

OECD ENV/NMC

The FEASIBLE Model, Rural cost functions

User Manual

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1 Methodological Considerations

The present chapter provides a brief introduction to the environmental financing strategy (EFS) methodology and describes the role of FEASIBLE. For a more detailed description of the EFS methodology, the reader is referred to the publications referenced at the end of this chapter.

2 Water supply

To enter the water supply module, select the *Water Supply* button at the bottom of the screen.

In the *Overview* screen, specify scenario and municipality for which you want to enter data. For the first scenario, start by selecting one region and fill in data for each municipality or municipality group within that region. Then repeat the procedure for the remaining regions.



Press the *Rural cost functions* button in the left panel of the screen to activate the rural cost functions.

Click the "Use rural cost functions" checkbox to tell the model to use rural cost functions for the selected municipality.

After pressing the *Rural cost functions* button in the left panel the following screen appear bringing up the buttons for navigating in the rural cost function part of the model.



Overall, the rural cost function modules comprise the following screens:

- Connection
- Technology
- Treatment
- Default values
- Detailed results

Each of these screens is explained in detail below.

The general concept is that the user must fill in water connections, technologies and treatment (if any). Having done this, the user can see the detailed results in the Detailed Result screen. The default value screen need not to be changed to calculate results. Although, it is recommended that the user review the default values to check if the default values corresponds to the local situation.

2.1 Connection

Connection rate

Data on connection rates should be entered in percent of people connected to the different systems. The percentage is entered as numbers between 0 and 100.

Having entered the share of population connected to the different systems the user should click the sum button in the lower right part of the screen to make sure the shares sum up to 100%.

Connections

Connection rate unit: percent of people connected to the different systems

	Non-improved supply (%)	Rainwater (%)	Dug well, Handpump and other manual method (%)	Protected spring and tap (%)	Borehole, Handpump and other manual method (%)
Tap	<input type="text"/>	<input type="text" value="100"/>	<input type="text"/>	<input type="text" value="100"/>	<input type="text"/>
Handpump and other manual meth	<input type="text"/>	<input type="text"/>	<input type="text" value="100"/>	<input type="text"/>	<input type="text" value="100"/>
	Piped system, protected spring, gravity pipe, reservoir (%)	Piped system, boreholes, pumps (%)	Piped system, boreholes, pumps, reservoir (%)	Piped system, surface water, gravity, reservoir (%)	Piped system, surface water, pumps, reservoir (%)
Standpost	<input type="text" value="20"/>	<input type="text" value="20"/>	<input type="text" value="20"/>	<input type="text" value="20"/>	<input type="text" value="20"/>
Yard Tap	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>
House connection	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>	<input type="text" value="40"/>
Total	100	100	100	100	100 Σ

The user must enter the allocation where the water for the specific connections. There are five types of connection:

- Tap
- Handpump
- Standpost
- Yard Tap
- in House connection.

There are nine different types of water supply technologies to supply the water for these connections:

- Non-improved supply
- Rainwater
- Dug well and HP
- Protected spring and tap
- Borehole and HP
- Piped system, protected spring, gravity pipe, reservoir
- Piped system, boreholes, pumps
- Piped system, boreholes, pumps, reservoir
- Piped system, surface water, gravity, reservoir
- Piped system, surface water, pumps, reservoir

These systems are described in more detail in the documentation to the model.

2.2 Water supply technology

The water production may be allocated on nine different types of technologies.

- Non-improved supply
- Rainwater
- Dug well and HP
- Protected spring and tap
- Borehole and HP
- Piped system, protected spring, gravity pipe, reservoir
- Piped system, boreholes, pumps
- Piped system, boreholes, pumps, reservoir
- Piped system, surface water, gravity, reservoir
- Piped system, surface water, pumps, reservoir

In the Technology screen the user enter the allocation of water supply in base year and target year. Having done this, the user should click the "New investments" button to calculate the amount of new investments needed to meet the demand for water supply in the target year.

