In [ ]:
```
# import required modules
from breastshot_calcs import *
from undershot_calcs import *
from user_interface import *
from river_class import *
from payback import *
```

TURBINE MODELLING, POSITION OPTIMISATION, POWER AND COST PREDICTION

This notebook will take a customer through the step by step process of assessing the installation of a PicoStream turbine at their location.

Section 1: begins with an input of estimated river, household and turbine features

In [ ]:
```
# Input river details

# width in meters
width = 1.2

# depth in meters
depth = 0.7

# velocity in m/s
velocity = 1.5

# initialise river object
river = river_obj(width, depth, velocity)
```

In [ ]:
```
# initialise default PicoStream breastshot turbine object with river obje
b_turbine = breastTurbine(river=river)
```

In [ ]:
```
# initialise default household object (either small, medium or large or n
house = household('small')
```

Section 2. the details of the turbine, river and household are inputted and so modelling begins

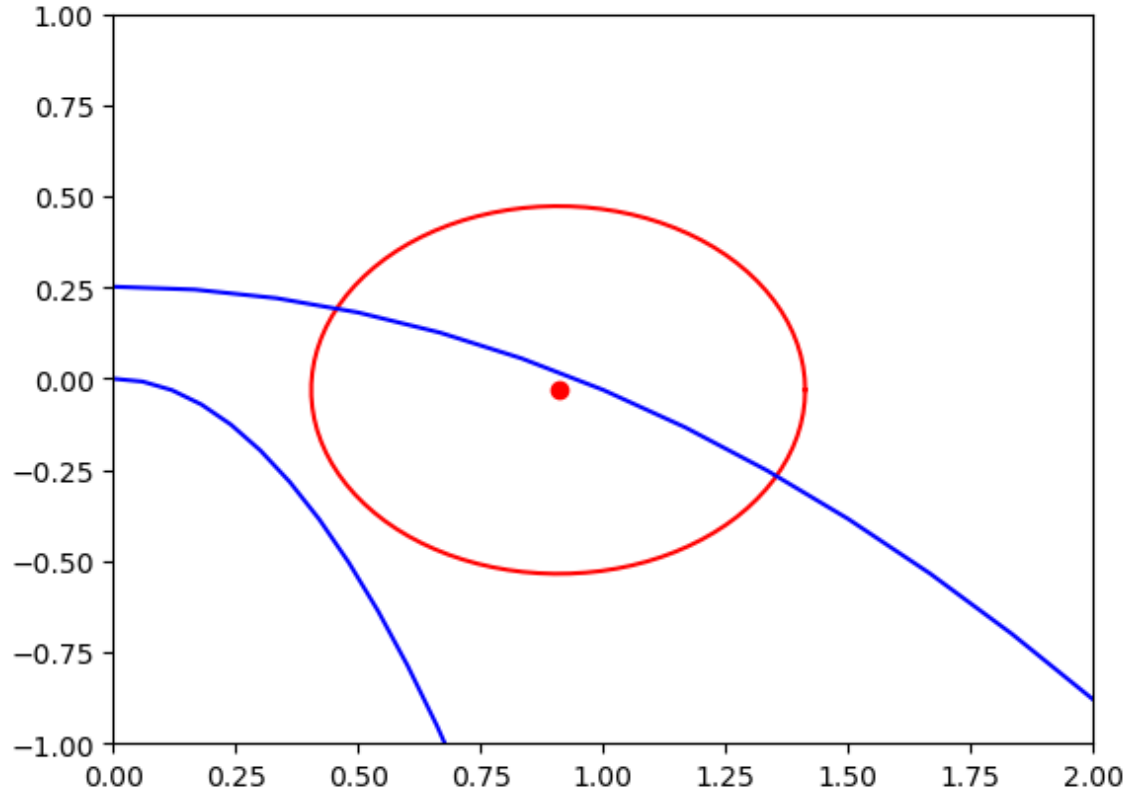
In [ ]:
```
power, x, y = b_turbine.optimise()
```

```
Turbine RPM: 14.21
Optimization terminated successfully.
         Current function value: -358.522894
         Iterations: 78
         Function evaluations: 157
The optimised average power output of the turbine is: 358.52 W
```

In [ ]:
```
# plot the turbine
# reinitialise the turbine object with the optimised coordinates
```

```
b_turbine = breastTurbine(river=river, x_centre=x, y_centre=y)
b_turbine.analysis(x_centre=x, y_centre=y)
b_turbine.plot_turbine()
```

```
Turbine RPM: 14.21
```




```
The turbine centre is positioned at: (0.91, -0.03)
```

Section 3. the payback and business calculations

In [ ]:
```
# calculate the payback period
payback_time, benefit = house.payback(b_turbine)
```

```
Normal annual electricity cost: 724.75 £ / year
Energy produced: 2699.77 kWh / year
Energy difference: -1199.77 kWh / year
Profit: 49.19 £ / year
Savings: 555.55 £ / year
Benefit: 604.75 £ / year
Payback time: 6.61 years for a turbine cost of £4000.00
```