User Guideline
for
Management Unit Control Plan Tool

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User Guideline for Management Unit Control Plan Tool

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Derek Malan, the previous technical manager for Working for Water Programme (WfW) in the Western Cape (now retired), and Wessel Wentzel were prime movers within WfW, and together with Nigel Wessel (previously of CapeNature), realized that a focus on a systematic, area and priority based, catchment-level approach to clearing invasive alien plants was needed rather than the current, largely unsystematic approach.

We have worked closely with Anthony Robinson of Handmade Connections to modify the pro-type MUCP tool to make it into a flexible and robust operational planning tool.

The authors wish to acknowledge the following persons and organisations for their valuable contributions: Andrew Wannenburgh of the Department of Environment Affairs' Chief Directorate: Natural Resources Management (NRM) for guidance and support. Tony Marshall who managers CapeNature's Integrated Catchment Monitoring Programme for his support in operationalizing of the MUCP tool and Therese Forsyth CapeNature's GIS Scientist, an early user of the MUCP tool, for technical input and proof reading the guide.

CONTENTS

SECTION 1. INTRODUCTION

The Management Unit Control Plan Generation Tool (MUCP tool) is a computerized planning system which schedules treatments of invasions in the catchment over a 20 year period based on the priorities that have been identified by the stakeholders in the plan and a suite of budget scenarios.

The schedule generated by the MUCP tool takes into account the current state of the invasions, benefits of clearing, treatments that are required and the resources provided in its budget. The MUCP tool allows stakeholders to vary the resource budgets to evaluate whether the goal is feasible or not and to set a more realistic goal where necessary. The MUCP tool does not generate a detailed annual schedule of annual operations but the DEA-Natural Resources Management (NRM) programme has an Annual Plan of Operations tool which serves that purpose.

1.1 Background

When the Working for Water (WfW) programme was launched in 1995, it was recognized that there was a need for a standardised way of mapping invasions so that records could be kept of the spatial boundaries of invaded areas, and so that the costs of treatments could be estimated and monitored. The mapping standards that were developed were based on those developed by the CSIR for the Catchment Management System (CMS) for fynbos (Le Maitre *et al.* 1993) and subsequently revised and modified (Working for Water 2016). The CMS included a series of spatial data layers aimed at providing managers with the information they needed on the spatial distributions of key species, fires, invasions and land ownership among others. One of the key ones was a management unit known as a "compartment" which was based on the approach developed earlier by the Department of Forestry for the mountain catchment areas they managed (similar units were used in forest plantations). Essentially these were spatial units with clearly defined and identifiable boundaries, generally corresponding with physical features that are easily located in the field.

They also provided a complete coverage of an area of interest, be it a catchment, nature reserve, conservancy or farm. In contrast, the mapping of invasions was based on mapping units with similar invasions (similar species mix and density and location in the landscape), generally with no consideration of compartment boundaries, although rivers and streams often formed natural units (Le Maitre and Versfeld 1994). This is because rivers, streams and their floodplains (i.e. riparian areas) often have invasions which differ in species composition, structure and density from adjacent dryland invasions, typically making them separate invaded units. The invaders in riparian areas generally also have a higher water-use (Le Maitre et al. 2015), which is another reason why it is important to map them properly so that their impacts on runoff can be estimated more accurately.

Invaded areas were then overlaid with compartments to provide information on the characteristics of the invaded areas in each compartment. The key point is that there was only one fixed management unit – the compartment. This choice was deliberate and was intended to ensure that as the different invaded units within each compartment were treated the changes would be documented and form a permanent record of the treatments, and the resulting changes in the state of the invasions in every compartment. In this way the boundaries of the treatment unit could change over time depending on what was best suited to contract requirements regarding workloads and time-frames but the compartment remained unchanged.

All the pertinent spatial information for each compartment such as the water flows (runoff), accessibility, slope and the age of the veld is stored in a shapefile[1], as is information on historical

[1] The shapefile format is a geospatial vector data format for geographic information system software.

and current invasions, previous control treatments and their costs for each of the treatment units (NBALs). There is also a cross-link which identifies which mapped invaded unit[2] (MIU) and NBALs fall within each compartment so this information can also be summarised at the compartment level. The shapefiles allow for all this information to be easily retrieved and presented at a compartment level and for such information to be loaded into the MUCP tool. This dataset can be used, for example, to depict the average slope for each compartment or to summarize the information according to slope classes used by the WfW programme. For example, steep ground and cliffs require additional safety precautions, which substantially increase the cost and the time taken to clear invasions.

The MUCP tool provides WfW and their implementing agents with the ability to set annual targets that are aligned with the overall goal and time frames set for a clearing project. It also enables them to update the plan based on changes in the status and impacts of invasions, conservation priorities, progress with control operations, the occurrence of events such as fires, and the availability of resources.

When invaded areas are identified for treatments, the portions of the MIUs in that designated area are included in that treatment unit (NBAL). Thus MIUs include invasions which have yet to be treated while NBALs include invasions which have been treated and, thus, have a treatment history. New NBALs (treatment units) are created during the process of generating clearing contracts. In the case of the spatial extent of compartments, because the MIUs and NBALs are identical, the same principles apply to each of these spatial datasets.

As a project progresses, all the MUIs (and parts of MIUs) will be treated and become NBALs until all the former MIUs are NBALs and treatments reach maintenance levels. However, the MUCP tool does not have the ability to create NBALs. What the MUCP tool does instead is the following: It examines each compartment and, where part or all of it is in an NBAL, it uses the NBAL data to estimate the costs rather than the data from the (portion of the) MIU which overlaps that NBAL. Where part or all of a compartment is in an MIU only, it uses the MIU data to estimate the costs. In this way it is able to calculate the total costs per treatment for a compartment.

Accurate identification of the invasive alien plant (IAP) species and their extent and densities is essential if realistic cost estimates are to be made. Every effort should be made to ensure the data are accurately mapped (Le Maitre and Forsyth 2016a & b). The latest mapping guidelines of Working for Water, "*Standards for Mapping and Management of Alien Vegetation and Operational Data: Version 6 - 2016",* should therefore be adhered to when capturing data (see also Appendix A).

1.2 Establishing priorities

Invasive alien plant control requires that managers match the available resources and budget with the work that needs to be accomplished so as to maximise benefits. This means that "trade-offs" often must be made in setting up schedules of which invasions plants will be treated and where over time., An important part of this process is to demarcate- the area of interest into management units known as "compartments", spatial units with clearly identifiable boundaries. The problem is to decide which of these compartments to treat first. This decision is influenced by two primary factors: (a) the benefits generated by the clearing (e.g. increased water flows); and (b) the nature and extent of the invasions in each compartment at a given time, its treatment history, and the funds available to deal with the problem in a given budgetary cycle. Prioritisation is, therefore, critical for ensuring that both the individual treatments and the overall programme are as effective as possible.

The general approach to prioritisation is to firstly establish a clear goal that states a desired outcome of what needs to be achieved where and by when. Any such goal should be S.M.A.R.T

[2] A mapped invaded unit (MIU) is a homogeneously invaded area that forms part of the "wall to wall" mapping of invasions in a particular area.

(Specific, Measurable, Assignable, Realistic and Time-bound). Once the goal has been defined the next step is to develop the criteria (objectives) and sub-criteria (sub-objectives) that have to be realized if the goal is to be achieved.

A multi-criteria decision making process, the Analytic Hierarchy Process (AHP, Saaty 1990), is a useful way of developing a goal for invasive alien plant control operations in any particular area, developing the criteria needed to achieve the goal, and to assess the relative importance of these criteria by allocating weights (ranking) to them by means of pair-wise comparisons. The AHP process is particularly useful for setting priorities when both qualitative and quantitative aspects of a decision need to be considered, and for achieving group consensus.

Literature on the application of multi-criteria decision techniques suggests that the difficulties of comparing criteria increase as the number of criteria increases, with the optimal being around seven criteria (Saaty and Ozdemir 2003). The hierarchical structure followed by the AHP method reduces that difficulty somewhat as it groups criteria into clusters that facilitate comparisons. Even so, as the number of criteria increase, it takes more and more time to do the comparisons and participants become fatigued or lose interest and focus. In our experience, many of the criteria are ultimately given low weights in the final models so they have little influence on the outcomes. The aim is therefore to limit the prioritisation model to as few criteria as possible at each level in the hierarchy, while maintaining the diversity of views among stakeholders.

The last step in the process is to source suitable spatial datasets that enabled objective comparisons to be made between compartments with regard to particular criteria. For example, mean annual run-off, erosion potential and veld age. This data is then assigned to each compartment data to reflect area weighted values of the prioritisation criteria used for scheduling the order of clearing of the compartments.

SECTION 2. INSTALLING THE MUCP TOOL

The executable file containing the Automated Management Unit Control Plan Generation Tool (MUCP tool) can be installed on a user's desktop or laptop computer with a Windows operating system (preferably Windows version 7 or a later version).

The installation package currently consists of an executable file (MUCP_Install.exe) that is approximately 30 Megabytes in size. The most recent version of the programme is version 2.00.001 (March 2018).

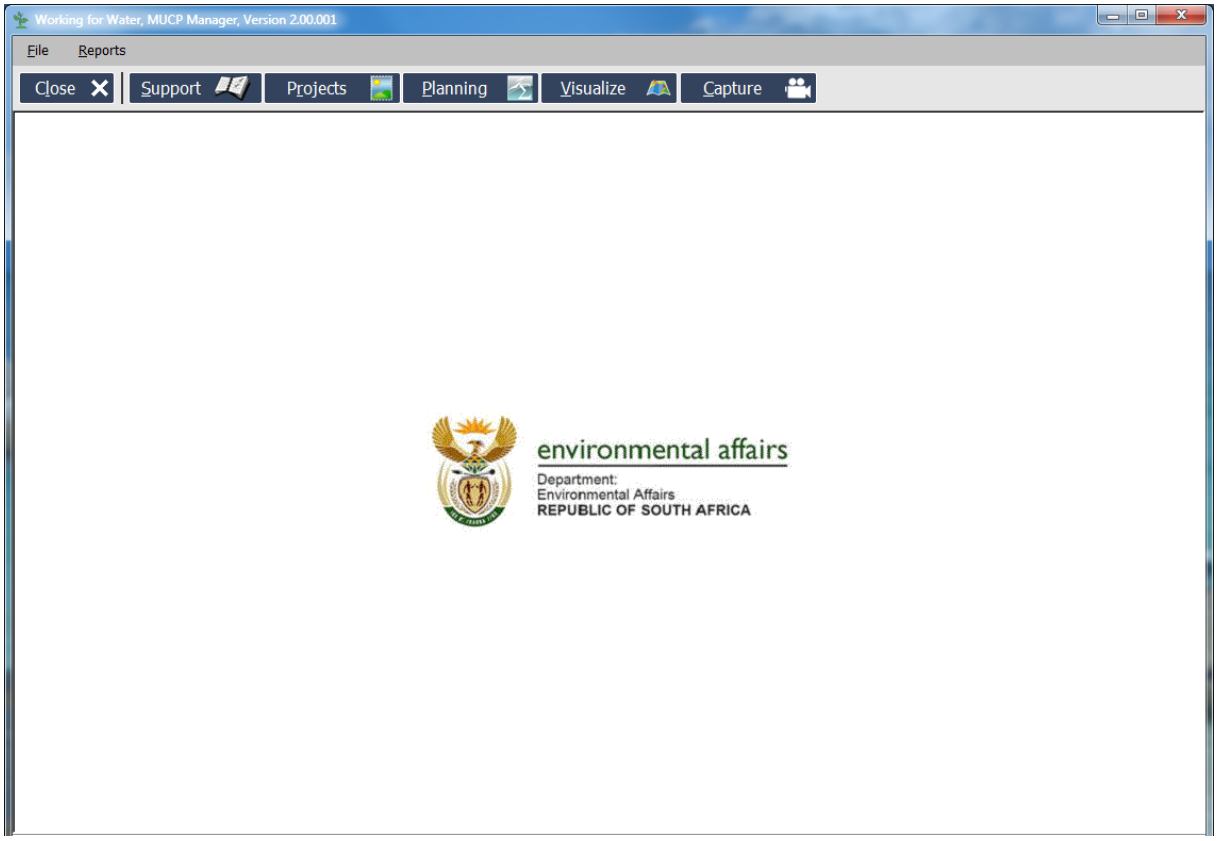
The installation uses the windows installation wizard and will be defaulted to the Windows programme files (x86) on the C: drive. However it also allows the user to specify any location of their choice and we prefer to use a location of our choice because this makes it much easier to update.

An icon  is created on the Windows Task Bar when the WfwMucp.exe file is run. This icon can be pinned to the Task Bar for future use or copied to the Desktop.

SECTION 3. OPENING WINDOW

The MUCP tool contains five main modules that are accessible via menu buttons. These modules are:

- Support
- Projects
- Planning
- Visualize
- Capture



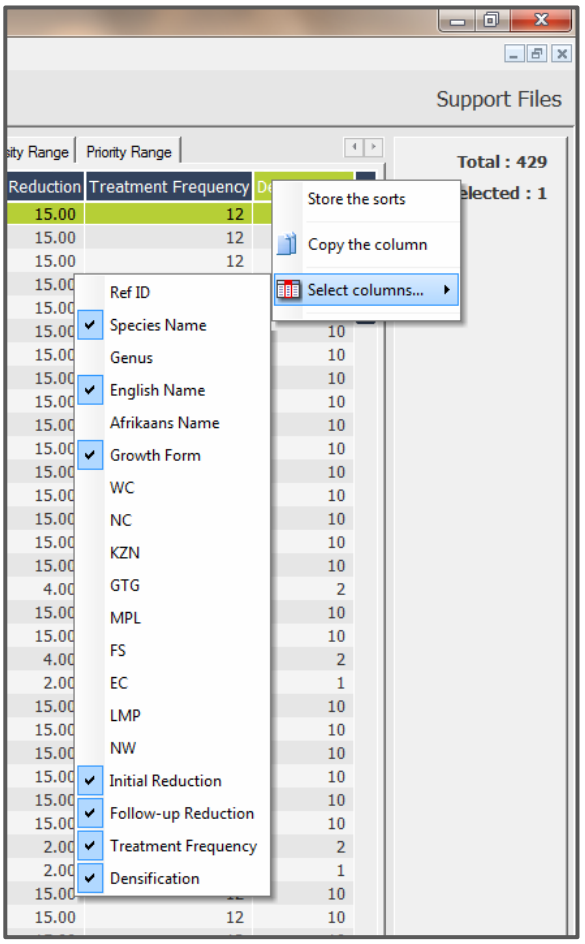
The functions and uses of these modules are described in detail in Section 4.

SECTION 4. MODULES

4.1 Support Module

The support module consists of eleven components. Each is accessible via a series of menu tabs that open different component windows. The information contained in any of these windows can be exported to MS Excel or MS Word via the "export" arrow  that is located on the right hand side of each individual title banner.

