4.2.4 Cormix Results

In addition to using the DIVAST, the dispersion and dilution of the effluent plume was also simulated using the CORMIX model. The reason for this was to compare concentrations predicted by the CORMIX model with those predicted by DIVAST, since CORMIX models the density of the effluent plume whereas DIVAST does not. This would give an indication of how much DIVAST is underestimating the effluent concentration in the near field (i.e. less than 300m) due to the assumption of full vertical mixing. Simulations were executed for a single tidal cycle on the neap and spring tides only. The simulations were performed for cadmium only since a comparison of one substance was all that was needed to determine how well the model predictions agreed. The calculated concentrations were compared with those predicted by DIVAST at distances of 10m, 100m and 300m from the diffuser. Details of each simulation are given in Table 4.6. The treated leachate from the outfall was specified as 500m^3/day with a cadmium concentration of 0.001mg/l or 1μg/l. The total discharge from the outfall including, treated wastewater effluent, is 1063 m^3/day which is equivalent to 12.3l/sec. As a conservative estimate it was assume the treated wastewater effluent also contained 0.001mg/l of cadmium giving an overall cadmium concentration of 0.001mg/l in the effluent.

Tidal stage	Velocity	Average Depth (m)	Flow l/sec	Cadmium Conc. [μg/litre]
spring ebb	0.320	5.000	12.3	1.000
spring flood	0.250	5.000	12.3	1.000
neap ebb	0.130	5.000	12.3	1.000
neap flood	0.100	5.000	12.3	1.000

Table 4.6: Details of CORMIX model simulations

The CORMIX model predicts cadmium concentrations and dilution levels along the centreline of the plume produced by the effluent discharge. It also calculates the plume thickness, depth and width, as well as the distance travelled by the plume in relation to the diffuser. Table 4.7 presents the predicted centreline solute concentration and plume characteristics for each model simulation at distances of 10m, 100m and 300m from the outfall. Cadmium concentrations predicted by the DIVAST model are also given for comparison. It should be noted that the orientation of the co-ordinate axes are as follows:

- X-axis – positive in the direction of current flow and parallel to shore
- Y-axis – positive in the direction of the shore and normal to shore
- Z-axis – positive in the upward direction

The origin of the co-ordinate system is located at the centre point of the diffuser manifold. Figures 4.60 – 4.65 show plan and side views of the predicted plumes and plots of concentration and dilution versus downstream distance for spring ebb and neap ebb runs. CORMIX requires a 'regulatory mixing zone' to be specified which allows the user to see if certain criteria have been fulfilled within this zone. In the present study an arbitrary value of 300m was chosen since this distance corresponds to the outer comparison point between the two models. In fact appropriate standards are achieved at the first comparison point, i.e. 10m, as will be discussed in the next chapter. The Toxic Dilution zone is not relevant to the present study and just appears as a default key in the graph legends.

Note: **BV = plume thickness, measured vertically**
BH = plume half-width, measured horizontally in y-direction

Tidal stage	BV (m)	BH (m)	BV (m)	BH (m)	BV (m)	BH (m)	Cormix Conc. [ng/litre]			Divast Conc. [ng/litre]		
	10m	10m	100m	100m	300m	300m	10m	100m	300m	10m	100m	300m
spring ebb	2.00	3.00	5.43	12.20	6.00	14.80	0.596	0.372	0.268	0.330	0.226	0.208
spring flood	2.00	3.00	4.75	13.70	5.00	23.75	0.770	0.479	0.287	0.510	0.330	0.268
neap ebb	2.00	3.00	3.38	19.80	2.38	80.22	1.511	0.936	0.562	0.930	0.453	0.406
neap flood	2.00	3.00	2.90	24.00	1.99	91.50	1.926	1.151	0.802	1.100	0.709	0.585

