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Variable Group	Variable	Variable Description	Source	Rationale
Geomorphology & Hydrology				
Flow & Velocity	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	FLASH_00	2000 flash index: Q10:Q90 for 2000 water year (USGS gage data)	Wilhelm et al. 2001	Eliminated: Year 2000 precedes period of fish data
	BASEFLOW	Standardized baseflow: Q90 standardized for drainage area (m3/s/km2)	Wilhelm et al. 2001	Eliminated: True baseflow conditions do not exist
	Q50	Average 50% exceedence level for discharge from USGS gage data (cms)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	MAD	Mean Annual Discharge from USGS gage data (cms)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	Q	Average discharge (?(XAREA*VEL)), calculated with MathCad (cms)	Wilhelm et al. 2001	Eliminated; redundant with Q50 and MAD
	MAX_VEL	Maximum velocity averaged for transects (m/s)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	LOCMAXV	Location of maximum velocity as a proportion of the total width	Wilhelm et al. 2001	Eliminated: data not available
	AVG_VEL	Average velocity (Q/XAREA) averaged for transects (m/s)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	EPA_5	Channel flow status	Wilhelm et al. 2001	Eliminated: Not applicable
	P51_3	Velocity-to-depth ratio	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	P51_4	Flow stability	Wilhelm et al. 2001	Eliminated: Not applicable
	STAGE	Stage level	MWRDGC PHA	Eliminated: Not applicable
	Flow_Power	Power per unit of stream length (W/m)	Short 2005	Eliminated: Not applicable
	WATER_LEVEL	CAWS PHA Stream order	MWRDGC PHA	Eliminated: Not applicable
Channel morphology	DR_AREA	Drainage area (km2)	Wilhelm et al. 2001	Eliminated: Not applicable
	LINK	Stream link calculated in GIS	Wilhelm et al. 2001	Eliminated: Not applicable
	ORDER	Stream order, for the Lower Peninsula from Folsom and Winters 1970	Wilhelm et al. 2001	Eliminated: Not applicable
	CAWS_ORDER	CAWS PHA Stream order	MWRDGC PHA	Eliminated: Not applicable
	TH_DEPTH	Average thalweg depth from measurements every 40 meters (m)	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	SD_THDEP	Standard deviation of thalweg depths (m)	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	XAREA	Cross-sectional area (?[(di+di+1)/2*wi]) of wetted channel (m2)	Wilhelm et al. 2001	Retained
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001	Retained
	HYDR_RAD	Low flow hydraulic radius: XAREA divided by WET_PER (m)	Wilhelm et al. 2001	Retained
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001	Retained
	LOCMAXD	Location of maximum depth as a proportion of total width	Wilhelm et al. 2001	Retained
	CWS_W_BO	CAWS width bottom of channel	CAWS Unique	Retained
	CAWS_WIDTH_S	Site channel width as measured for PHA	MWRDGC PHA	Eliminated: new widths measured at stations for consistency
	CAWS_DEPTH	Site depth as measured for PHA	MWRDGC PHA	Retained
	CAWS_CHNLZ	Site channelization for PHA	MWRDGC PHA	Eliminated: most of system is channelized
	AVG_DPTH	Average depth: XAREA divided by WET_WIDTH averaged for transects (m)	Wilhelm et al. 2001	Retained
	BF_WIDTH	Stream width at estimated bankfull condition, averaged for transects (m)	Wilhelm et al. 2001	Eliminated: bankfull condition does not exist
	WETWIDTH	Stream width at low flow wetted channel, averaged for transects (m)	Wilhelm et al. 2001	Retained
	WETWIDTH_ALT	alternate stream width	Wilhelm et al. 2001	Retained
	SD_WW	Standard deviation for wetted width (m)	Wilhelm et al. 2001	Eliminated: wetted width varies little
	WW_X_THD	Mean wetted width times mean thalweg depth (m2)	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	SD_WWXTH	Standard deviation wetted width times thalweg depth (m2)	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	WW_DIV_D	Mean wetted width divided by mean depth	Wilhelm et al. 2001	Retained
	BF_TO_WW	Ratio of bankfull width to wetted width	Wilhelm et al. 2001	Eliminated: bankfull condition does not exist
	BF_HGT	Incision: average bankfull height relative to low flow water level (m)	Wilhelm et al. 2001	Eliminated: bankfull condition does not exist
	SD_BF_HT	Standard deviation of bankfull height (m)	Wilhelm et al. 2001	Eliminated: bankfull condition does not exist
	SINUOS	Sinuosity: ratio of stream length to straight-line distance (1:24,000 map)	Wilhelm et al. 2001	Eliminated: sinuosity does not exist
	SINU_PH	Ratio of stream length to straight-line distance (aerial photographs)	Wilhelm et al. 2001	Eliminated: sinuosity does not exist
	SLOPE	Stream gradient: elevation drop divided by stream length (1:24,000 map)	Wilhelm et al. 2001	Eliminated: very low slope; does not vary
	EPA_3	Pool variability	Wilhelm et al. 2001	Eliminated: no pools
	EPA_7	Channel sinuosity	Wilhelm et al. 2001	Eliminated: sinuosity does not exist
	P51_6	Pools-Riffles-Runs-Bends	Wilhelm et al. 2001	Eliminated: no pools & riffles
	OFF_CHAN	Number of tributary, backwater, and off-channel habitats from on-site	Wilhelm et al. 2001	Retained
	TRIB_PH	Number of tributary and backwater habitats from aerial photographs	Wilhelm et al. 2001	Retained
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq.)	Alinghaus et al 2002* adopted	Retained
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique	Retained