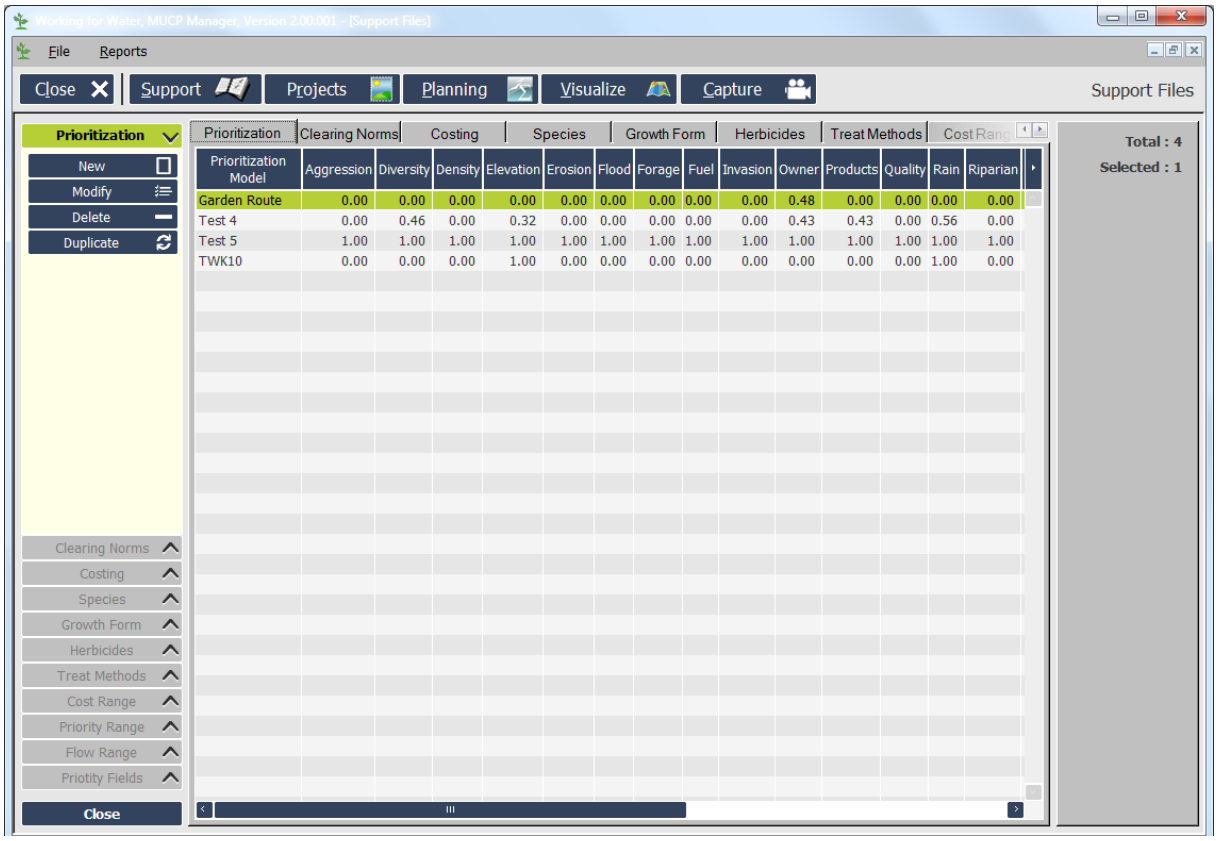
In any window by right "clicking" on any column heading, data fields can be hidden or displayed by ticking them on or off in the "Select columns" drop down box.



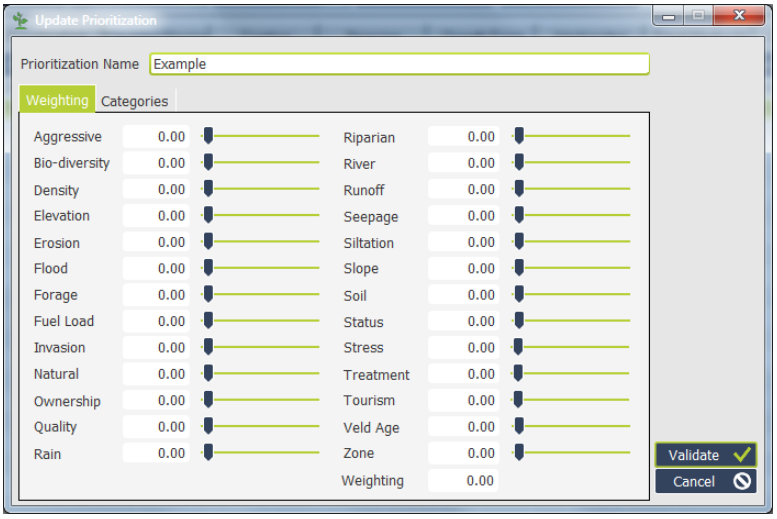
Each support component is described below.

4.1.1 Prioritization

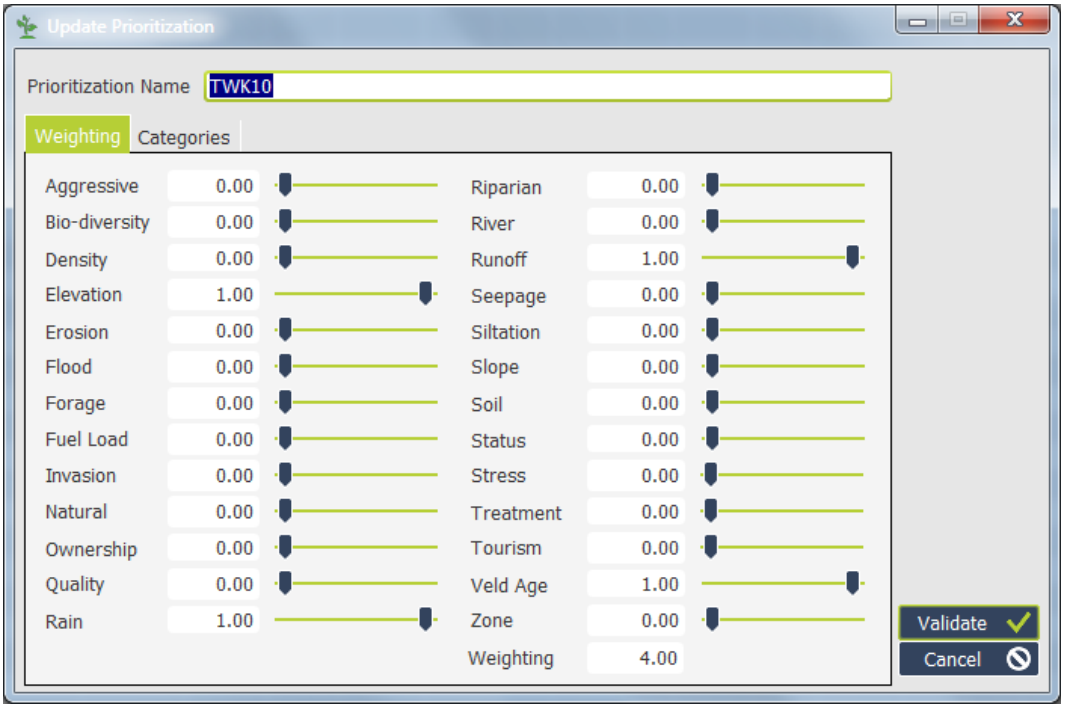
The prioritisation models which determine the sequence in which the compartments in different clearing operations or projects will be treated are set-up and saved using this tab (window).



New models are created via the "New" button in the left hand panel under "Prioritisation". Clicking on "New" will open a pop-up window requesting the user to enter a unique name for the prioritisation model. The user can create as many of these models as they need.



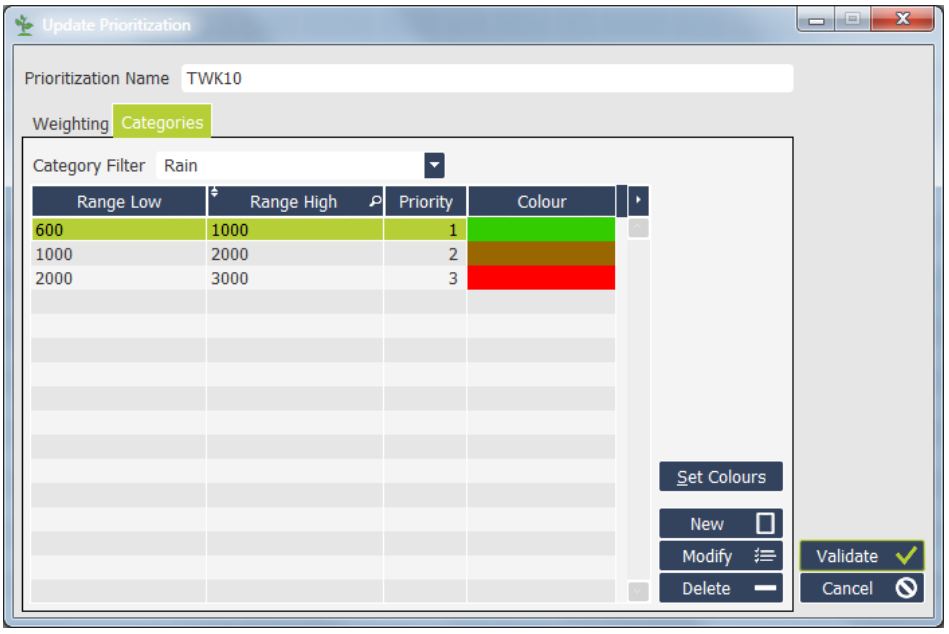
This window contains two tabs, Weighting and Categories. The next step is to set the weights using the set of sliders under the "Weighting" tab. There are 26 pre-defined or default prioritisation categories (see section 4.1.11 for details). The sliding bar is used to select the weights for each of the categories that will be used in a particular prioritisation model.



Once complete the category weightings must be validated to enable them to be stored. If the user selects "Validate" this window will close and the name they have just given will appear in the Prioritisation Model column under the Prioritisation tab in the Support section. The user now needs to select that model name and click on the "Modify" button to re-open the window above.

The next step is to set the ranges, priorities and colours to use to represent the priorities that will be shown when you run a plan. This has to be done for each category that will be used in a specific prioritisation model. For example, if only four of the 26 categories will be used, then this only needs to be done for those four categories. These same categories must also be created and populated in the "prioritization.csv" file.

The categories tab allows the user to set the range, priority and colours for each category via a drop down box.



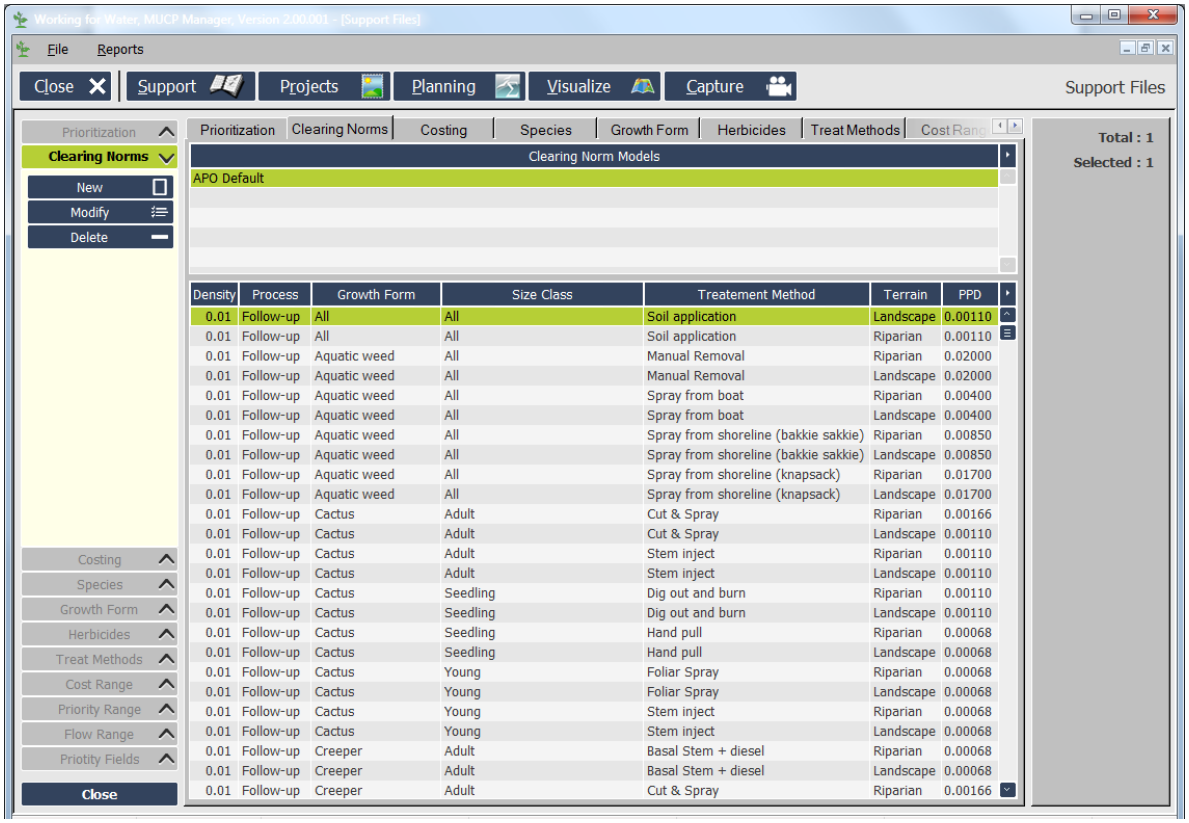
Once the user is satisfied with values and associated colours, the range is saved by clicking on the "Validate" button. The "Modify" button allows changes to be made to an existing prioritisation model.

If the user would like to Visualise the density of IAPs (see Section 4.4), it is important that the ranges and associated colours are set for the density category in the "Update Prioritisation" window as there is no separate tab to set these elsewhere.

If flow reductions are to be calculated, graphed or visualised in the MUCP tool, then the MAR (mean annual runoff) column in the "Priritisation.csv" file must be populated or otherwise the Flow Reduction graph in the Planning section will not display (for more see section 4.1.4).

4.1.2 Clearing Norms

The MUCP tool is pre-loaded with a default set of clearing norms, "APO Default". These can be modified if the user has the necessary information on the person days per growth forms, treatments and density classes. We recommend that new users retain the default values. The MUCP tool uses these norms and standard formulas for calculating person days and daily workloads for different species-linked treatments (e.g. herbicide on cut stumps, lopping) and densities and adjustments for slope and other factors. The team size, daily rates and other cost inputs are input elsewhere (see section 4.1.3).