Table 4.7: Plume characteristics and concentration levels

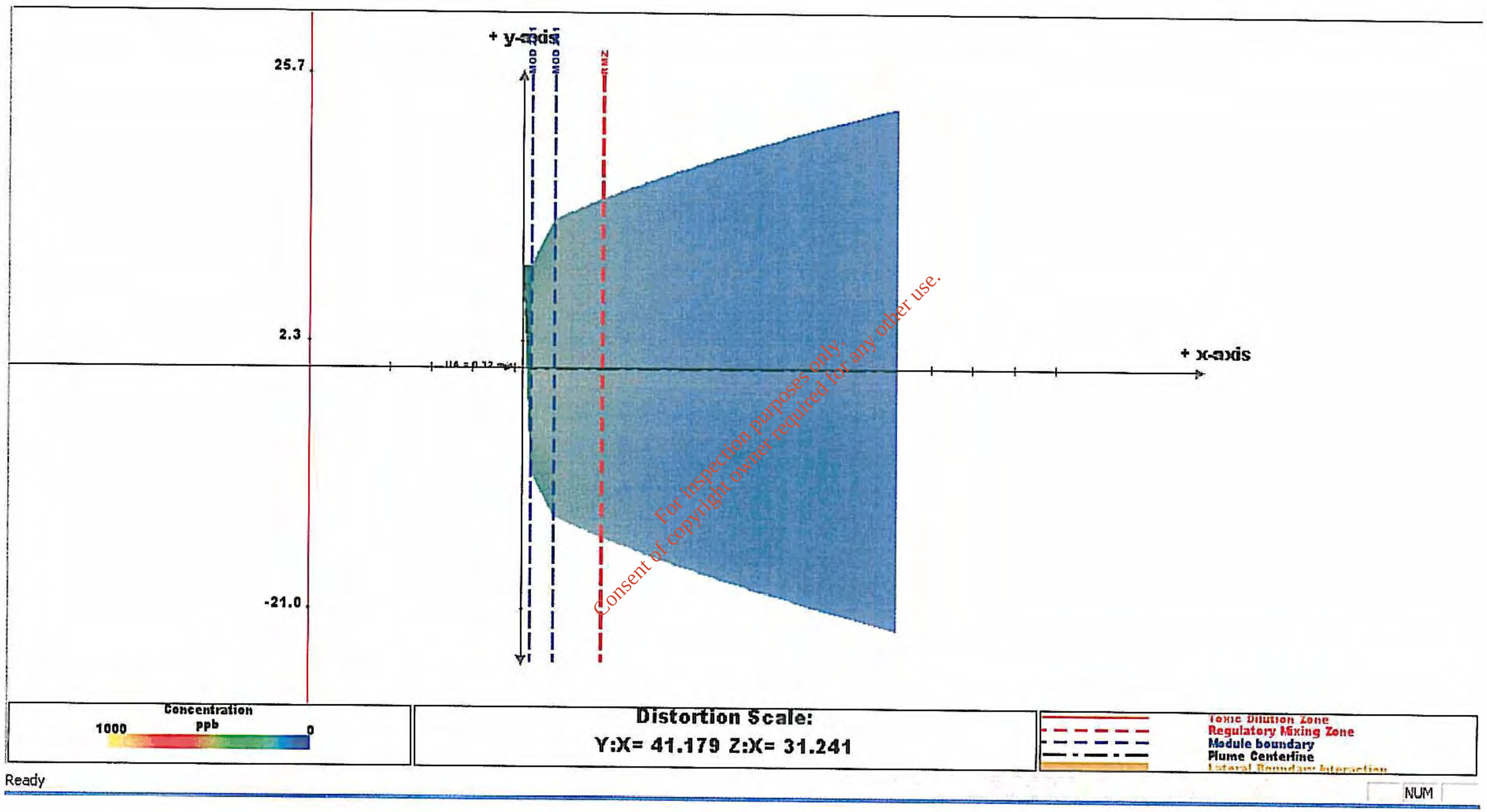

Figure 4.64 : Plan view of predicted plume at mid-flood on a neap tide

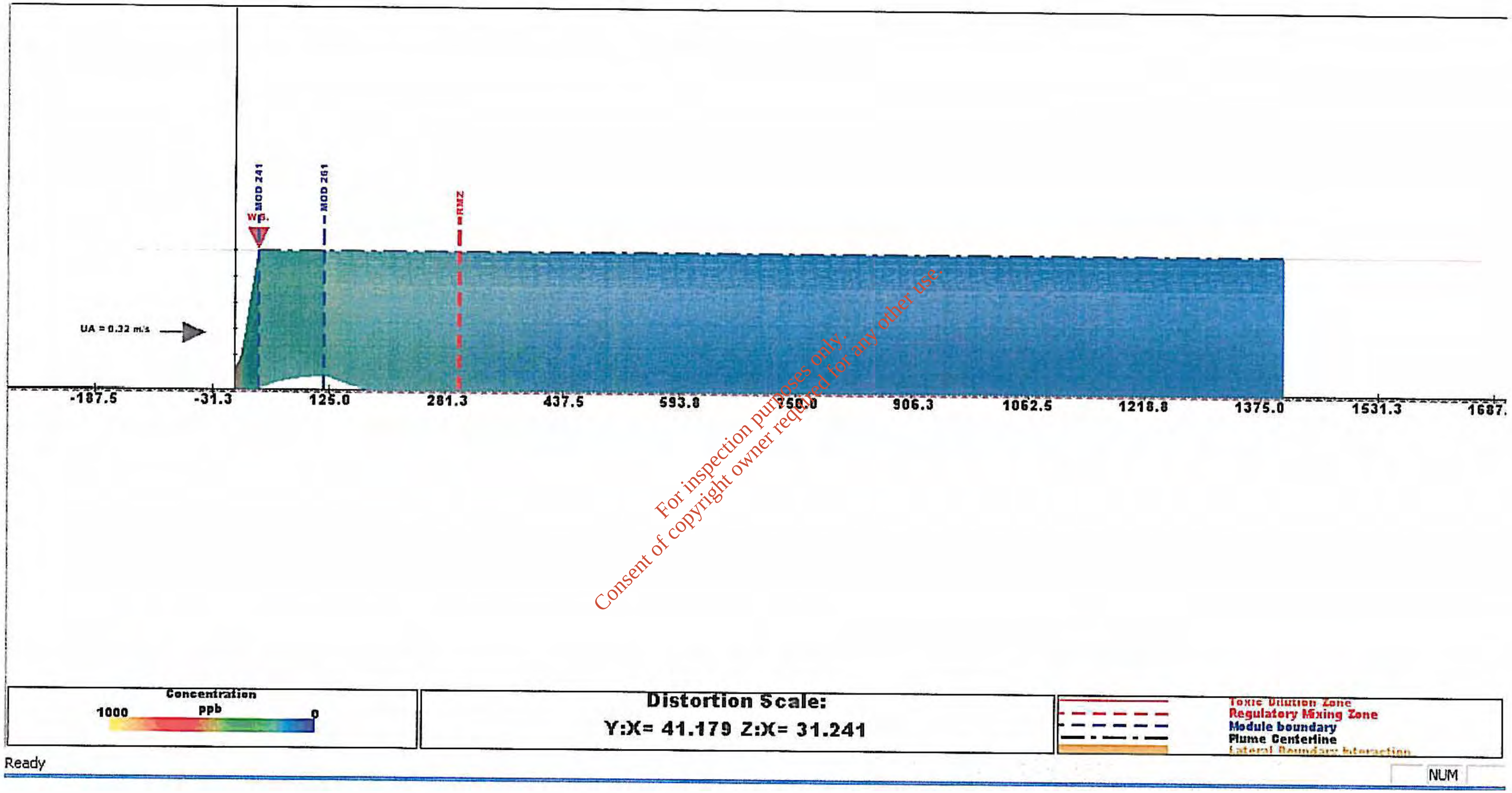

Figure 4.63 : Side view of predicted plume at mid-ebb on a spring tide

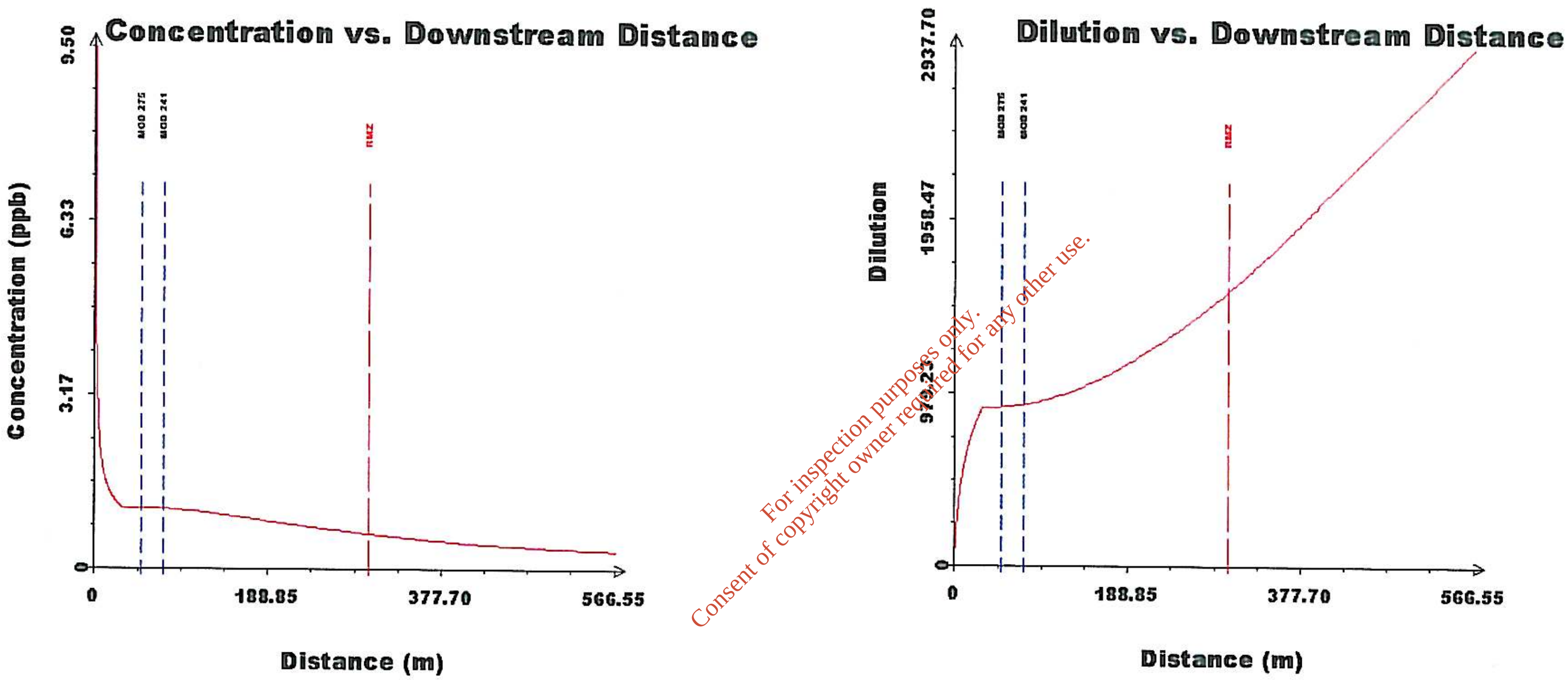

Figure 4.62 Plots of Cadmium concentration and dilution versus downstream distance at mid-flood on a neap tide

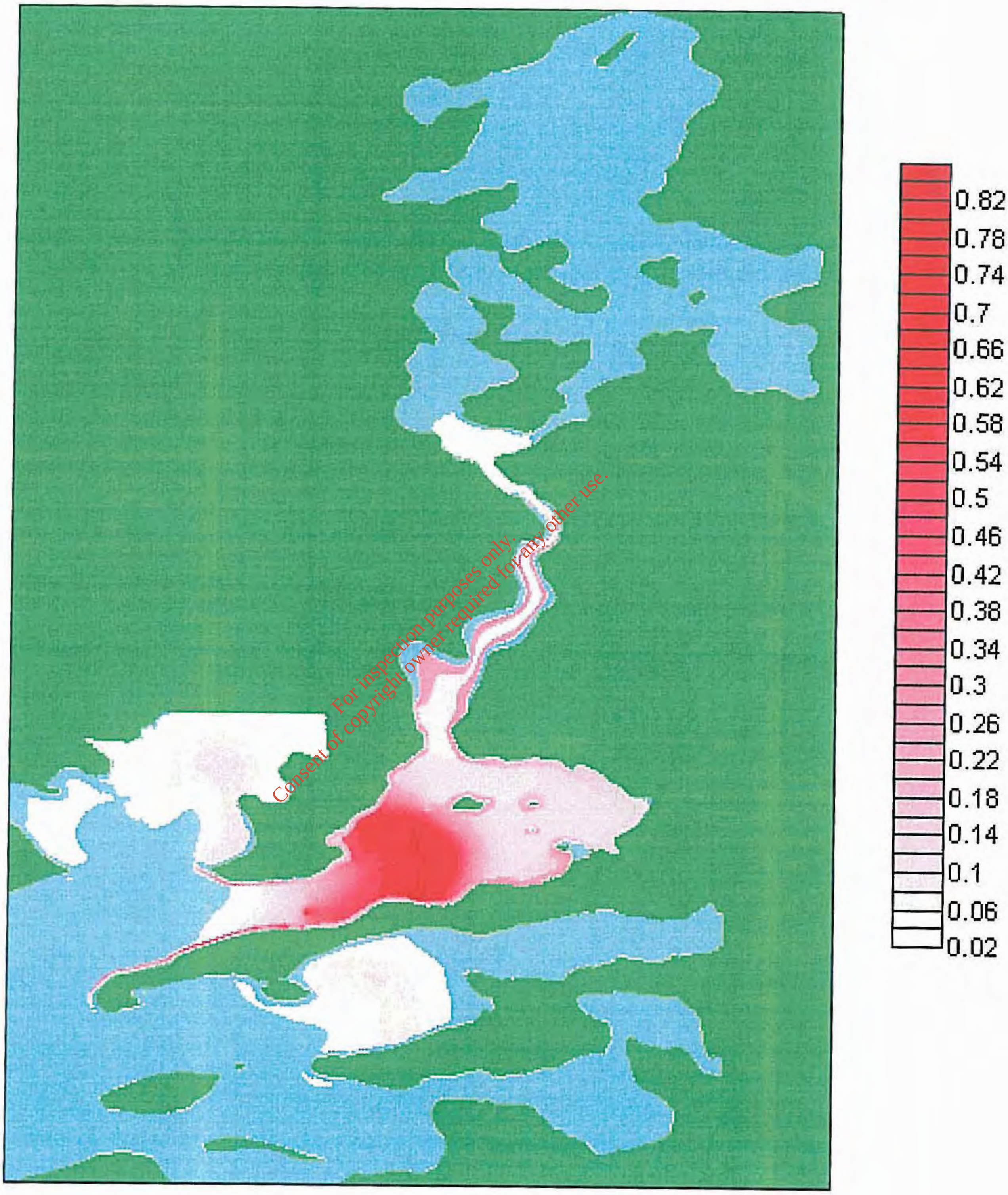

Figure 4.1 : Faecal coliform concentrations at mid-flood on a spring tide (number/100 ml)

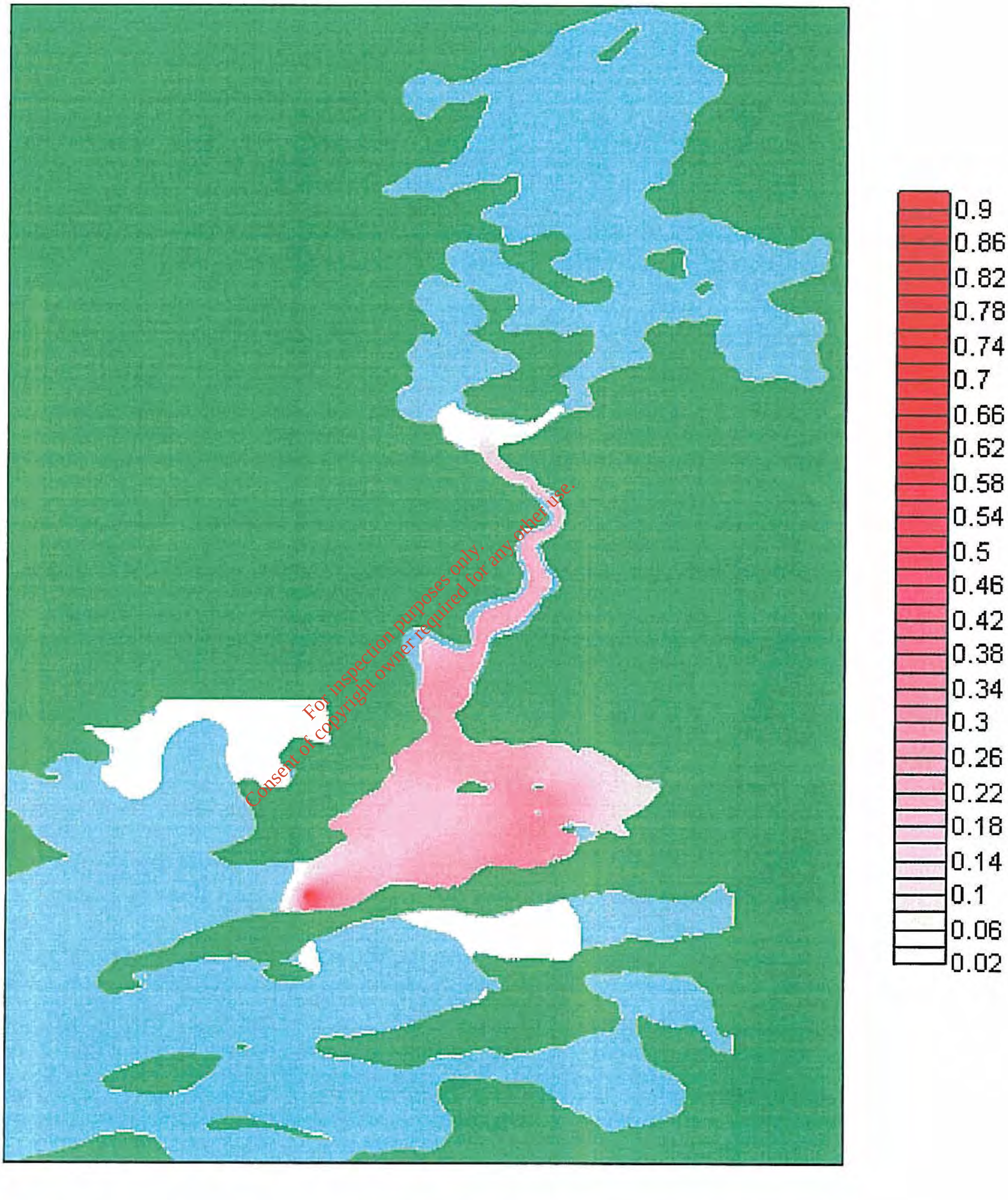

Figure 4.2 : Faecal coliform concentrations at high water on a spring tide (number/100 ml)