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Variable Group	Variable	Variable Description	Source	Rationale
Sediment				
Thalweg	BH_TH	% Hard pan, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	BL_TH	% Boulder, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	CB_TH	% Cobble, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	GC_TH	% Coarse Gravel, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	GF_TH	% Fine Gravel, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	SA_TH	% Sand, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	FN_TH	% Fines, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	DOM_TH	Dominant thalweg substrate	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	SBD_THWG	Second most dominant thalweg substrate	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	SAFN_TH	% Sand and Fines, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	BIG_TH	% Substrate fine gravel, coarse gravel, cobble, and boulder, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
	TH_AVGSZ	Average particle size, thalweg	Wilhelm et al. 2001	Eliminated: No thalweg exists in system
Deep	BH_D	% Hard pan, deep	Wilhelm et al. 2001	Retained
	BL_D	% Boulder, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	CB_D	% Cobble, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	GC_D	% Coarse Gravel, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	GF_D	% Fine Gravel, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	SA_D	% Sand, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	FN_D	% Fines, deep	Wilhelm et al. 2001	Eliminated: Insufficient data
	DOM_D	Dominant deep substrate	Wilhelm et al. 2001	Retained
	SBD_D	Second most dominant deep substrate	Wilhelm et al. 2001	Eliminated: Insufficient data
	SAFN_D	% Sand and Fines, deep	Wilhelm et al. 2001	Retained
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001	Retained
Shallow	D16	Particle size of 16th percentile from littoral pebble count	Wilhelm et al. 2001	Eliminated: not applicable
	D50	Median particle size from littoral pebble count	Wilhelm et al. 2001	Eliminated: not applicable
	D84	Particle size of 84th percentile from littoral pebble cont	Wilhelm et al. 2001	Eliminated: not applicable
	D84_D16	Ratio of size of 84th:16th percentile; a measure of particle size variability	Wilhelm et al. 2001	Eliminated: not applicable
	BH_S	% Hard pan, shallow	Wilhelm et al. 2001	Retained
	BL_S	% Boulder, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	CB_S	% Cobble, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	GC_S	% Coarse Gravel, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	GF_S	% Fine Gravel, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	SA_S	% Sand, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	FN_S	% Fines, shallow	Wilhelm et al. 2001	Eliminated: Insufficient data
	DOM_S	Dominant shallow substrate	Wilhelm et al. 2001	Retained
	SBD_S	Second most dominant shallow substrate	Wilhelm et al. 2001	Eliminated: Insufficient data
	SAFN_S	% Sand and fines, shallow	Wilhelm et al. 2001	Retained
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001	Retained
Comb. Shallow and Deep	BH_C	% Hard pan, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	BL_C	% Boulder, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	CB_C	% Cobble, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	GC_C	% Coarse Gravel, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	GF_C	% Fine Gravel, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	SA_C	% Sand, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	FN_C	% Fines, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA	Retained
	CAWS_INSLG	CAWS PHA % Inorganic Sludge	MWRDGC PHA	Retained
	CAWS_CLAY	CAWS PHA % Clay	MWRDGC PHA	Eliminated: Insufficient data
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA	Retained
	DOM_C	Dominant combined substrate	Wilhelm et al. 2001	Eliminated: Insufficient data
	SBD_C	Second most dominant combined substrate	Wilhelm et al. 2001	Eliminated: Insufficient data
	SAFN_C	% Sand and Fines combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	BIG_C	% Substrate fine gravel, coarse gravel, cobble, and boulder, combined	Wilhelm et al. 2001	Eliminated: Insufficient data
	EMBEDD	Mean substrate embeddedness	Wilhelm et al. 2001	Eliminated: Insufficient data
	SD_EMBED	Standard deviation substrate embeddedness	Wilhelm et al. 2001	Eliminated: Insufficient data
Visual Assessments	CAWS_DPTH_FNS	CAWS PHA Depth of fines	MWRDGC PHA	Retained
	EPA_1	Epifaunal substrate/Available cover	Wilhelm et al. 2001	Eliminated: not applicable
	EPA_2	Pool substrate characterization	Wilhelm et al. 2001	Eliminated: not applicable
	EPA_4	Sediment deposition	Wilhelm et al. 2001	Eliminated: not applicable
	P51_1	Bottom substrate/Available cover [also considered within instream cover]	Wilhelm et al. 2001	Eliminated: not applicable
	P51_2	Embeddedness/Siltation [also considered within instream cover]	Wilhelm et al. 2001	Eliminated: not applicable
	P51_5	Bottom deposition	Wilhelm et al. 2001	Eliminated: not applicable