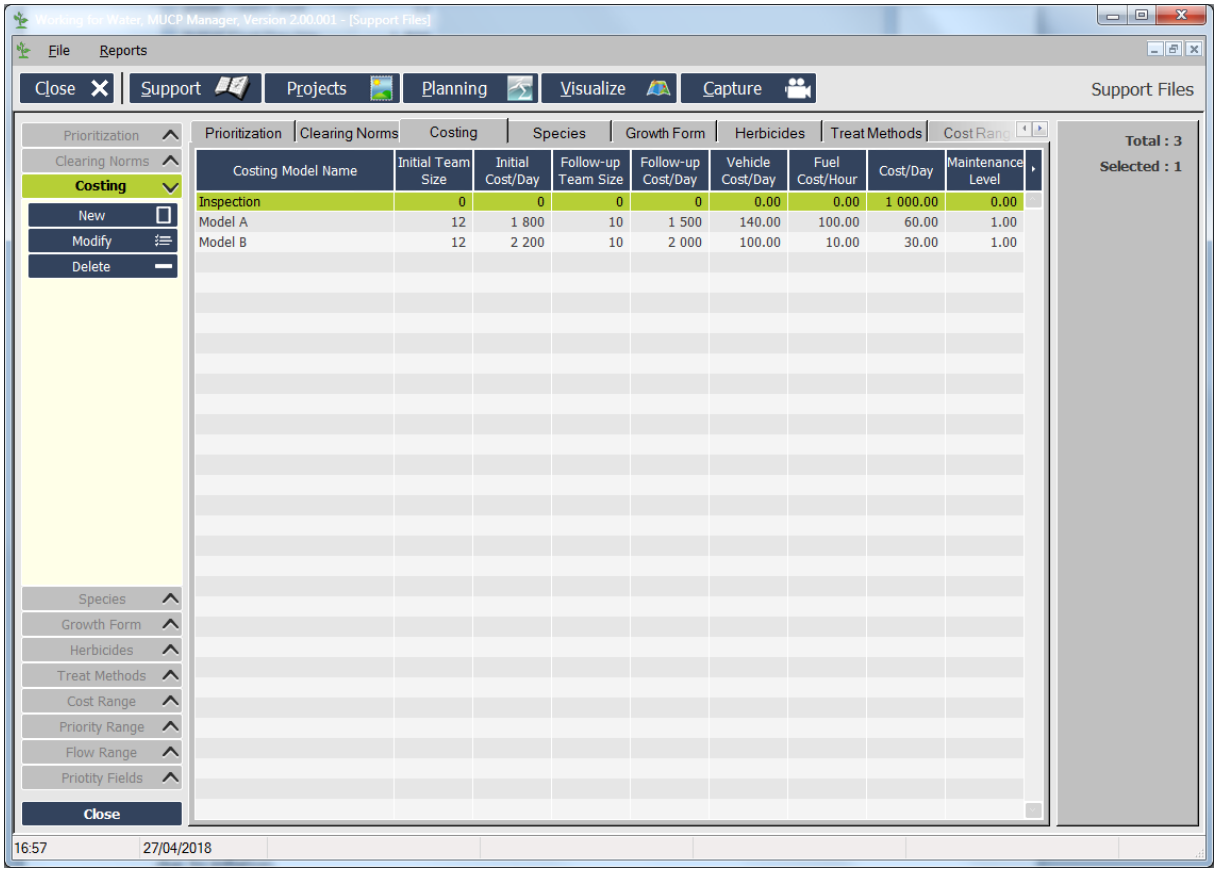


4.1.3 Costing

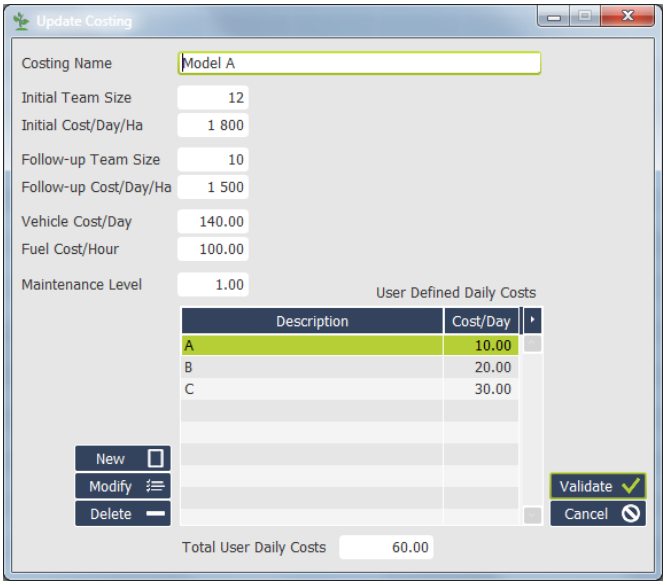
The costing model to be used for a project is created using the "Costing" tab. The MUCP tool allows a user to enter any number of costing models for use in one or more projects. For example,

this functionality allows for compartments where standard costing rates apply to be simultaneously run together with so-called "high-altitude" compartments where costs are substantial higher.

The MUCP tool also allows separate costing models to be entered to cater for activities such as annual inspections of uninvaded compartments that do not use the normal teams and costs. It just has a single item which is a cost per day for an inspection.



A new costing model can be entered via the "New" button or an existing model can be modified via the "Modify" button. Once the values have been entered the costing model is validated via the "Validate" button. Once validated the costing model is ready for use.



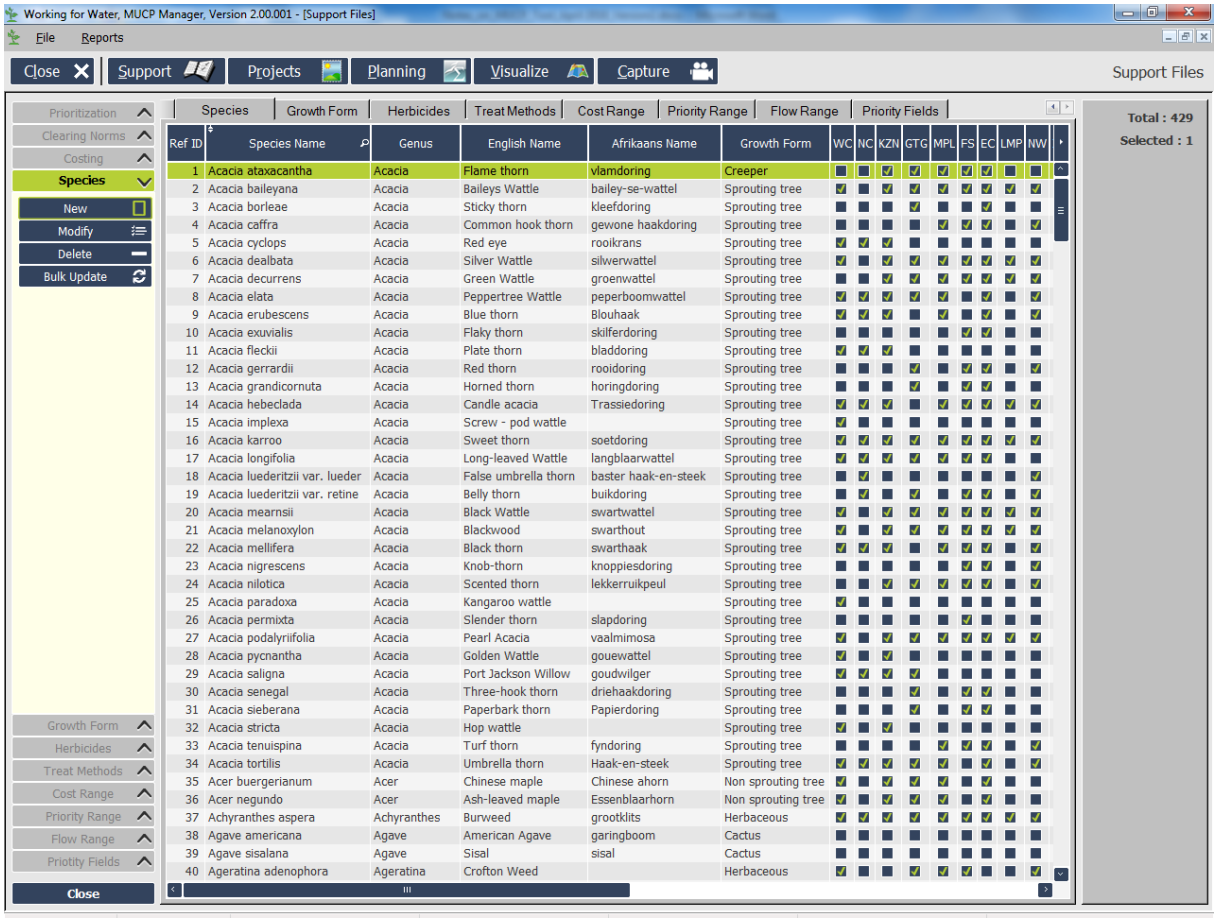
This function requires a costing field in the compartment shapefile's attribute table to enable the MUCP Tool to assign costing models per compartments. How to do this is explained in the Planning Module (Section 4.3).

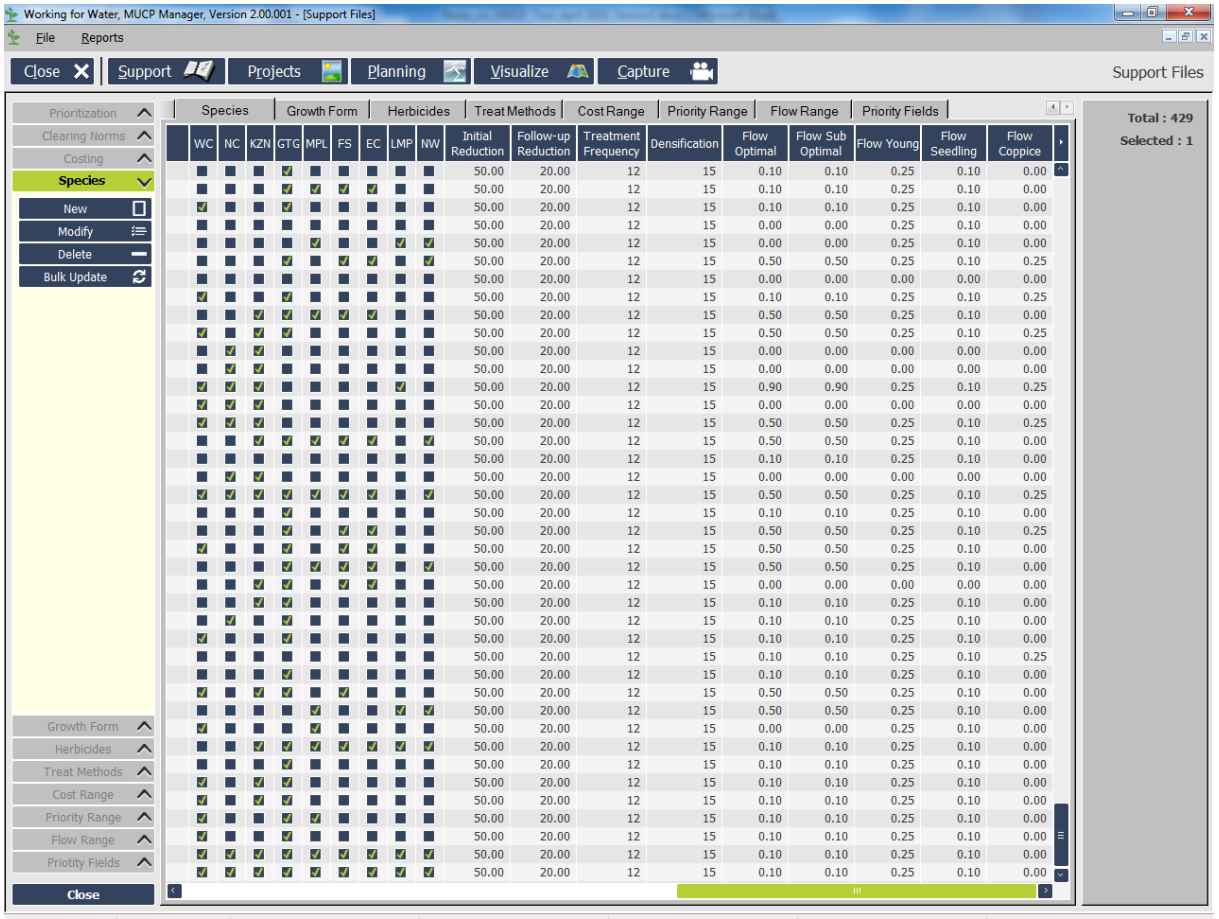
Costing models used in any project need to be reviewed on an annual basis to accommodate rising costs due to inflation. However the tool is able to adjust costs over time to allow for inflation rates over the 20-year planning time frame. The setting of the inflation rate is explained in the Planning Module (Section 4.3).

4.1.4 Species

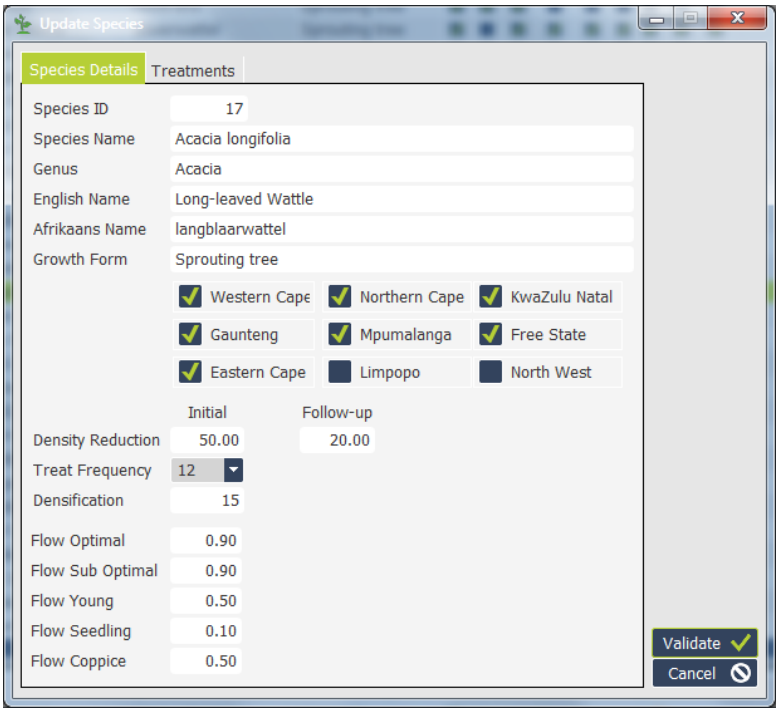
There are currently 415 invading plant species listed in the tool. Mostly these are alien invader plants (IAPs). However the list also includes the major indigenous plant species, particularly those that contribute to bush encroachments, which encountered in Working for Water (WfW) projects. This information, together with the WfW norms, is used for calculating compartment treatment workloads and scheduling and projecting them into the future.

The screen shot of the species table is presented in two sections below due to the number of columns in this table.


Working for Water, MUCP Manager, Version 2.00.001 - [Support Files]
File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Support Files
Prioritization
Clearing Norms
Costing
Species
New
Modify
Delete
Bulk Update
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priotity Fields
Close
Species
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priority Fields
Total : 429
Selected : 1
Ref ID
Species Name
Genus
English Name
Afrikaans Name
Growth Form
WC
NC
KZN
GTG
MPL
FS
EC
LMP
NW
1 Acacia ataxacantha Acacia Flame thorn vlamdoring Creeper
2 Acacia baileyana Acacia Baileys Wattle bailey-se-wattel Sprouting tree
3 Acacia borleae Acacia Sticky thorn kleefdoring Sprouting tree
4 Acacia caffra Acacia Common hook thorn gewone haakdoring Sprouting tree
5 Acacia cyclops Acacia Red eye rooikrans Sprouting tree
6 Acacia dealbata Acacia Silver Wattle silwerwattel Sprouting tree
7 Acacia decurrens Acacia Green Wattle groenwattel Sprouting tree
8 Acacia elata Acacia Peppertree Wattle peperboomwattel Sprouting tree
9 Acacia erubescens Acacia Blue thorn Blouhaak Sprouting tree
10 Acacia exuvialis Acacia Flaky thorn skilferdoring Sprouting tree
11 Acacia fleckii Acacia Plate thorn bladdoring Sprouting tree
12 Acacia gerrardii Acacia Red thorn rooidoring Sprouting tree
13 Acacia grandicornuta Acacia Horned thorn horingdoring Sprouting tree
14 Acacia hebeclada Acacia Candle acacia Trassiedoring Sprouting tree
15 Acacia implexa Acacia Screw - pod wattle Sprouting tree
16 Acacia karroo Acacia Sweet thorn soetdoring Sprouting tree
17 Acacia longifolia Acacia Long-leaved Wattle langblaarwattel Sprouting tree
18 Acacia luederitzii var. lueder Acacia False umbrella thorn baster haak-en-steek Sprouting tree
19 Acacia luederitzii var. retine Acacia Belly thorn buikdoring Sprouting tree
20 Acacia mearnsii Acacia Black Wattle swartwattel Sprouting tree
21 Acacia melanoxylon Acacia Blackwood swarthout Sprouting tree
22 Acacia mellifera Acacia Black thorn swarthaak Sprouting tree
23 Acacia nigrescens Acacia Knob-thorn knoppiesdoring Sprouting tree
24 Acacia nilotica Acacia Scented thorn lekkerruikpeul Sprouting tree
25 Acacia paradoxa Acacia Kangaroo wattle Sprouting tree
26 Acacia permixta Acacia Slender thorn slapdoring Sprouting tree
27 Acacia podalyriifolia Acacia Pearl Acacia vaalmimosa Sprouting tree
28 Acacia pycnantha Acacia Golden Wattle gouewattel Sprouting tree
29 Acacia saligna Acacia Port Jackson Willow goudwilger Sprouting tree
30 Acacia senegal Acacia Three-hook thorn driehaakdoring Sprouting tree
31 Acacia sieberana Acacia Paperbark thorn Papierdoring Sprouting tree
32 Acacia stricta Acacia Hop wattle Sprouting tree
33 Acacia tenuispina Acacia Turf thorn fyndoring Sprouting tree
34 Acacia tortilis Acacia Umbrella thorn Haak-en-steek Sprouting tree
35 Acer buergerianum Acer Chinese maple Chinese ahorn Non sprouting tree
36 Acer negundo Acer Ash-leaved maple Essenblaarhorn Non sprouting tree
37 Achyranthes aspera Achyranthes Burweed grootklits Herbaceous
38 Agave americana Agave American Agave garingboom Cactus
39 Agave sisalana Agave Sisal sisal Cactus
40 Ageratina adenophora Ageratina Crofton Weed Herbaceous


Working for Water, MUCP Manager, Version 2.00.001 - [Support Files]
File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Support Files
Prioritization
Clearing Norms
Costing
Species
New
Modify
Delete
Bulk Update
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priotity Fields
Close
Species
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priority Fields
Total : 429
Selected : 1
WC
NC
KZN
GTG
MPL
FS
EC
LMP
NW
Initial Reduction
Follow-up Reduction
Treatment Frequency
Densification
Flow Optimal
Flow Sub Optimal
Flow Young
Flow Seedling
Flow Coppice

The list is based on the default used by Working for Water, but new species can be added and existing information can be edited or deleted. This is done by clicking on the "New" button to enter additional species or the "Modify" button to edit existing information.



