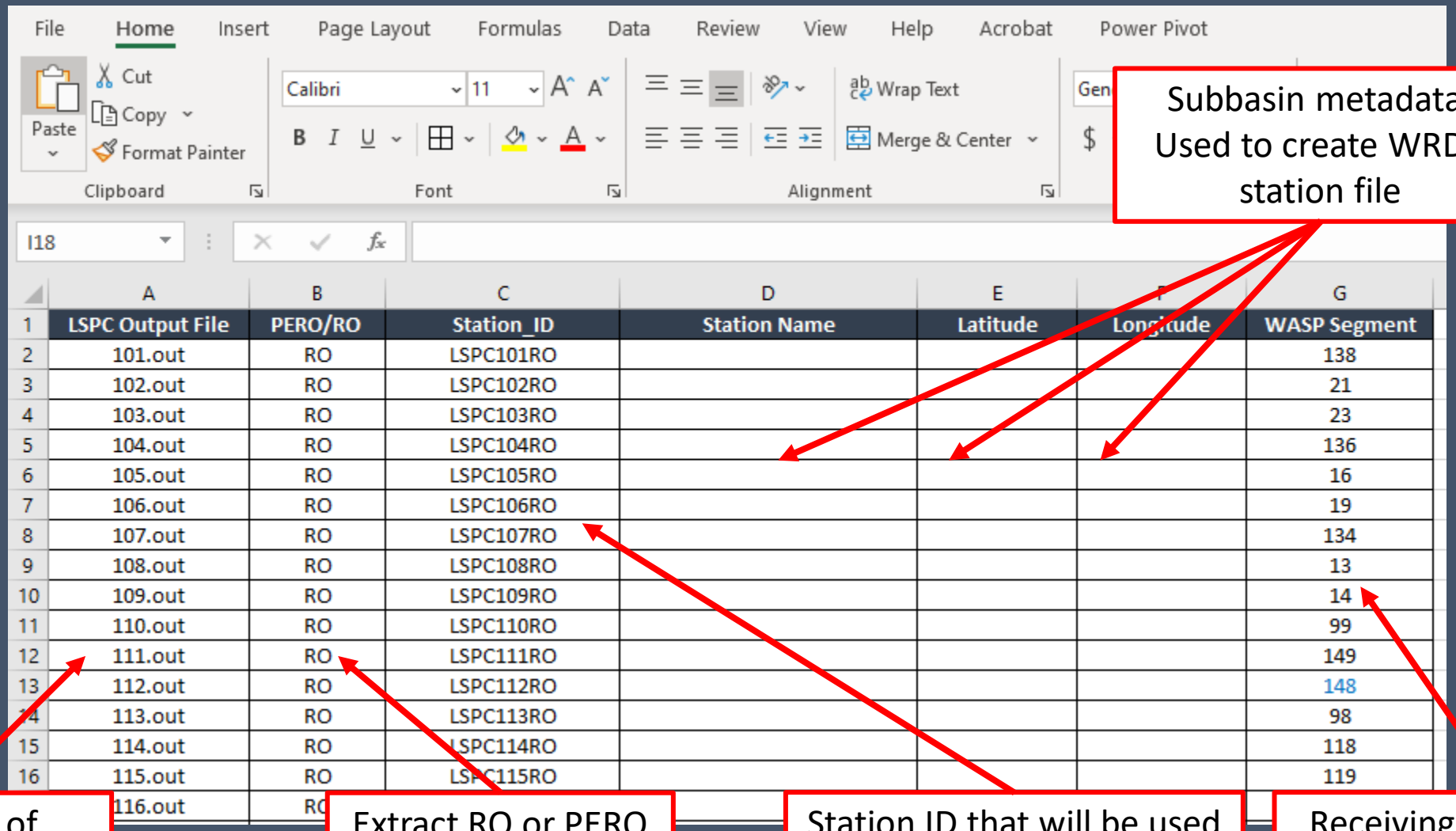
Filepath for LSPC .OUT files

If change Pcodes, change in all 3 places

Will be used in WRDB

Parameter metadata used to create WRDB file

LSPC to WASP: LSPC Output tab



	A	B	C	D	E	F	G
1	LSPC Output File	PERO/RO	Station_ID	Station Name	Latitude	Longitude	WASP Segment
2	101.out	RO	LSPC101RO				138
3	102.out	RO	LSPC102RO				21
4	103.out	RO	LSPC103RO				23
5	104.out	RO	LSPC104RO				136
6	105.out	RO	LSPC105RO				16
7	106.out	RO	LSPC106RO				19
8	107.out	RO	LSPC107RO				134
