|  |  |  |
| --- | --- | --- |
|  |  |  |
|  | **Candidate Urban FCM Variables (Eutrophication model)** | **Variable Class** |
| 1 | **Amount of dry weather runoff** | Runoff Sources |
| 2 | **Amount of wet weather runoff** | Runoff Sources |
| 3 | **Import of raw potable water** | Runoff Sources |
| 4\* | **Industrial wastewater effluent** | Runoff Sources |
| 5\* | **Municipal wastewater effluent** | Runoff Sources |
| 6\* | **Overflows of combined storm and sanitary sewers** | Runoff Sources |
| 7 | **Runoff and leachate from waste disposal sites** | Runoff Sources |
| 8 | **Runoff from abandoned mines** | Runoff Sources |
| 9\* | **Runoff from impervious surfaces** | Runoff Sources |
| 10\* | **Runoff from large construction sites** | Runoff Sources |
| 11 | **Runoff from mines** | Runoff Sources |
| 12 | **Runoff from oil fields** | Runoff Sources |
| 13\* | **Runoff from small construction sites** | Runoff Sources |
| 14\* | **Runoff from unsewered industrial sites** | Runoff Sources |
| 15\* | **Septic leachate and runoff from failed septic systems** | Runoff Sources |
| 16\* | **Storm sewer outfalls** | Runoff Sources |
| 17\* | **Urban runoff from unsewered and sewered areas** | Runoff Sources |
| 18\* | **Age of sewer system** | Urban Attributes |
| 19 | **Alteration of stream structure** | Urban Attributes |
| 20 | **Amount of traffic** | Urban Attributes |
| 21 | **Commercial development** | Urban Attributes |
| 22 | **Consumption of water** | Urban Attributes |
| 23 | **Habitat fragmentation** | Urban Attributes |
| 24\* | **Human population size** | Urban Attributes |
| 25\* | **Impervious surface area** | Urban Attributes |
| 26 | **Industrical development** | Urban Attributes |
| 27 | **Interruption of hydrologic cycle** | Urban Attributes |
| 28\* | **Land development** | Urban Attributes |
| 29\* | **Lawn size** | Urban Attributes |
| 30 | **Percent tree cover** | Urban Attributes |
| 31 | **Road maintenance** | Urban Attributes |
| 32\* | **Shoreline development** | Urban Attributes |
| 33\* | **Urban drainage** | Urban Attributes |
| 34\* | **Urban land area** | Urban Attributes |
| 35\* | **Wetland area** | Urban Attributes |
| 36 | **Amount of evapotranspiration** | Environmental Covariates |
| 37\* | **Amount of Precipitation** | Environmental Covariates |
| 38 | **Amount of wind** | Environmental Covariates |
| 39\* | **Frequency and intensity of storms** | Environmental Covariates |
| 40\* | **Frequency of intermittent pulse exposures** | Environmental Covariates |
| 41\* | **Frequency of rain events** | Environmental Covariates |
| 42\* | **Frequency of winter warming** | Environmental Covariates |
| 43\* | **Slope of land** | Environmental Covariates |
| 44\* | **Amount of Phosphorus in lawn fertilizers** | Measures/sources of Urban-derived P |
| 45\* | **Amount of phosphorus in Combined Sewer Overflows** | Measures/sources of Urban-derived P |
| 46\* | **Amount of sludge from wastewater treatment plants used as sludge for fertilizer** | Measures/sources of Urban-derived P |
| 47 | **Atmospheric Deposition of P** | Measures/sources of Urban-derived P |
| 48 | **Domestic pet population** | Measures/sources of Urban-derived P |
| 49 | **Household detergent phosphorus** | Measures/sources of Urban-derived P |
| 50 | **Lawn fertilizer phosphorus** | Measures/sources of Urban-derived P |
| 51\* | **Phosphorus burial in sediment** | Measures/sources of Urban-derived P |
| 52 | **Phosphorus from Vegetation clippings** | Measures/sources of Urban-derived P |
| 53\* | **Phosphorus transport to streams** | Measures/sources of Urban-derived P |
| 54 | **Population of urban wildlife (especially birds)** | Measures/sources of Urban-derived P |
| 55 | **Sedimentation** | Measures/sources of Urban-derived P |