Once the values have been entered they need to be validated via the "Validate" button so they are saved and ready to use in the MUCP tool.

The MUCP tool also includes information on the typical reduction in densities after initial and follow-up treatments which can be adjusted by the user either for individual species of for selected groups of species using the "Bulk Update" button. The user can also adjust the treatment frequency and how rapidly invasions by different species become denser if left untreated.

To best suit their local environments users can set their own values for initial reduction %, follow-up reduction % or densification % by entering or modifying these per species using either the "New" or "Modify" buttons. Settings can be made in bulk by selecting a range of species records and clicking on the "Bulk Update" button. Please note that "Bulk Update" will change the values for all the characteristics of the group of species to the values shown in the "Bulk Update" window so choose the groups with care.

A treatment frequency for each species can be set in months via a drop down list. The available options are 3, 4, 6, 12, 18 and 24 months. This allows the user to accommodate a range from species that require more than one treatment in a year to many years. Treatment frequencies of more than 12 months can be used for slower maturing species such as pines. Such species are often difficult to observe in the first year after treatment and they only produce seed after a number of years. Once the intervals have been defined the tool will treat a compartment at intervals based on the species in that compartment that has the most frequent treatments.

A flow reduction factor between 0 and 1 can be assigned to each species based on the proportion of the Mean Annual Runoff (MAR) that the plants use in different life stages. This MAR reduction is over and above the water use of the natural vegetation, which is considered to be the baseline for

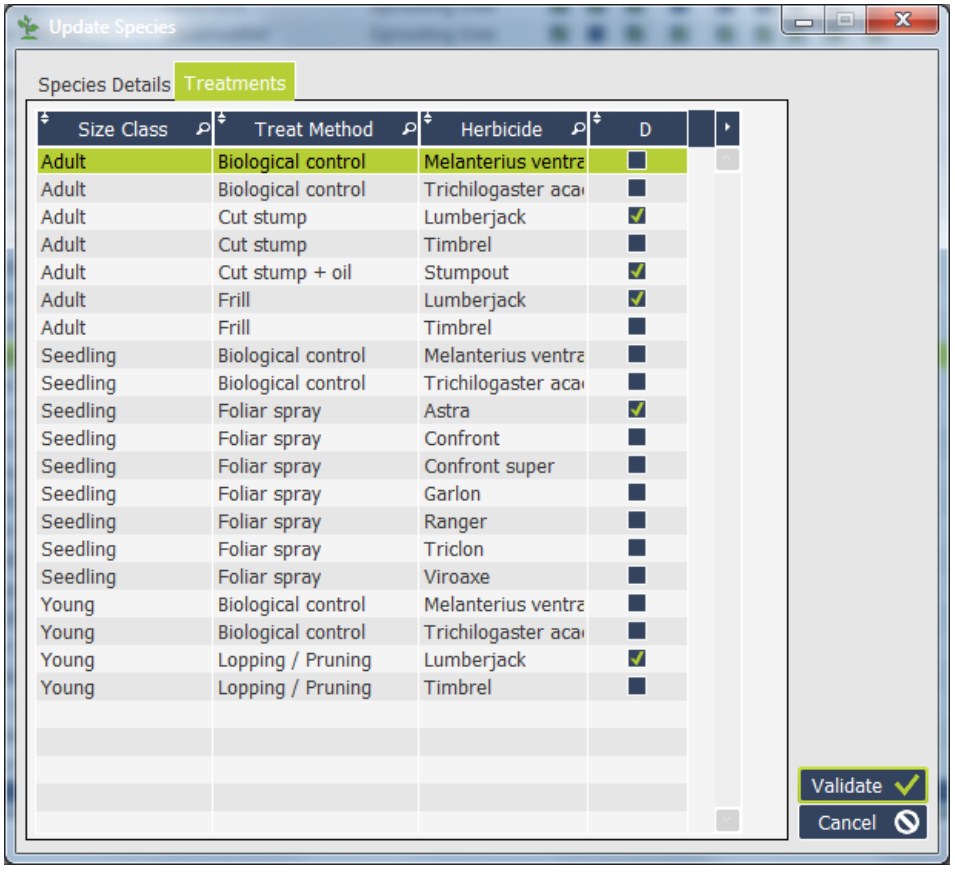
the area being treated. For example, if the MAR is 100 mm and the species "factor" is 0.85 then the plant is using 85 mm per year or 850 m^3/year/condensed[3] hectare.

There are five potential flow reduction factors that can be used which are linked to the growing conditions and life stage of the plant species. For adult (mature) plants there are optimal and sub-optimal conditions which are based on the growth rate of the plant (i.e. how favourable the growing conditions are). For immature plants there are three life stages: young plants, seedlings and coppicing plants, namely species resprouting after a fire or after ineffective treatment (see Appendix A for the standard classes for the "Age" or life-stage).

The information on the growing conditions is obtained from the "Grow_con" field in the compartment shapefile and the life stage of the plant from the "Age" field in the MIU and NBAL linked species spreadsheets. The estimated flow reduction is increased if the area being treated is riparian rather than landscape. This information is obtained from the "Riparian_c" field in the MIU shapefile.

The "New" or Modify" buttons can be used to edit these factors per species.

The recommended control treatments for each species and age class can be displayed by clicking on the treatments tab.



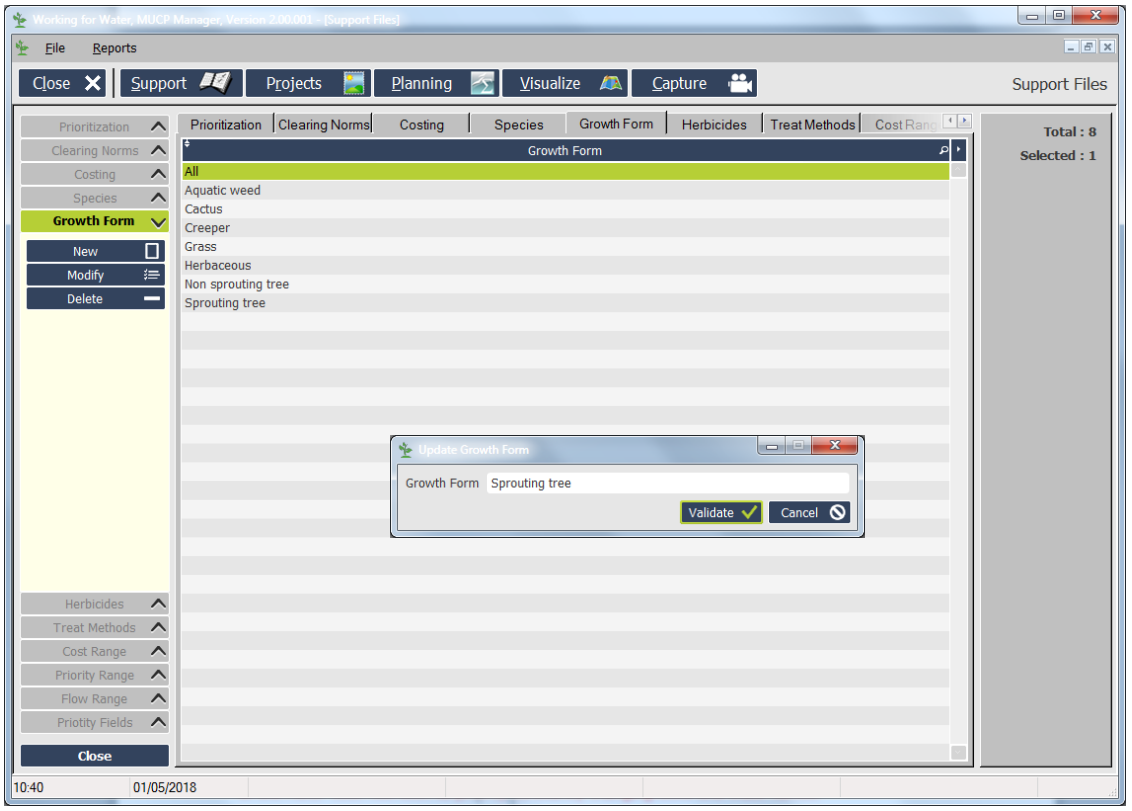
The historical data on the treatments and state of the NBALs in the MUCP tool is extracted from the data stored in Working for Water Information Management System (WIMS), so it is important

[3] A condensed hectare is the equivalent area when the canopy density is adjusted to 100%; thus 10 ha with 50% cover is equivalent to 5 ha with 100% cover.

that data are captured correctly in the field and entered correctly into WIMS and conform to the standards (Le Maitre *et al.* 2016). Project managers now have smart phone based applications which they can use for mapping NBALs and recording the state of invasions which reduces the potential for creating errors when recording the information on paper and then entering the data into WIMS.

4.1.5 Growth Form

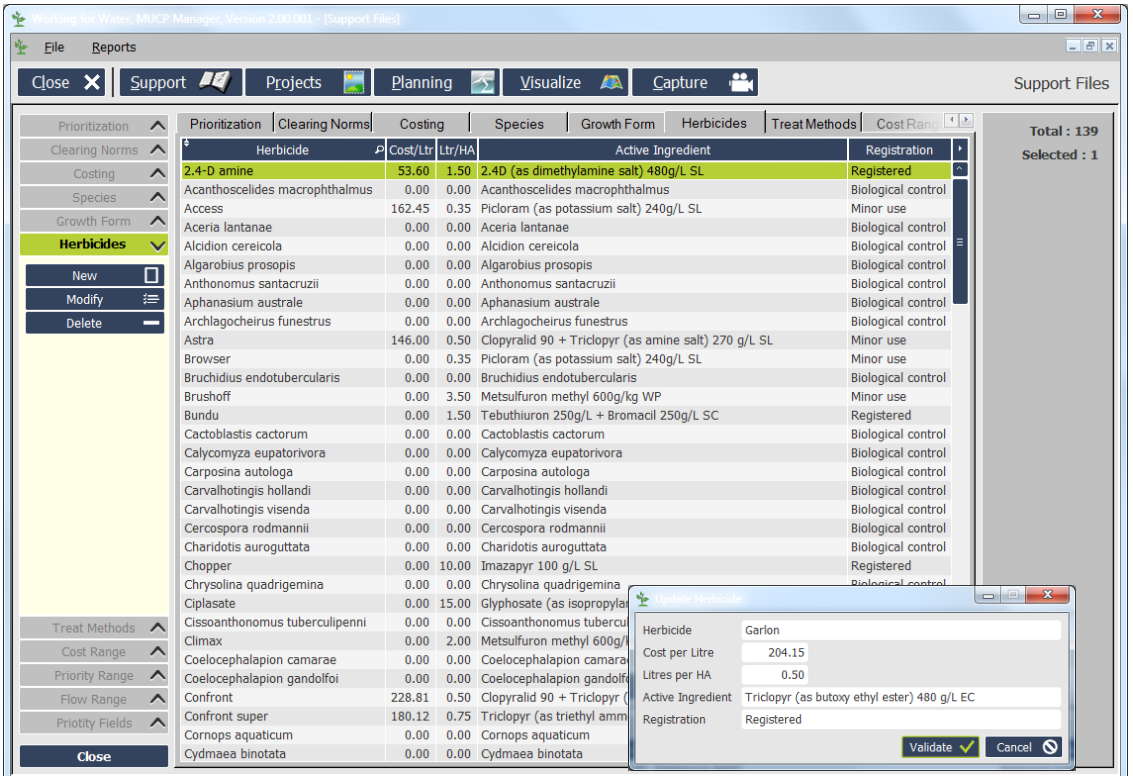
The growth forms used by the WfW programme are listed in this sub-menu and these can be added to, edited or deleted via the "New", "Modify" and "Delete" buttons.



Once new values have been entered or existing ones edited they must first be validated via the "Validate" button. Once validated these records are available for use in the MUCP tool.

4.1.6 Herbicides

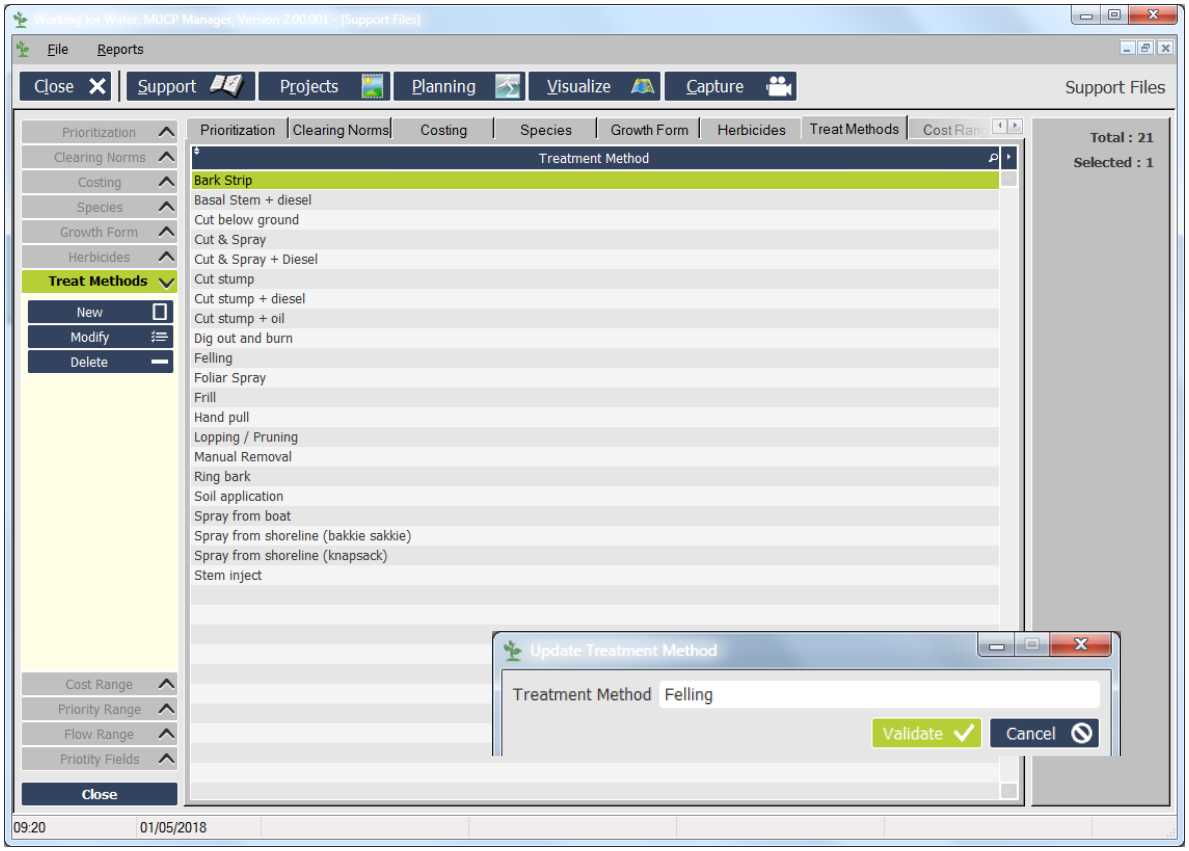
This window contains all the herbicides that are currently used in invasive alien plant control in the WFW programme. At present, the data are just provided for the user to refer to because they are not used by the MUCP tool when calculating the cost of control operations. This is largely because the selection of a particular herbicide for a specific species depends on a number of factors (e.g. dosage), many of which require expert input. However it is envisaged that some basic rules could be made available in a future release of the MUCP tool which would then include herbicides in the estimated costs.