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Variable Group	Variable	Variable Description	Source	Rationale
Instream cover				
	AQ_VEG	Number of aquatic vegetative types within area	MWRDGC PHA	Retained
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001	Retained
	SD_MACRO	Standard deviation macrophyte coverage (m)	Wilhelm et al. 2001	Eliminated: Insufficient data
	SUB_STR	Number of subsurface structures for potential cover	MWRDGC PHA	Eliminated: Insufficient data
	SUB_LRG_N	Number of large subsurface structures	CAWS Unique	Eliminated: Insufficient data
	Num_Cover	Number of instream cover type types within area	MWRDGC PHA	Eliminated: Insufficient data
	PERC_COV	Percent of canopy cover over water - GIS-derived	MWRDGC PHA	Retained
	PERC_COV_ALT	Percent of canopy cover over water - field-measured	CAWS Unique	Retained
	WIDTH_COV	Measured average width of cover at station	CAWS Unique	Eliminated: replaced by DEPTH_COV
	LENGTH_COV	Mesured length of cover at station	CAWS Unique	Retained
	DEPTH_COV	Depth of shade cover	CAWS Unique	Retained
	ALGAE	% Cover algae, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	MACROPHY	% Cover macrophytes, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	LWD	% Cover large woody debris (LWD), littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	SWD	% Cover small woody debris (SWD), littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	LIVETREE	% Cover live trees in stream, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	OVHNGVEG	% Cover overhanging vegetation, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	LENGTH_OVR	Measured length of undercut banks at station	CAWS Unique	Retained
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique	Retained
	UNDERCT	% Cover undercut banks, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	BOULDER	% Cover boulders, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	ARTIFIC	% Cover artificial substrates, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	FISH_ALL	% Cover (all coverage categories, littoral plots)	Wilhelm et al. 2001	Eliminated: Insufficient data
	FISH_VEG	% Cover ALGAE and MACROPHY, littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	FISH_BIG	% Cover LWD, BOULDER, OVHNGVEG, ARTIFIC; littoral plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	FISH_NAT	% Cover LWD, SWD, LIVETREE, OVHNGVEG, UNDERCT, BOULDER (natural)	Wilhelm et al. 2001	Eliminated: Insufficient data
	LWD_VOL	Volume of wood for entire reach (m3/2000 m) from longitudinal survey	Wilhelm et al. 2001	Eliminated: not applicable
	NUM_LWD	Number of pieces of wood counted during longitudinal survey	Wilhelm et al. 2001	Eliminated: not applicable
	AVG_WOOD	Average size wood (m3)	Wilhelm et al. 2001	Eliminated: not applicable
	ISLANDS	Number of islands within 2,000 m reach (counted on site or from aerial photos)	Wilhelm et al. 2001	Eliminated: not applicable
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001	Retained
	SD_SECCHI	Standard deviation secchi depth (m)	Wilhelm et al. 2001	Eliminated: deemed not necessary
	SEC_1.5M	Secchi depth as proportion of 1.5 meters	Wilhelm et al. 2001	Eliminated: deemed not necessary
	SD_SEC1.5	Standard deviation of secchi depth as proportion of 1.5 m	Wilhelm et al. 2001	Eliminated: deemed not necessary
	SEC_VISI	Is secchi disk visible at the stream bottom? (Yes or No)	Wilhelm et al. 2001	Eliminated: not applicable
	EPA_1	Epifaunal substrate/Available cover [also considered within substrate]	Wilhelm et al. 2001	Eliminated: Insufficient data
	P51_1	Bottom substrate/Available cover [also considered within substrate]	Wilhelm et al. 2001	Eliminated: Insufficient data