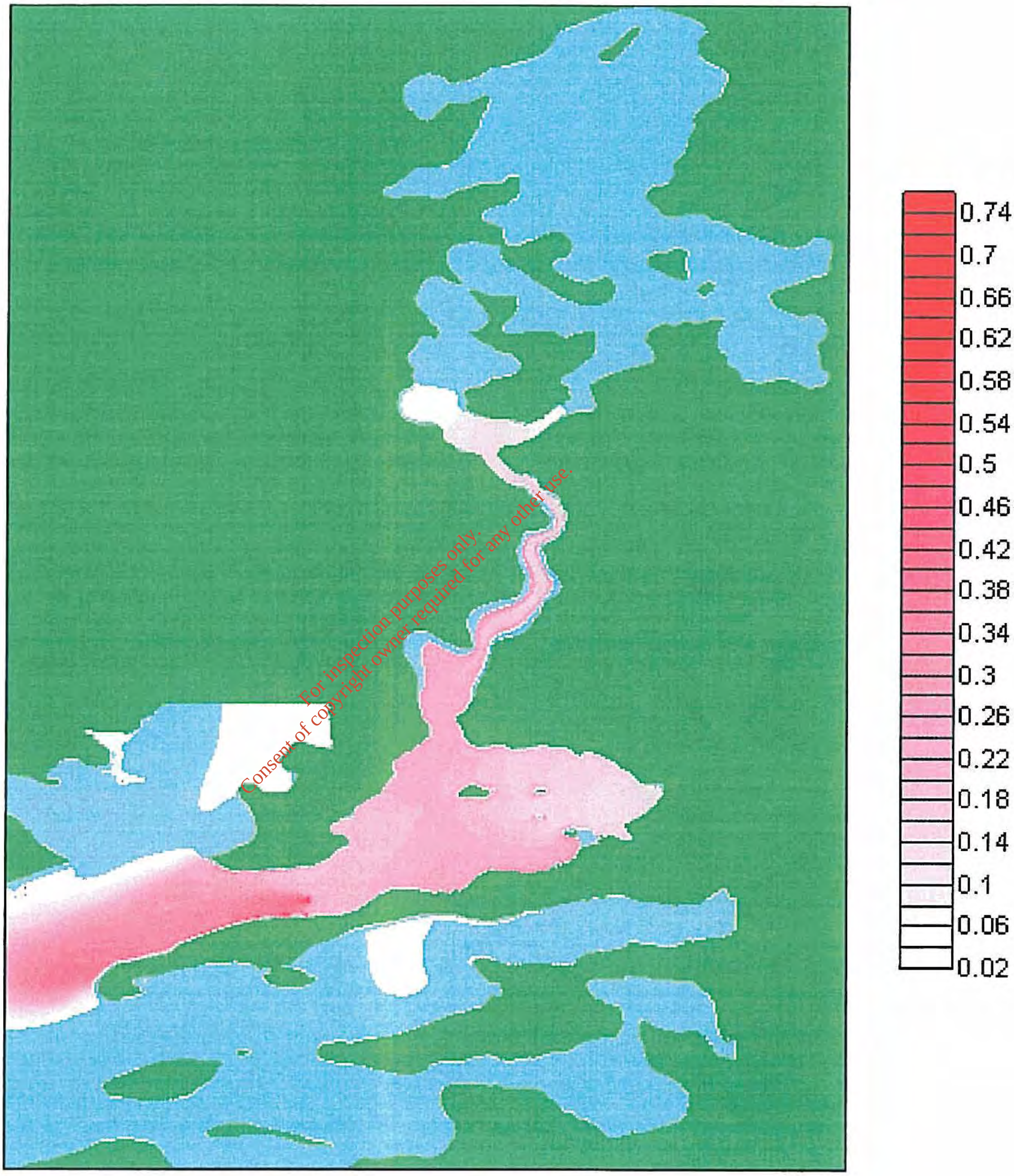

Figure 4.3 : Faecal coliform concentrations at mid-ebb on a spring tide (number/100 ml)

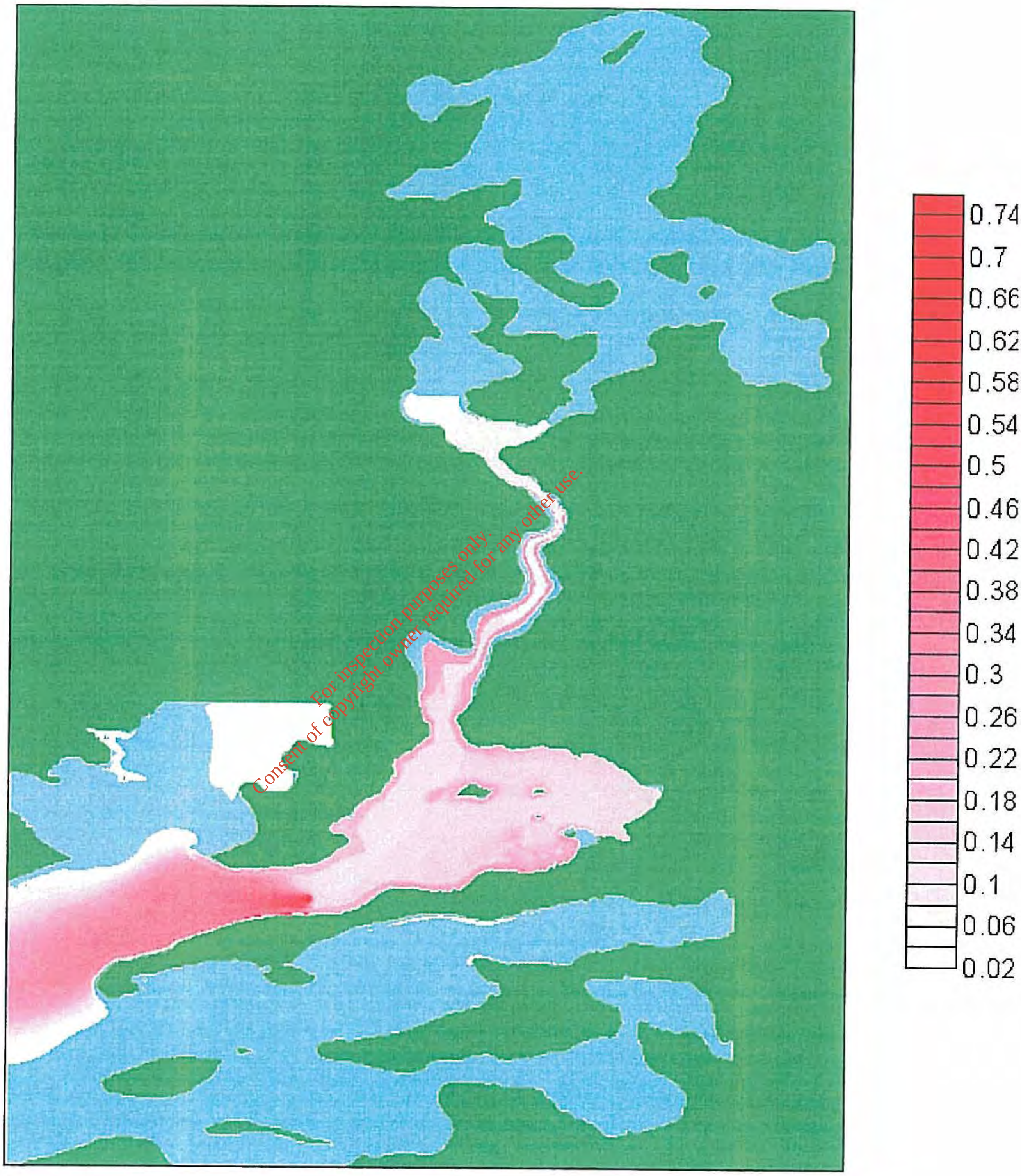

Figure 4.4 : Faecal coliform concentrations at low water on a spring tide (number/100 ml)

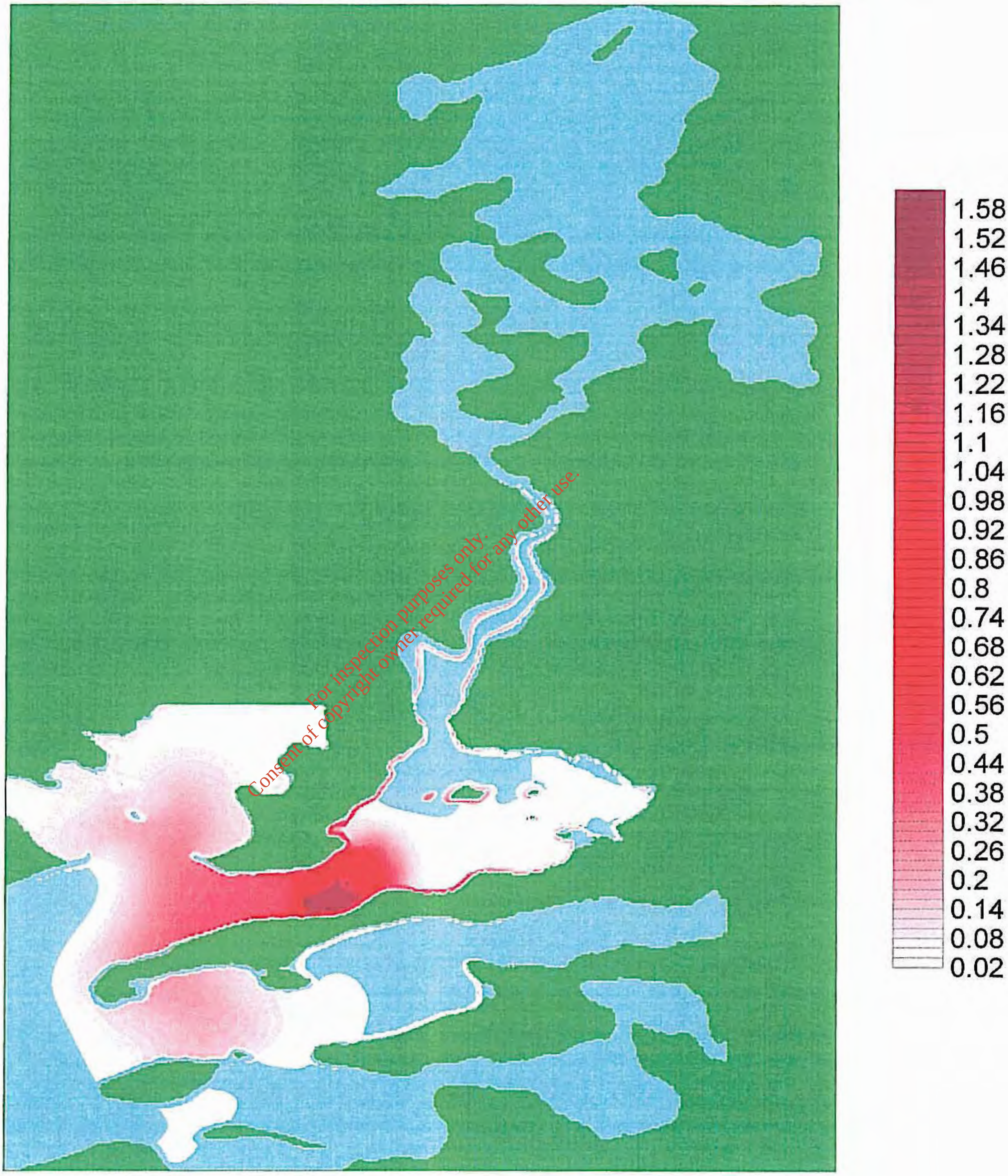

Figure 4.5 : Faecal coliform concentrations at mid-flood on a neap tide (number/100 ml)

