EXHIBIT 4

Hydrodynamic Assessment of Cameron Flow-way

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Summary

The purpose of this analysis was to determine whether return water from a proposed marsh flow-way will mix sufficiently with ambient lake water to prevent return water from reentering the flow-way. Treatment efficiency would be lowered if too great a fraction of return water is drawn back into the treatment system, possibly jeopardizing project feasibility. During conceptual design, it was assumed that water could be returned to the lake at a sufficient distance from the intake at Chub Creek to prevent such "short-circuiting". This analysis thus considered three different outfall locations for return water to assess the effect of outfall location on short-circuiting.

Results of this analysis showed the following:

A. Appreciable short-circuiting does not occur for water discharged about 3 miles west from the proposed intake at Chub Creek.

B. Short-circuiting does occur for water discharged within 1 mile of the intake and short-circuiting increases with flow rate.

It is recommended that the effect of reduced treatment efficiency be considered in the project design if more than 5 cfs of discharge from the system is directed within 1 mile west of the intake location. Any water directed more than two miles west from the intake location can be considered to have a negligible effect on treatment efficiency.

Tests

Numerical dye tracer tests were used to estimate the percentage of water released from the proposed treatment system that would return through the intake at Chub Creek. Three release points were tested (locations A, B and C, Figure 1). At each release point, a range of constant discharge of 9, 17.9 and 26.9 cfs was tested. Time-series of dye were output at stations OW-2, OW-3, OW-5, and the intake (Figure 1). All tests were performed over a model simulation period of 1995 to 2005. This period spans a range of wet and dry hydrologic conditions.

Initial tests used a passive dye tracer. This is a dye without decay or transformation. These tests show the fraction of water within the lake that passed (once) through the treatment system. Use of a passive dye tracer, however, resulted in a high ambient dye concentration within the lake, especially during periods of extended drought. Under these conditions, an equivalently high dye concentration is drawn back into the treatment system. This is not indicative of short-circuiting, however, but is an artifact of the large residence time of the lake during drought periods. Under these conditions, it is desirable to recirculate water through the flow-way.

A dye tracer with a decay rate was thus used to better define true short-circuiting. A decay rate of 0.23 day^{-1} was selected to produce a 90% decrease in dye concentration in 10 days. This rate was selected as reasonably representative of the time scale of water quality processes (i.e. algal growth) within the lake. Dye tests using this decay rate, then, show the fraction of newly released water (less than 10 days old) that is drawn back into the marsh flow-way.

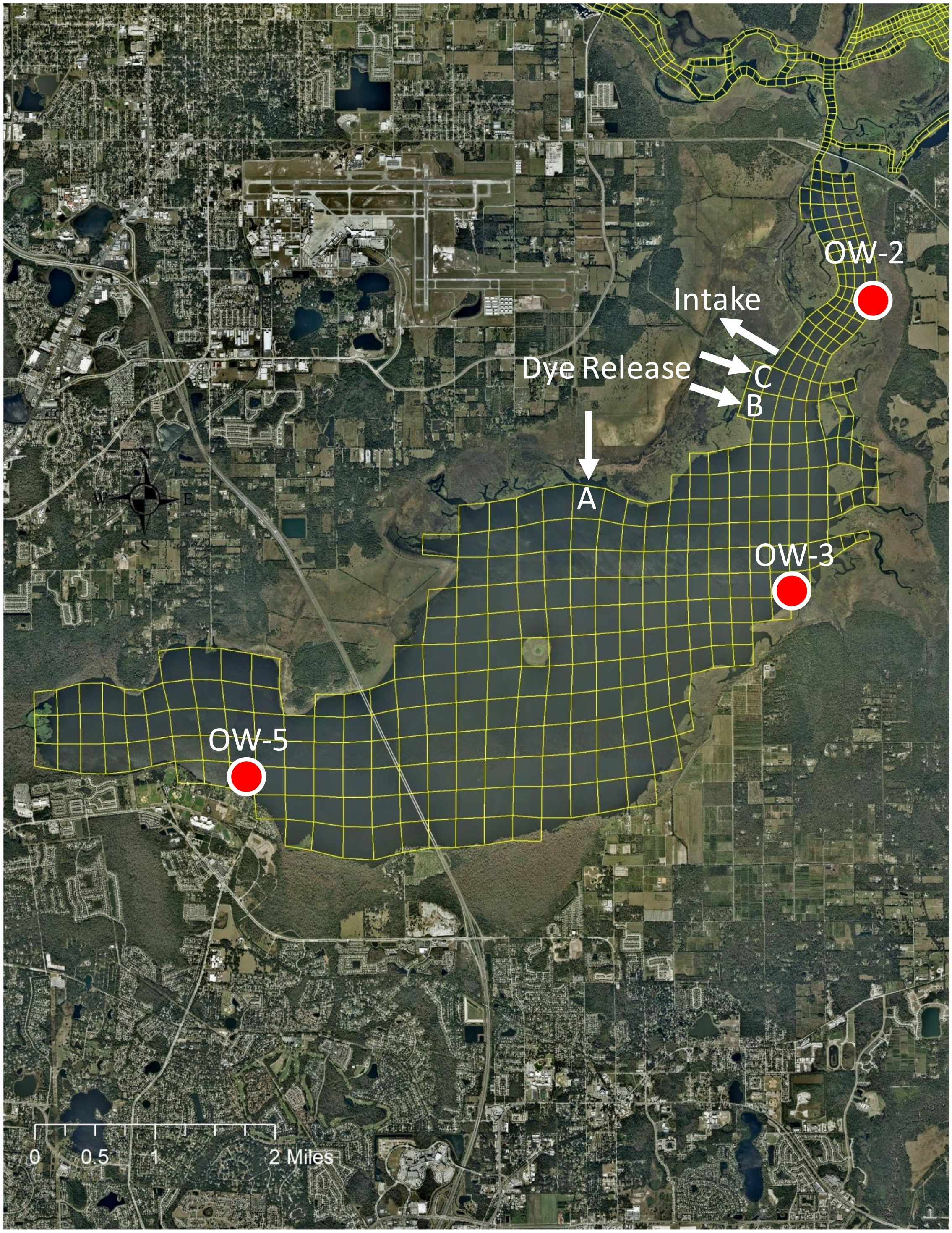
OW-2
Intake
Dye Release
C
B
A
OW-3
OW-5
N
W
E
S
0
0.5
1
2 Miles