Habitat Variable Reduction: Qualitative Screening

Variable Group	Variable	Variable Description	Source	Rationale
Bank and riparian condition				
Land Use	LB_LU	Dominant land use left bank (categorical)	Wilhelm et al. 2001	Retained
	RB_LU	Dominant land use right bank (categorical)	Wilhelm et al. 2001	Retained
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001	Retained
	WALL	Distance-weighted wall, dike, revetment, rip rap, dam	Wilhelm et al. 2001	Eliminated: not applicable
	BLDG	Distance-weighted buildings	Wilhelm et al. 2001	Eliminated: not applicable
	PVMT	Distance-weighted pavement and cleared lots	Wilhelm et al. 2001	Eliminated: not applicable
	ROAD	Distance-weighted roads and railroads	Wilhelm et al. 2001	Eliminated: not applicable
	TRASH	Distance-weighted trash and landfills	Wilhelm et al. 2001	Eliminated: not applicable
	LAWN	Distance-weighted lawns and parks	Wilhelm et al. 2001	Eliminated: not applicable
	CROPS	Distance-weighted crops	Wilhelm et al. 2001	Eliminated: not applicable
	PASTR	Distance-weighted pasture, rangeland, and hay fields	Wilhelm et al. 2001	Eliminated: not applicable
	LOGGING	Distance-weighted logging operations	Wilhelm et al. 2001	Eliminated: not applicable
	MINE	Distance-weighted mining	Wilhelm et al. 2001	Eliminated: not applicable
	OTHER	Distance-weighted other	Wilhelm et al. 2001	Eliminated: not applicable
	DIST_ALL	Distance-weighted all human disturbance combined	Wilhelm et al. 2001	Eliminated: not applicable
	DISTNOAG	Distance-weighted no agriculture (all disturbance except crop and pasture)	Wilhelm et al. 2001	Eliminated: not applicable
	DIST_AG	Distance-weighted agriculture (crops and pasture)	Wilhelm et al. 2001	Eliminated: not applicable
	EPA_6	Channel alteration	Wilhelm et al. 2001	Eliminated: Entire system altered
Bank	BNK_ANGL	Average bank angle of both banks	Wilhelm et al. 2001	Retained
	UNDCT_DI	Average distance of undercut banks (m)	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_UNDCT	Percentage of banks undercut	Wilhelm et al. 2001	Eliminated: Insufficient data
	BNK_EROS	Dominant bank erosion (extreme, extensive, moderate, limited, or none)	Wilhelm et al. 2001	Eliminated: Insufficient data
	EPA_8	Bank stability	Wilhelm et al. 2001	Eliminated: Insufficient data
	EPA_9	Vegetative protection	Wilhelm et al. 2001	Eliminated: Insufficient data
	P51_7	Bank stability	Wilhelm et al. 2001	Eliminated: Insufficient data
	P51_8	Bank vegetative stability	Wilhelm et al. 2001	Eliminated: Insufficient data
	BNK_NAT	Percent natural banks in sampling reach (sloped, no walls, riprap, or other armoring)	CAWS Unique	Retained
	BNK_CONC	Percent vertically walled concrete banks in sampling reach	CAWS Unique	Retained
	BNK_STEEL	Percent vertically walled steel banks in sampling reach	CAWS Unique	Retained
	BNK_WOOD	Percent vertically walled wood banks in sampling reach	CAWS Unique	Retained
	BNK_GRAN	Percent vertically walled stone block banks in sampling reach	CAWS Unique	Retained
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique	Retained
	BNK_MARINA	Percent bank length in sampling reach occupied by marina	CAWS Unique	Retained
	BNK_WATER	Percent bank length in sampling reach occupied by open water	CAWS Unique	Retained
Riparian (on-site)	RIP_WDTH	Riparian width measured from field data with a laser rangefinder (m)	Wilhelm et al. 2001	Eliminated: Insufficient data
	SD_RIP_W	Standard deviation riparian width (m)	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_RIP25M	Riparian width as a proportion of 25 m; > 25, proportion is 1	Wilhelm et al. 2001	Eliminated: Insufficient data
	RIP_MED	Median category riparian width, field data	Wilhelm et al. 2001	Eliminated: Insufficient data
	RIP_MODE	Modal category riparian width, field data	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_SHADE	% Channel shaded	Wilhelm et al. 2001	Eliminated: Insufficient data
	OPEN_CAN	Canopy openness; 180 = fully open; 0 = fully covered	Wilhelm et al. 2001	Eliminated: Insufficient data
	LG_TREES	% Large trees riparian plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	SM_TREES	% Small trees riparian plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	WD_SHRUB	% Woody shrubs riparian plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	GRASS	% Grass riparian plots	Wilhelm et al. 2001	Eliminated: Insufficient data
	RIP_CAN	Riparian canopy cover (% large and small trees)	Wilhelm et al. 2001	Eliminated: Insufficient data
	RIP_LOW	Riparian shrubs and ground cover (% shrubs and grass)	Wilhelm et al. 2001	Eliminated: Insufficient data
	RIP_ALL	% Canopy, shrubs, and grass combined (plots)	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_CANPY	% Riparian canopy from 10 m transect	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_SHRUB	% Shrub from 10 m transect	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_GRND	% Ground cover from 10 m transect	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_ALLRIP	% Canopy, shrubs, and grass combined - 10 m transect	Wilhelm et al. 2001	Eliminated: Insufficient data
	EPA_10	Riparian width	Wilhelm et al. 2001	Eliminated: Insufficient data
	P51_9	Streamside cover	Wilhelm et al. 2001	Eliminated: Insufficient data
	P_RIP_VEG	Percent riparian vegetation from site measurements	CAWS Unique	