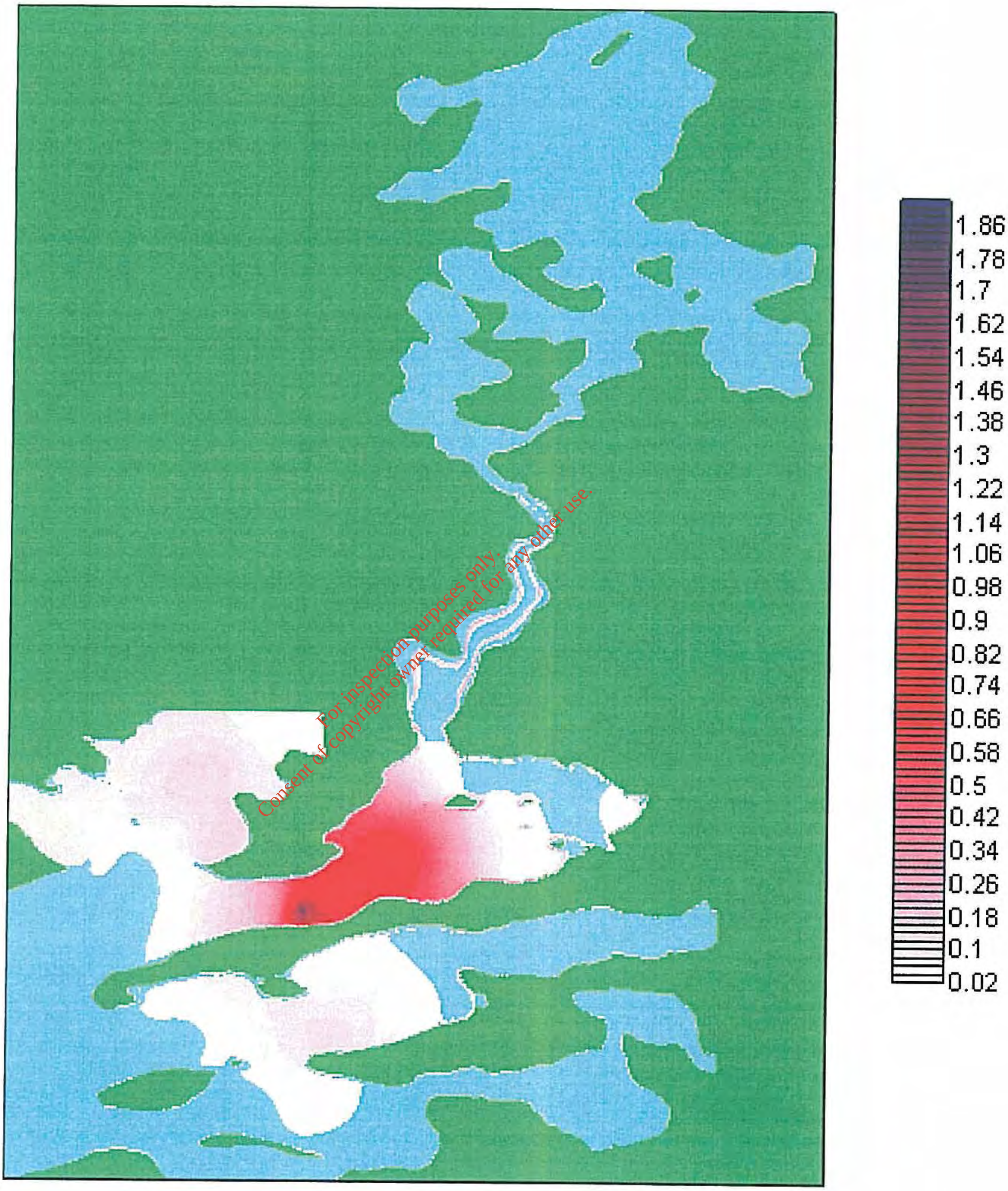

Figure 4.6 : Faecal coliform concentrations at high water on a neap tide (number/100 ml)

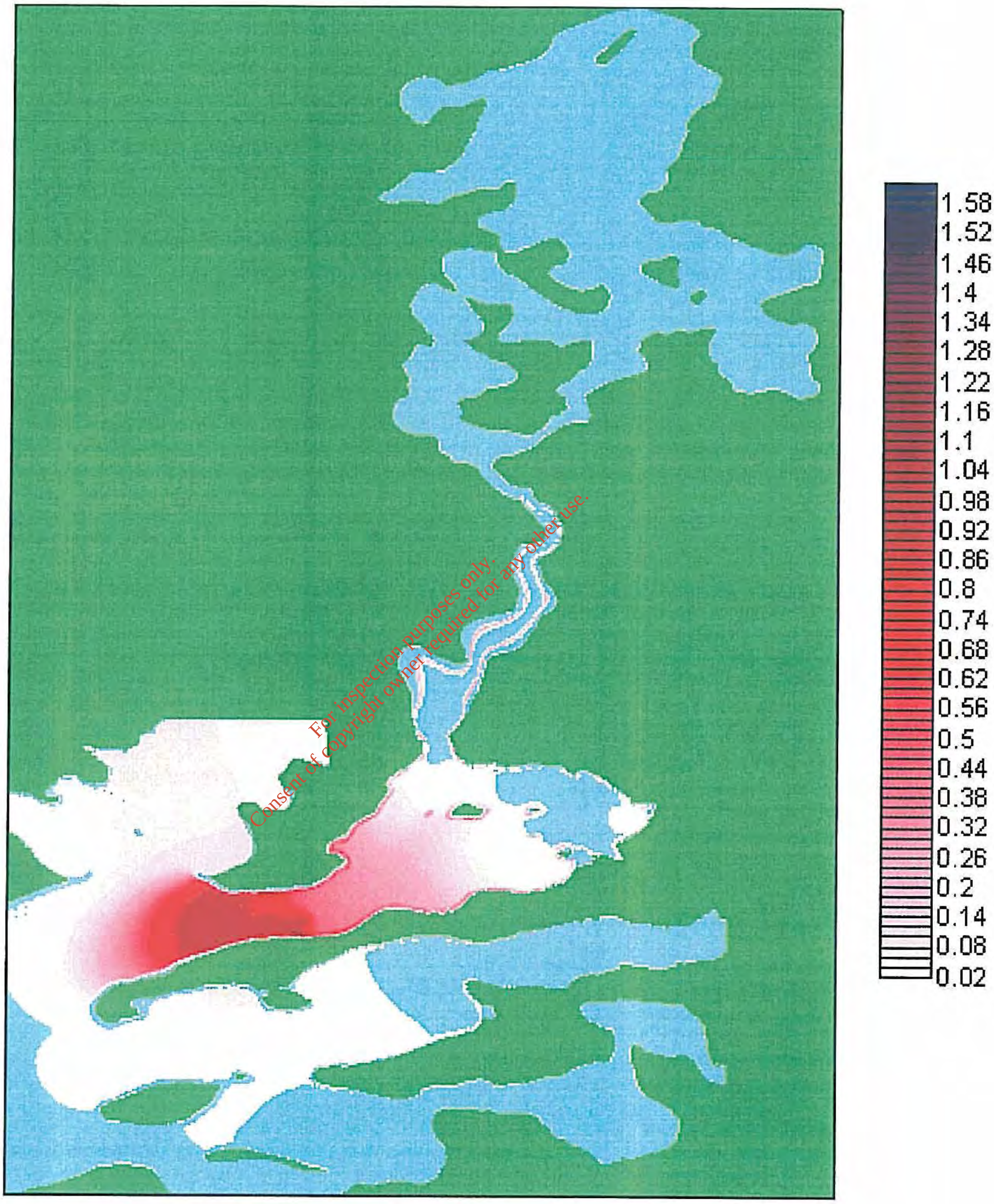

Figure 4.7 : Faecal coliform concentrations at mid-ebb on a neap tide (number/100 ml)

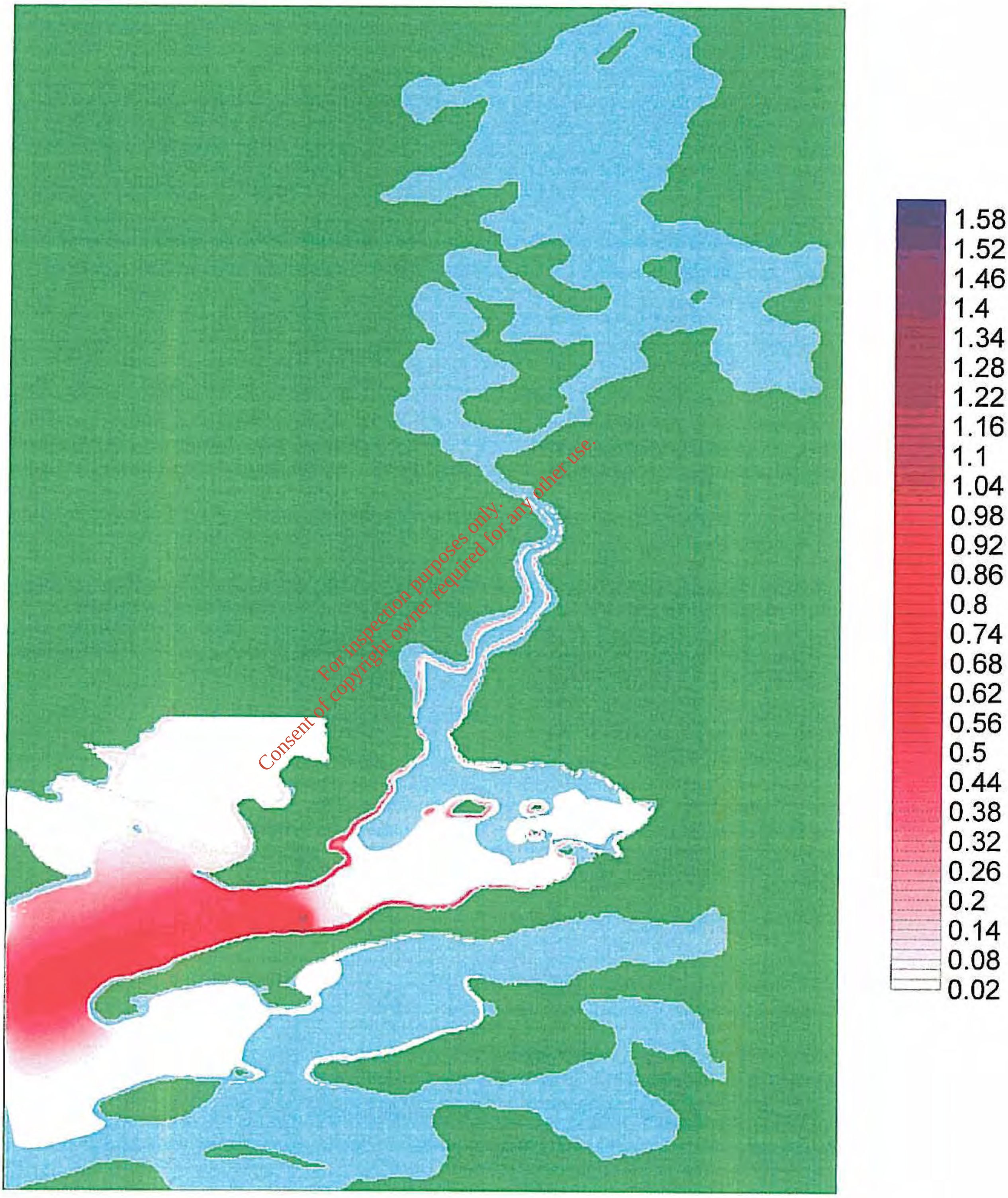

Figure 4.8 : Faecal coliform concentrations at low water on a neap tide (number/100 ml)

