Case 1:

$$\varepsilon^2 \boldsymbol{G} \equiv \begin{pmatrix} -r_o & -mD_n \\ mD_n & -r_o \end{pmatrix} \begin{pmatrix} \Psi_{nr}^m \\ \Psi_{ni}^m \end{pmatrix} + \begin{pmatrix} S_{nr}^m \\ S_{ni}^m \end{pmatrix}$$

where now

$$D_n = \left\{ \frac{2}{n(n+1)} + d_n \mathrm{u_o} \right\} \Omega$$

and

$$\varepsilon \boldsymbol{F} \eta \equiv \eta \mathsf{A} \begin{pmatrix} \Psi_r \\ \Psi_i \end{pmatrix} = \eta \Omega \begin{pmatrix} 0 & -md_n \\ md_n & 0 \end{pmatrix} \begin{pmatrix} \Psi_r \\ \Psi_i \end{pmatrix}.$$

It turns out that $\mathrm{C} \approx 2\,\tau_d \eta_o^{\,2}$,

with $\tau_d \approx 4\mathrm{d}$ and $a\Omega\,\eta_o \approx 7.5\mathrm{m/s}$,

so the equivalent SDE is of the form

$$d\Psi = \mathsf{L}\,\Psi\,dt + \mathsf{A}\eta_o\,(\sqrt{2\tau_d})\,\Psi \bullet dW + \boldsymbol{S_{ext}}.$$