



SAN ANTONIO
RIVER AUTHORITY

SARA Water Quality Modeling Tools



Agenda

- Background
- HSPF Model Development
- WQ Modeling Results & Tools
- Method for prioritizing where WQ improvements potentially need to be focused

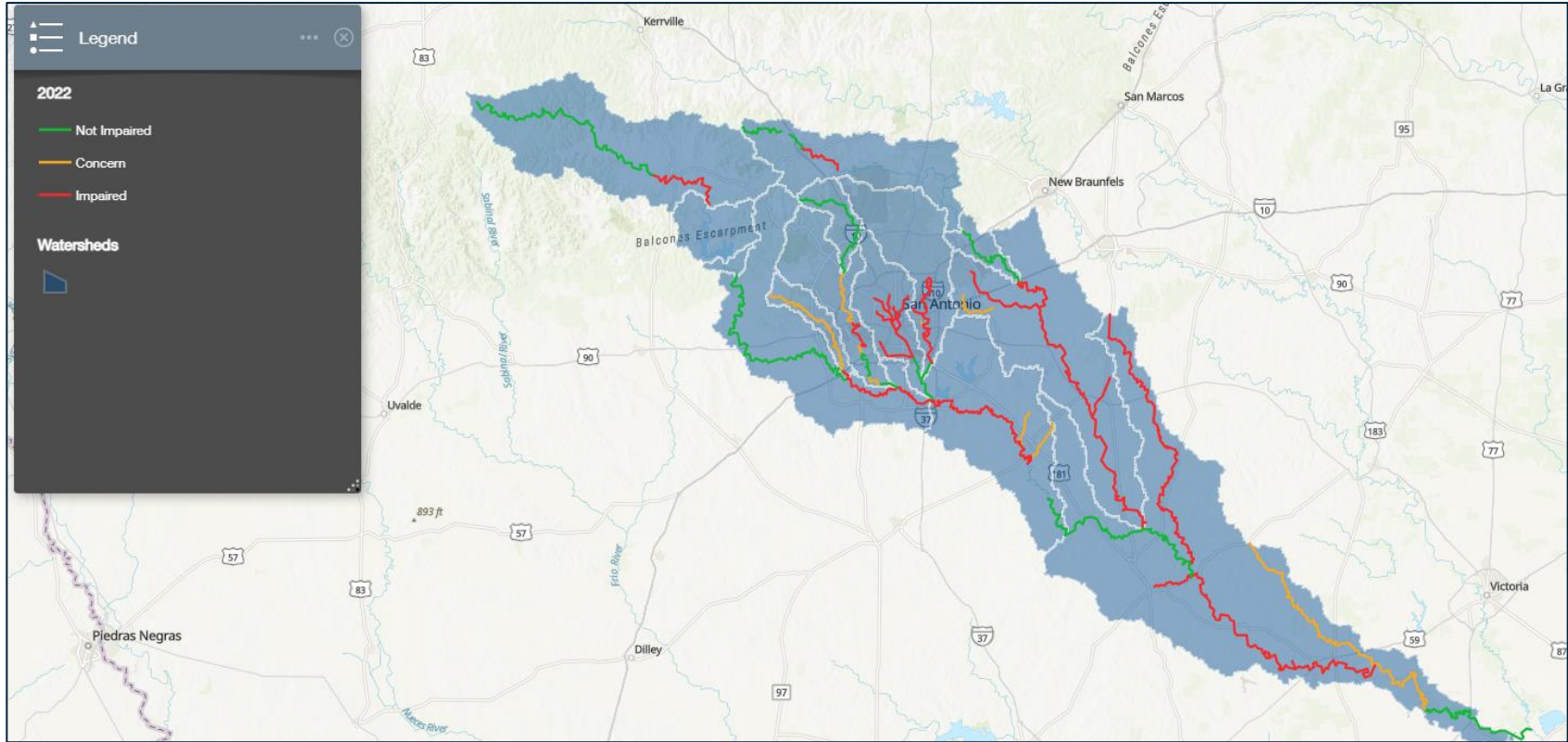




San Antonio River Basin



Impaired Waterbodies for Primary Contact Recreation



<https://sara-tx.maps.arcgis.com/apps/MapSeries/index.html?appid=3a4ca132222e41589e6f41eebfe6d36d>



Contact Recreation E-coli Standards

E-Coli Standards	Concentration
Primary Contact Recreation 1	126 #/dL
Primary Contact Recreation 2	206 #/dL
Secondary Contact Recreation 1	630 #/dL
Secondary Contact Recreation 2	1030 #/dL
Noncontact Recreation	2060 #/dL