9	108.out	RO	LSPC108RO				13
10	109.out	RO	LSPC109RO				14
11	110.out	RO	LSPC110RO				99
12	111.out	RO	LSPC111RO				149
13	112.out	RO	LSPC112RO				148
14	113.out	RO	LSPC113RO				98
15	114.out	RO	LSPC114RO				118
16	115.out	RO	LSPC115RO				119
	116.out	RO					

Subbasin metadata; Used to create WRDB station file

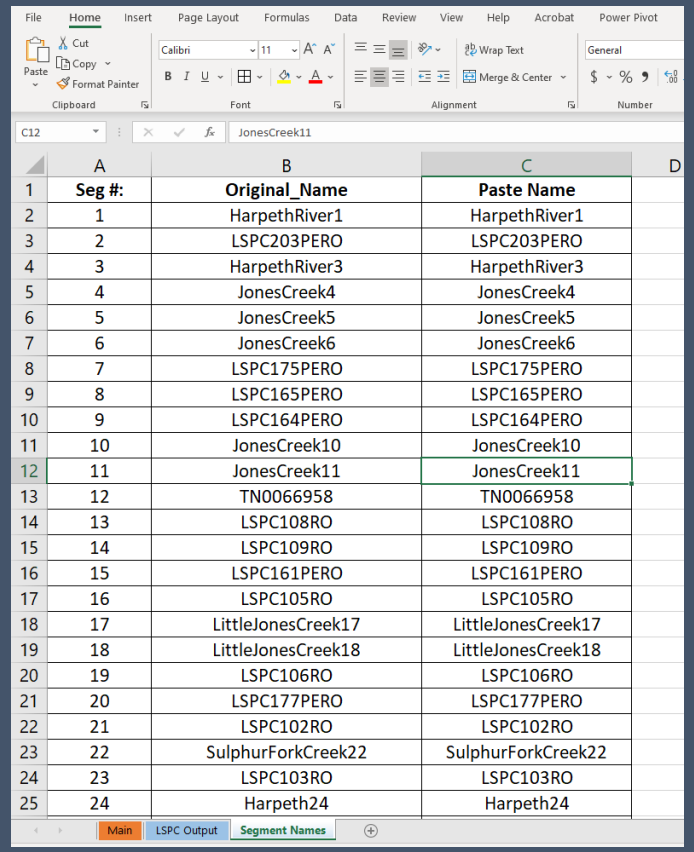
Filename of subbasin to extract

Extract RO or PERO for that subbasin

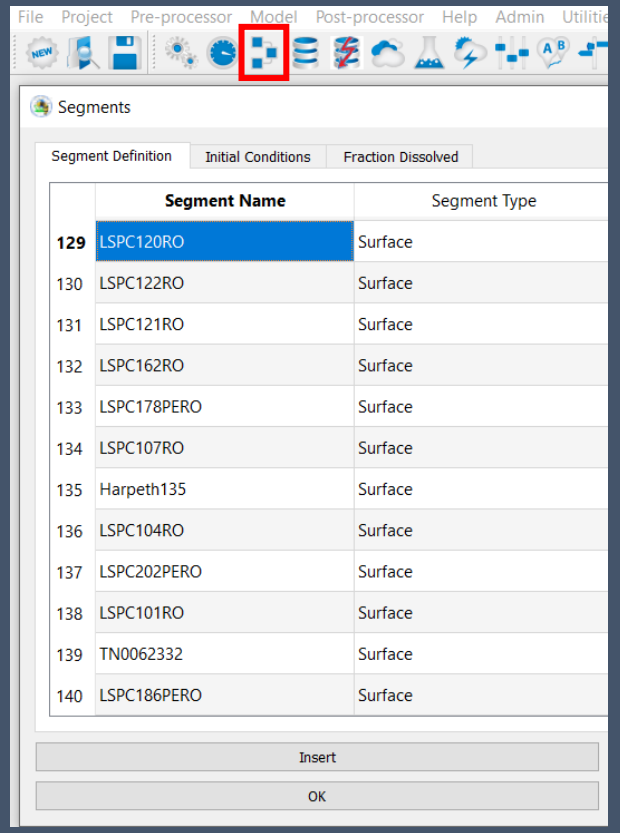
Station ID that will be used to name data in WRDB