Technology										
Share of population served with different technologies										
	Non-improved supply	Rainwater	Dug well, Handpump and other manual method	Protected spring and tap	Borehole, Handpump and other manual method	Piped system, protected spring, gravity pipe, reservoir	Piped system, boreholes, pumps	Piped system, boreholes, pumps, reservoir	Piped system, surface water, gravity, reservoir	Piped system, surface water, pumps, reservoir
Base year										
Σ	30	10	0	30	10					
Target year										
Σ	90 %	0	0	0	0	35	40	5	15	5
New investments	<input type="checkbox"/>									
	0	0	0	0	0	35	40	5	15	5
Remaining value of Water supply infrastructure - in % of the replacement value of fixed assets (%; 0-100)										
	Non-improved supply	Rainwater	Dug well and Handpump	Protected spring and tap	Borehole and Handpump	Piped system, protected spring, gravity pipe, reservoir	Piped system, boreholes, pumps	Piped system, boreholes, pumps, reservoir	Piped system, surface water, gravity, reservoir	Piped system, surface water, pumps, reservoir
Base year		50	50	50	50	50	50	50	50	50
Target year		60	60	60	60	60	60	60	60	60

In the lower part of the screen the user must enter the depreciation level of the existing technology. These data are used for calculation of eventual renovation of the existing water production system.

Specify the best estimate of the remaining value of the treatment plant in % of the replacement value of a new plant. The value entered will influence the estimated need for renovations.

2.3 Water Treatment

The water treatment screen operates with three different types of treatment:

- Groundwater treatment
- Surface water treatment
- Spring water treatment

Treatment

Treatment level

	Piped system, protected spring, gravity pipe, reservoir, Spring water treatment	Piped system, boreholes, pumps, groundwater treatment	Piped system, boreholes, pumps, reservoir, groundwater treatment	Piped system, surface water, gravity, reservoir, surfacewater treatment	Piped system, surface water, pumps, reservoir, surfacewater treatment
Ground water treatment		100 (%)	0 (%)		
Surface water treatment				100 (%)	100 (%)
Spring water treatment	0 (%)				

Treatment level is measured as the percentage of treated water of total amount of water abstracted from the source. (%; 0-100)

The user should enter the level of treatment for each of the piped water supply system.

The data entered in this screen control if there is water treatment or not, and how much. More detailed description of the treatment can be specified in the default values screen.

The model use the following treatment technologies for surface water

- Slow sand filter for spring water/clean stream water; and
- Conventional treatment (pre-treatment, coagulation/flocculation, sedimentation, filtration and disinfection).

The model use the following treatment technologies for ground water

- Pressure filter (in closed filter); and
- Open gravity filters.

2.4 Default values

The rural cost function module applies a rather detailed modelling of the rural cost function. These cost functions takes a large number of parameters (e.g. how deep down to get the water, transmission length, population density, population per unit etc.). It would be too much work for the user to enter these detailed data for each municipality. Instead there has been applied a large number of technical default values to enter into the cost functions. Then the user may change a few of these to make the cost calculations closer to the local situation.

The default values are specific for each municipality.

In general, the user should change the values to reflect the local situation.

The model offers the opportunity for the user to re-establish original default values by clicking the "Reset"-button. However, this will of course delete eventual changes in the values above the button. It will however not affect values entered in other screens.

The default values are separated in seven categories:

- Water demand
- Population
- Water supply
- Supply technology
- Water treatment
- Network
- Operation and maintenance

Each of these categories has its own screen.

Water demand

Water demand Population Water supply Supply technology Treatment Networks O&M		
Demand		
Connection Type	User value (lcd)	Default value (lcd)
Rainwater-tap	<input type="text" value="50"/> lcd	<input type="text" value="50"/>
Dug-well, HP	<input type="text" value="50"/> lcd	<input type="text" value="50"/>
Spring-tap	<input type="text" value="60"/> lcd	<input type="text" value="60"/>
Borehole-Hp	<input type="text" value="30"/> lcd	<input type="text" value="30"/>
Standpost	<input type="text" value="40"/> lcd	<input type="text" value="40"/>
Yard Tap	<input type="text" value="100"/> lcd	<input type="text" value="100"/>
House connection	<input type="text" value="150"/> lcd	<input type="text" value="150"/>
<input type="button" value="Reset"/>		
Population per unit		
Connection Type	User value	Default value
Taps	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
Handpumps	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
Standpost	<input type="text" value="150"/> Persons/unit	<input type="text" value="150"/>
Yard connection	<input type="text" value="18"/> Persons/unit	<input type="text" value="18"/>
House connection	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
<input type="button" value="Reset"/>		

In this screen the user can enter the average water consumption measured in litre per capita per day for the specific systems. The model uses this value to calculate total water consumption based on population, connection rates and lcd.