Figure 1. Portion of EFDC Hydrodynamics model grid covering Lake Jesup. A constant dye tracer was released at locations A, B, and C with discharges of 9, 17.9 and 26.9 cfs. Dye time-series were examined at locations OW-2, OW-3, OW-5 and the intake location.

Results

Passive Dye Tests

Table 1 compares average dye concentrations resulting from a 26.9 cfs discharge released at location A, B and C. The average percent dye concentration at the intake also represents the percentage of dye returned to the treatment system under the assumption that the intake discharge is constant. The average intake concentrations are all high (12.4 to 22.5%). Dye released from location A results in about half the amount of dye returned to the treatment system compared with locations B and C. This result does not account for the much greater percentage of ambient dye within the lake for location A, however.

Table 1. Average percent dye (passive) for a constant discharge of 26.9 cfs released at locations A, B and C. (1995 to 2005).

Location	**A**	**B**	**C**
OW-2	10.4	6.2	5.9
OW-3	11.3	3.9	3.3
OW-5	7.3	2.1	1.8
Intake	12.4	21.6	22.5

Figure 2 shows time-series of dye concentration for the passive dye tracer tests at the intake and at OW-3 on the opposite shore from the release locations. Dye released at locations B and C resulted in large concentrations of dye, at times exceeding 50%, at the intake locations, while producing relatively modest concentrations within the lake. These results are in sharp contrast to the similarity between dye concentration at the intake and at OW-3 for dye released at location A (top plot of Figure 2). This result indicates that much of the dye occurring at the intake for location A is dye mixed into the ambient lake water, while dye occurring at the intake for locations B and C results from short-circuiting.

Table 2 provides average dye concentration at the intake for each tested discharge level and release location for the passive dye tests. Results for release points B and C are not appreciably different, while release point A results in about ½ the dye concentration at the intake compared with release point B and C. Percent dye at the intake is nearly linear with discharge rate. Smaller discharge rates result in a lower percentage of dye returned to the treatment system.

Table 2. Average percent dye (passive) for a constant discharge of 26.9 cfs released at locations A, B and C. (1995 to 2005).

Release Point	**9 cfs**	**17.9 cfs**	**26.9 cfs**
A	4.5	8.6	12.3
B	8.6	15.7	21.6
C	9.1	16.4	22.5