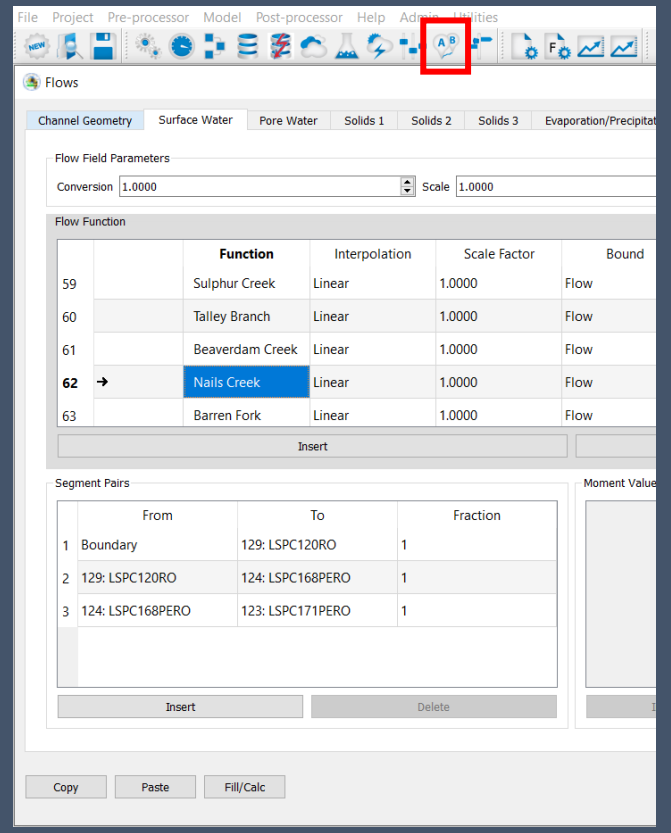
Receiving WASP segment for subbasin flow boundary

LSPC to WASP: Segment names tab



	A	B	C	D
1	Seg #:	Original_Name	Paste Name	
2	1	HarpethRiver1	HarpethRiver1	
3	2	LSPC203PERO	LSPC203PERO	
4	3	HarpethRiver3	HarpethRiver3	
5	4	JonesCreek4	JonesCreek4	
6	5	JonesCreek5	JonesCreek5	
7	6	JonesCreek6	JonesCreek6	
8	7	LSPC175PERO	LSPC175PERO	
9	8	LSPC165PERO	LSPC165PERO	
10	9	LSPC164PERO	LSPC164PERO	
11	10	JonesCreek10	JonesCreek10	
12	11	JonesCreek11	JonesCreek11	
13	12	TN0066958	TN0066958	
14	13	LSPC108RO	LSPC108RO	
15	14	LSPC109RO	LSPC109RO	
16	15	LSPC161PERO	LSPC161PERO	
17	16	LSPC105RO	LSPC105RO	
18	17	LittleJonesCreek17	LittleJonesCreek17	
19	18	LittleJonesCreek18	LittleJonesCreek18	
20	19	LSPC106RO	LSPC106RO	
21	20	LSPC177PERO	LSPC177PERO	
22	21	LSPC102RO	LSPC102RO	
23	22	SulphurForkCreek22	SulphurForkCreek22	
24	23	LSPC103RO	LSPC103RO	
25	24	Harpeth24	Harpeth24	