Furthermore, the user can enter average population per connection for the specific connection systems. These values are used for calculation of number of connections needed.

Population

Default values

Water demand | Population | Water supply | Supply technology | Treatment | Networks | O&M

Population served

	User value	Maximum	Default value
Dug wells	<input type="text" value="24"/>		24
Borehole/hp	<input type="text" value="200"/>	200	200
Protected spring	<input type="text" value="15"/>		15
Spring Box, gravity	<input type="text" value="0"/>		

Population

	Core Area (Ha)		SP area	
	User value	Default value	User value	Default value
Population Density	<input type="text" value="100"/>	100	<input type="text" value="100"/>	100
Pop. in % in Area	<input type="text" value="50"/>	50	<input type="text" value="50"/>	50

In this screen the user can enter number of people served by the specific water sources. These values enter in the calculation of need for sources to cover water consumption.

Furthermore, the user can specify population in core and fringe area. These values determine the size of the area and thereby the total pipe length.

Water supply

Default value

Water demand | Population | **Water supply** | Supply technology | Treatment | Networks | O&M

Peak demand factor

	User value	Default value
Peak-day	<input type="text" value="1,6"/>	<input type="text" value="1,6"/>
Peak-hour	<input type="text" value="2"/>	<input type="text" value="2"/>
Operating hours	<input type="text" value="20"/>	<input type="text" value="20"/>

Note: The default peak factor 2 would double the capacity of the water supply system compared to the needed capacity if the demand was equally distributed

Reservoir

	User value	Default value
Steel-elevated tank, if yes then check	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Extra capacity for peak day demand	<input type="text" value="50 %"/>	<input type="text" value="50"/>

Note: The default peak factor 50% would increase the capacity of the reservoir compared to the needed capacity if the demand was equally distributed

The water supply screen allows the user to control the need for extra capacity in the water supply due to peak demand.

The default peak factor 2 in the upper part of the screen would double the capacity of the water supply system compared to the needed capacity if the demand was equally distributed.

The default peak factor 50% in the lower part of the screen would increase the capacity of the reservoir compared to the needed capacity if the demand was equally distributed

Supply technology

The supply technology screen offer the user the opportunity to describe the supply technology in more detail.

For instance the user can enter

- the depth in meter drilling for water
- capacity of the specific well; and
- the transmission length from source to network

All these values influence the investment and operation and maintenance cost of the individual water supply systems.

Default value

Water demand | Population | Water supply | Supply technology | Treatment | Networks | O&M

Drilling for water

	Average Depth in m		Success Rate (%)	
	User value	Default value	User value	Default value
Dug well+Hp	15 m	15		
Borehole/Hp	40 m	40	75 %	75
Borehole with electric pump	75 m	75	75 %	75
	<input type="button" value="Reset"/>		<input type="button" value="Reset"/>	

Water supply capacity and transmission length

	Capacity (m3/day)		Transmission length from source to distribution network (m)	
	User value	Default value	User value	Default value
Rainwater	0,324 m3/day	0,324		
Dug well+Hp	5 m3/day	5		
Borehole/Hp	10 m3/day	10		
Borehole with electric pump	400 m3/day	400	500 m	500
Spring	1,5 m3/day	1,5		
Spring Box, Gravity	5 m3/day	5	1000 m	1000
Surface Water, pumping	0 m3/day		1000 m	1000
Surface Water, gravity	0 m3/day		1000 m	1000
	<input type="button" value="Reset"/>		<input type="button" value="Reset"/>	

Treatment

The amount of water treatment is specified in the main treatment screen in the beginning of the document.

The default values treatment screen shown below allows the user to describe the treatment technology in more detail.

The user is referred to the technical report and annexes for more detailed description of the individual treatment technologies.