*Source: Texas Surface Water Quality Standards



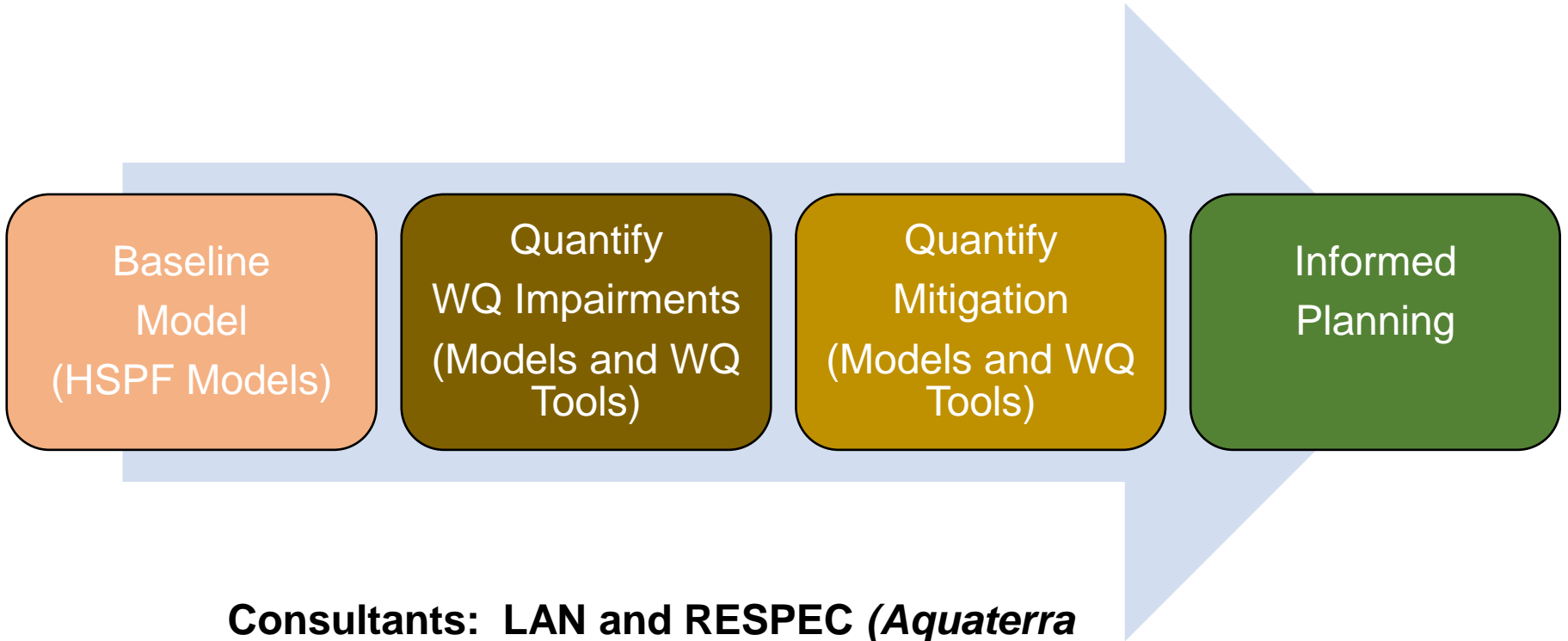
Water Quality Watershed Master Planning



- **To date: mostly Qualitative**
 - Best Management
 - To the extent possible/practicable
- **303(d)/ Impairments listing based on monitoring data (CRP)**
 - Quarterly monitoring – temporal gap
 - Limited SWQM station locations – spatial gap
- **BMPs/LIDs planning:**
 - Little modeling; the “right kind” of models don’t exist.
 - Build first, then monitor to see effectiveness



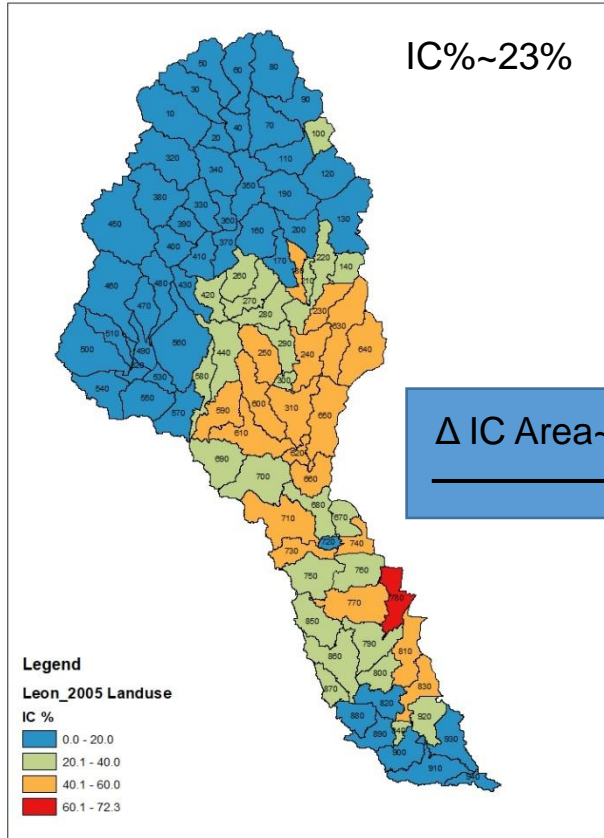
Our Vision



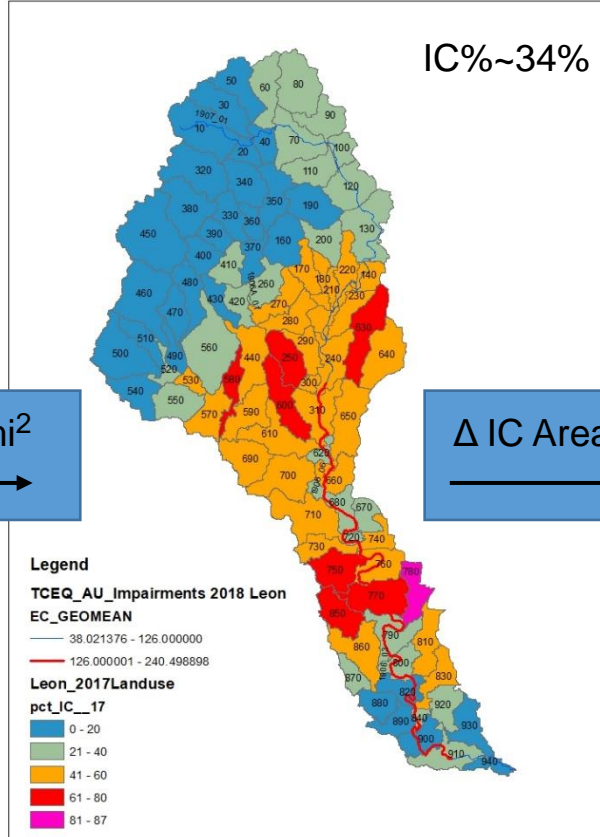
Consultants: LAN and RESPEC (*Aquaterra formerly*)