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Variable Group	Variable	Variable Description	Source	Rationale
Bank and riparian condition - continued				
Riparian (from aerials)	GAP_NUM	Number of gaps per 2000 m reach, both banks combined	Wilhelm et al. 2001	Eliminated: not applicable
	GAP_LG	Total length of gaps in riparian vegetation	Wilhelm et al. 2001	Eliminated: not applicable
	Tot_LG	Total length of riparian vegetation	CAWS Unique	Retained
	GAP_AVG	Average gap length	Wilhelm et al. 2001	Eliminated: not applicable
	P_GAP_MS	Proportion of reach with gaps in riparian (gap length measured)	Wilhelm et al. 2001	Eliminated: not applicable
	P_GAP_42	Proportion of 42 riparian measurements with gaps	Wilhelm et al. 2001	Eliminated: not applicable
	RIPPHOTO	Average of 42 riparian width measurements (21 each bank)	Wilhelm et al. 2001	Eliminated: not applicable
	MD_RIP_PH	Median riparian width	Wilhelm et al. 2001	Eliminated: n/a - ext. disconnection of chan. from rip. area
	SD_RIP_PH	Standard deviation riparian width	Wilhelm et al. 2001	Eliminated: retained one measure of riaprian width
	CV_RIP_PH	Coefficient of variation of riparian width	Wilhelm et al. 2001	Eliminated: retained one measure of riaprian width
	MAX_RIP	Maximum riparian width	Wilhelm et al. 2001	Eliminated: retained one measure of riaprian width
	MIN_RIP	Minimum riparian width	Wilhelm et al. 2001	Eliminated: retained one measure of riaprian width
	RIP_RNG	Range of riparian widths	Wilhelm et al. 2001	Eliminated: retained one measure of riaprian width
Anthropogenic impacts				
	EPA_Tox_Sites	Number of EPA toxic release sites (#/reach)*	Tate et al. 2005	Eliminated: Insufficient data
	RAPPS_D	Distance to RAPPS station	CAWS Unique	Eliminated: only applicable to Bubbly Creek
	NBPS_D	Distance to NBPS	CAWS Unique	Eliminated: only applicable to North Branch Chicago River
	ROADCROSS	Number of road crossings within 2,000 m reach	Wilhelm et al. 2001	Eliminated: not applicable
	PIPE	Distance-weighted pipes - inlet and outlet	Wilhelm et al. 2001	Eliminated: Insufficient data
	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA	Retained
	NUM_PIPE	Number of intake and outtake pipes within stream reach	Wilhelm et al. 2001	Eliminated: Insufficient data
	NUM_CSO	Number of NPDES permitted CSO outfalls	CAWS Unique	Retained
	NUM_NPS_NOCSO	Number of NPDES permitted non-CSO outfalls	CAWS Unique	Retained
	NUM_TARP	Number of TARP related features	CAWS Unique	Eliminated: Insufficient data
	RDCROSSPH	# of road crossings within the reach, from aerial photographs	Wilhelm et al. 2001	Eliminated: not applicable
	Nav_Rel_No	Number reach-level commercial shipping use	Wolter and Arlinghaus 2003	Eliminated: Insufficient data
	Nav_Rel_Yes	Reach-level commercial shipping use	CAWS Unique	Eliminated: Insufficient data
	Nav_Rel_High	High relative shipping use based on lock counts	CAWS Unique	Eliminated: retained NAV_THRU
	Nav_Rel_Med	Medium relative shipping use based on lock counts	CAWS Unique	Eliminated: retained NAV_THRU
	Nav_Rel_low	Low relative shipping use based on lock counts	CAWS Unique	Eliminated: retained NAV_THRU
	LMICH_D	Distance to nearest U/S Lake Michigan access point	CAWS Unique	Retained
	NAV_THRU	Commercial tonnage passing	CAWS Unique	Retained
	PUMPSTA_D	Distance to nearest pumping station	CAWS Unique	Retained
	WWTP_D	Distance to nearest wastewater treatment plant	CAWS Unique	Retained
	SED_CD	Cadmium concentration in sediment	CAWS Unique	Retained
	SED_SEM	Simultaneously extracted metals in sediment	CAWS Unique	Retained
	SED_TOT_PCB	Total PCBs in sediment	CAWS Unique	Retained

Habitat Variable Reduction: Combination of Like Variables

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Variable Group	Variable	Variable Description	Source	Rationale
Geomorphology & Hydrology				
	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001	
	Q50	Average 50% exceedence level for discharge from USGS gage data (cms)	Wilhelm et al. 2001	
	MAD	Mean Annual Discharge from USGS gage data (cms)	Wilhelm et al. 2001	
	MAX_VEL	Maximum velocity averaged for transects (m/s)	Wilhelm et al. 2001	
	AVG_VEL	Average velocity (Q/XAREA) averaged for transects (m/s)	Wilhelm et al. 2001	
	P51_3	Velocity-to-depth ratio	Wilhelm et al. 2001	
	XAREA	Cross-sectional area (?[(di+di+1)/2*wi]) of wetted channel (m2)	Wilhelm et al. 2001	
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001	
	HYDR_RAD	Low flow hydraulic radius: XAREA divided by WET_PER (m)	Wilhelm et al. 2001	
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001	
	LOCMAXD	Location of maximum depth as a proportion of total width	Wilhelm et al. 2001	
	CWS_W_BO	CAWS width bottom of channel	CAWS Unique	
	CAWS_DEPTH	Site depth as measured for PHA	MWRDGC PHA	
	AVG_DPTH	Average depth: XAREA divided by WET_WIDTH averaged for transects (m)	Wilhelm et al. 2001	
	WETWIDTH	Stream width at low flow wetted channel, averaged for transects (m)	Wilhelm et al. 2001	
	WETWIDTH_ALT	alternate stream width	Wilhelm et al. 2001	
	WW_DIV_D	Mean wetted width divided by mean depth	Wilhelm et al. 2001	
	OFF_CHAN	Number of tributary, backwater, and off-channel habitats from on-site	Wilhelm et al. 2001	
	TRIB_PH	Number of tributary and backwater habitats from aerial photographs	Wilhelm et al. 2001	
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq)	Alinghaus et al 2002* adopted	
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique	

Habitat Variable Reduction: Combination of Like Variables

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Variable Group	Variable	Variable Description	Source	Rationale
Sediment				
	BH_D	% Hard pan, deep	Wilhelm et al. 2001	
	DOM_D	Dominant deep substrate	Wilhelm et al. 2001	
	SAFN_D	% Sand and Fines, deep	Wilhelm et al. 2001	
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001	
	BH_S	% Hard pan, shallow	Wilhelm et al. 2001	
	DOM_S	Dominant shallow substrate	Wilhelm et al. 2001	
	SAFN_S	% Sand and fines, shallow	Wilhelm et al. 2001	
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001	
	CAWS_INSLG	CAWS PHA % Inorganic Sludge	MWRDGC PHA	
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA	
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA	
	CAWS_DPTH_FNS	CAWS PHA Depth of fines	MWRDGC PHA	