Default value

Water demand | Population | Water supply | Supply technology | Treatment | Networks | O&M

Filtering, share of water that is filtered

	Gravity filter (%)		Pressure filter (%)	
	User value	Default value	User value	Default value
Ground water				
Treatment, GW, single filtration	0 %	0	100 %	100
Treatment, GW, double filtration	0 %	0	0 %	0
			<input type="button" value="Reset"/>	
Surface water				
Full Treatment	100 %	100		
Roughing filter+slowsand	0 %	0		
Spring water				
Treatment, spring	0 %	0		
	<input type="button" value="Reset"/>			

Network

The Networks allows the user to adjust the networks to reflect local conditions. These values influence the energy cost for pumping the water out through the network.

Default value

Water demand | Population | Water supply | Supply technology | Treatment | Networks | O&M

Transmission

Geometric head	User value	Default value
Spring gravity	20 m	20
Borehole	20 m	50
Intake surface water(pump)	50 m	50
Intake, surface water, gravity	40 m	40
Hydraulic head	50 m	50
Borehole	20 m	50
Intake, surface water, gravity	1000 m	50
Friction of pipes (Hazan Williams)	130	130

Reset

Networks: Distribution pipes

Geometric head	User value	Default value
Geometric head	20 m	20
Hydraulic head	20 m	20
Friction of pipes (Hazan Williams)	130	130

Reset

Operation and maintenance

The operation and maintenance screen holds values to adjust pumping efficiency and operating hours. These are major elements in the operation and maintenance cost.

Default values

Water demand | Population | Water supply | Supply technology | Treatment | Networks | O&M

Operation and maintenance

	User value	Default value
Pump efficiency	0.6	0.6
kWH cost	0.15	0.15
Operation hours	20	20

Reset

2.5 Results

The results from the rural cost functions are integrated in the general feasible model and the user is referred to the user manual for information on reporting from the model.

However, to offer the user better opportunities for testing and understanding the results from the model the rural cost functions include a screen with more detailed results.

It should be noted that the detailed results here are given in EURO and that both investment cost and operation and maintenance cost only covers the new investments in the target year.

Results are calculated by pressing the OK button in the lower right corner of the result screens. This will also transfer data to the general result part of FEASIBLE, making data available for further analysis in parallel with other data in the FEASIBLE model.

The following screen shows the overall detailed results from the rural water supply component of the model.

Detailed results

Overview | Capital cost | O&M cost | Pipes |

Cost elements for new investments in international prices (EURO)

	Rainwater	Dug well and Handpump	Protected spring and tap	Borehole and Handpump	Piped system, protected spring, gravity pipe, reservoir	Piped system, boreholes, pumps	Piped system, boreholes, pumps, reservoir	Piped system, surface water, gravity, reservoir	Piped system, surface water, pumps, reservoir
People served with new structure	0	0	0	0	3500	4000	500	1500	500
Capacity M3/day	0	0	0	0	726	829	104	311	104
Total cost/Year									
Service extension	0	0	0	0	741428	2050806	70449	561768	269259
O&M/Year	0	0	0	0	14829	113921	3892	32938	17029
Re-invest	0	0	0	0	18536	51270	1761	14044	6731
Per capita cost									
Service extension	0	0	0	0	212	513	141	375	539
O&M	0	0	0	0	4	28	8	22	34
Re-invest	0	0	0	0	5	13	4	9	13
Total/Year	0	0	0	0	221	554	152	406	586
Lifetime	15	25	40	20	40	40	40	40	40

OK

Two more screens shows these cost components in more detail. First

Investment cost for new investments

Detailed results

Overview | Capital cost | O&M cost | Pipes

Capital cost for new investments in international prices (EURO)

	Rainwater	Dug well	Protect spring	Bore.handpump	Pipe sys 1	Pipe sys 2	Pipe sys 3	Pipe sys 4	Pipe sys 5
New Capacity					726	829	104	311	104
Other Cap. cost									
Boreholes					53.133	62.250	33.934	17.073	33.411
Transmission Main					17.863	12.158	5.509	16.739	5.680
Treatment						1.138.086		303.076	176.914
Reservoir									
Pumping station						15.934		10.763	
Distribution pipes					584.775	740.418	18.770	130.819	18.770
SP, Connections					2.823	3.227	403	1.210	403
HC, Connections					58.333	66.667	8.333	25.000	8.333
YC, Connections					24.500	28.000	3.500	10.500	3.500

OK

Operation and maintenance cost for new investments

Detailed results

Overview | Capital cost | O&M cost | Pipes

Operation and maintenance cost for new investments in international prices (EURO)

