(1) diameter = 2.

Distance between any 2 non-center nodes is 2.

(2) $\frac{(5 \cdot 4)}{2}$ pairs have distance 2

5 pairs have distance 1

$$\Rightarrow \frac{10(2) + 5(1)}{15} = \frac{25}{15} = \boxed{\frac{5}{3}}$$

(3) 1

fully connected

(4) 5

(5) Yes. consider graph with $(N-d)$ nodes fully connected and then a line of d nodes leaving it.

This has diameter d.

As $N \to \infty$, the average distance $\to 1$.

$\Rightarrow$ $\frac{\text{diameter}}{\text{avg distance}} \Rightarrow d$.

for $d > 4$

intuitively, the fully connected graph size "dominates" the average distance calculation.