- Can review LSPC to WASP segment mapping by viewing ‘Segments’ & ‘Flows’ screen

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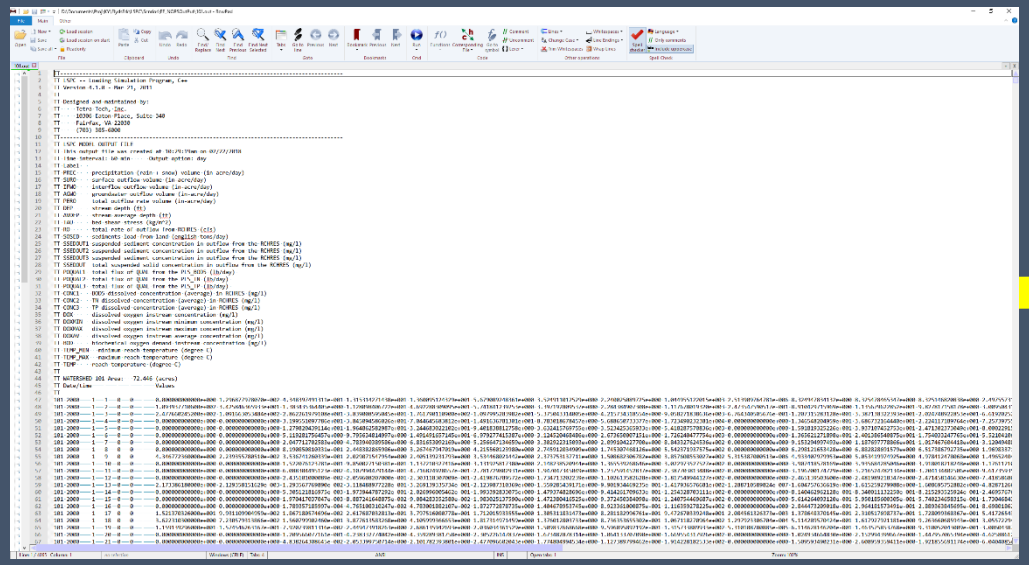
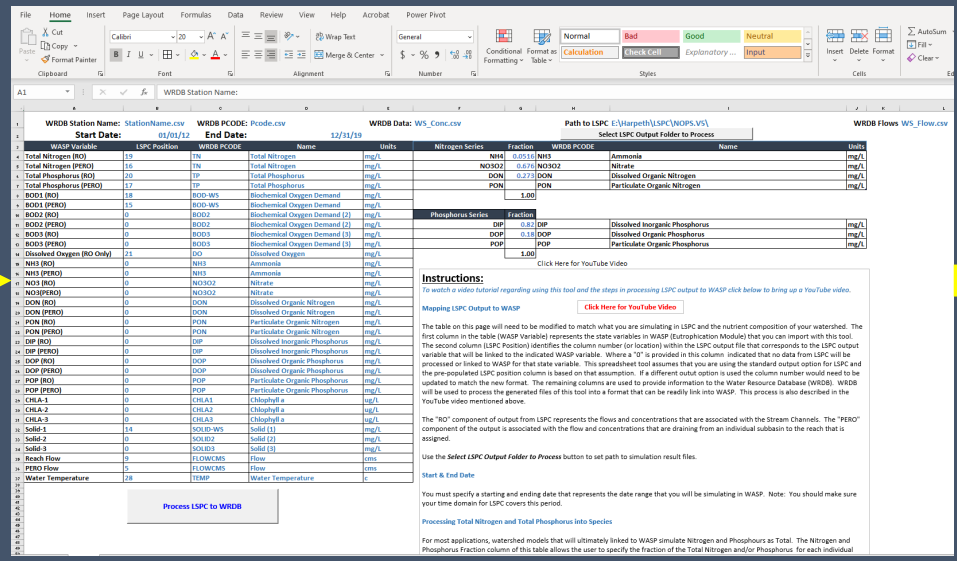
LSPC to WASP: Processing workflow