	Rainwater	Dug well	Protect spring	Bore. handpump	Pipe sys 1	Pipe sys 2	Pipe sys 3	Pipe sys 4	Pipe sys 5
New Capacity					726	829	104	311	104
Other OM cost									
Intake					1.063	16.927	3.162	341	668
Transmission Main					357	243	110	335	114
Treatment						79.666		24.246	14.153
Reservoir								1.141	443
Pumping station						319		3.524	1.031
Distribution pipes					11.695	14.808	375	2.616	375
SP, Connections					56	65	8	24	8
HC, Connections					1.167	1.333	167	500	167
YC, Connections					490	560	70	210	70

OK

Finally the pipe screen shows the length and dimension of the water supply network.

Detailed results

Overview | Capital cost | O&M cost | Pipes

Pipe dimensions and length

	Rainwater	Dug well	Protected spring	Borehole handpump	Pipe system protected spring gravity pipe reservoir	Pipe system boreholes pumps	Pipe system boreholes pumps reservoir	Pipe system surface water gravity reservoir	Pipe system surface water pumps reservoir
Pipe Diam (mm)					157	170	47	47	
Pipe length (km)					13	15	1	1	

✓ OK

3 Wastewater

The structure of the wastewater module is very similar to that of the water supply module. The opening screen is the same.

In the *Overview* screen, specify scenario and municipality for which you want to enter data. For the first scenario, start by selecting one region and fill in data for each municipality or municipality group within that region. Then repeat the procedure for the remaining regions.



Press the *Rural cost functions* button in the left panel of the screen to activate the rural cost functions.

Click the "Use rural cost functions" checkbox to tell the model to use rural cost functions for the selected municipality.

After pressing the *Rural cost functions* button in the left panel the following screen appear bringing up the buttons for navigating in the rural cost function part of the model.



Overall, the rural cost function modules comprise the following screens:

- Collection
- Technology
- Treatment
- Default values
- Detailed results

Each of these screens is explained in detail below.

The general concept is that the user must fill in water collections, technologies and treatment (if any). Having done this, the user can see the detailed results in the Detailed Result screen. The default value screen needs not to be changed to calculate results. Although, it is recommended that the user review the default values to check if the default values corresponds to the local situation.

3.1 Wastewater collection rates

Connection rate

Data on collection rates must be entered in percent, i.e. in this screen numbers between 0 and 100. In other screens the user might need to use negative values as well as numbers above 100.

The model offers eight specific collection technologies:

- Non-improved Sanitation
- Simple Pit Latrine
- Improved Latrine
- Pour Flush Latrine
- On site septic tank
- Sewered interceptor tanks +/- treatment
- Simplified sewerage +/- treatment
- Conventional sewerage +/- treatment

The collection systems are described in more detail in the documentation of the model.

The user must enter the share of population covered by each specific collection system in both base year and target year. This is done in the wastewater collection screen.

Collection Enter the share of population connected to the different collection systems.

Connections	Non-improved Sanitation	Simple Pit Latrine	Improved Latrine	Pour Flush Latrine	On site septic tank	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage	Total
	%	%	%	%	%	%	%	%	Σ
Base year	<input type="text"/>	<input type="text" value="100"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	sum
Target year	<input type="text"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="50"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	sum

Click the sum button to verify that the connection rates sum up to 100%.

3.2 Wastewater collection technology

Based on information on connection rates and water supply, the model can calculate the amount of necessary investments for each technology. To do that the user should press the "Calculate new infrastructure" - button.

Technology

	Non-improved Sanitation	Simple Pit Latrine	Improved Latrine	Pour Flush Latrine	On site septic tank	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage
	%	%	%	%	%	%	%	%
Share of population served								
Base year	<input type="text"/>	<input type="text" value="100"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Share of population to be served								
Target year	<input type="text"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="50"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Share of population that will need to be served with new infrastructure								
	<input type="text"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="50"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

In the lower part of the screen, shown below, the user must enter the depreciation level of the existing technology. These data are used to calculate eventual renovation of the existing water production system exactly as for the water supply module.