Habitat Variable Reduction: Combination of Like Variables

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Variable Group	Variable	Variable Description	Source	Rationale
Instream cover				
	AQ_VEG	Number of aquatic vegetative types within area	MWRDGC PHA	
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001	
	PERC_COV	Percent of canopy cover over water - GIS-derived	MWRDGC PHA	
	PERC_COV_ALT	Percent of canopy cover over water - field-measured	CAWS Unique	
	LENGTH_COV	Mesured length of cover at station	CAWS Unique	
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique	Retained
	DEPTH_COV	Depth of shade cover	CAWS Unique	
	LENGTH_OVR	Measured length of undercut banks at station	CAWS Unique	
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001	
Bank and riparian condition				
	LB_LU	Dominant land use left bank (categorical)	Wilhelm et al. 2001	
	RB_LU	Dominant land use right bank (categorical)	Wilhelm et al. 2001	
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001	
	BNK_ANGL	Average bank angle of both banks	Wilhelm et al. 2001	
	BNK_NAT	Percent natural banks in sampling reach (sloped, no walls, riprap, or other armoring)	CAWS Unique	
	BNK_CONC	Percent vertically walled concrete banks in sampling reach	CAWS Unique	
	BNK_STEEL	Percent vertically walled steel banks in sampling reach	CAWS Unique	These variables were combined into one new variable (BNK_WALL) for subsequent analysis.
	BNK_WOOD	Percent vertically walled wood banks in sampling reach	CAWS Unique	
	BNK_GRAN	Percent vertically walled stone block banks in sampling reach	CAWS Unique	
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique	
	BNK_MARINA	Percent bank length in sampling reach occupied by marina	CAWS Unique	These variables were combined into one new variable (BNK_MARWA) for subsequent analysis.
	BNK_WATER	Percent bank length in sampling reach occupied by open water	CAWS Unique	
	P_RIP_VEG	Percent riparian vegetation from site measurements	CAWS Unique	
	Tot_LG	Total length of riparian vegetation	CAWS Unique	

Habitat Variable Reduction: Combination of Like Variables

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Variable Group	Variable	Variable Description	Source	Rationale
Anthropogenic impacts				
	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA	
	NUM_CSO	Number of NPDES permitted CSO outfalls	CAWS Unique	These variables were combined into one new variable (NUM_SUM)
	NUM_NPS_NOCSO	Number of NPDES permitted non-CSO outfalls	CAWS Unique	for subsequent analysis.
	LMICH_D	Distance to nearest U/S Lake Michigan access point	CAWS Unique	
	NAV_THRU	Commercial tonnage passing	CAWS Unique	
	PUMPSTA_D	Distance to nearest pumping station	CAWS Unique	
	WWTP_D	Distance to nearest wastewater treatment plant	CAWS Unique	
	SED_CD	Cadmium concentration in sediment	CAWS Unique	
	SED_SEM	Simultaneously extracted metals in sediment	CAWS Unique	
	SED_TOT_PCB	Total PCBs in sediment	CAWS Unique	

Habitat Variable Reduction: Spearman's Correlation Analysis

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Variable Group	Variable	Variable Description	Source	Rationale
Geomorphology & Hydrology				
	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	Q50	Average 50% exceedence level for discharge from USGS gage data (cms)	Wilhelm et al. 2001	Eliminated: highly correlated with MAX_DEP (> 0.7)
	MAD	Mean Annual Discharge from USGS gage data (cms)	Wilhelm et al. 2001	Eliminated: highly correlated with MAX_DEP (> 0.7)
	MAX_VEL	Maximum velocity averaged for transects (m/s)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	AVG_VEL	Average velocity (Q/XAREA) averaged for transects (m/s)	Wilhelm et al. 2001	Retained: Modified from USGS data to DUFLOW model output
	P51_3	Velocity-to-depth ratio	Wilhelm et al. 2001	Eliminated: highly correlated with AVG_VEL (> 0.7)
	XAREA	Cross-sectional area (?[(di+di+1)/2*wi]) of wetted channel (m2)	Wilhelm et al. 2001	Eliminated: highly correlated with WET_PER (> 0.7)
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001	Retained
	HYDR_RAD	Low flow hydraulic radius: XAREA divided by WET_PER (m)	Wilhelm et al. 2001	Eliminated: highly correlated with MAX_DEP (> 0.7)
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001	Retained
	LOCMAXD	Location of maximum depth as a proportion of total width	Wilhelm et al. 2001	Eliminated: highly correlated with MAX_DEP (> 0.7)
	CWS_W_BO	CAWS width bottom of channel	CAWS Unique	Eliminated: highly correlated with WET_PER (> 0.7)
	CAWS_DEPTH	Site depth as measured for PHA	MWRDGC PHA	Eliminated: highly correlated with MAX_DEP (> 0.7)
	AVG_DPTH	Average depth: XAREA divided by WET_WIDTH averaged for transects (m)	Wilhelm et al. 2001	Eliminated: highly correlated with MAX_DEP (> 0.7)
	WETWIDTH	Stream width at low flow wetted channel, averaged for transects (m)	Wilhelm et al. 2001	Eliminated: highly correlated with WET_PER (> 0.7)
	WETWIDTH_ALT	alternate stream width	Wilhelm et al. 2001	Eliminated: highly correlated with WET_PER (> 0.7)
	WW_DIV_D	Mean wetted width divided by mean depth	Wilhelm et al. 2001	Eliminated: highly correlated with CAWS_CH_RAT (> 0.7)
	OFF_CHAN	Number of tributary, backwater, and off-channel habitats from on-site	Wilhelm et al. 2001	Retained
	TRIB_PH	Number of tributary and backwater habitats from aerial photographs	Wilhelm et al. 2001	Eliminated: highly correlated with OFF_CHAN (> 0.7)
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq)	Alinghaus et al 2002* adopted	Retained
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique	Retained
Sediment				
	BH_D	% Hard pan, deep	Wilhelm et al. 2001	Retained
	DOM_D	Dominant deep substrate	Wilhelm et al. 2001	Retained
	SAFN_D	% Sand and Fines, deep	Wilhelm et al. 2001	Retained
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001	Retained
	BH_S	% Hard pan, shallow	Wilhelm et al. 2001	Retained
	DOM_S	Dominant shallow substrate	Wilhelm et al. 2001	Retained
	SAFN_S	% Sand and fines, shallow	Wilhelm et al. 2001	Retained
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001	Retained
	CAWS_INSLG	CAWS PHA % Inorganic Sludge	MWRDGC PHA	Eliminated: highly correlated with DOM_D (> 0.7)
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA	Retained
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA	Retained
	CAWS_DPTH_FNS	CAWS PHA Depth of fines	MWRDGC PHA	Retained