Records can be added, edited or deleted via the "New", "Modify" and "Delete" buttons. Once new values have been entered or existing ones edited they must first be validated via the "Validate" button. Once validated these records are available for use in the MUCP tool.

4.1.7 Treat Methods

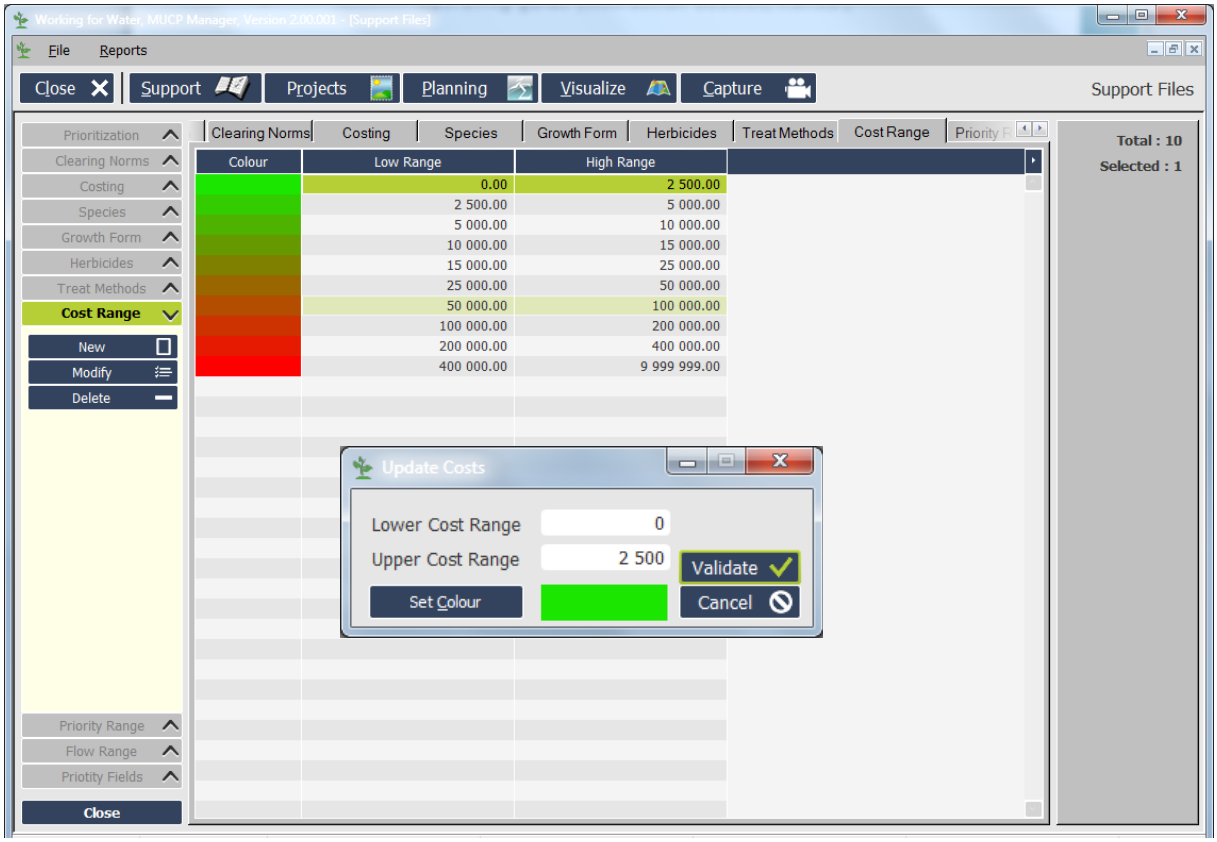
This window contains all the current treatment methods and combinations of these used by the WfW programme.



New treatment methods can be entered and existing methods can be edited or deleted using either the "New" or "Modify" buttons in the left hand column. If any new records are added or modified they must first be "Validated" before it becomes active.

4.1.8 Cost Range

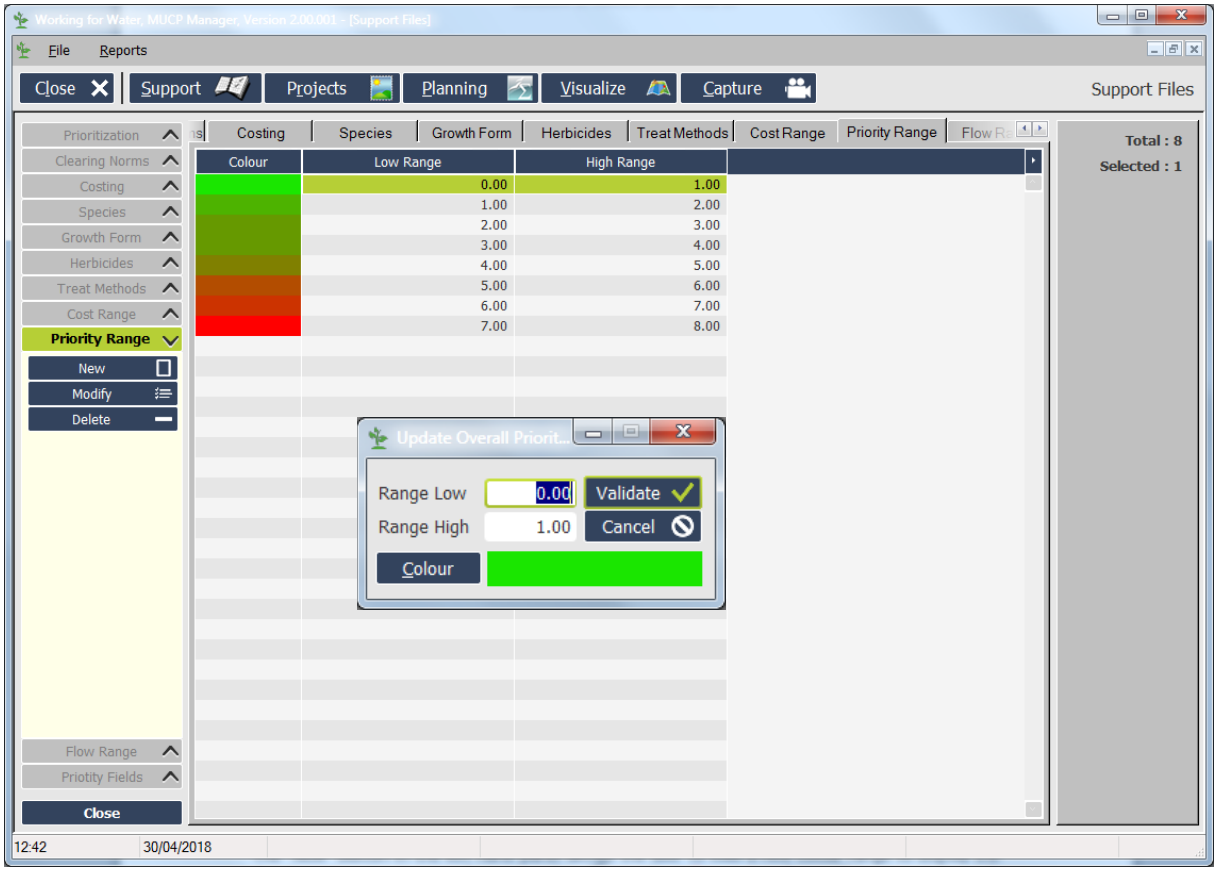
The "New" button in the left hand panel allows the user to load a new colour range to display the cost categories to use when presenting the results of the cost of clearing for each compartment in the Visualisation component of the MUCP tool (Section 4.4). The default range allows for all the likely amounts that can be spent on a compartment in a year. The user can customise this range to more accurately capture the range of costs per compartment per year that is estimated by the tool.



The "Modify" button allows an existing colour range to be revised. If any new information is added it must first be "Validated" before it becomes active.

4.1.9 Priority Range

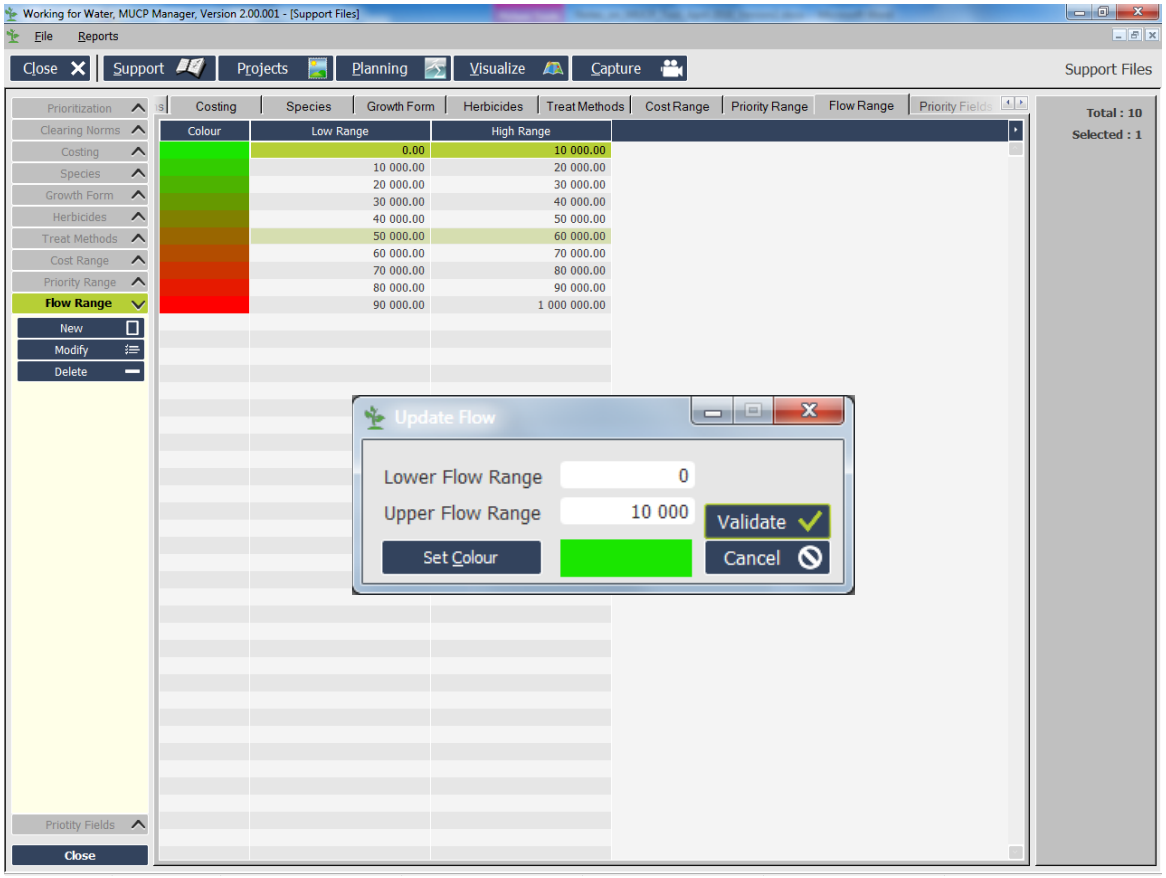
The "New" button in the left hand panel allows the user to load a new colour range to display the priority categories to use when presenting the resultant priorities after each treatment for each compartment in the Visualisation component of the MUCP tool (Section 4.4). The range of values that the tool generates for the priorities for the compartments depends on the number of categories that are used, the values in them and the weights they are given. The user can customise the ranges to suit the values generated for their particular project.



The "Modify" button allows an existing colour range to be revised. If any new information is added it must first be "Validated" before it becomes active.

4.1.10 Flow Range

The "New" button in the left hand panel allows the user to load a new colour range to display the flow reduction categories to use when presenting the estimated flow reductions in m^3 per year for each compartment in the Visualisation component of the MUCP tool (Section 4.4). The range of flow reduction values that the tool generates for the compartments depends on the species, their densities, whether the invasions are riparian on landscape (uplands) and the mean MAR estimated for the compartment. The user can customise the ranges to suit the values generated for their particular project.

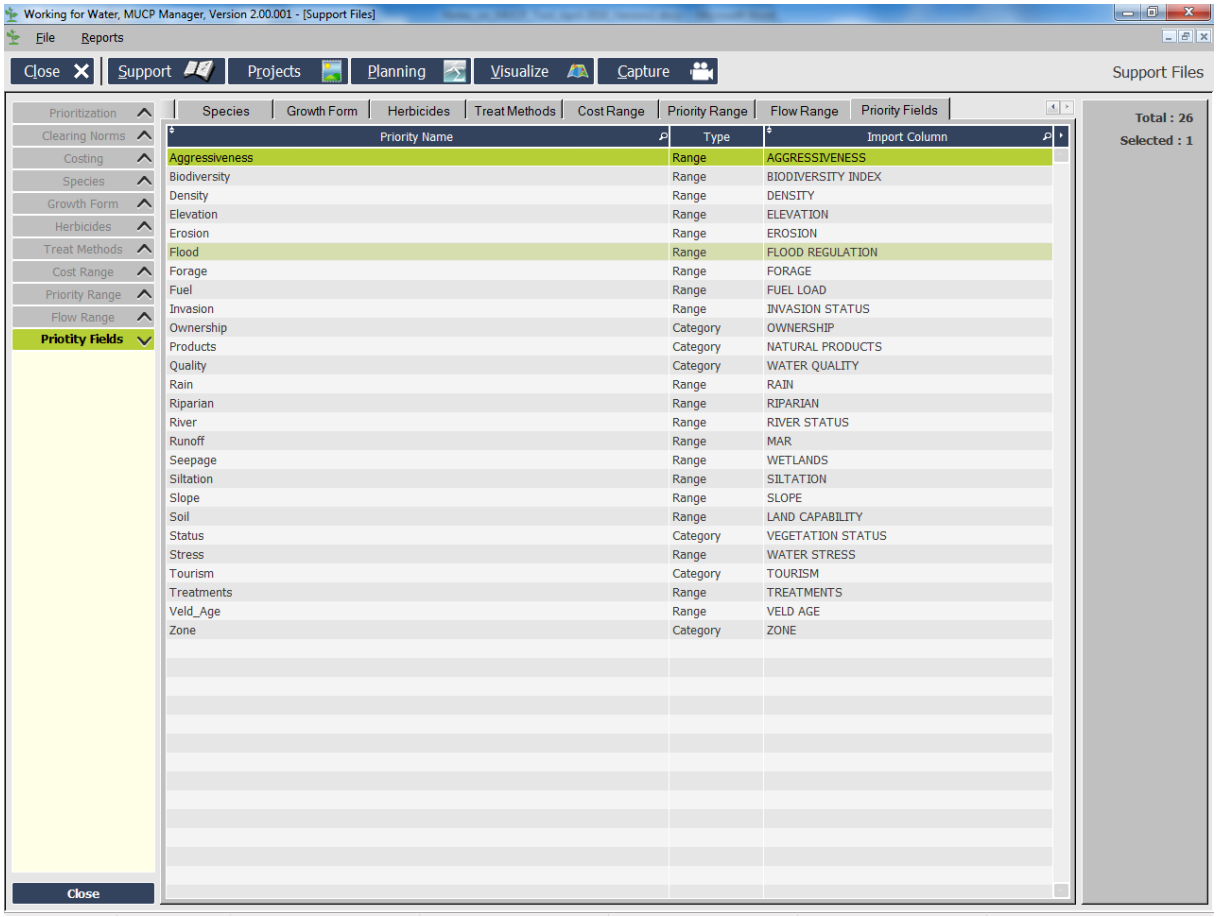


The "Modify" button allows an existing colour range to be revised. If any new information is added it must first be "Validated" before it becomes active.