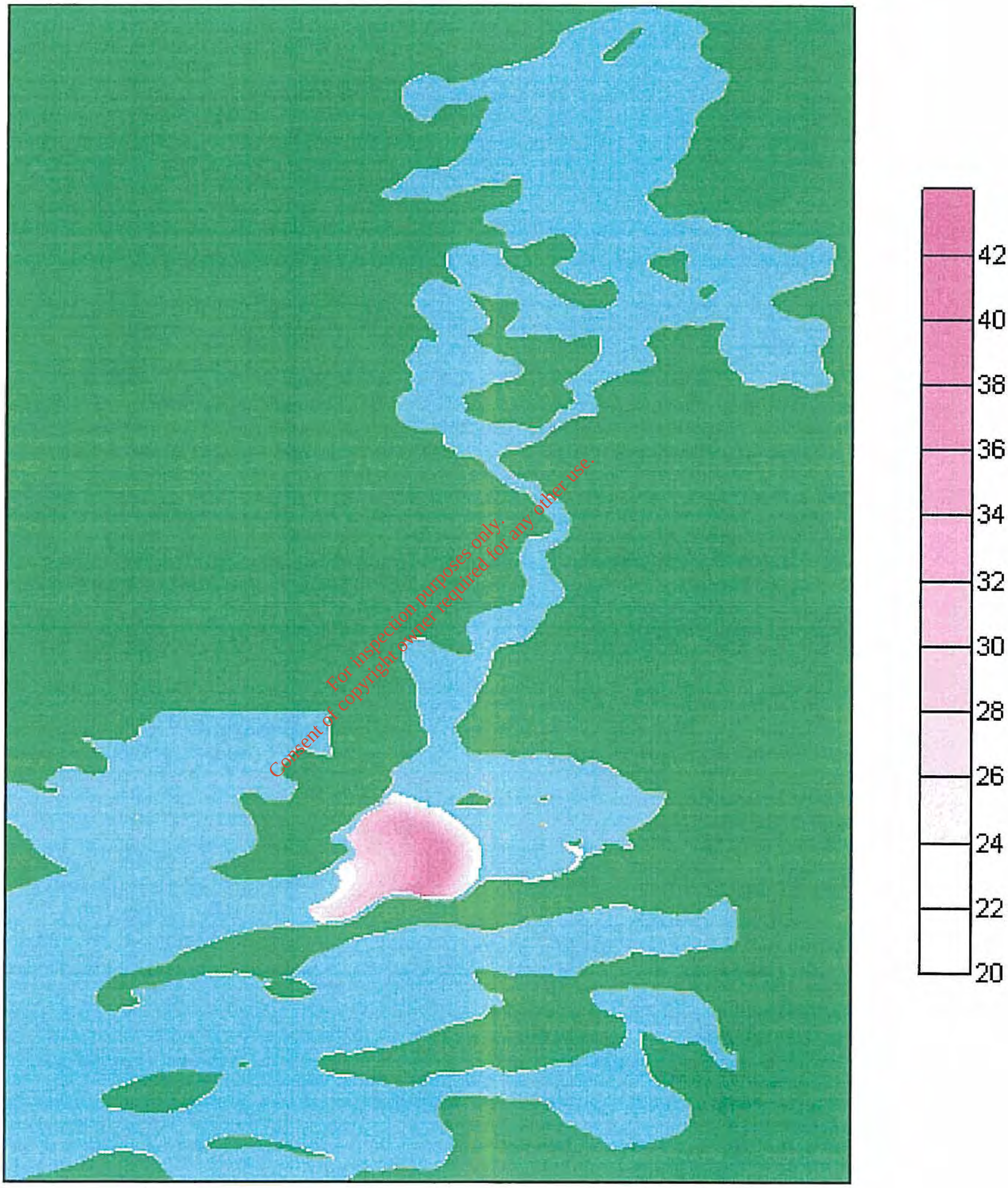

Figure 4.9 : Copper concentrations (ng/l) at mid-flood on a spring tide

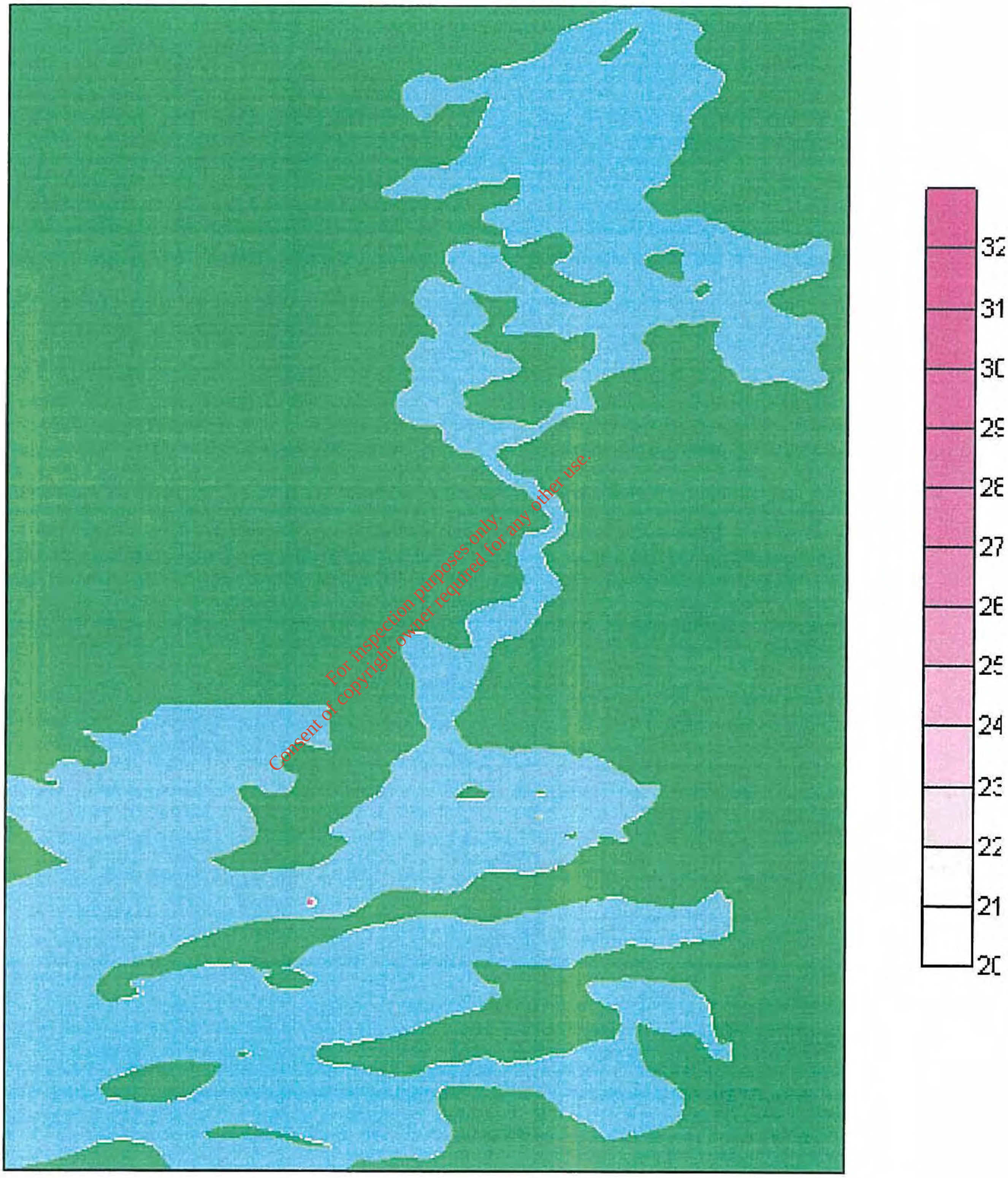

Figure 4.10 : Copper concentrations (ng/l) at high water on a spring tide

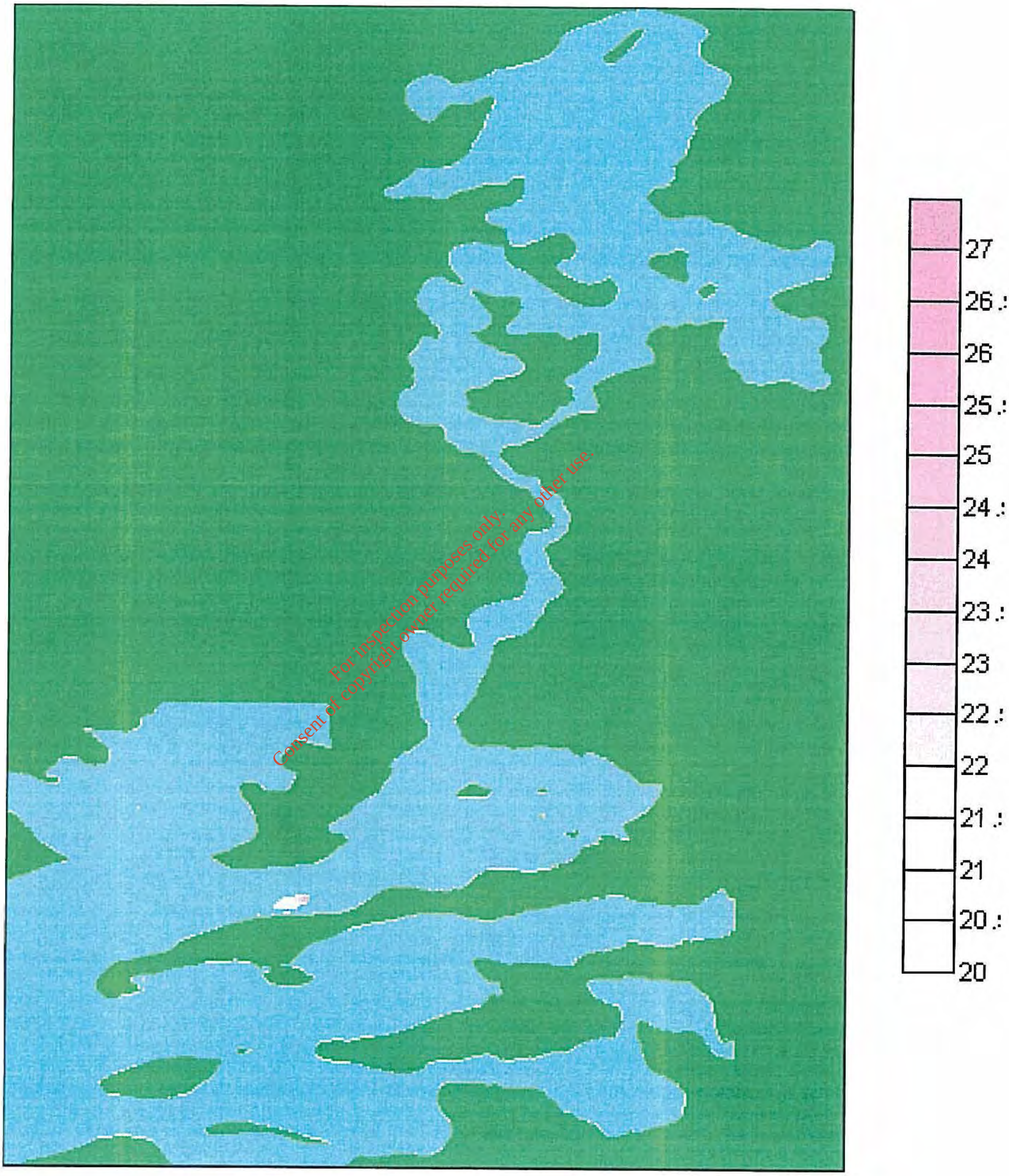

Figure 4.11 : Copper concentrations (ng/l) at mid-ebb on a spring tide

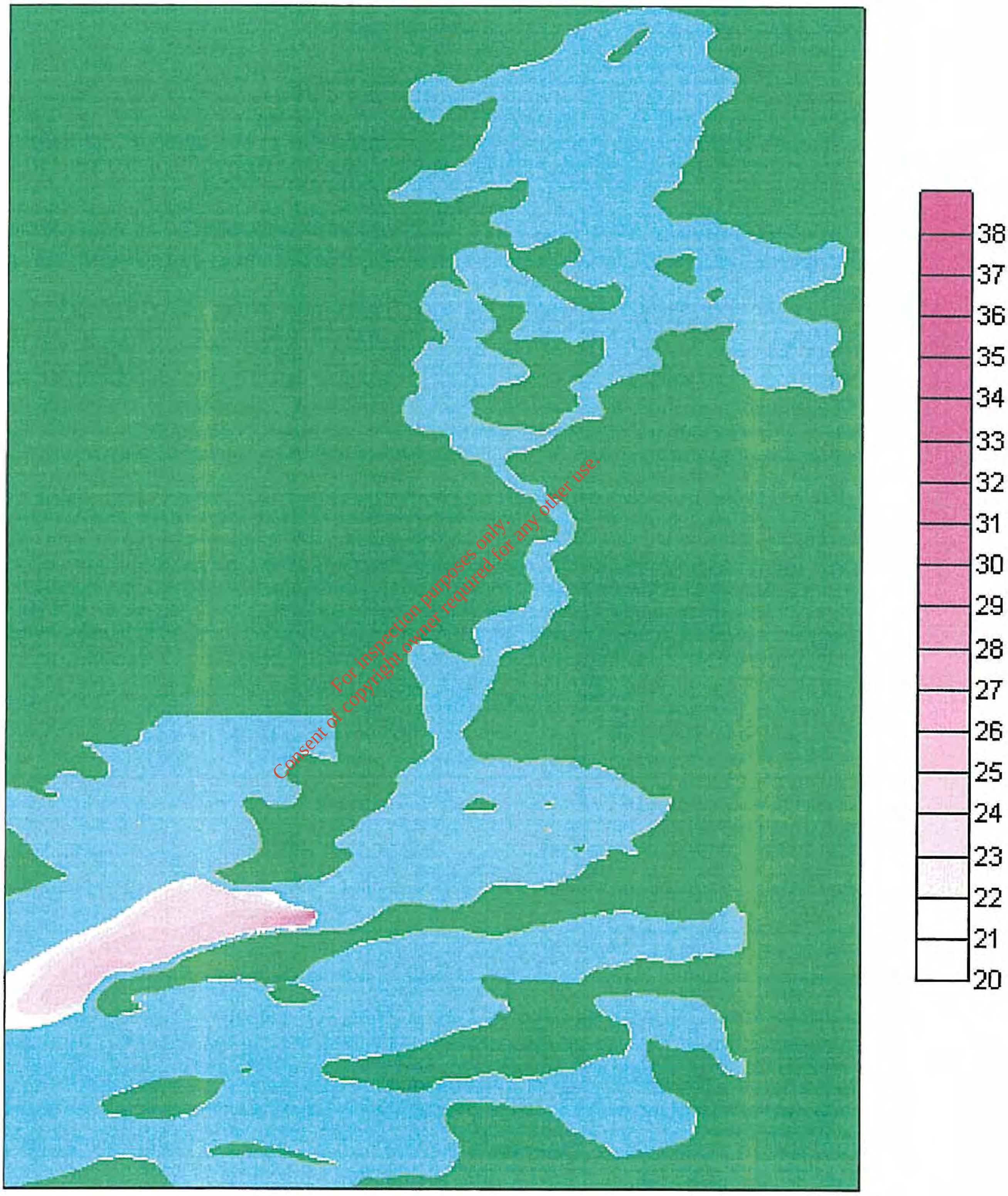