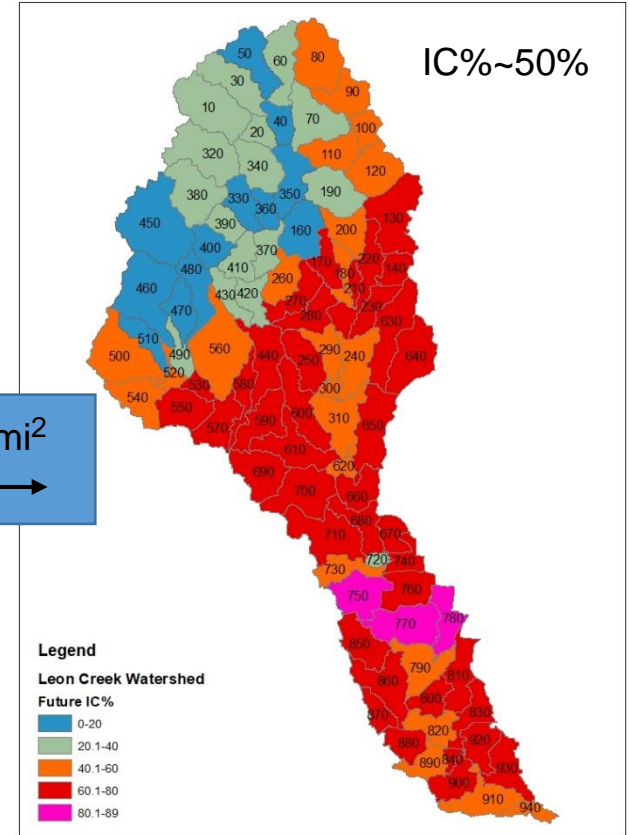
Leon Creek Watershed



2005 Impervious Cover



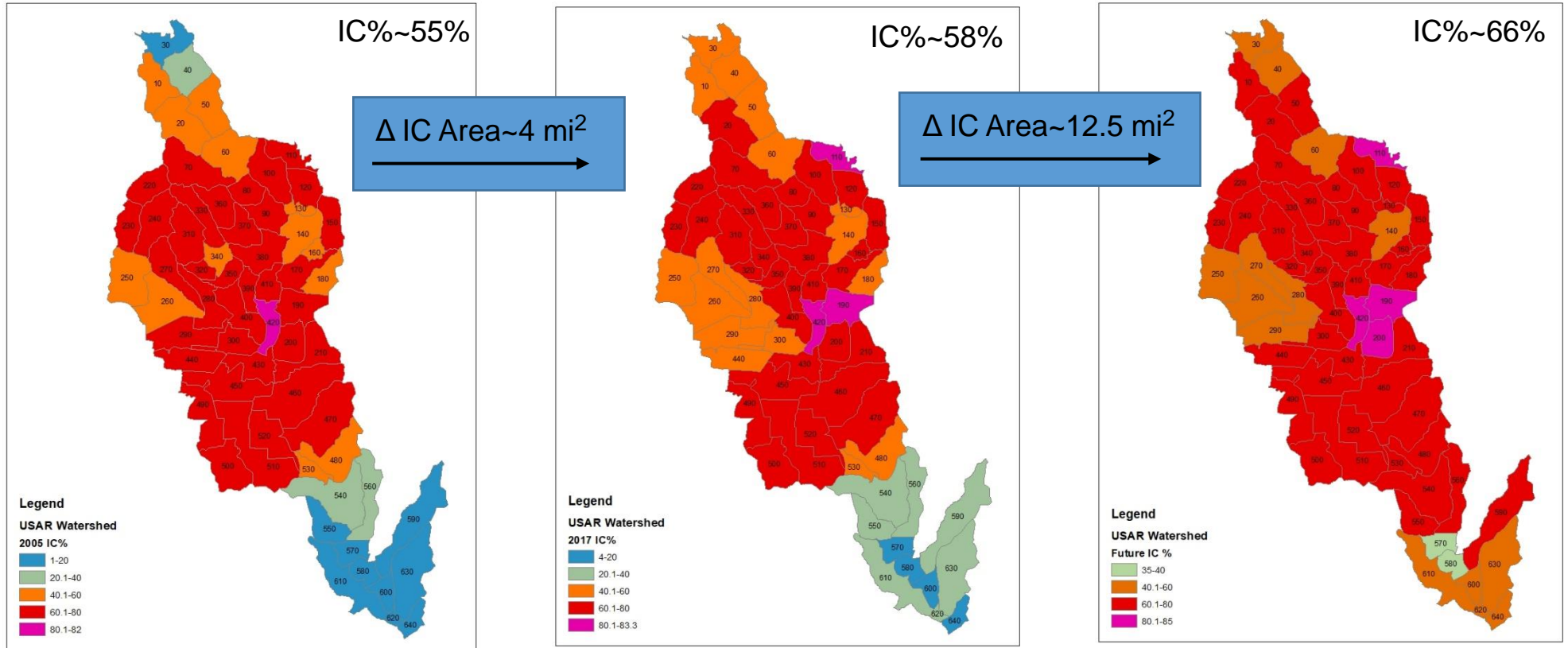
2017 Impervious Cover



2040 Impervious Cover



USAR Watershed



2005 Impervious Cover

2017 Impervious Cover

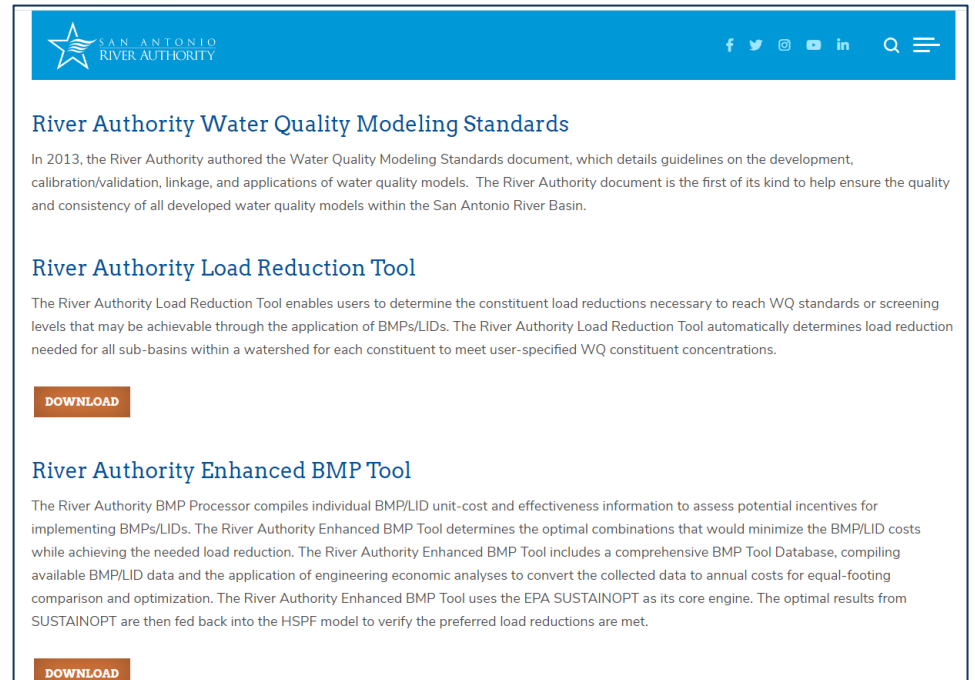
Future Conditions Impervious Cover



WQ Modeling Tools

Approach and Tools to allow quantitative WQ planning

- SARA WQ modeling standards
- Timeseries Utility Tool
- Load Reduction Tool
- SARA Enhanced BMP Tool
 - BMP Database
- *BMP Processor Tool*



The screenshot displays the San Antonio River Authority website. The header features the organization's logo and social media icons. The main content area lists three key tools:

- River Authority Water Quality Modeling Standards**
In 2013, the River Authority authored the Water Quality Modeling Standards document, which details guidelines on the development, calibration/validation, linkage, and applications of water quality models. The River Authority document is the first of its kind to help ensure the quality and consistency of all developed water quality models within the San Antonio River Basin.
- River Authority Load Reduction Tool**
The River Authority Load Reduction Tool enables users to determine the constituent load reductions necessary to reach WQ standards or screening levels that may be achievable through the application of BMPs/LIDs. The River Authority Load Reduction Tool automatically determines load reduction needed for all sub-basins within a watershed for each constituent to meet user-specified WQ constituent concentrations.
- River Authority Enhanced BMP Tool**
The River Authority BMP Processor compiles individual BMP/LID unit-cost and effectiveness information to assess potential incentives for implementing BMPs/LIDs. The River Authority Enhanced BMP Tool determines the optimal combinations that would minimize the BMP/LID costs while achieving the needed load reduction. The River Authority Enhanced BMP Tool includes a comprehensive BMP Tool Database, compiling available BMP/LID data and the application of engineering economic analyses to convert the collected data to annual costs for equal-footing comparison and optimization. The River Authority Enhanced BMP Tool uses the EPA SUSTAINOPT as its core engine. The optimal results from SUSTAINOPT are then fed back into the HSPF model to verify the preferred load reductions are met.