Remaining value of existing wastewater infrastructure								
	Non-improved Sanitation	Simple Pit Latrine	Improved Latrine	Pour Flush Latrine	On site septic tank	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage
	%	%	%	%	%	%	%	%
Base year	70	70	70	70	70	70	70	70
Target year	70	100	70	70	70	70	70	70

Specify your best estimate of the remaining value of the treatment plant in % of the replacement value of a new plant. The value entered will influence the estimated renovation need.

3.3 Water Treatment

The water treatment screen operates with four different types of treatment:

- No treatment
- Sandfilter
- Reed Bed Filter
- Stabilisation ponds
- M&B treatment

Treatment			
Treatment level is measured as the percentage of treated wastewater of total amount of wastewater collected. (%; 0-100)			
	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage
	%	%	%
No treatment	0	0	0
Sandfilter	0	0	0
Reed Bed Filter	0	0	0
Stabilisation ponds	0	0	100
Biological and/or mechanical treatment (Select mechanical or biological treatment in default value screen)	100	100	0
Σ Total	sum	sum	sum

The user should enter the level of treatment for each of the three advanced wastewater collection systems. Since the options include "No treatment" the horizontal sum should equal 100.

The treatment technologies are described in more detail in the main documentation of the model.

3.4 Default values

As mentioned before, the rural cost function module apply a rather detailed modelling of the rural cost function. These cost functions takes a large number of parameters (e.g. Interceptor system, m per house, Interceptor system, m collector to outfall, population density, population per unit etc.). It would be too much work for the user to enter these detailed data for each municipalities. Instead there has been applied a large number of technical default values to enter into the cost functions. Then the user may change a few of these to make the cost calculations closer to the local situation. The default values are specific for each municipality. The default values are separated in six categories:

- Wastewater collection network
- Population
- Wastewater collection
- Pumping station
- Wastewater treatment

Each of these categories has its own screen.

Wastewater collection network

The wastewater collection screen allows the user to adjust the dimensions and length of the collection network to reflect local conditions.

Default values

Wastewater collection network |
 Population |
 Wastewater collection |
 Pumping station |
 Treatment |
 Average_lcd

Network

	User value	Default values
Conventional system, pipe, average diameter, mm	<input type="text" value="200"/> mm	<input type="text" value="200"/>
Including payment rehabilitation	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Interceptor system, m per house	<input type="text" value="25"/> m/house	<input type="text" value="25"/>
Interceptor system, m collector to outfall	<input type="text" value="500"/> m	<input type="text" value="500"/>
Hydraulic slope of interceptor collector	<input type="text" value="0,005"/> m	<input type="text" value="0,005"/>
Interceptor system, dia. mm collector to outfall	<input type="text" value="200"/> mm	<input type="text" value="200"/>
Simplified system, dia. Mm for collector	<input type="text" value="150"/> mm	<input type="text" value="150"/>
<input type="button" value="Reset"/>		

Operation and maintenance

	Operation and maintenance cost % of replacement value	Default values
System		
Conventional system	<input type="text" value="1"/> %	<input type="text" value="1"/>
Interceptor system	<input type="text" value="1"/> %	<input type="text" value="1"/>
Simplified system	<input type="text" value="1"/> %	<input type="text" value="1"/>
<input type="button" value="Reset"/>		

Furthermore, in the lower part the user may insert local values for calculation of operation and maintenance from the replacement value.

Population

In this screen the user can enter number of people served by the specific water collection systems. These values enter in the calculation of need for number of wastewater collection units and affect both investment cost and operation and maintenance cost.

Default values

Wastewater collection network | Population | Wastewater collection | Pumping station | Treatment | Average_lcd

Population served

	Population served	Default value
Simple Pit Latrine	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
Improved Latrine	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
Pour Flush Latrine	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>
On site septic tank	<input type="text" value="6"/> Persons/unit	<input type="text" value="6"/>

Wastewater collection

The upper part of this screen allow the user to change the share of water consumption is discharged to the wastewater collection system.