Figure 4.12 : Copper concentrations (ng/l) at low water on a spring tide

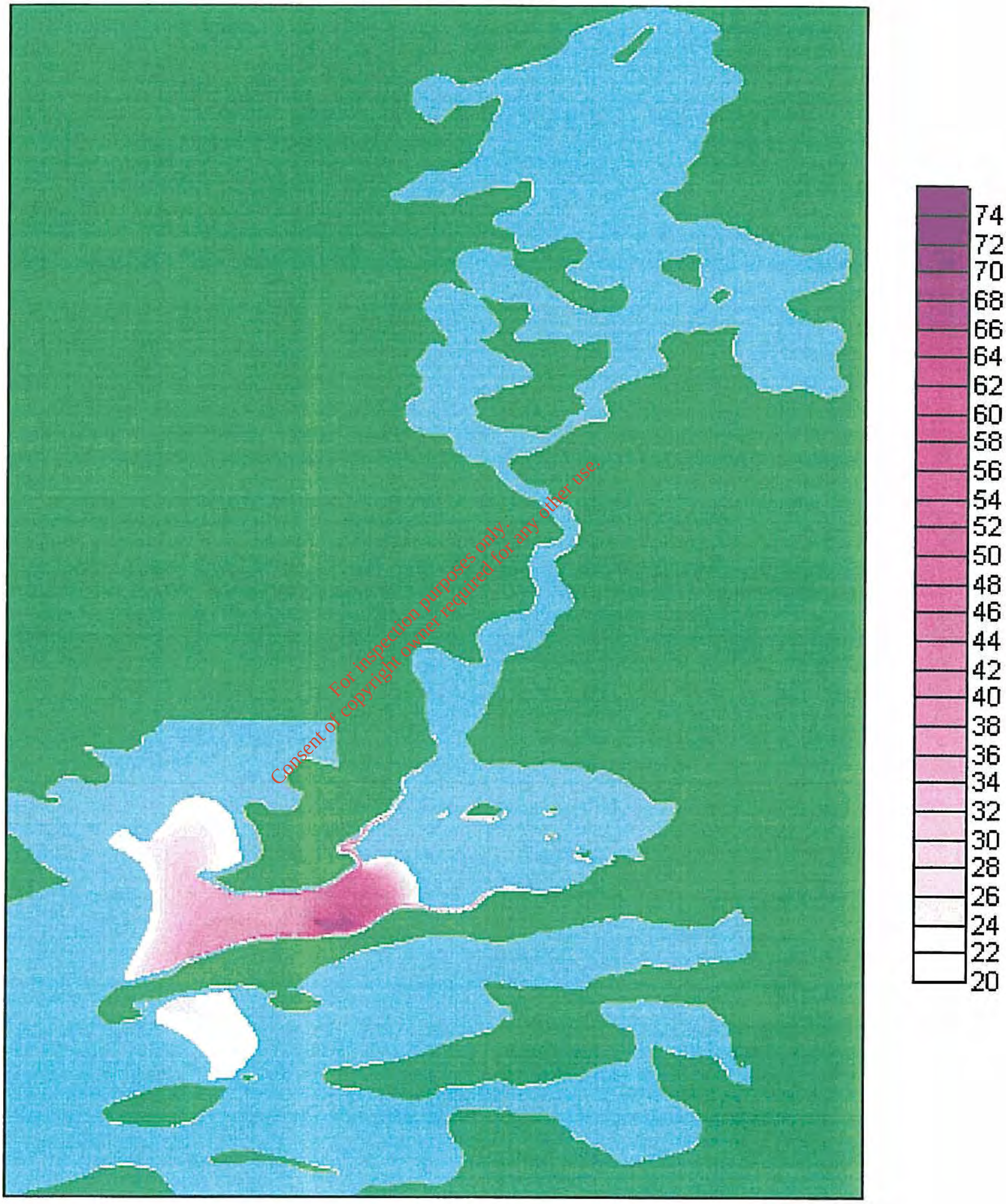

Figure 4.13 : Copper concentrations (ng/l) at mid-flood on a neap tide

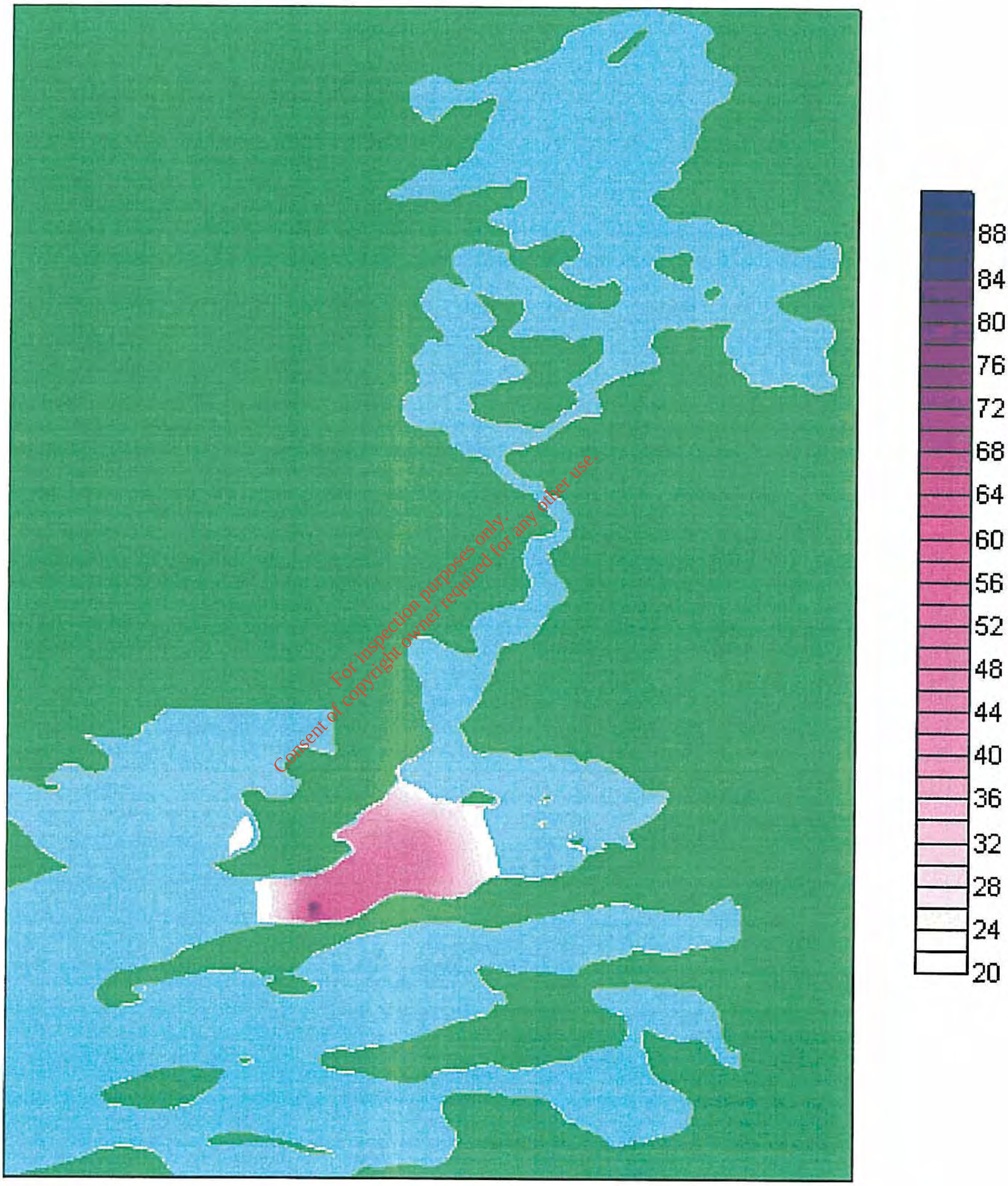

Figure 4.14 : Copper concentrations (ng/l) at high water on a neap tide

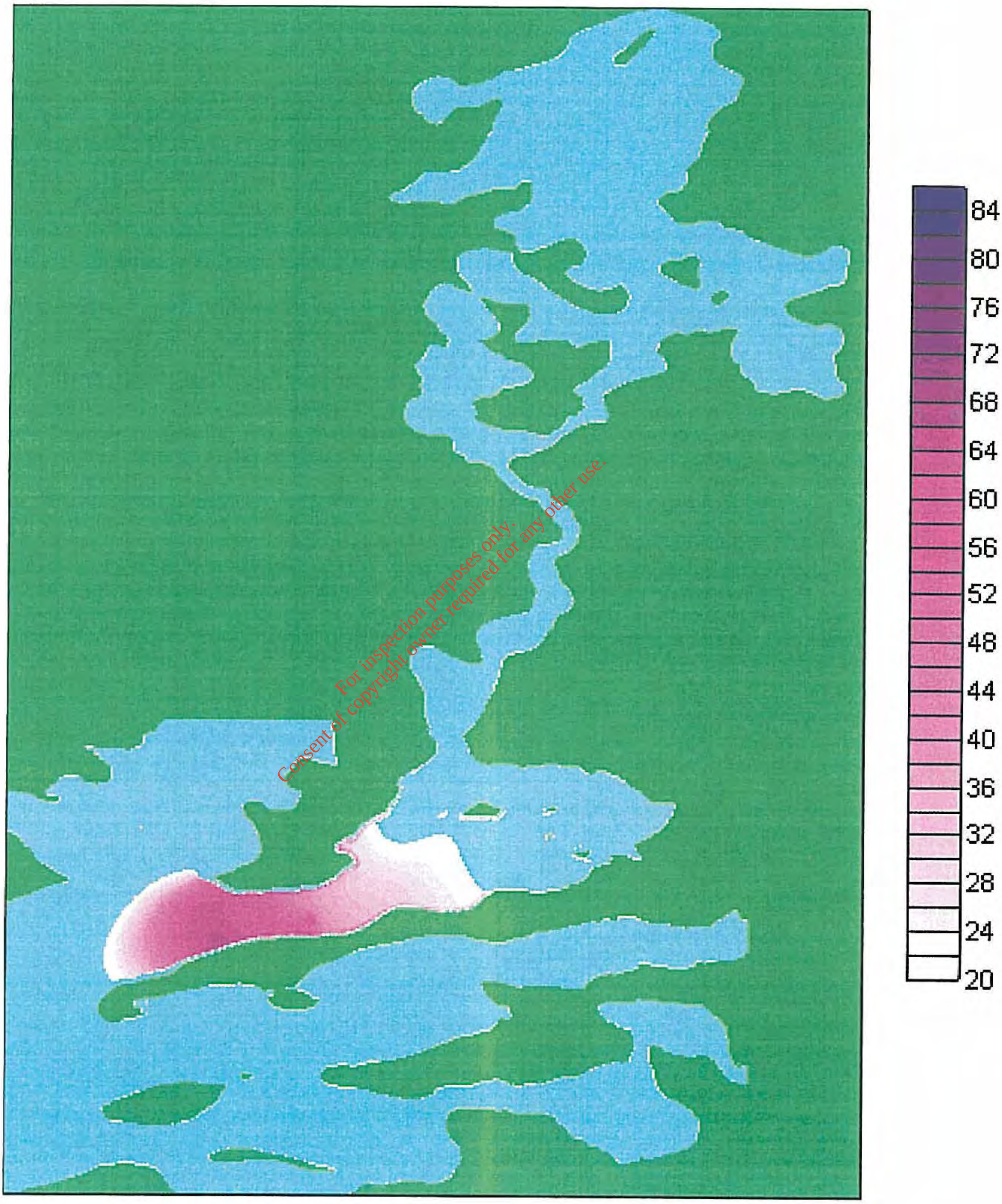