| 56 | **Spills** | Measures/sources of Urban-derived P |
| 57 | **Accumulation of sediment in sewers** | Measures of Urban activity |
| 58 | **Acid rain** | Measures of Urban activity |
| 59 | **Air quality** | Measures of Urban activity |
| 60 | **Amount of lawn pesticides used** | Measures of Urban activity |
| 61 | **Amount of porous concrete and asphalt (which can trap and store VOCs)** | Measures of Urban activity |
| 62\* | **Beach closures** | Measures of Urban activity |
| 63 | **Degradation of the chemical profile of the water that flows through streams** | Measures of Urban activity |
| 64 | **Degree of demand on energy and other resources** | Measures of Urban activity |
| 65\* | **Discharge of sediments** | Measures of Urban activity |
| 66\* | **Drain erosion** | Measures of Urban activity |
| 67 | **Dumping** | Measures of Urban activity |
| 68 | **Fixation of N via burning fossil fuels** | Measures of Urban activity |
| 69\* | **Flooding and bank erosion** | Measures of Urban activity |
| 70 | **Illicit sewer connections** | Measures of Urban activity |
| 71 | **Quality of drinking water** | Measures of Urban activity |
| 72 | **Quality of human health** | Measures of Urban activity |
| 73 | **Sanitary sewer cross-connections** | Measures of Urban activity |
| 74\* | **Soil erosion** | Measures of Urban activity |
| 75\* | **Stream stability** | Measures of Urban activity |
| 76 | **Surface attrition/corrosion/elution/erosion** | Measures of Urban activity |
| 77 | **Amount of erosion fences used** | Urban Management Practices |
| 78\* | **Ban P in lawn fertilizers in P-sensitive basins** | Urban Management Practices |
| 79\* | **Creation of open channels to replicate predevelopment stream hydrology** | Urban Management Practices |
| 80\* | **Creation of retention ponds** | Urban Management Practices |
| 81\* | **Education and outreach to waterfront residents on septic system construction and maintenance** | Urban Management Practices |
| 82 | **Efficiency of public transit** | Urban Management Practices |
| 83\* | **Filtration of water through soil to recharge groundwater aquifers** | Urban Management Practices |
| 84\* | **Improvement of waste, wastewater, stormwater, and transportation infrastructure** | Urban Management Practices |
| 85\* | **Intensification of development within existing urban areas/ Restriction of future land development beyond current urban boundaries** | Urban Management Practices |
| 86\* | **Maintenance of vegetated riparian buffer zones** | Urban Management Practices |
| 87\* | **Managing the specific mix of nutrient sources in eutrophic areas** | Urban Management Practices |
| 88\* | **Mandatory disconnection of direct on-site septic systems to Great Lakes** | Urban Management Practices |
| 89\* | **Mandatory pumping of on-site septic systems on a periodic basis** | Urban Management Practices |
| 90\* | **Optimizing delivery of agency programs to address point and non-point sources of P** | Urban Management Practices |
| 91\* | **Optimizing STP operations** | Urban Management Practices |
| 92 | **Plant uptake of Phosphorus** | Urban Management Practices |
| 93 | **Promoting nutrient-use efficiency in urban communities** | Urban Management Practices |
| 94\* | **Public education about low P fertlilizer use** | Urban Management Practices |
| 95\* | **Reduction of erosion from construction sites** | Urban Management Practices |
| 96 | **Regulation of technology standards** | Urban Management Practices |
| 97\* | **Retrofitting existing infrastructure to green infrastructure** | Urban Management Practices |
| 98\* | **Retrofitting/monitoring facilities** | Urban Management Practices |
| 99\* | **Sustainable building practices** | Urban Management Practices |
| 100\* | **Use of filters and infiltration trenches** | Urban Management Practices |