Default values

Wastewater collection network | Population | Wastewater collection | Pumping station | Treatment

Discharge factor

	User value	Default value
Conventional Sewerage	<input type="text" value="0.9"/>	<input type="text" value="0.9"/>
Sewerage Interceptor	<input type="text" value="0.9"/>	<input type="text" value="0.9"/>
Simplified Sewerage	<input type="text" value="0.6"/>	<input type="text" value="0.6"/>

Peak factor

	User value	Default value
Conventional Sewerage	<input type="text" value="2"/>	<input type="text" value="2"/>
Sewerage Interceptor	<input type="text" value="2"/>	<input type="text" value="2"/>
Simplified Sewerage	<input type="text" value="2"/>	<input type="text" value="2"/>

The lower part allows the user to enter values to secure capacity for peak demand. The default peak factor 2 would double the capacity of the waste water system compared to the needed capacity if the discharge was evenly distributed

Pumping station

The "pumping station" screen contains data to describe pumping efficiency and operation and maintenance of pumping.

Default values					
Wastewater collection network	Population	Wastewater collection	Pumping station	Treatment	Average_lcd
Wastewater Pumping Station					
		User value		Default value	
Capacity in KW		<input type="text" value="40"/> KW		<input type="text" value="40"/>	
Total lift in m		<input type="text" value="10"/> m		<input type="text" value="10"/>	
Total system efficiency		<input type="text" value="50"/> %		<input type="text" value="50"/>	
Opererating hours		<input type="text" value="24"/> Hours/day		<input type="text" value="24"/>	
<input type="button" value="Reset"/>					
Operation and maintainance					
		User value		Default value	
Operation and maintainance, % of replacement value		<input type="text" value="2"/> %		<input type="text" value="2"/>	
<input type="button" value="Reset"/>					
Electricity price					
		User value		Default value	
EURO/Kwh		<input type="text" value="0,15"/> EURO/Kwh		<input type="text" value="0,15"/>	
<input type="button" value="Reset"/>					

Since this is one of the major costs of advanced wastewater collection systems, it is recommended that the user verify that the default in this screen to a reasonable extent covers the local situation.

Treatment

The treatment screen holds data to select the specific technology for wastewater treatment.

Default values

Wastewater collection network | Population | Wastewater collection | Pumping station | **Treatment** | Average_lcd

Treatment

	User value	Default values
Biological treatment activated	<input type="radio"/> Mechanical only <input checked="" type="radio"/> Mechanical and biological	<input type="radio"/> Mechanical only <input checked="" type="radio"/> Mechanical and biological
Sludge from septic tank, ton per cap per year	<input type="text" value="0,5"/> <input type="button" value="Reset"/>	<input type="text" value="0,5"/>

Operation and maintenance

	User value	Default values
Operation, kWh/pe		
Mechanical only	<input type="text" value="15 kWh/pe"/>	<input type="text" value="15"/>
Mechanical and biological	<input type="text" value="25 kWh/pe"/>	<input type="text" value="25"/>
Other O&M %	Operation and maintenance cost % of replacement value	
Mechanical only	<input type="text" value="3 %"/>	<input type="text" value="3"/>
Mechanical and biological	<input type="text" value="3 %"/>	<input type="text" value="3"/>

Furthermore this screen also contain data for operation and maintenance of wastewater systems.

Average lcd

Finally, the "Average lcd" screen holds data for the distribution of water supply. These data are included to ensure consistency with the water supply.

Default values

Wastewater collection network | Population | Wastewater collection | Pumping station | Treatment | **Average_lcd**

Distribution of water supply

Water supply distribution					
	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage	Default value	Water supply lcd
Comes from:					
Taps	<input type="text" value="0 %"/>	<input type="text" value="0 %"/>	<input type="text" value="0 %"/>	<input type="text" value="10 %"/>	ldc
Handpumps	<input type="text" value="0 %"/>	<input type="text" value="0 %"/>	<input type="text" value="0 %"/>	<input type="text" value="10 %"/>	ldc
Standpost	<input type="text" value="20 %"/>	<input type="text" value="20 %"/>	<input type="text" value="20 %"/>	<input type="text" value="20 %"/>	ldc
Yard connection	<input type="text" value="40 %"/>	<input type="text" value="40 %"/>	<input type="text" value="40 %"/>	<input type="text" value="30 %"/>	ldc
House connection	<input type="text" value="40 %"/>	<input type="text" value="40 %"/>	<input type="text" value="40 %"/>	<input type="text" value="30 %"/>	ldc
	ldc	ldc	ldc		
Average lcd	Σ <input type="text" value="100 %"/>	<input type="text" value="108 %"/>	<input type="text" value="108 %"/>		

The model calculate an average lcd for each specific wastewater technology based on the data in this screen. This figure and the population determine the amount of wastewater generated.