Each tool description is followed by a "DOWNLOAD" button.

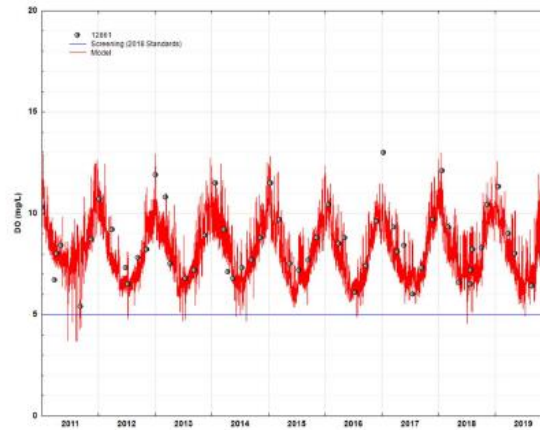
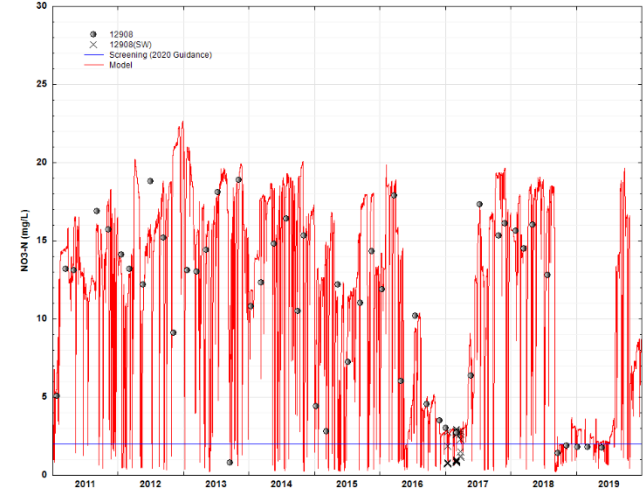
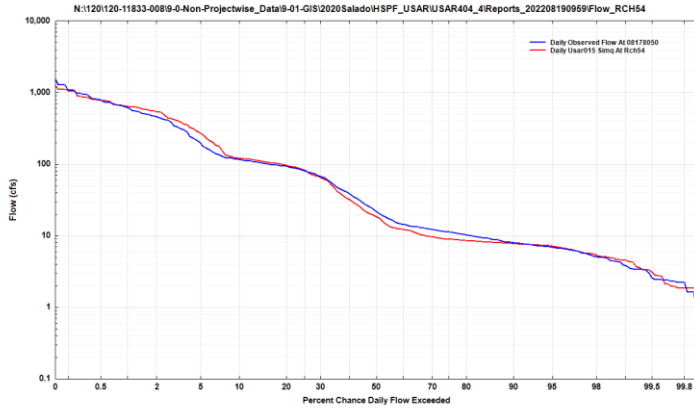


Data

- DFIRM
 - Subbasin delineation
 - Stream shapefile
 - HEC-HMS
 - HEC-RAS
 - Topography
 - DEM
 - Contours
 - Aerial images
 - SSURGO soil data
 - Landuse & IC%
 - Met data (NOAA)
- Rainfall
 - NOAA
 - EAA (gage, NEXRAD)
 - SARA
 - USGS
 - Diversion
 - Wastewater data
 - USGS flow data
 - Water Quality
 - SWQM
 - USGS
 - 2020 303(d)
 - Screening levels
- SSO
 - OSSF (estimates)
 - Dams/reservoirs
 - From HMS
 - Groundwater recharge & spring flow
 - Major development centers
 - QUAL-TX models
 - Atmospheric deposition*
 - No relevant data
 - Agricultural data
 - SELECT or EC loading estimates



Calibration

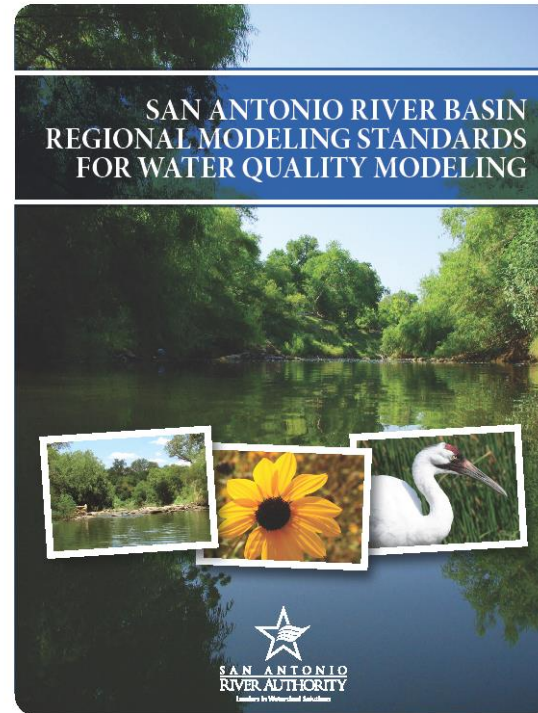
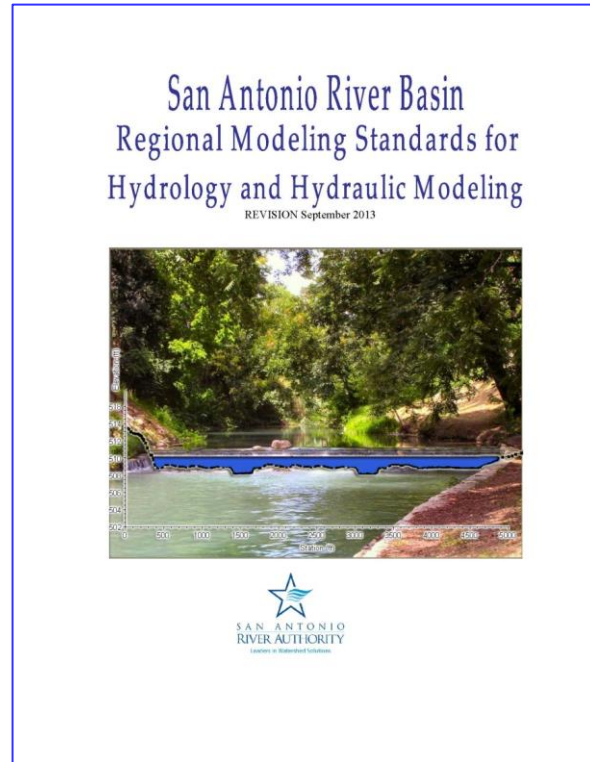


Peer-Review Comments

- Overall, the setup of the model appears to have been an extensive and impressive effort with a high level of detail, especially in the spatial definition for both land uses and stream reaches.
- In summary, the model demonstrates that a significant and comprehensive effort was invested in this model development work. The models contain reasonable parameter sets, have no serious flaws (to our knowledge), and should provide a sound basis for future use.