Figure 4.15 : Copper concentrations (ng/l) at mid-ebb on a neap tide

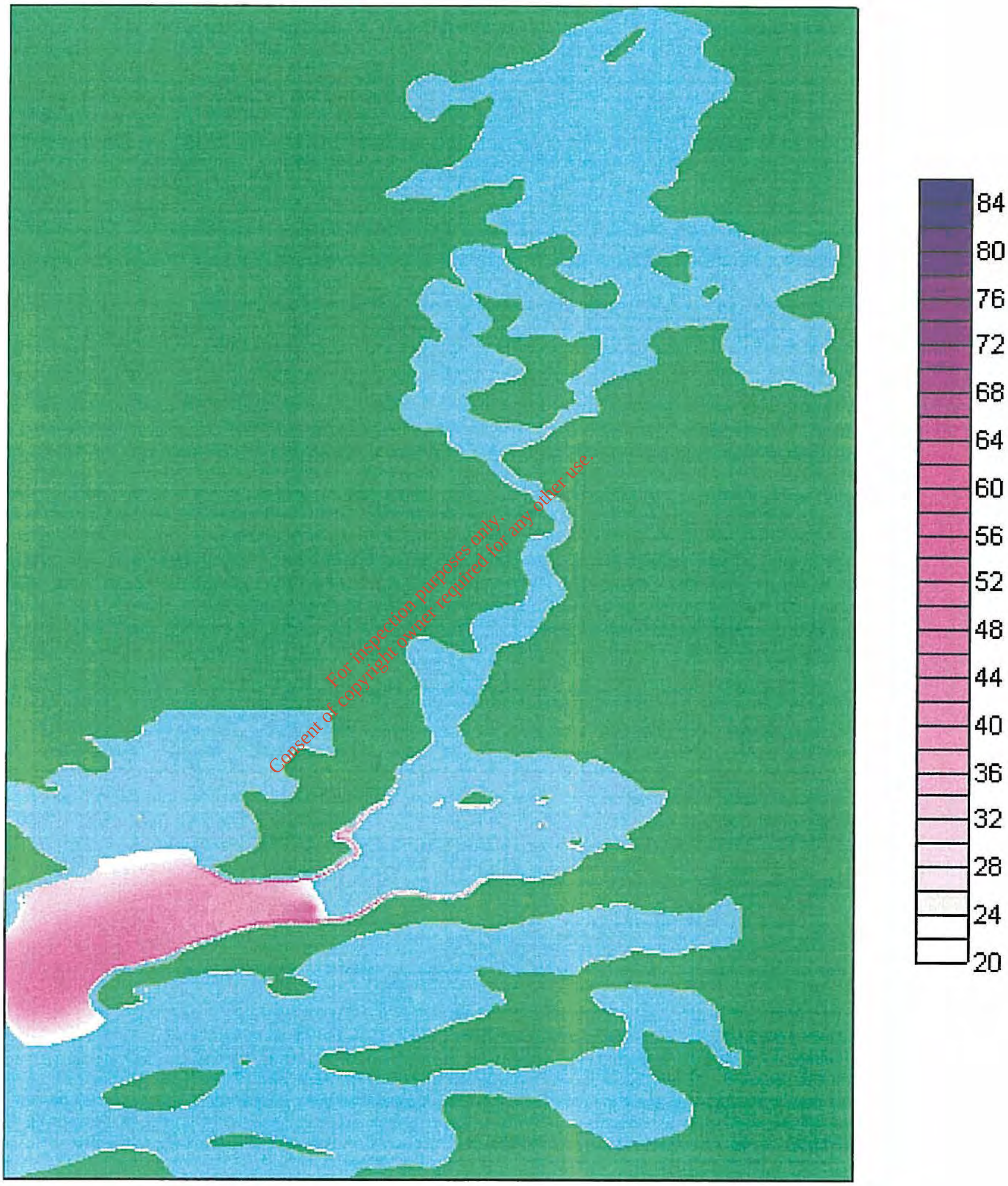

Figure 4.16 : Copper concentrations (ng/l) at low water on a neap tide

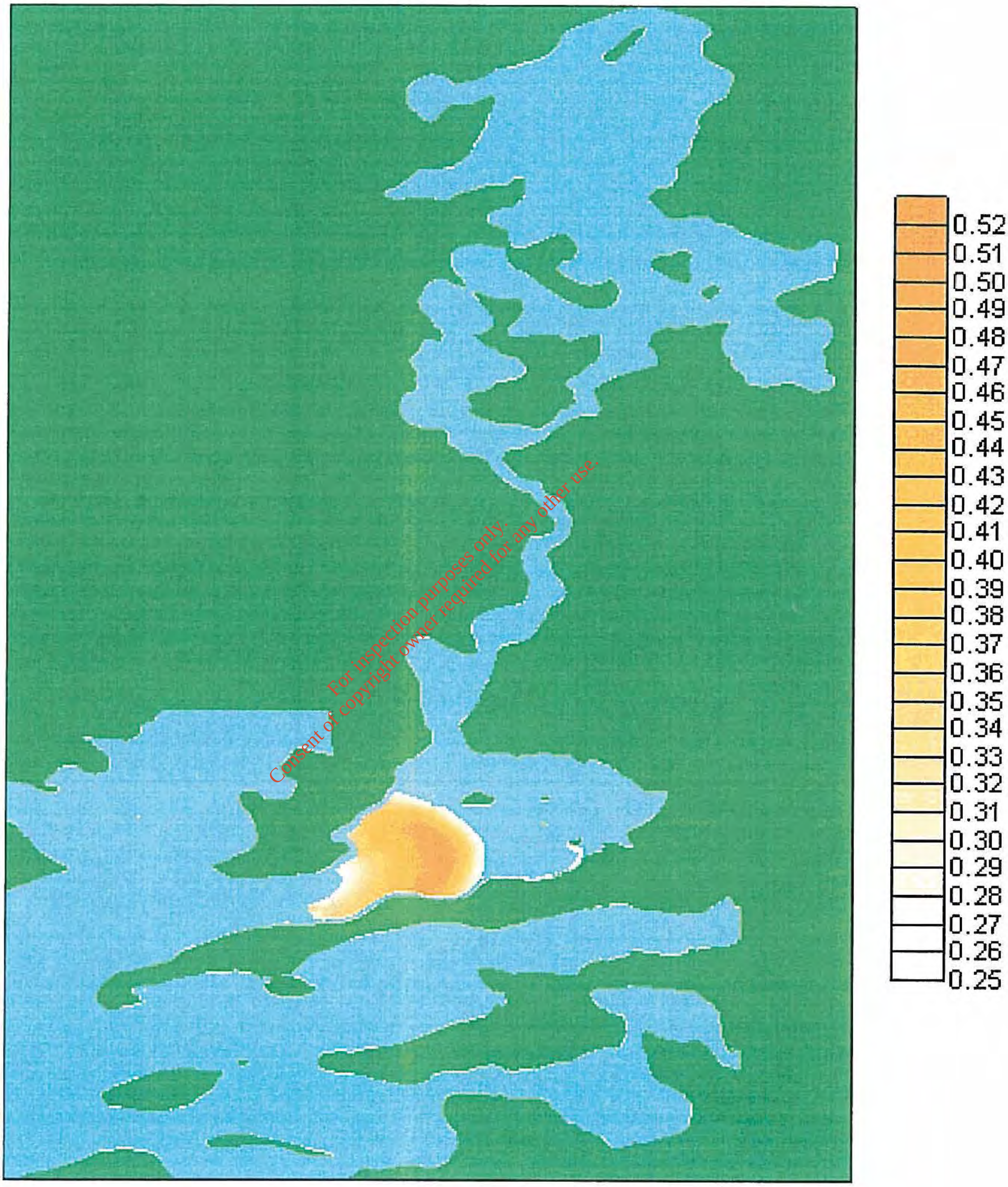

Figure 4.17 : Cadmium concentrations (ng/l) at mid-flood on a spring tide

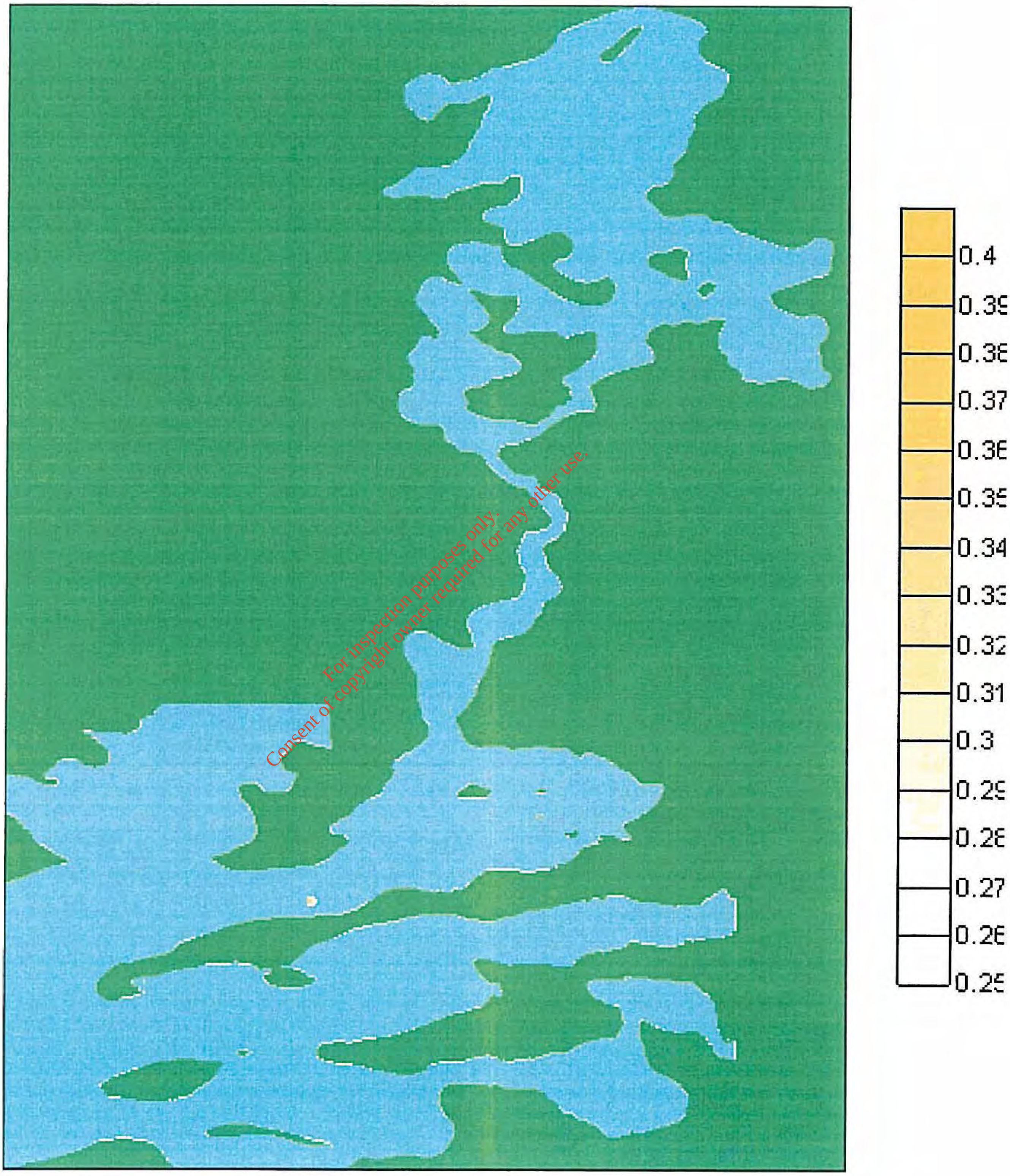

Figure 4.18 : Cadmium concentrations (ng/l) at high water on a spring tide

