Barton Springs Impervious Surfaces

This scenario is intended to be used to mimic hydrology of untreated portions of the Barton Springs Segment (BSS) of the Edwards Aquifer. The intention is to couple the edge of field concentrations from this scenario with the edge of field concentrations from the residential scenario for Barton Springs to generate weighted concentrations for areas of varying impervious cover. Therefore, this scenario relies on a similar soil series as the residential scenario; however the upper horizon has been adjusted to a non-soil nature.

Although this scenario has undergone basic testing, the scenario should be used with caution since it has not been fully tested under a range of conditions to ensure that PRZM is capable of simulating pesticide runoff from impervious surfaces. For instance, During development, it was impossible to force PRZM to convert all precipitation to surface runoff (even with a curve number of 100). In addition, setting all soil parameters to zero in the surface horizon caused errors in PRZM. For example, soil moisture parameters cannot be set to zero, since PRZM requires soil moisture for partitioning the chemical into the dissolved phase for transport. Additionally, CAM selection appears to be somewhat problematic. Since there are no crops in an impervious surface the maximum interception storage of crop, rooting depth, and coverage has been set to zero. However, the consequences for a foliar application (CAM = 2) which may result from direct spraying of the surface, CAM may not be pertinent. During testing, this scenario was run several times using various CAM values. When setting CAM = 1 versus CAM = 2 the same EECs were produced. When using CAM = 1, an application depth of 4 cm is automatically used. When running PRZM/EXAMS with CAM = 4, depth = 1 EECs were even higher than with CAM = 1 or 2. If the scenario is run with depth = 0 the model produces no EECs. For this scenario, users may need to set CAM = 4, depth = 0.1 cm. Furthermore, if this scenario is couple with a residential scenario, the effects of irrigation in one scenario versus not irrigation in another must be considered.

Analysis of land use and soils data indicates that Brackett soils are found in both the contributing and recharge zones of the Edwards Aquifer and are the most common soil on which residential dwellings are located, accounting for 35% of all soils in residential areas (USDA 2006; USGS 2003). Brackett soils are often undulating (Soil Survey Staff 2006) and are desirable for development due to their scenic nature (Volente 2004). The Brackett series is loamy, carbonatic, thermic, shallow Typic Haplustepts. This soil consists of very shallow to shallow soils over bedrock. These well drained and moderately permeable soils formed in residuum over chalky limestone bedrock (USDA 2001).

The Brackett series was selected for this scenario because it is both highly representative of residential areas in the BSS and because it represents the 90th percentile of vulnerability, drainage, erodibility, and slope. The relatively low organic matter content is also expected to result in lower microbial activity and thus reduced potential for pesticide degradation. Brackett soils have a USLE K factor of 0.37 which includes the 90th percentile of these soils in erodibility (Table 5). Brackett is a Hydrologic Group C soil which accounts for approximately 47% of residential soils in drainage. Slopes range from 1 to 60 percent (Soil Survey Staff, 2006); however the most typical range for the Brackett series in residential areas is 1-12 percent (USDA 2006; USGS 2003).

The meteorological station selected for this scenario is located in Austin, Texas. This station is the closest available weather station that includes data required for PRZM.

Table 1. PRZM 3.12 Climate and Time Parameters for Barton Springs, TX.		
Parameter	**Value**	**Source/Comments**
Starting Date	Jan. 1, 1961	Meteorological File from Austin, TX (W13958)
Ending Date	Dec. 31, 1990	Meteorological File from Austin, TX (W13958)
Pan Evaporation Factor (PFAC)	0.69	PRZM Manual Figure 5.1 (EPA 1998).
Snowmelt Factor (SFAC)	0.36	PRZM Manual, Table 5.1 (EPA 1998).
Minimum Depth of Evaporation (ANETD)	25	Mid point of range (20-30), PRZM Manual, Figure 5.2 (EPA 1998).

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Barton Springs – impervious surfaces.		
Parameter	**Value**	**Source/Comments**
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	Default value.
USLE K Factor (USLEK)	0	Set to zero, no erodibility for impervious surfaces.
USLE LS Factor (USLELS)	1.34	Calculated according to Haan and Barfield (1978) equation: $LS = ((\lambda/72.6)^m)((430x^2 + 30x + 0.43)/6.613)$, where λ = slope length, $x = SLP/100$ and m = constant. In this case, λ = 400 m (default value) and m = 0.5 (EPA 2004).
USLE P Factor (USLEP)	1	Contour plowing is not applicable (EPA 2004).
Field Area (AFIELD)	10 ha	Default drainage area for standard ecological pond (EPA, 2004).
NRCS Hyetograph (IREG)	4	PRZM Manual, Figure 5.12 (EPA, 1998).
Slope (SLP)	6 %	Brackett-Rock Outcrop-Complex slope range 1-12% (USDA 2006). Midpoint of the range as per guidance (EPA, 2004)
Hydraulic Length (HL)	356 m	Default value for standard ecological pond (EPA, 2004)
Irrigation Flag (IRFLAG)	0	Irrigation is not warranted for impervious surfaces.
* EI = 100 ft-tons * in/ acre*hr		