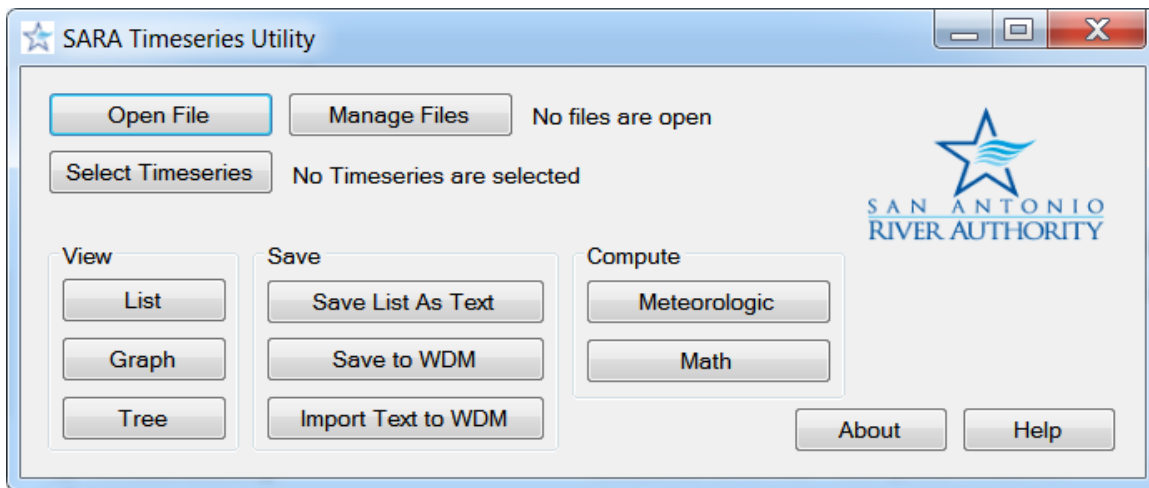


SARA WQ Modeling Standards Document



SARA Timeseries Utility Tool

- Enhanced efficiency in reading large timeseries records (e.g. HSPF binary output).
- Developed, tested, and released to public through EPA BASINS user community on 10/24/2013.
- Replaced WDMUtil
- Added GSSHA Converter in 2014



SARA Tools Suggested by National Experts

From: Tom Jobs [mailto:TJobs@sjrwmd.com]

Sent: Monday, April 18, 2016 10:09 AM

To: Private list for BASINS users

Subject: RE:[basinsinfo] WdmUtil and Office 2016

Thanks for the reply, Laura. There is no special connection with Office products – it's simply that the Office 2016 installation apparently breaks some system call used by WdmUtil, probably by updating a system DLL in a way that makes it incompatible with the old programs. Uninstalling and reinstalling WdmUtil etc. does not help. Virtual XP might be worth looking at as a temporary fix, though **I do recommend for you (and my colleagues) to make the move to SARA** and BASINS 4 in the long run.

Tom Jobs

Senior Engineer Scientist

Bureau of Watershed Management

St. Johns River Water Management District

P.O. Box 1429 ● Palatka, FL 32178-1429

Office: (386) 329-4463

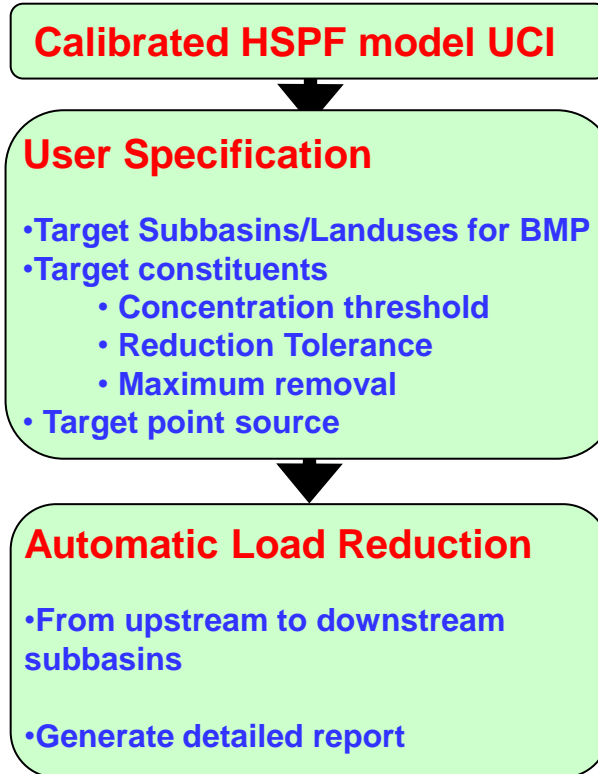
Email: tjobs@sjrwmd.com

Website: www.sjrwmd.com

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SARA Load Reduction Tool



- Uses load reduction factors in HSPF BMP Module.
- Automates tedious process for large watershed models.
- Compared to manual processes.
- Developed, tested, and released to public through EPA BASINS user community on 5/09/2014.




SARA Load Reduction Tool

SARA Load Reduction Tool Version 1.0 (January, 2014)

UCI:

Spec:

Auto Run Status

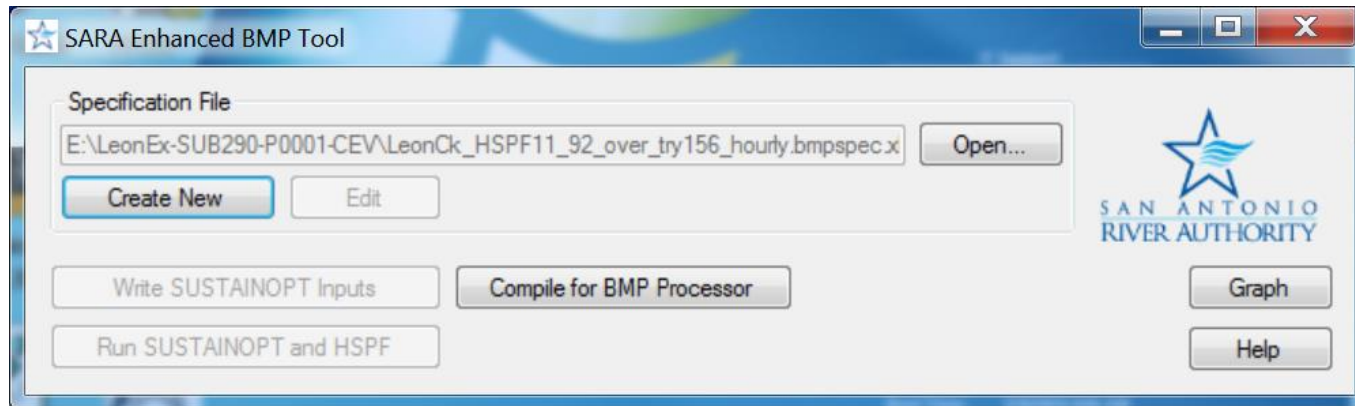


Reach	BACT	TEMP	CBOD	ORGN	NH3N	NO3N	ORGP	ORTHOP	SED	PB	ZN	CHLA
10	79.222	19.157	1.580	0.181	0.013	0.484	0.024	0.008	26.072	0.103	1.752	0.016
20	89.995	19.463	1.623	0.177	0.013	0.500	0.025	0.008	39.277	0.102	1.722	0.017
30	126.000	20.476	1.476	0.134	0.016	0.479	0.020	0.012	49.988	0.140	1.854	0.012
40	125.590	20.454	1.770	0.175	0.017	0.500	0.031	0.016	50.000	0.107	2.112	0.014
50	126.000	21.262	1.999	0.215	0.028	0.483	0.044	0.032	50.000	0.117	2.684	0.014
60	125.230	21.883	2.000	0.377	0.056	0.500	0.050	0.040	50.000	0.193	5.000	0.900
70	136.400	21.133	2.000	0.544	0.039	0.500	0.079	0.035	50.000	0.125	3.393	4.050
80	125.950	21.962	1.943	0.383	0.073	0.497	0.048	0.039	50.000	0.143	5.000	0.198
90	126.000	22.387	1.998	0.335	0.060	0.500	0.048	0.040	50.000	0.133	4.492	0.029
100	139.450	21.687	1.993	0.528	0.045	0.500	0.076	0.039	49.960	0.140	4.155	3.441
110	126.000	22.821	1.991	0.299	0.051	0.493	0.050	0.038	50.000	0.137	3.896	0.034
120	126.000	22.099	1.999	0.383	0.070	0.500	0.049	0.039	50.000	0.152	4.554	1.078
130	126.000	22.145	2.000	0.349	0.054	0.500	0.050	0.037	50.000	0.142	4.047	0.709
140	362.310	24.953	1.828	0.279	0.037	0.373	0.047	0.041	95.779	0.187	4.717	0.026

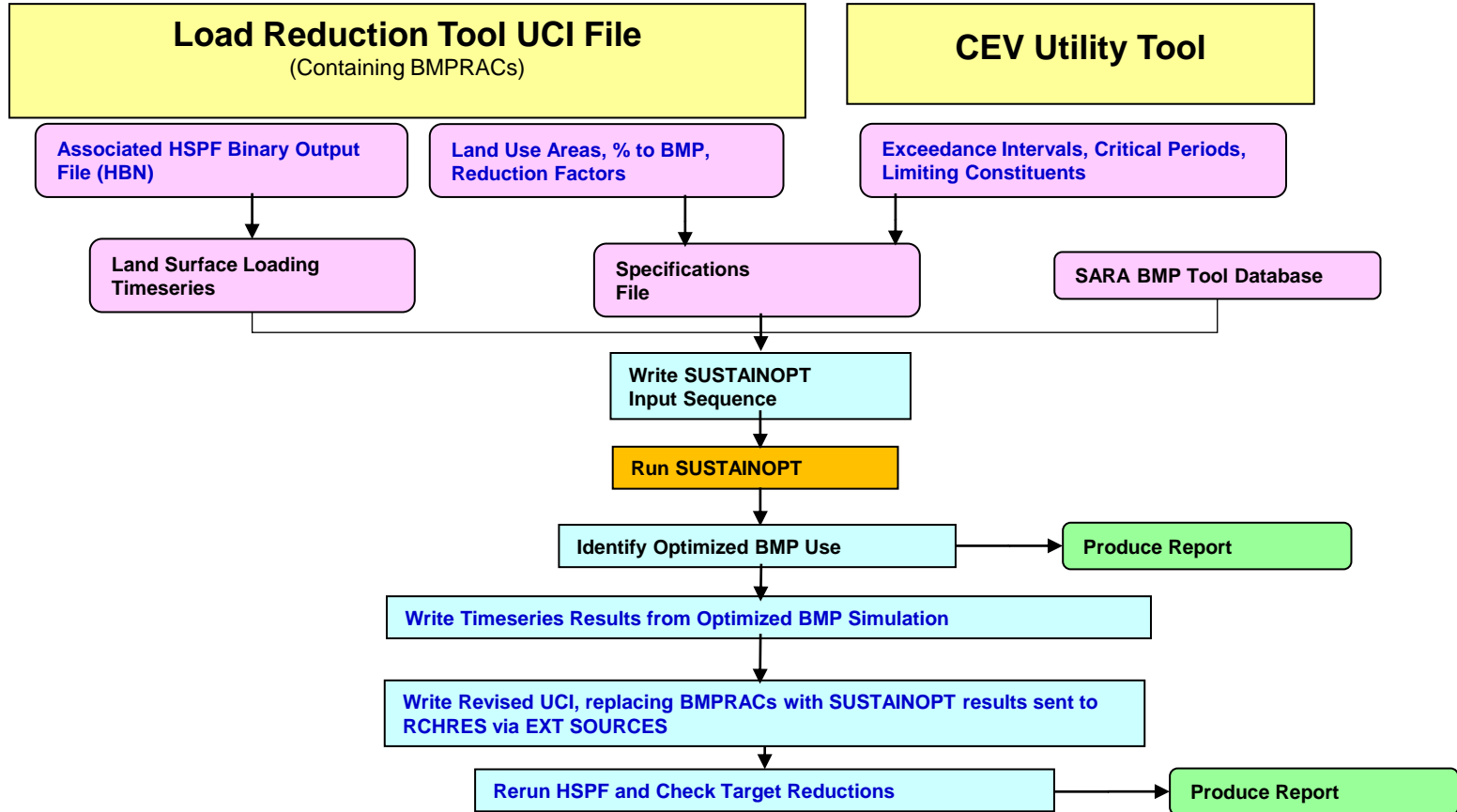


SARA Enhanced BMP Tool

- Identify LID/BMPs to achieve needed load reductions.
- Use LRT results or any calibrated HSPF models.
- Combines robust land surface representation from HSPF with EPA SUSTAIN's BMP capabilities.
- Avoids ArcGIS version issue inherent in SUSTAIN by using non-GIS component (SUSTAINOPT)



BMP Tool Workflow Diagram



SARA BMP Tool Database

SustainBMPParameters_021015TextOnly - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Juhn-Yuan Su