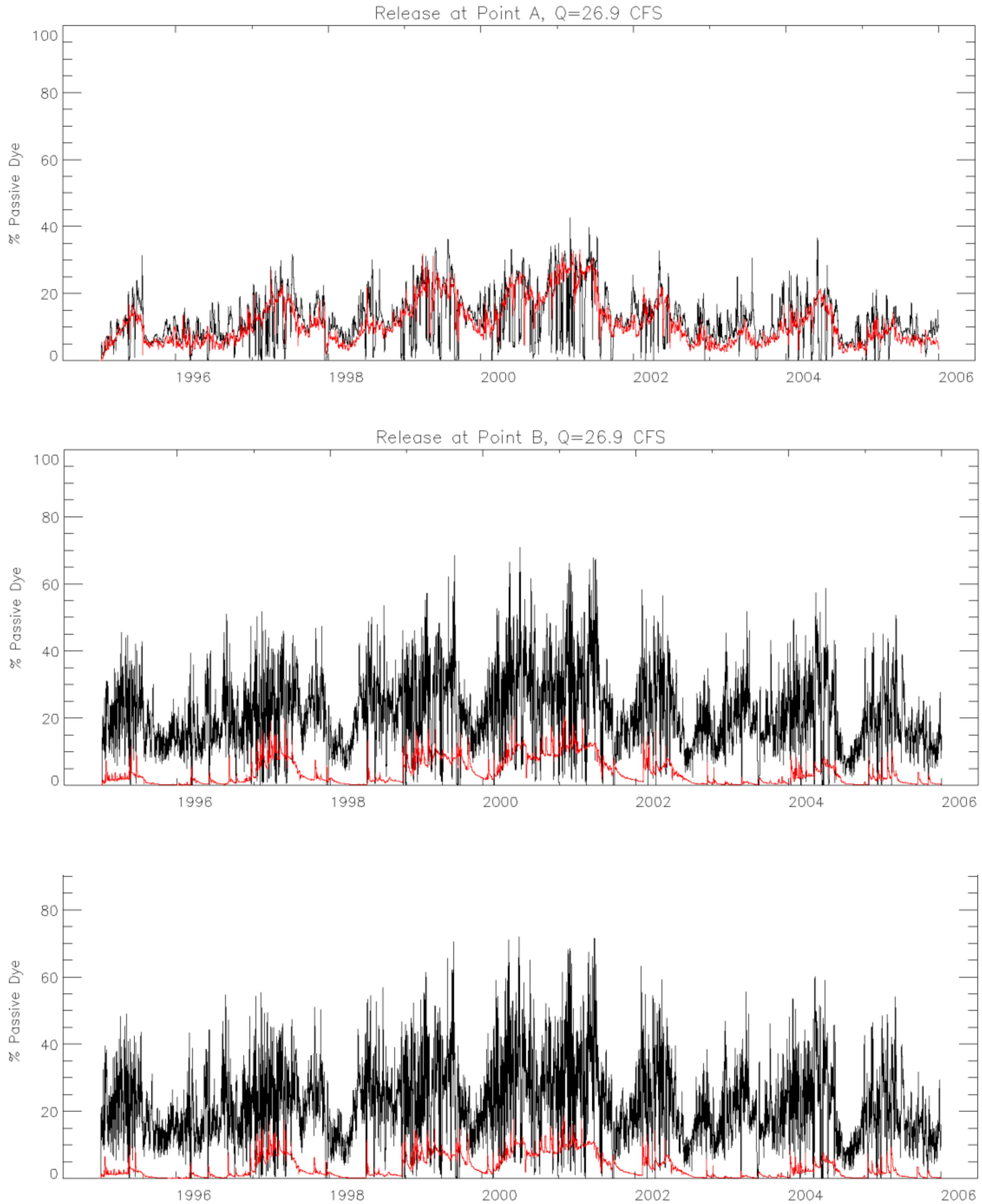

Figure 2. Dye concentrations at the intake location (black line) and OW-3 (red line) for a constant discharge of 26.9 cfs resulting from release at locations A, B and C. (Passive dye).

Dye Tests with Decay

Table 3 compares average dye concentrations resulting from a 26.9 cfs discharge released at location A, B and C with a decay rate of 0.23 day^{-1}. The average lake concentrations are all less than 1.3%. Average dye concentration at the intake exceeds 10% for locations B and C (Table 3). These results contrast with an average concentration of only 0.6% for dye released from location A. These results indicates that passive dye concentrations resulting from discharge at location A, previously shown in Table 1, represent ambient dye that exited the treatment system more than 10 days prior and are not indicative of short-ciurcuiting.

Table 3. Average percent dye for a constant discharge of 26.9 cfs released at locations A, B and C. (1995 to 2005) and a dye decay rate of 0.23 day^{-1}.

Location	**A**	**B**	**C**
OW-2	0.3	1.2	1.3
OW-3	0.3	0.2	0.2
OW-5	0.02	0.003	0.002
Intake	0.6	10.9	12.9

The appreciable difference between location A and locations B/C in water returning to the treatment system with 10 days of discharge from the system is clearly shown in Figure 3. For a 26.9 cfs discharge from either location B or C, as much as 40% of the discharge can be returned to the system, while dye discharged from location A never exceeds about 6%.

