

## **Appendix 2**

### **Habitat Survey**

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**October 2011**

## Habitat Data Collection

The purpose of the habitat survey was to determine spatial proportions of the mesohabitat units in selected sections. The date and flow at the time of each survey are shown in **Table 1** below. For each Hydromorphological Unit (HMU), the location and size was determined with GPS and ArcPad software in conjunction with high-resolution aerial photographs, creating a detailed map of selected sites on the river. The outlines of each HMU were drawn as geo-referenced polygons on a Hewlett-Packard iPAQ palmtop computer running ArcPad software.

Within each HMU, mean column velocity, depth and estimated substrate were measured in at least seven random locations. The number of measurements was empirically chosen as the smallest statistically relevant quantity. Measurements for depth and mean column velocity were usually taken with a Dipping Bar (Jens, 1968) in areas shallower than 1.0 m. The other physical attributes (below) were estimated for each unit (using three categories: absent, present, abundant) and entered into a GIS table associated with the corresponding polygon. For substrate definitions, we referred to the choriotope classification system according to Austrian Standard ÖNORM 6232 (1995) (below).

## Site Details

The following information was recorded at the time of mapping for each HMU.

**Date:** Date of mapping

**HMU Number:** Unique sequential numbering for that day and site

**HMU Type:** See HMU Definitions section.

**Choriotope:** See Choriotope Definitions section.

**Fishing (Yes/No):** Was the HMU mapped during fishing survey?

**Low Gradient (Yes/No):** Was the HMU mapped on a low-gradient river?

**Wetted Width:** The current wetted width (meters) obtained using a range finder.

**Bankfull Width:** The bank-full width (meters) obtained using a range finder.

**Table 1: Records of date and flow conditions corresponding to each hydromorphological survey.**

Wekepeke Brook HMU Surveys									
Study Site	0.2 cfsm survey			0.5 cfsm Survey			1.0 cfsm Survey		
	Date	cfsm	cfs	Date	cfsm	cfs	Date	cfsm	cfs
Site 1	08/26/08	0.27	0.23	08/06/08	0.63	0.54	11/19/08	1.10	0.95
Site 1b	08/26/08	0.32	0.31	08/06/08	0.71	0.68	11/19/08	1.07	1.02
Site 2	08/26/08	0.12	0.15	08/04/08	0.22	0.29	11/19/08	0.60	0.78
Site 3	08/26/08	0.24	0.56	08/04/08	0.52	1.23	11/19/08	0.93	2.19
Site 4	08/26/08	0.26	0.65	08/04/08	0.57	1.44	11/20/08	0.90	2.28
Site 5	08/26/08	0.28	0.72	08/04/08	0.64	1.62	11/20/08	1.04	2.65
Site 6	08/27/08	0.36	1.03	08/05/08	0.59	1.70	11/20/08	1.03	2.99
Site 7	08/27/08	0.37	1.12	08/05/08	0.63	1.90	11/20/08	1.02	3.06
Site 8	08/27/08	0.42	1.31	08/05/08	0.69	2.16	11/21/08	1.02	3.19

## HMU Definitions

The following are brief definitions for the Hydromorphological Units.

**Backwater** – Slack area along a channel margin caused by eddies behind obstructions, the development of sandbars during flood events, or through the abandonment of older channels.

**Cascade** – Stepped rapids with very small pools behind boulders and small waterfalls.

**Fast Run** – Uniform fast-flowing stream channel.

**Glide** – Moderately shallow stream channel with laminar flow. Lacks pronounced turbulence, and exhibits flat streambed morphology.

**Plunge Pool** – Area where main flow passes over a complete channel obstruction and drops vertically to scour the streambed.

**Pool** – Deep water impounded by a channel blockage or partial channel obstruction. Slow velocities with a concave streambed shape.

**Rapid** – Higher gradient reach than a riffle, with faster current velocity, coarser choriotope, greater surface turbulence, and convex streambed morphology.

**Riffle** – Shallow stream reach with moderate current velocity, some surface turbulence, high gradient, and convex streambed morphology.

**Ruffle** – De-watered (lacking water) rapid in transition to either run or riffle.

**Run** – Deeper stream reach with moderate current velocity, but no surface turbulence (laminar flow). Streambed is longitudinally flat and laterally concave.

**Side Arm** – Channel around an island, smaller than half the width of the river, frequently at a different elevation than the main channel.

## Choriotope Definitions

The following are choriotope classification categories according to Austrian Standard OEN M6232, specifically developed for benthic habitat classification. They generally describe bin grain-size and other possible organic substrate. When conducting a hydrologic survey we consider an area of one square meter (with the dipstick at its center) and record the dominant choriotope type. There may be a mix of grain sizes included in this square meter, but in most cases, a mean particle size will be apparent. When conducting an HMU survey, the mean particle size of the entire HMU will be considered when selecting a choriotope.

- 1) **PELAL** - silt, loam, clay and sludge (<0.063 mm).
- 2) **PSAMMAL** – sand (0.063 - 2 mm).
- 3) **AKAL** – medium to fine gravel (0.2 - 2 cm).
- 4) **MICROLITHAL** – coarse gravel with mixture of medium to fine gravel (2 - 6.3 cm).
- 5) **MESOLITHAL** – fist to hand-sized cobbles with a mixture of medium to fine gravel (6.3 - 20 cm).

6) **MACROLITHAL** – coarse blocks, head-sized cobbles, mix of cobbles, gravel and sand (20 - 40 cm).

7) **MEGALITHAL** – large cobbles, blocks, and bedrock (>40 cm).

8) **GIGALITHAL** – bedrock.

9) **SAPROPEL** – organic sludge.

10) **DETRITAL** – deposits of particulate organic matter. Different types are CPOM = coarse particulate matter (e.g. fallen leaves) and FPOM (fine particulate organic matter).

11) **DEBRIS** – organic and inorganic matter deposited within the splash zone area by wave motion and changing water levels (e.g. mussel and snail shells).

12) **PHYTAL** – submerged plants, floating stands or mats, lawns of bacteria or fungi, and tufts, often with aggregations of detritus, moss or algal mats (INTERPHYTAL = habitat within a vegetation stand or plant mat).

13) **XYLAL** – tree trunks, roots, branches or other dead wood.

### **Embeddedness Definitions**

Embeddedness refers to the cohesive nature of the choriotope. The guidelines followed for selecting the choriotope type while conducting hydrologic surveys also applies to selecting Embeddedness. The characteristics in a one-meter grid around the dipstick are recorded as the mean grid characteristic.

(L) **Loose** – dislodges easily when stepped on or kicked (e.g. sand, gravel, detritus).

(E) **Embedded** – river-bottom materials are firmly in place and only dislodged with great effort, typical result of stream armoring.

(S) **Solid** – river section is flowing over exposed bedrock, large slabs of rock, or an artificial surface.

### **Attributes**

Mapping teams indicate whether the following are present (>10% of area), absent or abundant (>50% of area): Boulders, Riprap (manufactured concrete erosion control), Overhanging Vegetation, Submerged Vegetation, Canopy Shading, Undercut Bank, Woody Debris, and Shallow Margin.

### **Shore Properties**

Properties of the river's banks are recorded individually for each bank. The banks are described when looking in the downstream direction for both the *Left Shore Use* and the *Right Shore Use*. *Shore Use* refers to the adjacent land-use for that section, not necessarily the characteristic of embankment: Agriculture, Field, Forested, Pasture, Residential, Road, Shrub brush, or Urbanized. Other characteristics recorded are: Eroded, Stabilized (non-rip-rap erosion control), Irregular Shoreline, and Clay.