Clipboard Font Alignment Number Styles Cells Editing

F26 : fx 5

	A	B	C	D	E	F	G	H
	cBMP SITE	BMP NAME	BMP TYPE	D Area	NUM UNIT	DD AREA	Pre LUType	Aquifer ID
2								
3	1	DryPond_Ave	DRYPOND	-99	-99	10	1	0
4	2	ExtendedDetention_Small	DRYPOND	-99	-99	10	1	0
5	3	ExtendedDetention_Ave	DRYPOND	-99	-99	42.5	1	0
6	4	ExtendedDetention_Large	DRYPOND	-99	-99	75	1	0
7	5	StreetSweep_Arterial_4X	DRYPOND	-99	-99	1	1	0
8	6	StreetSweep_Arterial_4X_New	DRYPOND	-99	-99	1	1	0
9	7	StreetSweep_Arterial_8X	DRYPOND	-99	-99	1	1	0
10	8	StreetSweep_Arterial_8X_New	DRYPOND	-99	-99	1	1	0
11	9	StreetSweep_Resid_2X	DRYPOND	-99	-99	1	1	0
12	10	StreetSweep_Resid_2X_New	DRYPOND	-99	-99	1	1	0
13	11	StreetSweep_Resid_4X	DRYPOND	-99	-99	1	1	0
14	12	StreetSweep_Resid_4X_New	DRYPOND	-99	-99	1	1	0
15	13	StreetSweep_CBD_363	DRYPOND	-99	-99	1	1	0
16	14	StreetSweep_CBD_363_New	DRYPOND	-99	-99	1	1	0
17	15	StreetSweep_CBD_182	DRYPOND	-99	-99	1	1	0
18	16	StreetSweep_CBD_182_New	DRYPOND	-99	-99	1	1	0
19	20	RainBarrel_Ave	RAINBARREL	-99	-99	0.01377	1	0
20	30	BioRetentionBasin_Ave	BIORETENTION	-99	-99	2.5	1	0
21	31	BioRetentionBasin_Small	BIORETENTION	-99	-99	0.03061	1	0
22	32	BioRetentionBasin_Large	BIORETENTION	-99	-99	5	1	0
23	33	PlanterBox_Ave	BIORETENTION	-99	-99	0.35	1	0
24	40	WetPond	WETPOND	-99	-99	25	1	0
25	41	StormWaterWetland	WETPOND	-99	-99	10	1	0
26	45	WetPond	WETPOND	-99	-99	10	1	0

BMP_LanduseMatrix BMP_Trains 715_BMPDef 725_ClsABMPParm 730_CisternControl 735_ClsBBMPParm ...

READY 120%

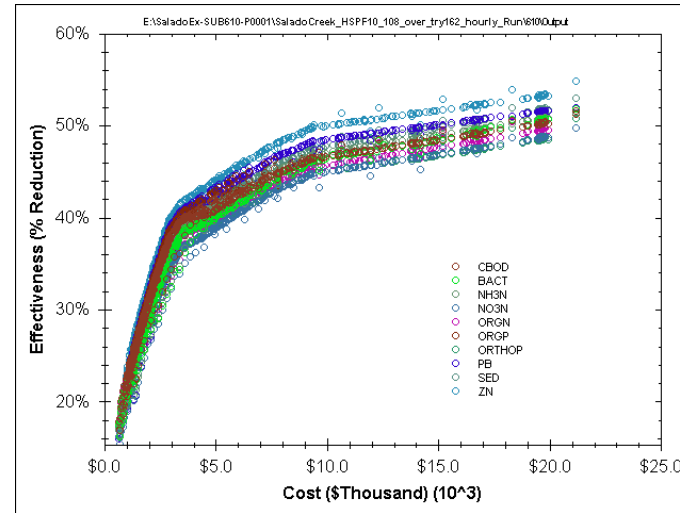
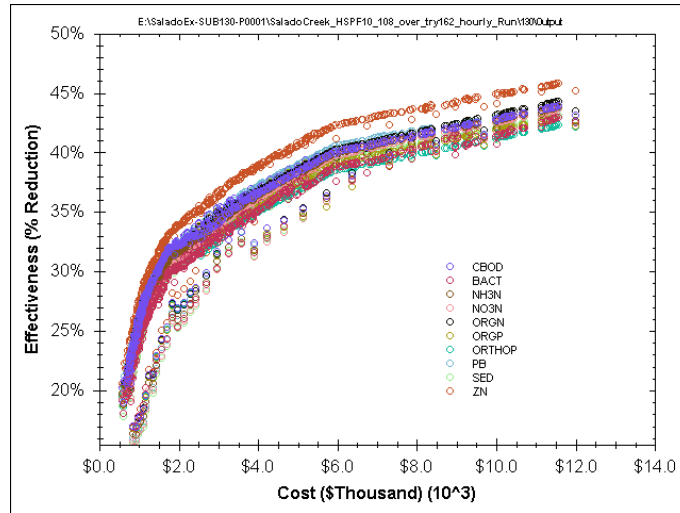


BMP Tool – Optimization

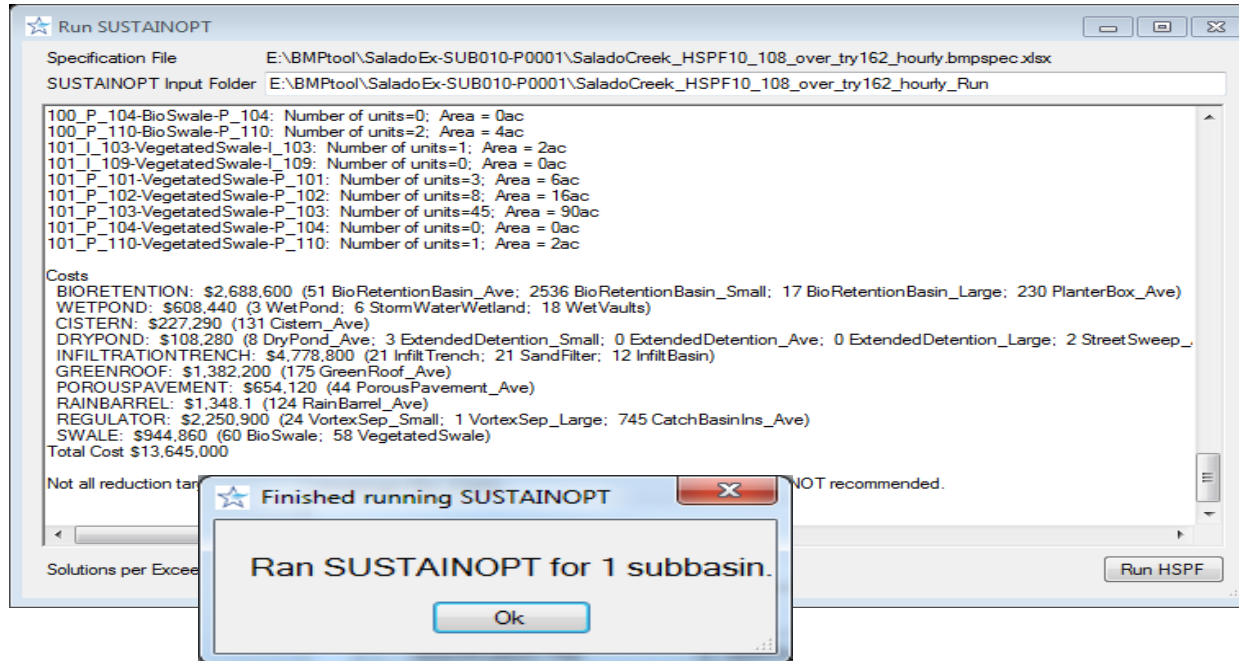
- SUSTAINOPT provides two optimization methods:
- **Scatter Search**
 - Single objective - seeks to identify a unique optimal solution for multiple reduction targets
 - Proved ineffective for BMP Tool's requirements (code deficiencies noted in limiting optimization run time)
- **Non-dominated Sorting Genetic Algorithm II (NSGA-II)**
 - Multi-objective - generates Cost Effectiveness (CE) curve of optimal solutions
 - Based on a single “limiting” constituent
 - Allows for substantial computational efficiency using CEV approach
 - Explores full solution space, providing greater understanding of cost/benefit trade-offs