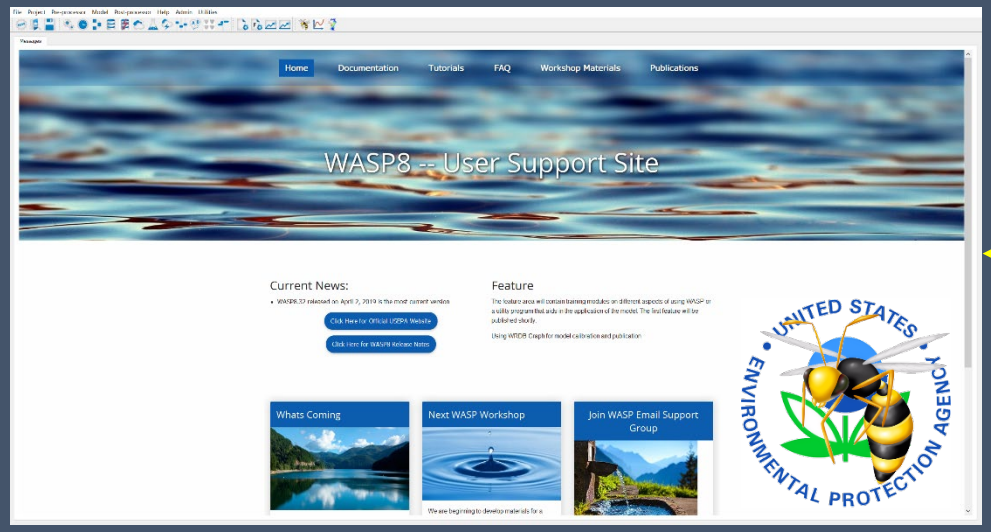
Run LSPC and export .OUT files



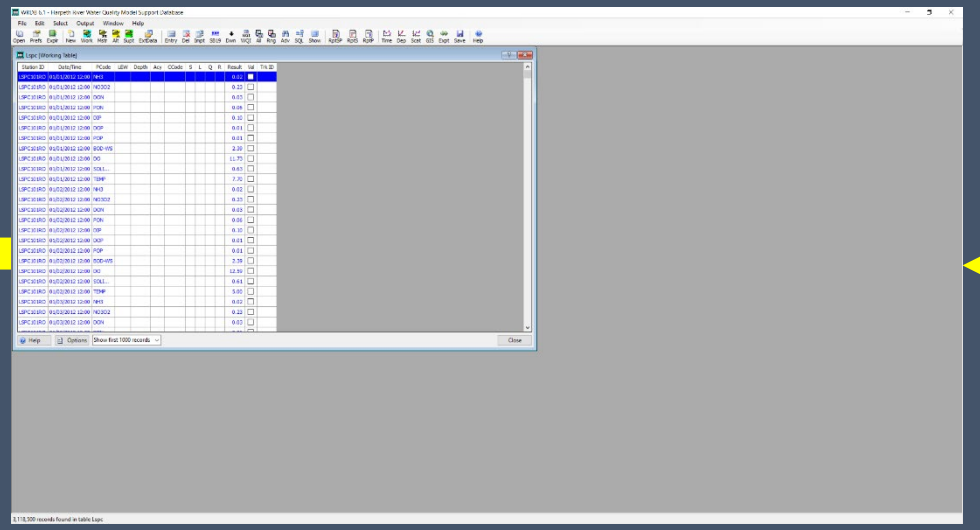
Preprocess LSPC .OUT files w/ Excel utility



Link WASP .WIF to WRDB



Import preprocessed files into WRDB



Linking LSPC .AIR file to WASP

Processing weather .AIR files

- Only a single weather station mapped to WASP
  - X304Y089_X304Y089_X304Y08
  - Hourly time step
- Use .AIR file generated by LSPC plug-in
  - Imported into WRDB
  - Applied English to metric unit conversion
- WASP requires
  - Solar (Harpeth WASP model calculates based on Lat/Long)
  - Air temperature
  - Dew point
  - Wind speed
  - Cloud cover

Parameter	LSPC Units	WASP Units	LSPC to WASP conversion
Solar Radiation	Langley / hour	Watts / m^2	11.63
Solar Radiation	Langley / day	Watts / m^2	0.484583
Dew Point	degF	degC	degF to degC conversion
Air Temperature	degF	degC	degF to degC conversion
Wind Speed	miles / hr	meter / second	0.447
Cloud Cover	Range 1-10	Range 0-1	0.10

Questions?