Habitat Variable Reduction: Spearman's Correlation Analysis

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Variable Group	Variable	Variable Description	Source	Rationale
Instream cover				
	AQ_VEG	Number of aquatic vegetative types within area	MWRDGC PHA	Retained
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001	Retained
	PERC_COV	Percent of canopy cover over water - GIS-derived	MWRDGC PHA	Eliminated: highly correlated with PERC_COV_ALT (> 0.7)
	PERC_COV_ALT	Percent of canopy cover over water - field-measured	CAWS Unique	Retained
	LENGTH_COV	Mesured length of cover at station	CAWS Unique	Eliminated: highly correlated with PERC_COV_ALT (> 0.7)
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique	Retained
	DEPTH_COV	Depth of shade cover	CAWS Unique	Eliminated: highly correlated with PERC_COV_ALT (> 0.7)
	LENGTH_OVR	Measured length of undercut banks at station	CAWS Unique	Eliminated: highly correlated with PERC_COV_ALT (> 0.7)
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001	Retained
Bank and riparian condition				
	LB_LU	Dominant land use left bank (categorical)	Wilhelm et al. 2001	Eliminated: highly correlated with DOM_LU (> 0.7)
	RB_LU	Dominant land use right bank (categorical)	Wilhelm et al. 2001	Eliminated: highly correlated with ?? (> 0.7)
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001	Retained
	BNK_ANGL	Average bank angle of both banks	Wilhelm et al. 2001	Retained
	BNK_NAT	Percent natural banks in sampling reach (sloped, no walls, riprap, or other armoring)	CAWS Unique	Retained
	BNK_WALL	Percent vertically walled banks in sampling reach	CAWS Unique	Retained
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique	Retained
	BNK_MARWA	Percent bank length in sampling reach occupied by marina & open water	CAWS Unique	Retained
	P_RIP_VEG	Percent riparian vegetation from site measurements	CAWS Unique	Retained
	Tot_LG	Total length of riparian vegetation	CAWS Unique	Eliminated: highly correlated with P_RIP_VEG (> 0.7)
Anthropogenic impacts				
X	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA	Retained
X	NUM_SUM	Number of NPDES permitted outfalls	CAWS Unique	Retained
X	LMICH_D	Distance to nearest U/S Lake Michigan access point	CAWS Unique	Retained
X	NAV_THRU	Commercial tonnage passing	CAWS Unique	Retained
	PUMPSTA_D	Distance to nearest pumping station	CAWS Unique	Eliminated: highly correlated with NAV_THRU (> 0.7)
X	WWTP_D	Distance to nearest wastewater treatment plant	CAWS Unique	Retained
X	SED_CD	Cadmium concentration in sediment	CAWS Unique	Retained
X	SED_SEM	Simultaneously extracted metals in sediment	CAWS Unique	Retained
X	SED_TOT_PCB	Total PCBs in sediment	CAWS Unique	Retained