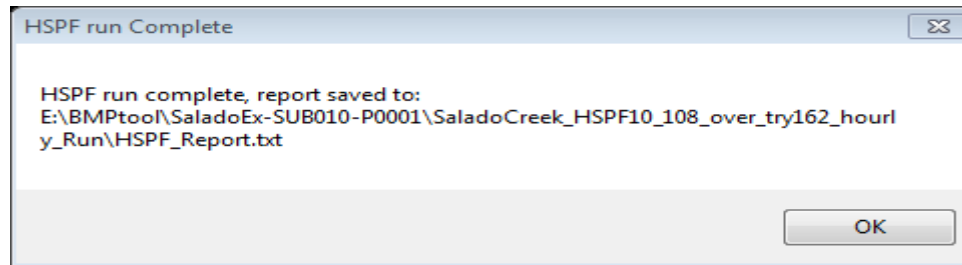
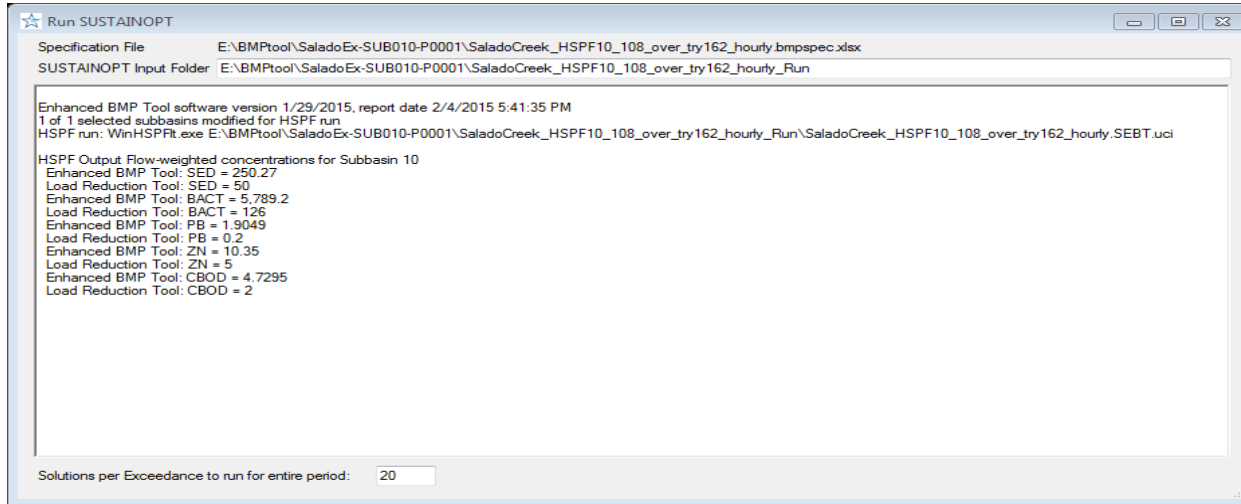
Cost Effective Curves



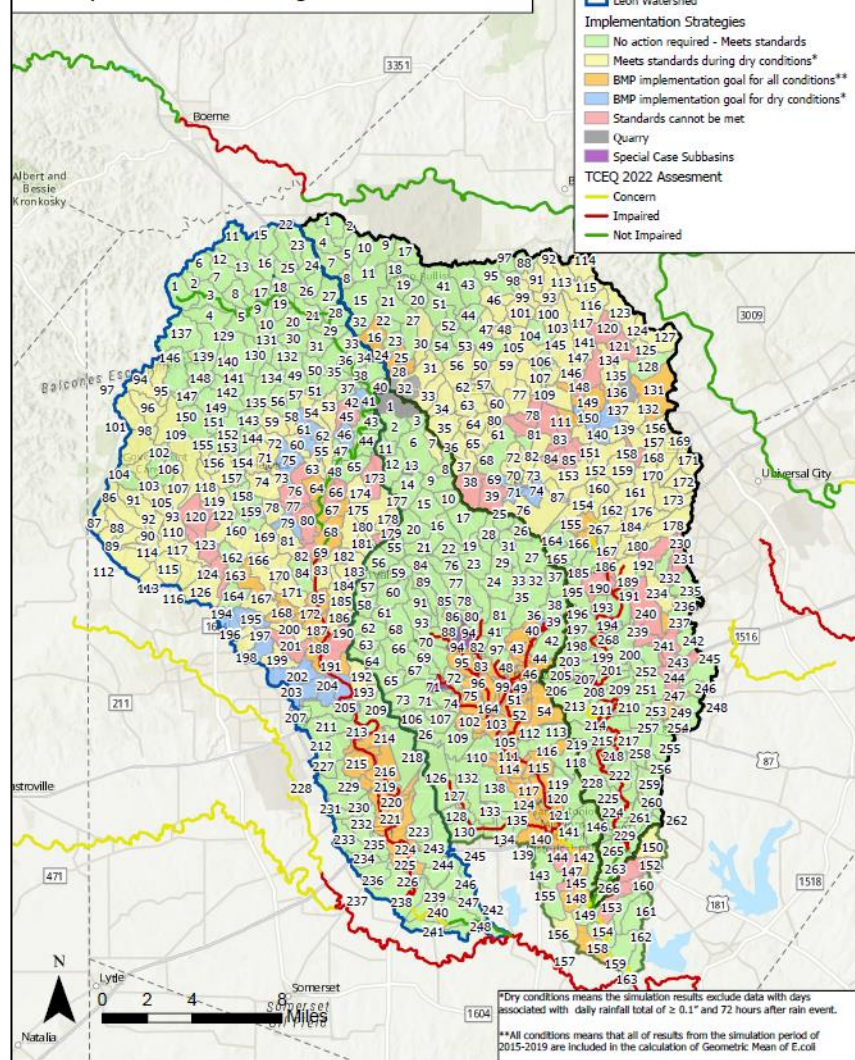
Running Enhanced BMP Tool



Running Enhanced BMP Tool



USAR, Leon Creek, and Salado Creek Watersheds BMP Implementation Strategies



BMP Implementation Strategies

Awards and Recognitions

- WEF Project Excellence Award (2020)
- ACEC Texas Gold Medal Award (2016)
- ACEC National Recognition Award (2016)
- Numerous presentations (invited and conference), publications and magazine articles



Questions?

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210-302-4290