4.1.11 Priority Fields

There are 26 predefined priority categories in the MUCP Tool. These are listed alphabetically in the "Priority Name" column. Each of these is defined in the "Type" column as being either a range or category variable. Range variables are numbers while Category variables are alpha-numeric values. These "Type" assignments cannot be edited but the data in the other columns can be edited.

The "Import Column" displays the default column heading to be used when setting up the column headings and data in the "prioritisation.csv" file (see Section 5.7.1). However, users can customize the column headings using their own descriptive names for a prioritisation variable. Changes can be made by simply double-clicking on the name in the "Import Column" and retyping it to match the column heading name that will be used in the "prioritisation.csv" file. Although they are shown as upper case, they are not case sensitive; but spelling and spaces must match exactly.


Working for Water, MUCP Manager, Version 2.00.001 - [Support Files]
File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Support Files
Prioritization
Clearing Norms
Costing
Species
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priotity Fields
Close
Species
Growth Form
Herbicides
Treat Methods
Cost Range
Priority Range
Flow Range
Priority Fields
Priority Name
Type
Import Column
Aggressiveness Range AGGRESSIVENESS
Biodiversity Range BIODIVERSITY INDEX
Density Range DENSITY
Elevation Range ELEVATION
Erosion Range EROSION
Flood Range FLOOD REGULATION
Forage Range FORAGE
Fuel Range FUEL LOAD
Invasion Range INVASION STATUS
Ownership Category OWNERSHIP
Products Category NATURAL PRODUCTS
Quality Category WATER QUALITY
Rain Range RAIN
Riparian Range RIPARIAN
River Range RIVER STATUS
Runoff Range MAR
Seepage Range WETLANDS
Siltation Range SILTATION
Slope Range SLOPE
Soil Range LAND CAPABILITY
Status Category VEGETATION STATUS
Stress Range WATER STRESS
Tourism Category TOURISM
Treatments Range TREATMENTS
Veld_Age Range VELD AGE
Zone Category ZONE
Total : 26
Selected : 1

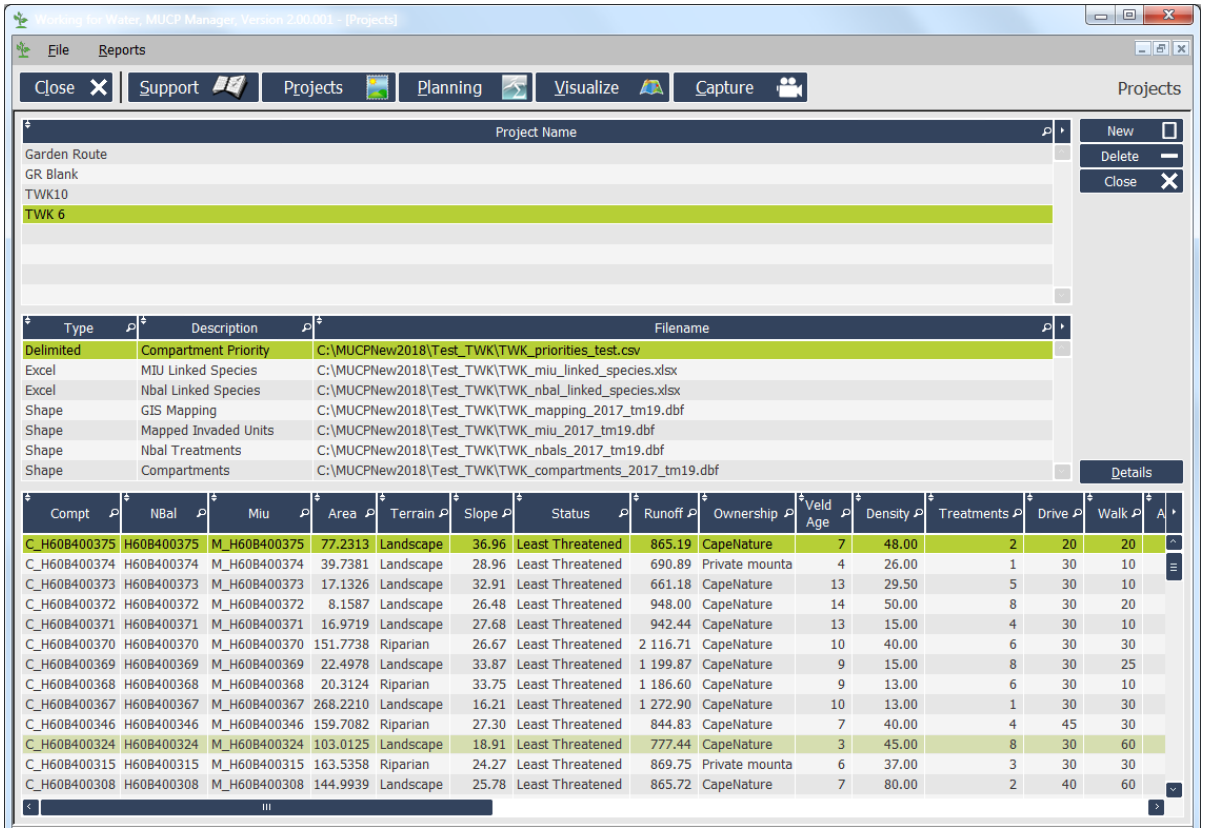
4.2 Project Module

This is the module where the files that make up a project are loaded into the MUCP tool via the "New" button. Each project consists of seven files:

- Compartments (dbf format)
- Mapped Invaded Units (dbf format)
- NBALs (dbf format)
- The union of the above three files (dbf format)
- The plant species linked to the NBAL files (xlsx format)
- The plant species linked to the MUI files (xlsx format)
- Prioritization file (csv format)

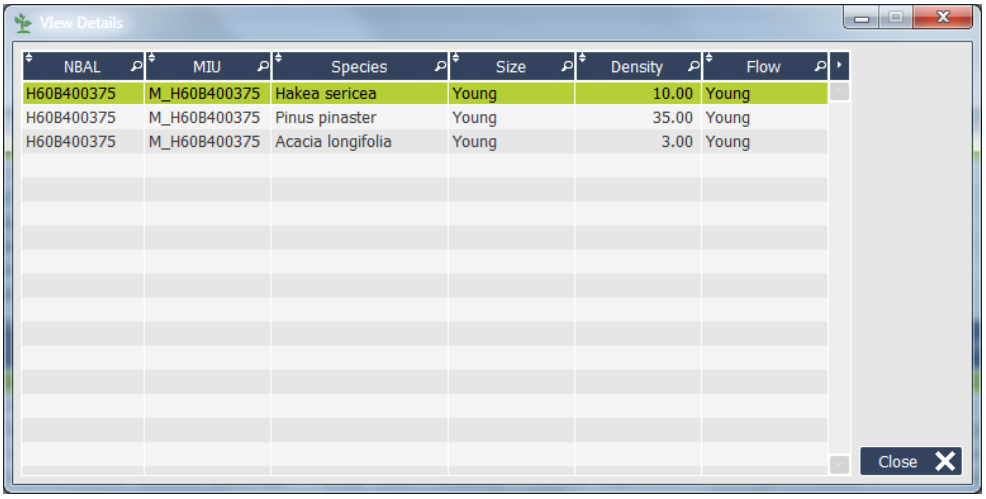
When loading these files the user is prompted to indicate the path to where they are stored on the computer (e.g. C:\MUCP\Project1\Project1_Compartments.dbf).

The project name is stored in the "Project Name" panel at the top of the window, the files comprising a project are displayed in the middle panel, while attribute data for each compartment, MUI and NBAL are displayed in the bottom panel.



The full datasets can be viewed by scrolling up and down, and to the left and right. Section 5 contains further instructions regarding the formatting and loading of these files.

Certain details regarding the full list of the species present in any particular MIU or NBAL within an individual compartment can be displayed by firstly highlighting the compartment of interest and then clicking on the "Details" button in the right hand panel of the Projects window.

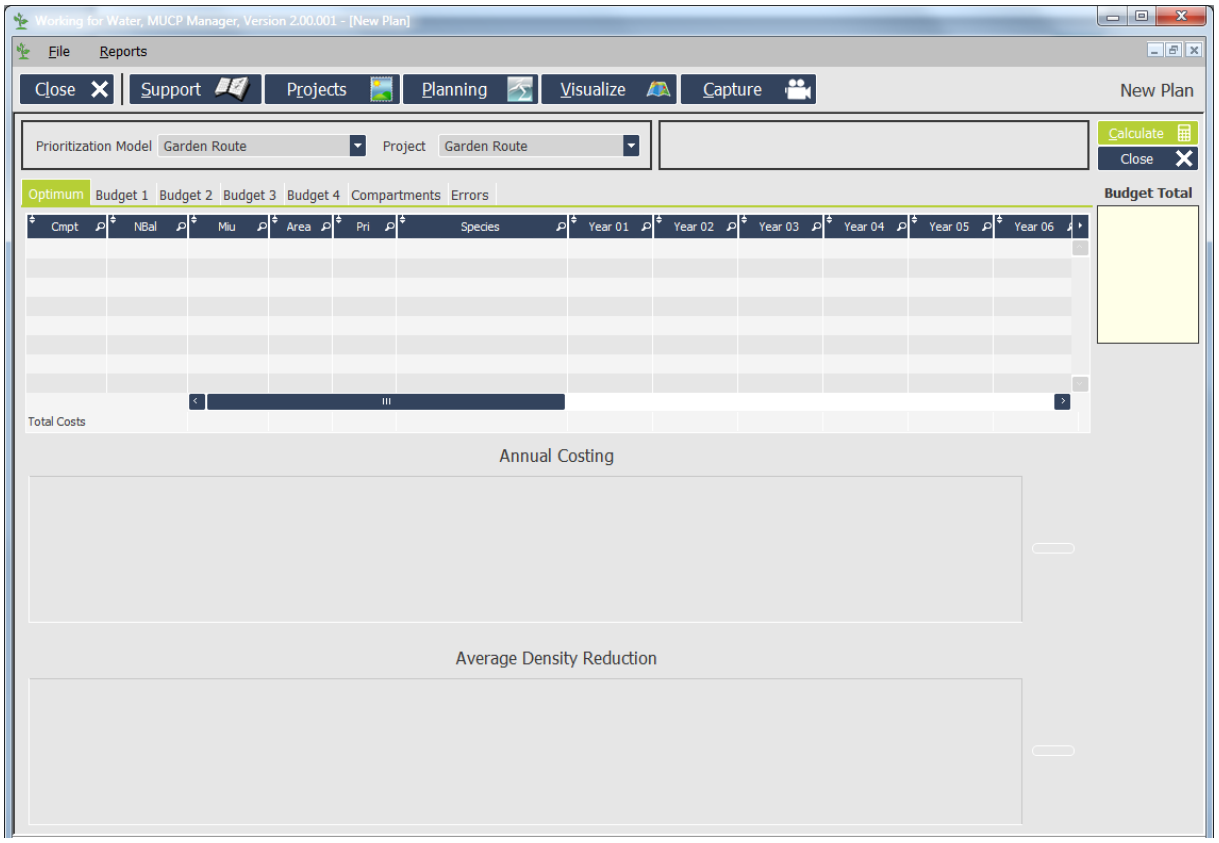

View Details
NBAL
MIU
Species
Size
Density
Flow
H60B400375
M_H60B400375
Hakea sericea
Young
10.00
Young
H60B400375
M_H60B400375
Pinus pinaster
Young
35.00
Young
H60B400375
M_H60B400375
Acacia longifolia
Young
3.00
Young
Close

4.3 Planning Module

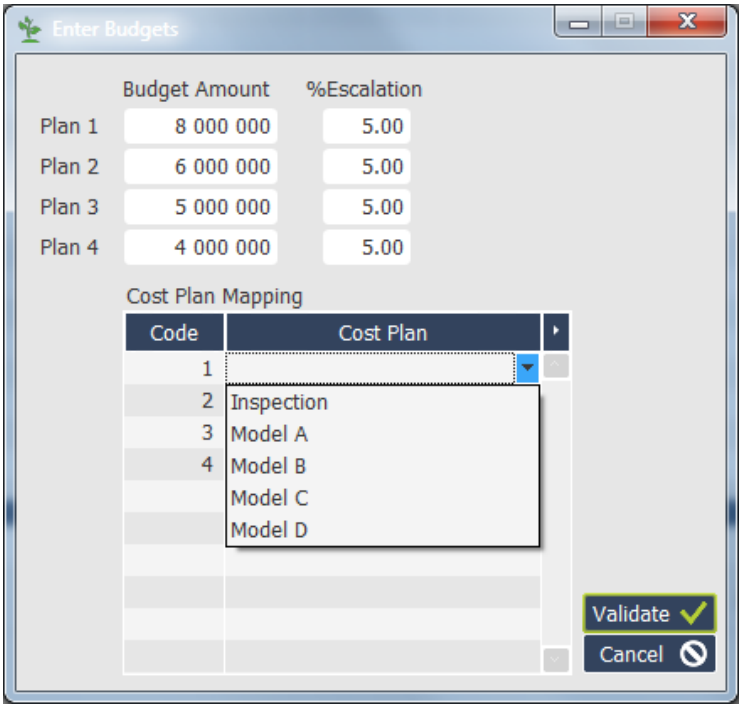
The MUCP tool allows different annual budgets to be applied over a 20 year period based on the prioritisation of the compartments for clearing. These include an optimal (i.e. unlimited) budget, which is estimated by the tool itself based on the number of treatments each invaded area needs to reach a maintenance level, and four additional annual budget scenarios which can be set by the user.

From the Planning Module window, a new plan for a specific project can be created by clicking on the "New" button.

In this window a combination of a prioritisation model and a project needs to be selected from what has already been loaded in the Project window. Once the user has selected their choice from the Prioritisation Model and Project drop down boxes, the planning function is ready to run. This is done by clicking on the "Calculate" button.