Conclusions and Recommendations

Treated water discharged to Location A, located about 3 miles from the proposed intake at Chub Creek, will rarely be returned to the treatment system within 10 days of discharge. Most water discharged at location A will mix with ambient lake water. In contrast, short-circuiting can occur for treated water discharged at location B and C, located within ½ mile of the intake, depending on the discharge rate. For the largest discharge rate tested (26.9 cfs), discharge at these locations returned over 10% of discharged water to the system intake. For a discharge rate of 9 cfs, the returned percentage drops to 4 to 5%.

It is recommended that the effect of reduced treatment efficiency be considered in the project design if more than 5 cfs of discharge from the system is directed within 1 mile west of the intake location. Any water directed more than two miles west from the intake location can be considered to have a negligible effect on treatment efficiency.

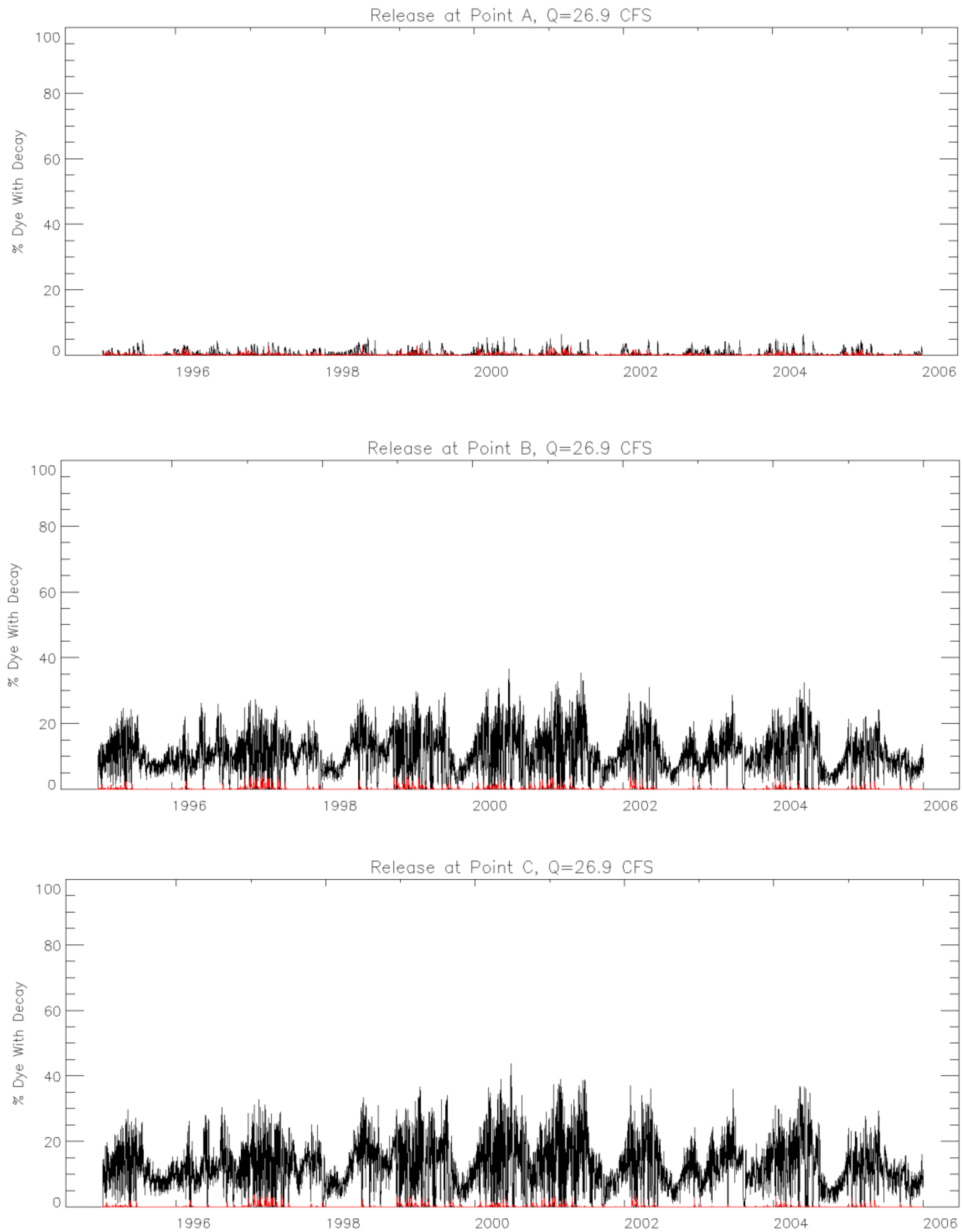

Figure 3. Dye concentrations at the intake location (black line) and OW-3 (red line) for a constant discharge of 26.9 cfs resulting from release at locations A, B and C. (Dye subject to a decay rate of 0.23 day^{-1}).