Habitat Variable Reduction: Principal Components Analysis

Variable Group	Variable	Variable Description	Source	Rationale
Geomorphology & Hydrology				
	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001	Retain for MLR
	MAX_VEL	Maximum velocity averaged for transects (m/s)	Wilhelm et al. 2001	Eliminate: matched with FLASH_IN on PC3; 0.789 corr. w/ NAV_THRU)
	AVG_VEL	Average velocity (Q/XAREA) averaged for transects (m/s)	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001	Retain for MLR
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001	Retain for MLR
	OFF_CHAN	Number of tributary, backwater, and off-channel habitats from on-site	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq)	Alinghaus et al 2002* adopted	Retain for MLR
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique	Retain for MLR
Sediment				
	BH_D	% Hard pan, deep	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	DOM_D	Dominant deep substrate	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	SAFN_D	% Sand and Fines, deep	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001	Retain for MLR
	BH_S	% Hard pan, shallow	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	DOM_S	Dominant shallow substrate	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	SAFN_S	% Sand and fines, shallow	Wilhelm et al. 2001	Retain for MLR
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001	Retain for MLR
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA	Retain for MLR
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA	Retain for MLR
	CAWS_DPTH_FNS	CAWS PHA Depth of fines	MWRDGC PHA	Eliminate: not strongest on any PCA axis
Instream cover				
	AQ_VEG	Number of aquatic vegetative types within area	MWRDGC PHA	Eliminate: not strongest on any PCA axis
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001	Retain for MLR
	PERC_COV_ALT	Percent of canopy cover over water - field-measured	CAWS Unique	Retain for MLR
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique	Retained
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001	Retain for MLR
Bank and riparian condition				
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001	Retain for MLR
	BNK_ANGL	Average bank angle of both banks	Wilhelm et al. 2001	Eliminate: not strongest on any PCA axis
	BNK_NAT	Percent natural banks in sampling reach (sloped, no walls, riprap, or other armoring)	CAWS Unique	Retain for MLR
	BNK_WALL	Percent vertically walled banks in sampling reach	CAWS Unique	Retain for MLR
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique	Retain for MLR
	BNK_MARWA	Percent bank length in sampling reach occupied by marina & open water	CAWS Unique	Eliminate: not strongest on any PCA axis
	P_RIP_VEG	Percent riparian vegetation from site measurements	CAWS Unique	Retain for MLR
Anthropogenic impacts				
	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA	Retain for MLR
	NUM_SUM	Number of NPDES permitted outfalls	CAWS Unique	Eliminate: not strongest on any PCA axis
	LMICH_D	Distance to nearest U/S Lake Michigan access point	CAWS Unique	Retain for MLR
	NAV_THRU	Commercial tonnage passing	CAWS Unique	Retain for MLR
	WWTP_D	Distance to nearest wastewater treatment plant	CAWS Unique	Eliminate: not strongest on any PCA axis
	SED_CD	Cadmium concentration in sediment	CAWS Unique	Eliminate: not strongest on any PCA axis
	SED_SEM	Simultaneously extracted metals in sediment	CAWS Unique	Retain for MLR
	SED_TOT_PCB	Total PCBs in sediment	CAWS Unique	Eliminate: not strongest on any PCA axis

Habitat Variable Reduction

Variable Group	Variable	Variable Description	Source	Rationale
Geomorphology & Hydrology				
	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001	
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001	
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001	
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq)	Alinghaus et al 2002* adopted	
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique	
Sediment				
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001	
	SAFN_S	% Sand and fines, shallow	Wilhelm et al. 2001	Eliminated: correl. w/ macrophyte cover (0.601)
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001	
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA	
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA	
Instream cover				
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001	
	PERC_COV_ALT	Percent of canopy cover over water - field-measured	CAWS Unique	Eliminated: correl. w/ vertical walled banks (-0.600)
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique	
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001	
Bank and riparian condition				
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001	
	BNK_NAT	Percent natural banks in sampling reach (sloped, no walls, riprap, or other armoring)	CAWS Unique	Eliminated: correl. w/ macrophyte cover (0.726)
	BNK_WALL	Percent vertically walled banks in sampling reach (concrete, sheet piling, stone blocks)	CAWS Unique	
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique	
	P_RIP_VEG	Percent riparian vegetation from site measurements	CAWS Unique	Eliminate: correlated with DOM_LU (-0.665)
Anthropogenic impacts				
	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA	
	LMICH_D	Distance to nearest U/S Lake Michigan access point	CAWS Unique	Eliminate: correlated with BANK_POC_AREA (0.645)
	NAV_THRU	Commercial tonnage passing	CAWS Unique	Eliminated: correl. w/ maximum depth (0.789)
	SED_SEM	Simultaneously extracted metals in sediment	CAWS Unique	Eliminated: correl. w/ vertical wall banks (0.726)

Final Habitat Variables for Regression with Fish Metric

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Variable Group	Variable	Variable Description	Source
Geomorphology & Hydrology			
	FLASH_IN	Flash index: ratio of 10 to 90% exceedence flows (USGS gage data, all years)	Wilhelm et al. 2001
	WET_PER	Wetted perimeter (?[(di+di+1)2+(wi+wi+1)2]1/2) of wetted channel (m)	Wilhelm et al. 2001
	MAX_DEP	Maximum depth averaged for transects (m)	Wilhelm et al. 2001
	OFF_CH_BAY	Off channel bay areas (areas connected to main channel, isolated from general flow of main channel, and >5 m sq)	Alinghaus et al 2002* adopted
	BANK_POC_AREA	Pocket areas within the bank that may serve as refuge for spp from the main channel flow	CAWS Unique
Sediment			
	BIG_D	% Substrate fine gravel, coarse gravel, cobble, and boulder, deep	Wilhelm et al. 2001
	BIG_S	% Substrate fine gravel, coarse gravel, cobble, and boulder, shallow	Wilhelm et al. 2001
	CAWS_ORSLG	CAWS PHA % Organic Sludge	MWRDGC PHA
	CAWS_PLDBR	CAWS PHA % Plant debris	MWRDGC PHA
Instream cover			
	MCRPH_CO	Average macrophyte coverage (area*density) (m)	Wilhelm et al. 2001
	NUM_COV	Recorded presence or absence of in-stream cover (woody debris, boulders, etc.)	CAWS Unique
	SECCHI	Secchi depth (m)	Wilhelm et al. 2001
Bank and riparian condition			
	DOM_LU	Dominant land use, both banks combined (categorical)	Wilhelm et al. 2001
	BNK_WALL	Percent vertically walled banks in sampling reach (concrete, sheet piling, stone blocks)	CAWS Unique
	BNK_RIPRAP	Percent riprapped banks in sampling reach	CAWS Unique
Anthropogenic impacts			
	MAN_Made_Struct	Number of manmade structures at the site	MWRDGC PHA