The Math

C_{WRaw} : The concentration in stream water not correcting for sediment binding. This is what Gleams – Driver currently gives.

C_{WAdj} : The concentration in stream water adjusted for sediment binding. This is what we want to know.

$K_d = \frac{C_{Sed}}{C_{Wat}}$ by definition. Here, $C_{Wat} = C_{WAdj}$.

Take a 1 cm^2 area on the stream bed. (any other area would do just as well)

For a 1 meter (100 cm) deep stream,
we have a concentration in the water from G – D of C_{WRaw} in units of mg / L.

This concentration is in a volume of:

$V_{Wat} = 1.\ cm^2 * 100\ cm * 1\ L / (1000\ cm^3)$

0.1 L

The total amount (not concentration) of the chemical in this water column, A_{tot} is thus
$A_{tot} = C_{WRaw} * V_{Wat}$.

To calculate the adjusted concentration in water (C_{WAdj}) we need to get the amount in water (A_w) and the amount in sediment (A_S).

By definition, $A_{tot} = A_w + A_S$

Define V_w as the volume of the water column and V_S as the volume of the sediment under the water column.

$$C_{WAdj} = \frac{A_w}{V_w}$$

$$C_S = \frac{A_S}{V_S}$$

Then, $Kd = \frac{C_S}{C_{WAdj}} = \frac{\frac{A_S}{V_S}}{\frac{A_w}{V_w}}$

In the above expression, substitute $A_{tot} - A_S$ for A_w.

$$Kd = \frac{C_S}{C_{WAdj}} = \frac{\frac{A_S}{V_S}}{\frac{A_{tot} - A_S}{V_w}}$$

Solve for A_s in Mathematica :

$$\text{Solve}\left[Kd == \frac{\frac{A_s}{V_s}}{\frac{A_{tot} - A_s}{V_w}},\ A_s\right]$$

$$\left\{\left\{A_s \to \frac{Kd\, A_{tot}\, V_s}{Kd\, V_s + V_w}\right\}\right\}$$

As noted above, $A_{tot} = A_w + A_s$. Thus, $A_w = A_{tot} - A_s$.

Now we can solve for both A_s and A_w and we can calculate C_{WAdj} and C_s.

An Example

Suppose we have a 1 meter (100 cm) deep stream and consider binding to a 1 cm depth of sediment. The volume of water is 0.1 L and the volume of sediment is 0.01 L.

Gleams – Driver gives us a C_{WRaw} of 0.8 mg / L.

$$A_{tot} = 0.8\, \frac{mg}{L} \times 0.1\, L$$

0.08 mg

Assume a Kd of 3030

Kd = 3030;
V_s = 0.01 L;
V_w = 0.1 L;

The amount is sediment is :

$$A_s = \frac{Kd\, A_{tot}\, V_s}{Kd\, V_s + V_w}$$

0.0797368 mg

The amount in water is

$$A_w = A_{tot} - A_s$$

0.000263158 mg

The concentration in water adjusted for sediment binding (C_{WAdj}) is :

$$C_{WAdj} = \frac{A_w}{V_w}$$

$$\frac{0.00263158\, mg}{L}$$

The concentration in sediment is :

$$C_{Sed} = \frac{A_s}{V_s}$$

$$\frac{7.97368\,\text{mg}}{\text{L}}$$

The ratio of C_{Sed} to C_{WAdj} should equal the Kd :

$$\frac{C_{Sed}}{C_{WAdj}}$$

3030.

The adjustment factor for getting C_{WAdj} from C_{Raw} is :

$$\frac{C_{WAdj}}{(0.8\,\text{mg}/\text{L})}$$

0.00328947

This checks out.

Send to Linda just to be sure.

CRITICAL NOTE

**Unlike the pond, Gleams – Driver has no "memory" for the stream. In other words,
G – D does not now "remember" the concentration in sediment. At the start of each new day,
the concentration is zero (prior to pesticide input). In reality,
the concentration in sediment may / will build. Thus,
using the above correction is anti – conservative.**

Dare I say that the sediment will be a "Reservoir" of sorts.