| 101 | **Use of litter control and street sweeping** | Urban Management Practices |
| 102\* | **Abundance of aquatic macrophytes and algal biomass in Lake Erie** | Biological measures- L. Erie  |
| 103 | **Abundance of fish** | Biological measures- L. Erie |
| 104 | **Biodiversity** | Biological measures- L. Erie |
| 105\* | **Cladophora in Nearshore Lake Erie** | Biological measures- L. Erie |
| 106 | **Fish kills** | Biological measures- L. Erie |
| 107\* | **Hazardous algal blooms** | Biological measures- L. Erie |
| 108 | **Invertebrate abundance in Lake Erie** | Biological measures- L. Erie |
| 109\* | **Dissolved oxygen concentration** | Environmental Covariates in Lake Erie |
| 110 | **Sediment contamination** | Environmental Covariates in Lake Erie |
| 111\* | **Sunlight penetration in Lake Erie** | Environmental Covariates in Lake Erie |
| 112\* | **Water quality in Lake Erie** | Environmental Covariates in Lake Erie |
| 113\* | **Water temperature in Lake Erie** | Environmental Covariates in Lake Erie |
| 114\* | **Bioavailable Phosphorus in water** | Measures of P in Receiving waters |
| 115\* | **Dissolved inorganic phosphates in water** | Measures of P in Receiving waters |
| 116\* | **Dissolved inorganic phosphorus in water** | Measures of P in Receiving waters |
| 117 | **Nitrogen concentration in water** | Measures of P in Receiving waters |
| 118\* | **Particulate Phosphorus in water** | Measures of P in Receiving waters |
| 119 | **Sodium and chloride concentrations in water** | Measures of P in Receiving waters |
| 120\* | **Soluble Reactive phosphorus Concentration in Nearshore Lake Erie**  | Measures of P in Receiving waters |
| 121\* | **Soluble reactive phosphorus Concentration in Offshore Lake Erie** | Measures of P in Receiving waters |
| 122\* | **Total phosphorus Concentration in Nearshore Lake Erie** | Measures of P in Receiving waters |
| 123\* | Total phosphorus Concentration in Offshore Lake Erie | Measures of P in Receiving waters |
| 124\* | **Total phosphorus in water** | Measures of P in Receiving waters |
| 125 | **Zinc, copper, cadmium, PAHs in water** | Measures of P in Receiving waters |
| 126 | Instream and bank erosion | Urban Management |
| 127 | Area of green roof coverage | Urban Management |
| 128 | Area of ground level green infrastructure | Urban Management |
| 129 | Length of discharge pipe from WWTP | Urban Management |
| 130 | Amount of sludge liquor (dewatering phase in WWTP) | Measures/Sources of urban derived P |
| 131 | Amount of Recycled Phosphorus from waste water directly into food/biomass | Urban Management |
| 132 | Amount Recycled Phosphorus at WWTP into fertilizer | Urban Management |
| 133 | Amount of Recycled Phosphorus from waste water directly into biomass energy | Urban Management |
| 134 | Runoff over bare frozen ground | Runoff Sources |
| 135 | Amount of fertilizer on bare agricultural soil (picked up by wind) | Environmental Covariates |
| 136 | urban-like residential clusters along LE shoreline | Environmental Covariates |
| 137 | River/stream transport and storage characteristics | Environmental Covariates |
| 138 | River/stream sediment mobilization factors - floods, ice action, erosion  | Environmental Covariates |
| 139 | Caffeine and PCP/Pharmaceuticals in nearshore/offshore zone | Traces urban activity |
| 140 | Faecal indicators (bacteria) in nearshore/offshore zones | Traces urban activity |
| 141 | Other contaminants e.g. flame retardants) | Traces urban activity |
| 142 | Stormwater reuse at the source |  |
| 143 |  Water reuse from the municipal sewage treatment plants |  |
| 144 |  Water reuse at industrial, commercial and institutional facilities |  |
| 145 |  Water conservation and reuse by residents |  |
| 146 | Stormwater reuse from the pond/outfall |  |