Table 3. PRZM 3.12 Crop Parameters for Barton Springs – impervious surfaces.		
Parameter	**Value**	**Source/Comments**
Initial Crop (INICRP)	1	Default value
Initial Surface Condition (ISCOND)	1	Scenario does not warrant crop parameters. Set to 1 to allow PRZM to execute.
Number of Different Crops (NDC)	1	Scenario does not warrant modeling crop cover. Set to 1 to allow PRZM to execute.
Number of Cropping Periods (NCPDS)	30	Set to weather data in meteorological file: Austin, TX (W13958).
Maximum rainfall interception storage of crop (CINTCP)	0	No interception on impervious surfaces (Dunne and Leopold, 1978)
Maximum Active Root Depth (AMXDR)	0 cm	Crop parameters are not applicable to this scenario.
Maximum Canopy Coverage (COVMAX)	0	Crop parameters are not applicable to this scenario.
Soil Surface Condition After Harvest (ICNAH)	1	Crop parameters are not applicable to this scenario; however value was set to 1 to allow PRZM to assign curve number.
Date of Crop Emergence (EMD, EMM, IYREM)	1/1/61	Crop parameters are not applicable to this scenario; however values were assigned to prevent PRZM from crashing.
Date of Crop Maturity (MAD, MAM, IYRMAT)	2/1/61	Crop parameters are not applicable to this scenario; however values were assigned to prevent PRZM from crashing.
Date of Crop Harvest (HAD, HAM, IYRHAR)	31/12/61	Crop parameters are not applicable to this scenario; however values were assigned to prevent PRZM from crashing.
Maximum Canopy Height (HTMAX)	0	Crop parameters are not applicable to this scenario.
Maximum Dry Weight (WFMAX)	0.0	Crop parameters are not applicable to this scenario.
SCS Curve Number (CN)	98, 98, 98	TR-55 (Table 2-2a) CN for impervious areas (USDA 1986)
Manning's N Value (MNGN)	0.011	TR-55 (Table 3-1). Value for smooth surfaces (concrete, asphalt, gravel, or bare soil)
USLE C Factor (USLEC)	0	Set to zero. No cover and management fact or is applicable. Expected to produce 100% less soil loss than a similar continuously tilled areas.

Table 4. PRZM 3.12 “Brackett-Rock Outcrop-Complex” Soil Parameters for Barton Springs, TX – impervious surfaces.

Parameter	Value	Source/Comments
Total Soil Depth (CORED)	46 cm	Brackett-Rock outcrop-complex, 1-12% slopes, Travis County, TX. NRCS Soil Data Mart Database (http://soildatamart.nrcs.usda.gov/).
Number of Horizons (NHORIZ)	3	This scenario is intended to be coupled with the residential scenario. According to an extension agent (Cris Perez), residential areas reside on a variety of soils. Brackett is a common soil type of residential areas in the BSS.
Horizon Thickness (THKNS)	10 cm (HORIZN =1) 5 cm (HORIZN =2) 31 cm (HORIZN =3)	Additional data were listed for a 4^{th} HORIZN. However, these were not included in this soil profile since the 4^{th} HORIZN is composed of bedrock.
Bulk Density (BD)	1.90 g/cm3 (HORIZN =1) 1.40 g/cm3 (HORIZN =2) 1.43 g/cm3 (HORIZN =3)	Set horizon 1 to high bulk density to mimic impervious surface. The actual density of asphalt is actually quite low, around 1 (Conoco Philips MSDS) and the density of concrete asphalt is 2.24 (http://www.simetric.co.uk/si_materials.htm). For this scenario, PRZM accepted BD as high as 1.9 before producing a fatal error.
Initial Water Content (THETO)	0.280 cm3/cm3 (HORIZN =1) 0.280 cm3/cm3 (HORIZN =2) 0.252 cm3/cm3 (HORIZN =3)	
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 5.0 cm (HORIZN = 2) 1.0 cm (HORIZN = 3)	PRZM Scenario Guidance (EPA 2004).
Field Capacity (THEFC)	0.280 cm3/cm3 (HORIZN =1) 0.280 cm3/cm3 (HORIZN =2) 0.252 cm3/cm3 (HORIZN =3)	THEFC for Horiz 1 is not representative of impervious surfaces, however PRZM requires soil moisture content in Horiz 1 to allow partitioning of pesticide into runoff water (Eq. 6-1, PRZM Manual, EPA 1998).
Wilting Point (THEWP)	0.280 cm3/cm3 (HORIZN =1) 0.164 cm3/cm3 (HORIZN =2) 0.145 cm3/cm3 (HORIZN =3)	THEWP for Horiz 1 set to THEFC to prevent transpiration.
Organic Carbon Content (OC)	0.00 % (HORIZN =1) 1.16 % (HORIZN =2) 0.73 % (HORIZN =3)	Adjusted using the relationship % OC = % Organic Matter/1.724 (Doucette 2000). Set to 0 in upper horizon to mimic impervious surface.

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