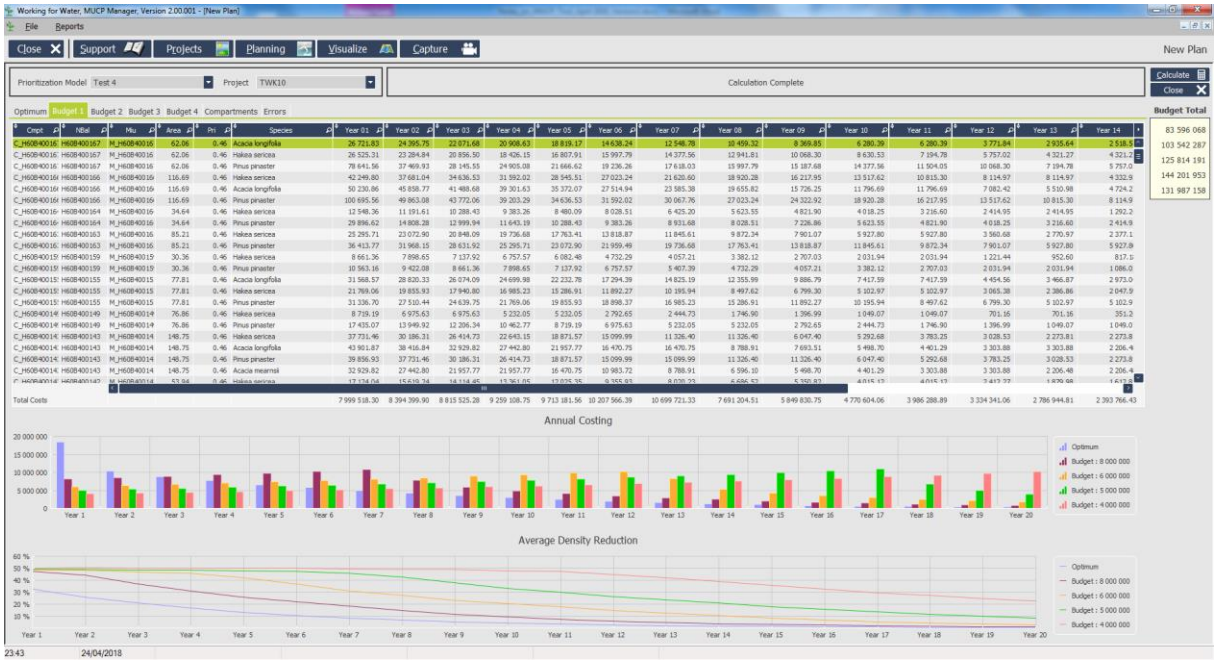


The user is then prompted via the "Enter Budgets" dialogue box to add or modify four budget scenarios and add cost escalation rates (percentages) to include estimated future inflation.



Costing models the user created using the Costing tab in the Support window (see section 4.1) can be linked to compartments via the "Code" field under "Cost Plan Mapping". The "Code" numbers the tool displays are obtained from the codes listed in the "Costing" field in the compartment shapefile. A "Cost Plan" (Costing model) must be selected under "Cost Plan Mapping" and matched to each "Code" in the list.

Once this information has been edited it needs to be validated by clicking on the "Validate" button. This action initiates the calculation of the annual costs and priorities for each compartment and for each of the budgets over a 20 year period. Once the process has been initiated, the progress can be monitored in the display of the budget name and the year that is being processed. The time this process takes to run depends on the number of compartments, MIUs and NBALS in the project and the processing capacity of the user's computer. It typically takes a few minutes or less. The results are returned in the Planning window and displayed in three panels.



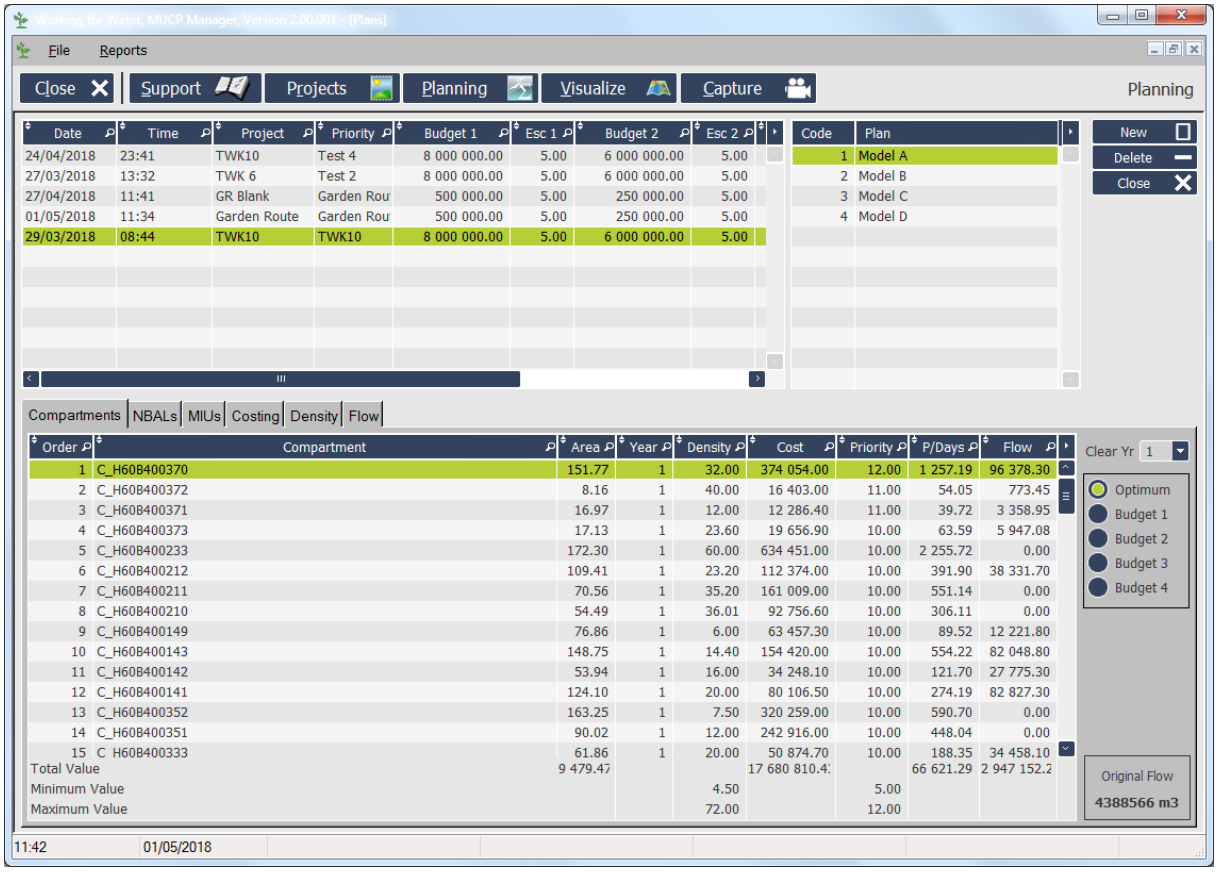
This window also contains an "error" table accessed via the "error" tab that highlights, for example, any misspelt species names. The user can then correct these errors in the appropriate input file.

The duration and total annual cost for each treatment unit, either a compartment, MIU or an NBAL, for each species and treatment is displayed in the top panel. This information can be exported via the export arrow  to a MS Excel spreadsheet for further sorting, analysis and summarising using the functionality of MS Excel (see Section 4.1).

The bar chart (histogram) in the middle panel displays the total cost per year with different colours for different annual budget ceilings. The line graph in the bottom panel shows how average species densities change over time for each of these budgets. The total amount that would be spent over the 20 years for each clearing budget scenario is displayed at the top right of the window.

To return to the Planning Module window, close the current planning run by clicking the "close" button in the right hand panel. The plan that has just been run will then be listed in the top panel of the Planning Module window, together with any previous plans.

The use can select any plan from the list in the top panel and information regarding this plan can then be accessed through a number of tabs in bottom panel.



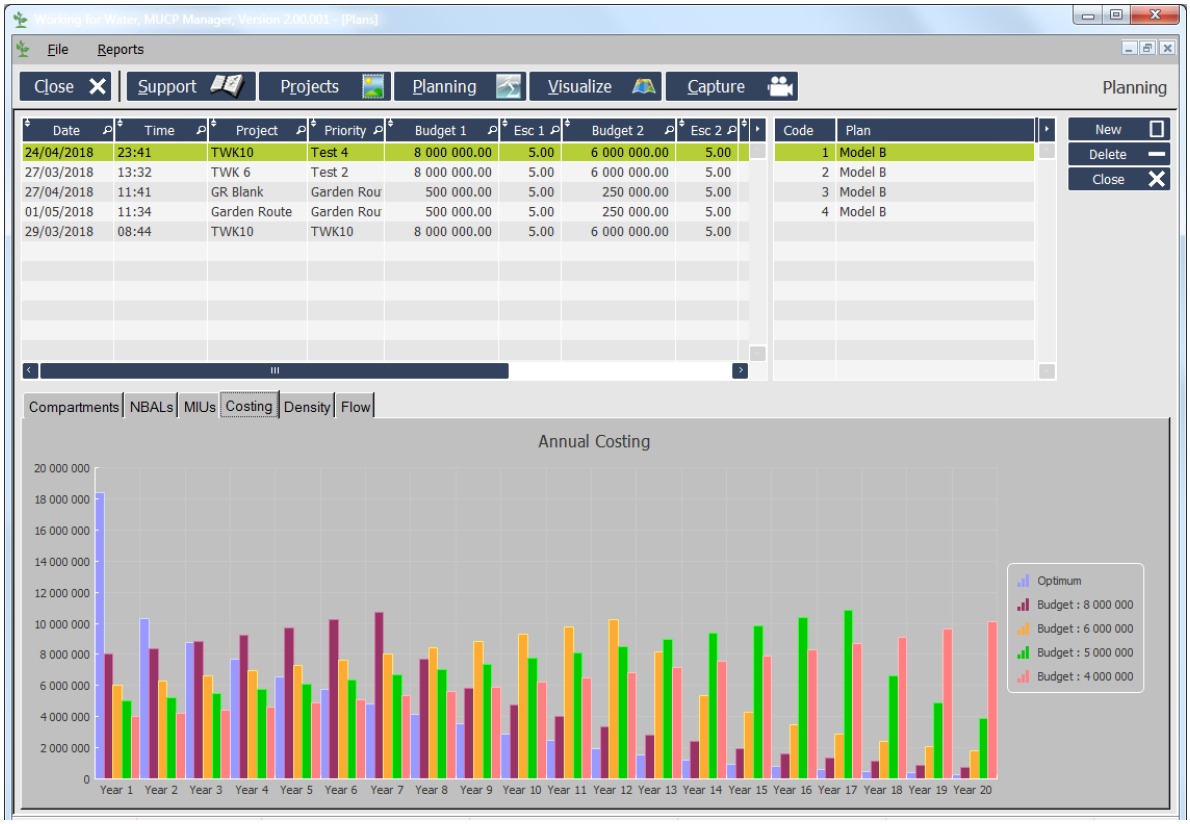
The results for each compartment are listed in their order of priority in the "order" column. The information displayed includes densities, costs, priority values, person days and flow reductions applicable to the year selected from the drop down box in the right hand panel as well as the budget selected. The priority order does not change irrespective of the year selected as these are the most important compartments to treat based on their priorities.

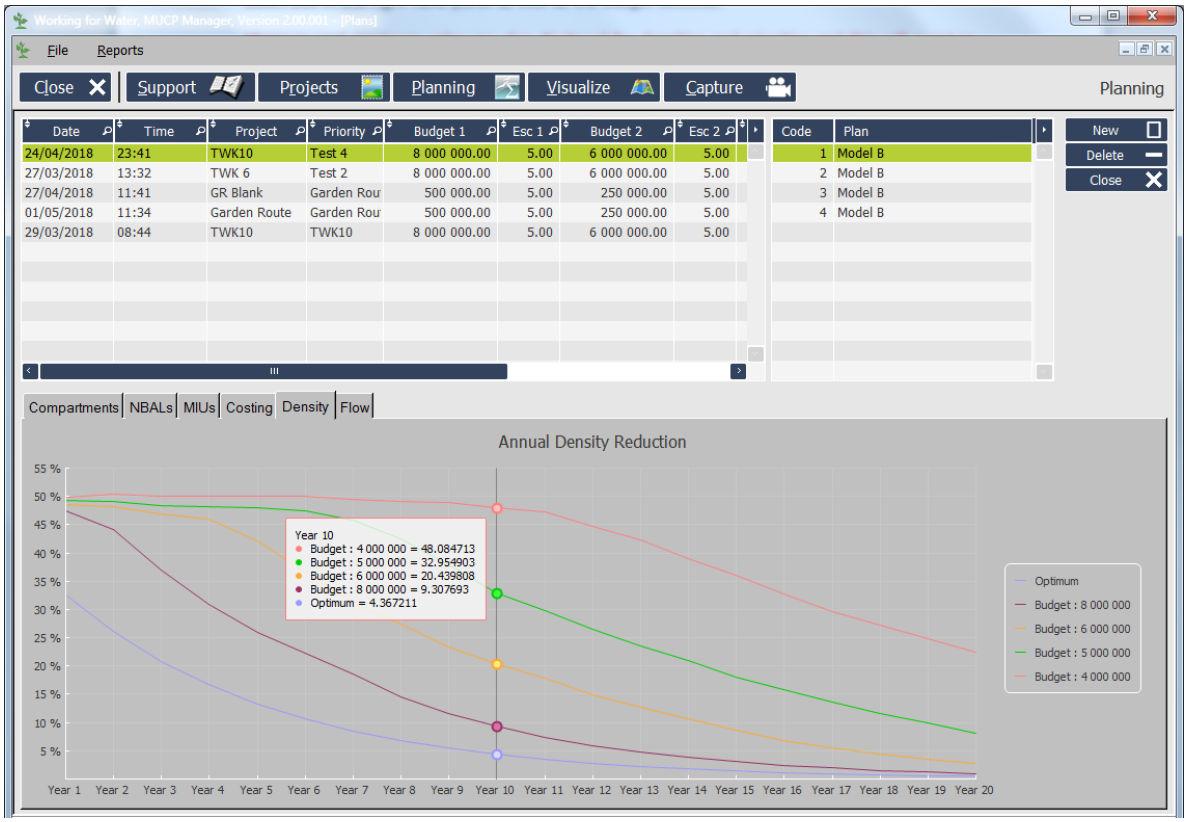
Minimum and maximum values are also displayed for the density and priority variables. These values can be used to help set the low and high ranges used for displaying compartment, MIU or NBAL maps of these variables in the Visualize Module. The values and colours for these ranges are set in the Support Module (see Sections 4.1.8 to 4.1.11).

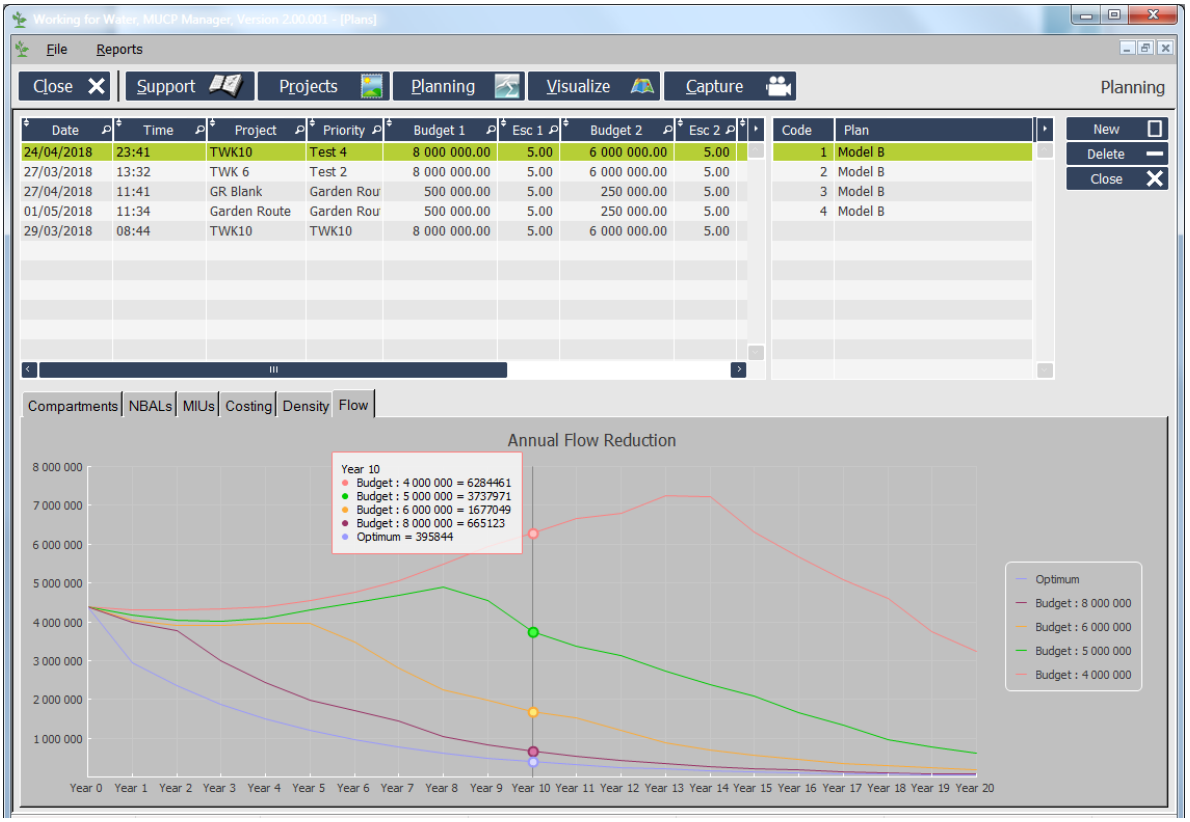
The box at the bottom on the right hand panel indicates the original flow reduction (m^3) based on the initial state of the invasions in the project area. This is the volume of water that could potentially be released if all invasive alien plants were cleared in the project area.