Default values

Wastewater collection network | Population | Wastewater collection | Pumping station | Treatment | Average_lcd

Treatment

	User value	Default values
Biological treatment activated	<input type="radio"/> Mechanical only <input checked="" type="radio"/> Mechanical and biological	<input type="radio"/> Mechanical only <input checked="" type="radio"/> Mechanical and biological
Sludge from septic tank, ton per cap per year	<input type="text" value="0,5"/> <input type="button" value="Reset"/>	<input type="text" value="0,5"/>

Operation and maintenance

	User value	Default values
Operation, kWh/pe		
Mechanical only	<input type="text" value="15 kWh/pe"/>	<input type="text" value="15"/>
Mechanical and biological	<input type="text" value="25 kWh/pe"/>	<input type="text" value="25"/>
Other O&M %	Operation and maintenance cost % of replacement value	
Mechanical only	<input type="text" value="3 %"/>	<input type="text" value="3"/>
Mechanical and biological	<input type="text" value="3 %"/>	<input type="text" value="3"/>
	<input type="button" value="Reset"/>	

3.5 Results

As for water supply, the results from the rural cost functions are integrated in the general feasible model and the user is referred to the user manual for information on reporting from the model.

However, to offer the user better opportunities for testing and understanding the results from the model the rural cost functions include a screen with more detailed results.

It should be noted that the detailed results here are given in EURO and that both investment cost and operation and maintenance cost only covers the new investments in the target year.

Results are calculated by pressing the OK button in the lower right corner of the result screens. This will also transfer data to the general result part of

FEASIBLE, making data available for further analysis in parallel with other data in the FEASIBLE model.

The following screen shows the overall detailed results from the rural wastewater component of the model.

Detailed results

Overview | Capital cost | O&M cost | Treatment

Cost elements for new investments in international prices (EURO)

	Simple Pit Latrine	Improved Latrine	Pour Flush Latrine	On site septic tank	Sewered interceptor tanks	Simplified sewerage	Conventional sewerage
People served with new structure	2114	2657	3180	26661	19903	6731	9715
Capacity	352	443	530	4443	4492	1008	2030
Total cost							
Capital Cost	140916	354315	583018	20228684	19746356	7884888	6811394
Annual O&M Cost	2818	7086	14575	213387	973677	203815	141207
Weighted lifetime	10	10	10	20	20	20	20
Annual Repl. Cost	14092	35431	58302	1011434	987318	394244	340570
Per capita cost							
Capital Cost.	67	133	183	759	992	1171	701
O&M	1	3	5	8	49	30	15
Replacement	7	13	18	38	50	59	35
Total annual cost	75	149	206	805	1091	1260	751

OK

Two more screens shows these cost components in more detail.

Investment cost for new investments

Detailed results

Overview | Capital cost | O&M cost | Treatment

Capital cost for new investments in international prices (EURO)

	Simple Pit Latrine	Impr Pit Latrine	Pour flush Latrin	Septic tank	Inceptor sewer	Simple sewer	Convention sewer
New Capacity	352	443	530	4,443	4,492	1,008	2,030
General	140,916	354,315	583,018	20,228,684			
Interceptor tank					6,634,366		
Collection pipes					3,007,796	3,408,624	5,060,154
Sand Filter					2,408,002	1,302,930	
Reed Bed Filter					5,323,940	2,345,120	
Stabilisation ponds					1,504,996	459,838	
M&B treatment					867,257	368,376	1,673,620
Pumping Station							77,619

OK

Operation and maintenance cost for new investments

Detailed results

Overview | Capital cost | O&M cost | Treatment

Operation and maintenance cost for new investments in international prices (EURO)

	Simple Pit Latrine	Impr Pit Latrine	Pour flush Latrin	Septic tank	Inceptor sewer	Simple sewer	Convention sewer
New Capacity	352	443	530	4,443	4,492	1,008	2,030
General	2,818	7,086	14,575	213,387			
Interceptor tank					159,325		
Collection pipes					30,078	34,086	50,602
Sand Filter					30,932	17,655	
Reed Bed Filter					35,410	14,827	
Stabilisation ponds					678,480	122,863	
M&B treatment					39,452	14,383	82,997
Pumping Station							7,608

OK