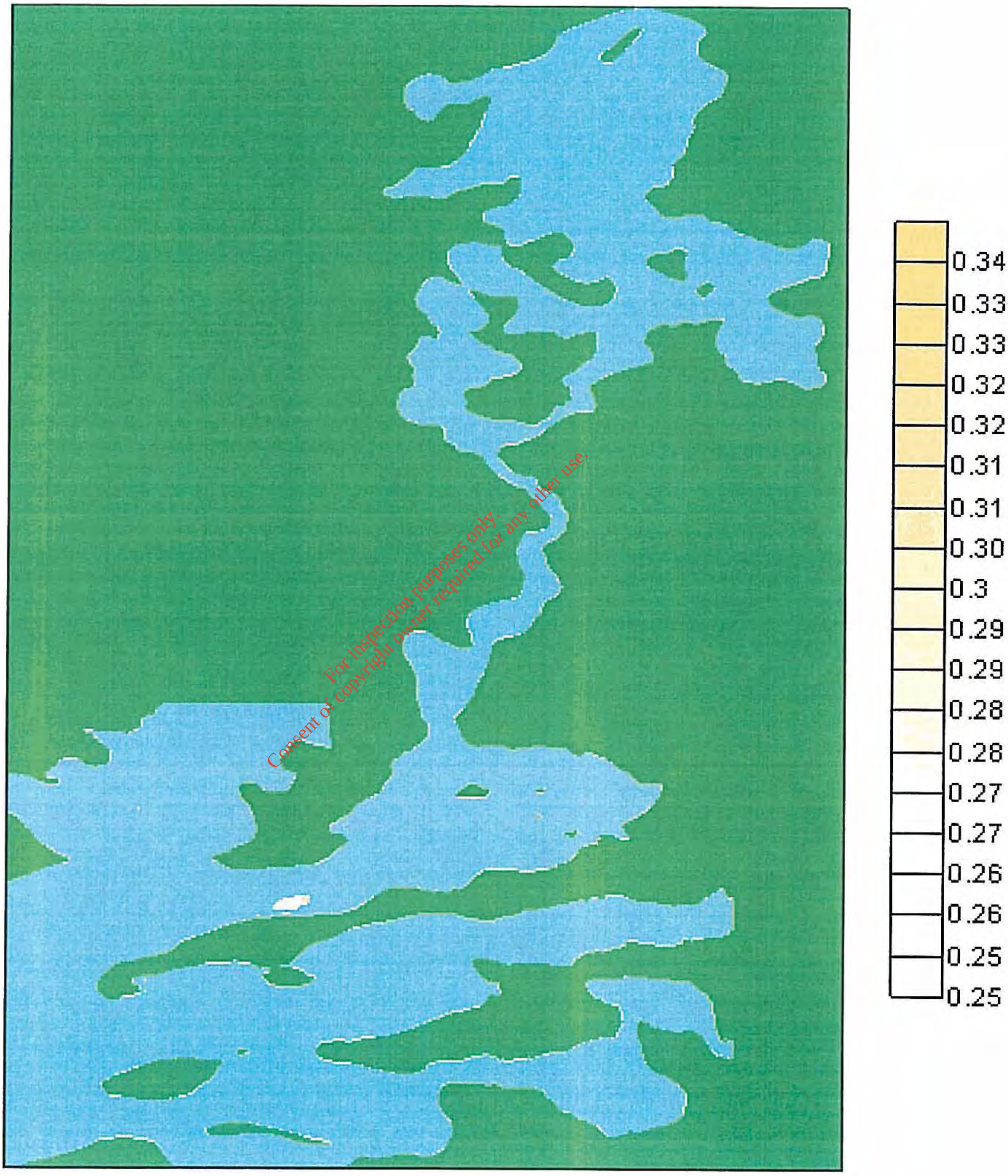

Figure 4.19 : Cadmium concentrations (ng/l) at mid-ebb on a spring tide

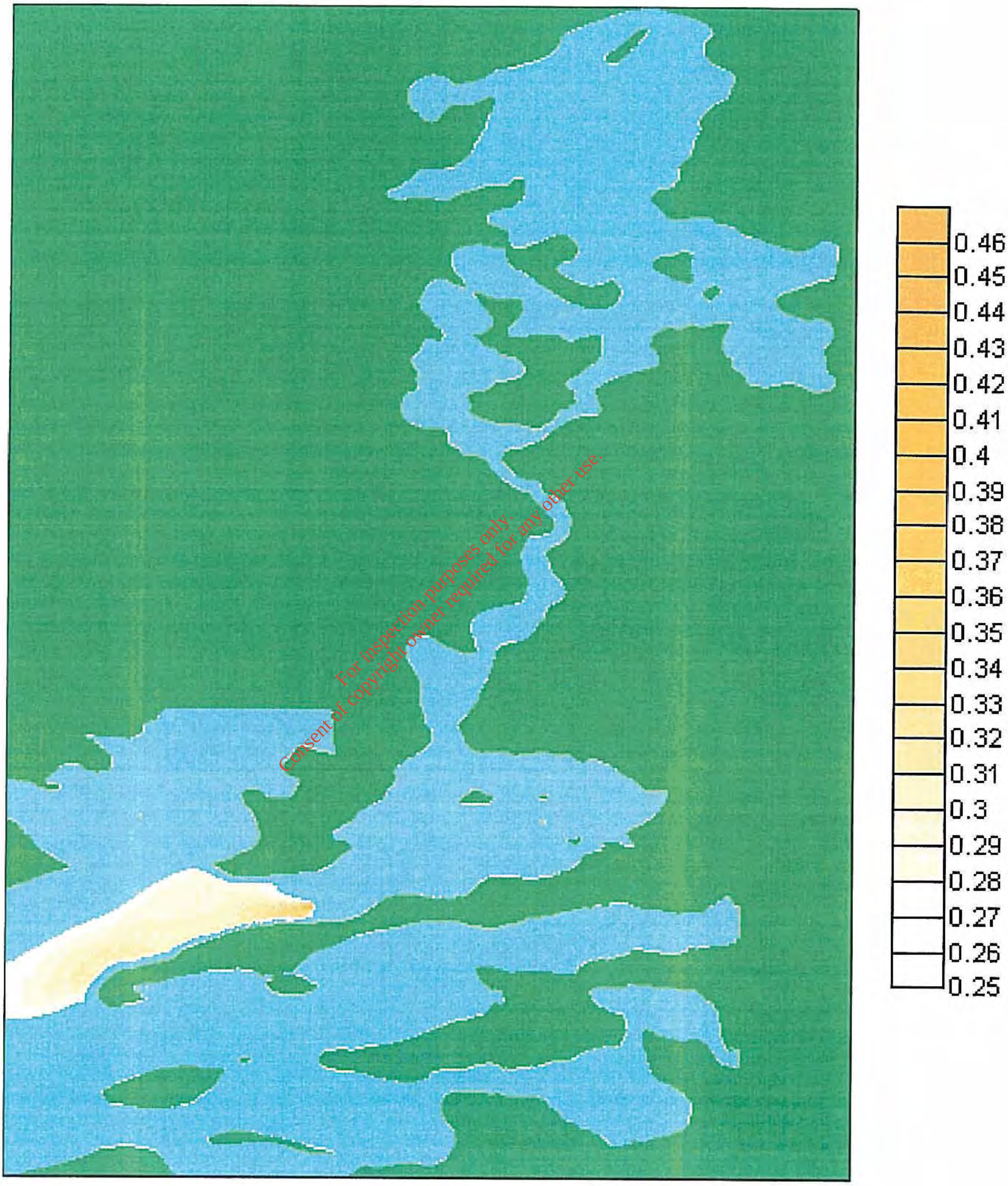

Figure 4.20 : Cadmium concentrations (ng/l) at low water on a spring tide

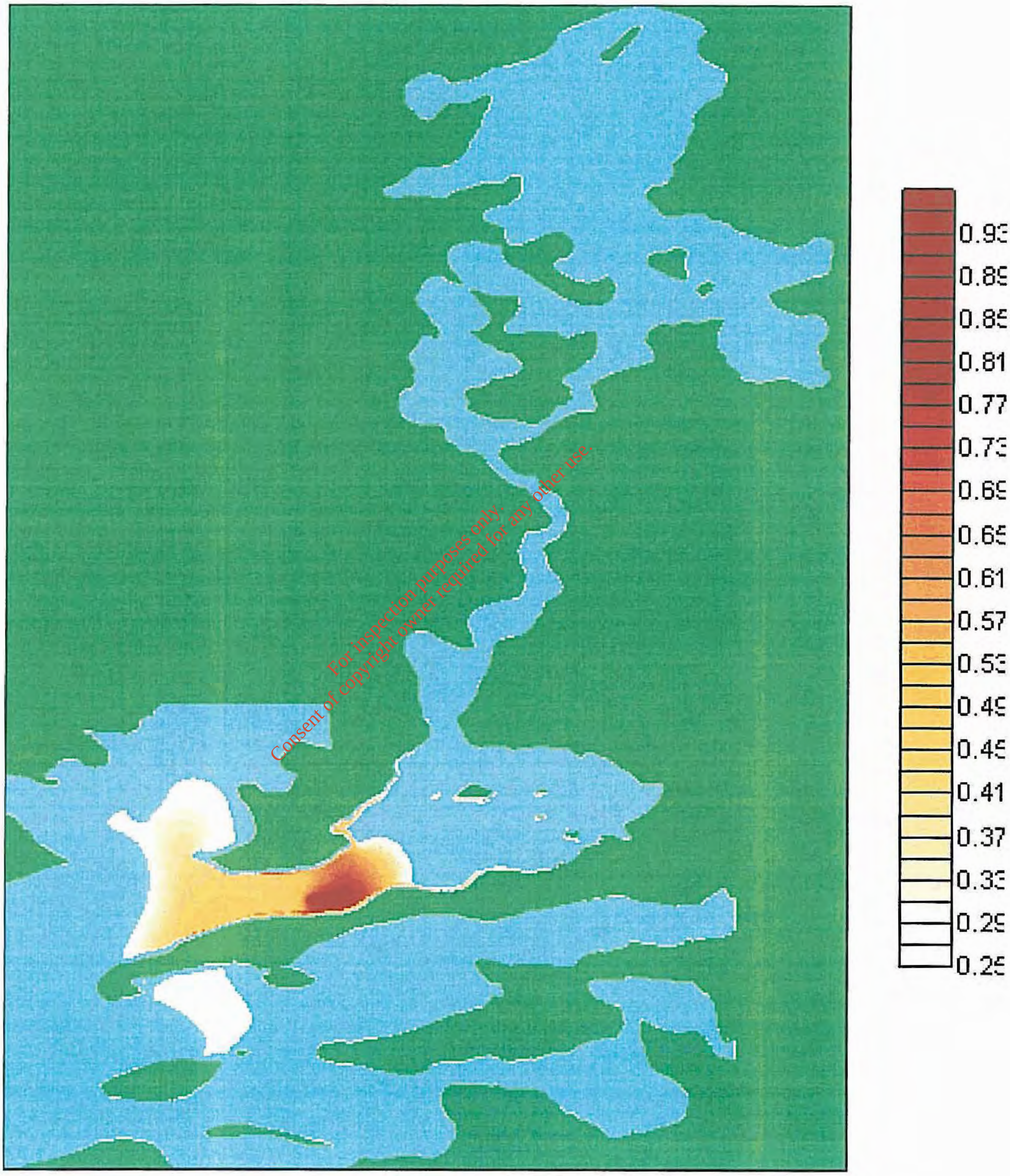

Figure 4.21 : Cadmium concentrations (ng/l) at mid-flood on a neap tide