The same information can be viewed for NBALs and MIUs using their respective tabs.

Graphs of costing, density reduction and flow reduction for any of the projects listed in the top panel can be displayed in the bottom panel by switching between the applicable tabs.


File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Planning
Date
Time
Project
Priority
Budget 1
Esc 1
Budget 2
Esc 2
Code
Plan
24/04/2018 23:41 TWK10 Test 4 8 000 000.00 5.00 6 000 000.00 5.00 1 Model B
27/03/2018 13:32 TWK 6 Test 2 8 000 000.00 5.00 6 000 000.00 5.00 2 Model B
27/04/2018 11:41 GR Blank Garden Rou 500 000.00 5.00 250 000.00 5.00 3 Model B
01/05/2018 11:34 Garden Route Garden Rou 500 000.00 5.00 250 000.00 5.00 4 Model B
29/03/2018 08:44 TWK10 TWK10 8 000 000.00 5.00 6 000 000.00 5.00
New
Delete
Close
Compartments
NBALs
MIUs
Costing
Density
Flow
Annual Costing
20 000 000
18 000 000
16 000 000
14 000 000
12 000 000
10 000 000
8 000 000
6 000 000
4 000 000
2 000 000
0
Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 11 Year 12 Year 13 Year 14 Year 15 Year 16 Year 17 Year 18 Year 19 Year 20
Optimum
Budget : 8 000 000
Budget : 6 000 000
Budget : 5 000 000
Budget : 4 000 000


File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Planning
Date
Time
Project
Priority
Budget 1
Esc 1
Budget 2
Esc 2
Code
Plan
24/04/2018 23:41 TWK10 Test 4 8 000 000.00 5.00 6 000 000.00 5.00 1 Model B
27/03/2018 13:32 TWK 6 Test 2 8 000 000.00 5.00 6 000 000.00 5.00 2 Model B
27/04/2018 11:41 GR Blank Garden Rou 500 000.00 5.00 250 000.00 5.00 3 Model B
01/05/2018 11:34 Garden Route Garden Rou 500 000.00 5.00 250 000.00 5.00 4 Model B
29/03/2018 08:44 TWK10 TWK10 8 000 000.00 5.00 6 000 000.00 5.00
New
Delete
Close
Compartments
NBALs
MIUs
Costing
Density
Flow
Annual Density Reduction
55 %
50 %
45 %
40 %
35 %
30 %
25 %
20 %
15 %
10 %
5 %
Year 10
Budget : 4 000 000 = 48.084713
Budget : 5 000 000 = 32.954903
Budget : 6 000 000 = 20.439808
Budget : 8 000 000 = 9.307693
Optimum = 4.367211
Year 1 Year 2 Year 3 Year 4 Year 5 Year 6 Year 7 Year 8 Year 9 Year 10 Year 11 Year 12 Year 13 Year 14 Year 15 Year 16 Year 17 Year 18 Year 19 Year 20
Optimum
Budget : 8 000 000
Budget : 6 000 000
Budget : 5 000 000
Budget : 4 000 000

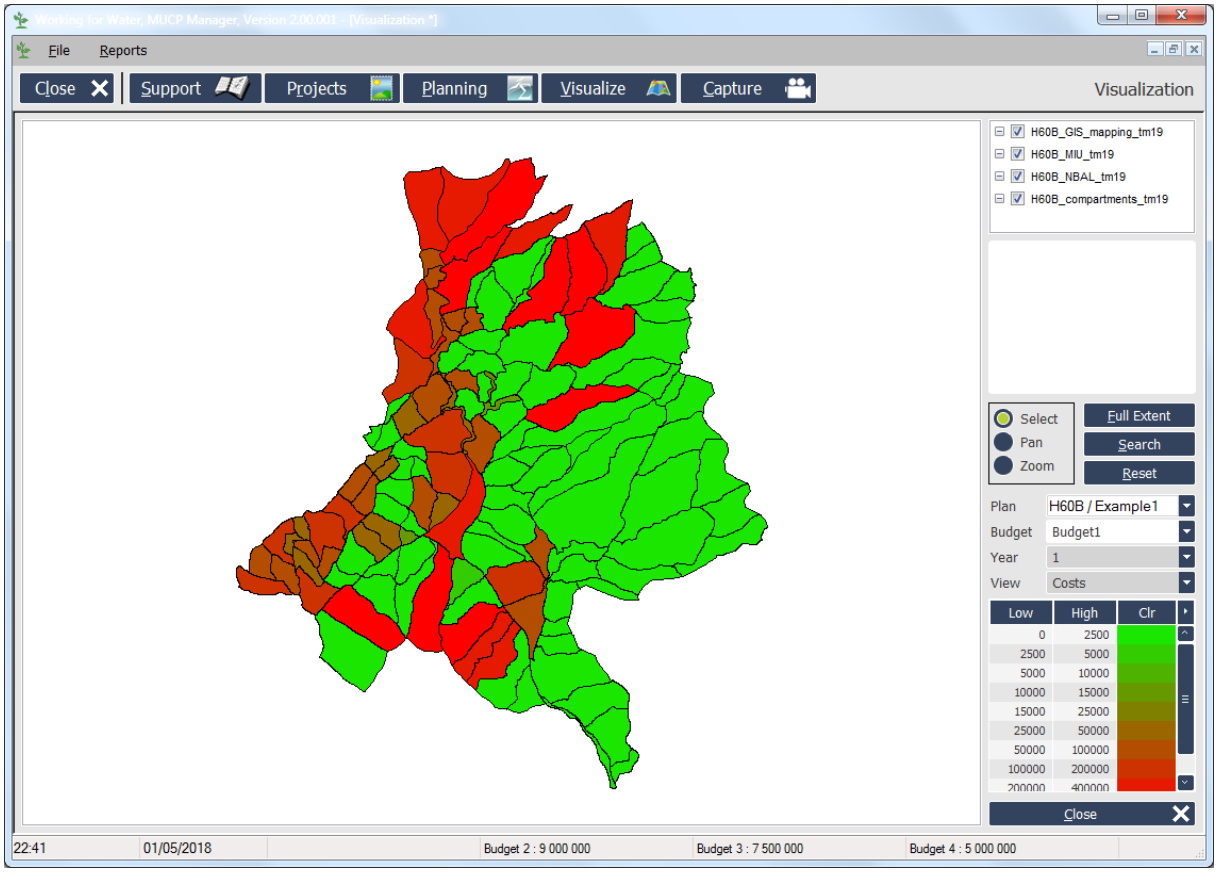


4.4 Visualize Module

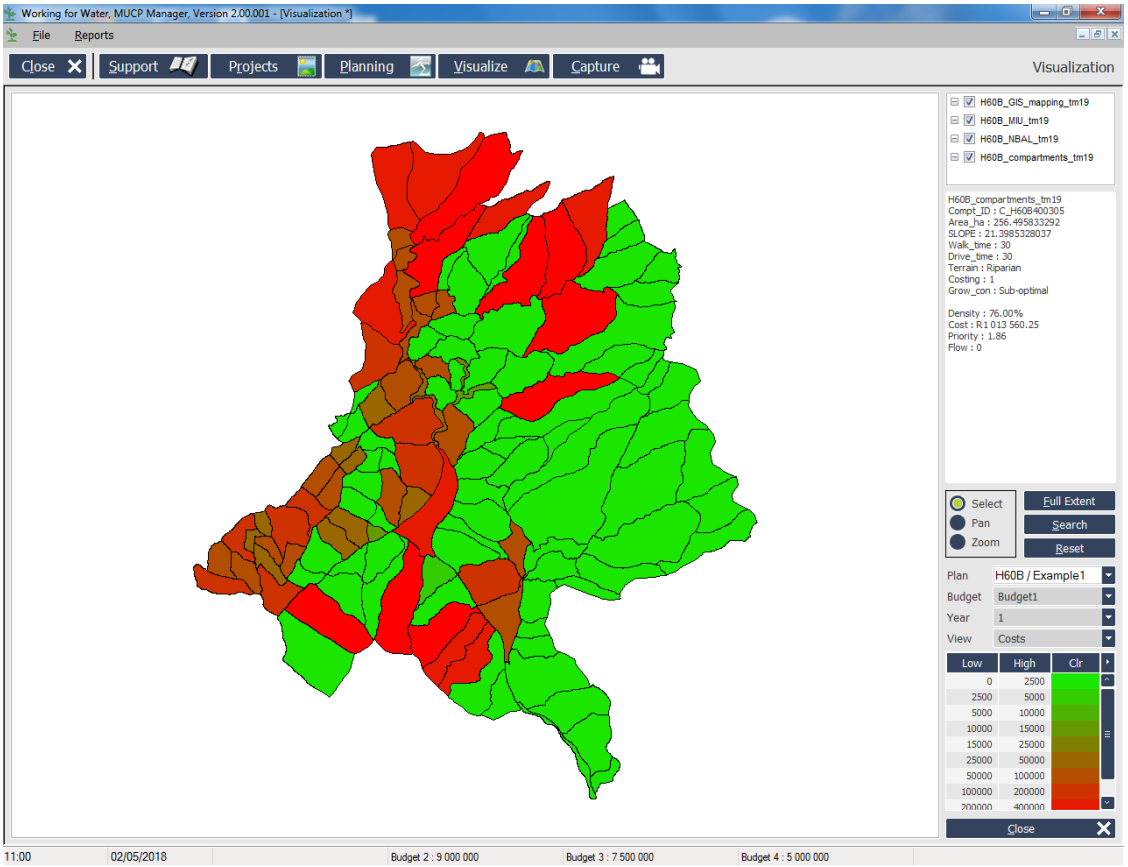
In the Visualization Module, the analyses can be displayed for five budget options one of which is the optimum (the shortest time the problem can be addressed if the budget was not a constraining factor) for each year from the present until 20 years in the future.

Views can be created to visualise the data from a cost, density or priority prospective. For each of these choices the data can be viewed displayed by compartments, MUIs or NBALs or a combination of these by ticking the boxes in the top right hand panel of the window.

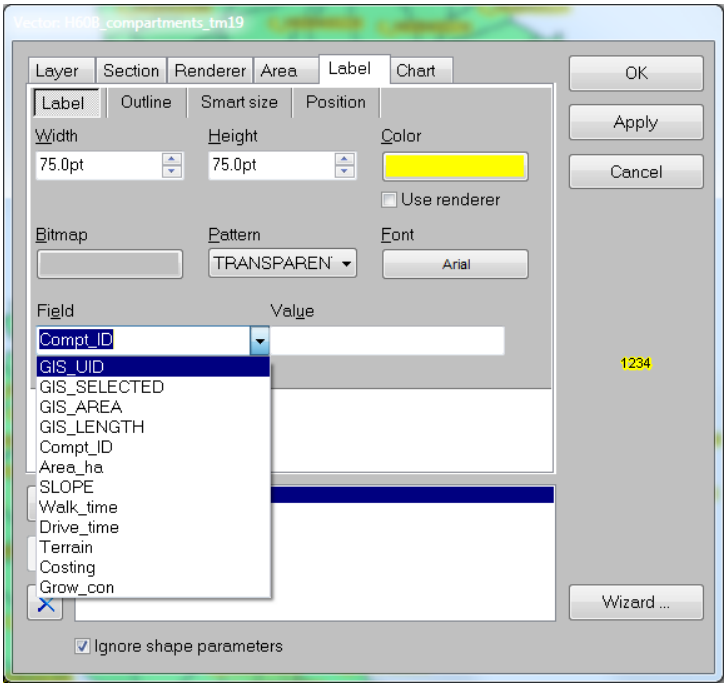
In the example below for the optimum budget and year 1 the costs of clearing for priority areas are highlighted in red. This view shows the union of compartments with MIUs and NBALs.

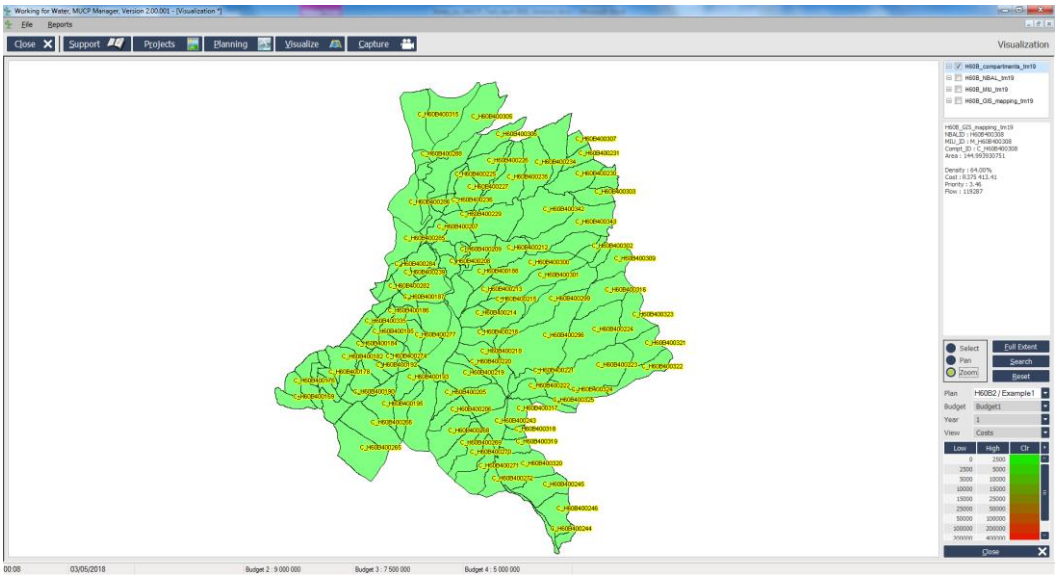


This view of the Visualize window shows the costs for compartments for Budget 1 and Year 1. This view of costs can be set in the legend panel for compartments, MIUs and NBALs for any budget and year combination. Similarly, the view in the legend panel can be set for Density, Priorities or Flow Reductions.



Double clicking on the compartment legend in the right hand side upper panel opens a window that allows the user to select labels to be displayed in the Visualize Window.

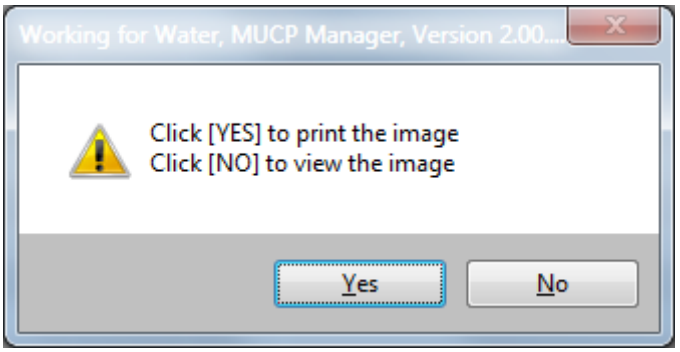



File
Reports
Close
Support
Projects
Planning
Visualize
Capture
Visualization
Select
Pan
Zoom
Full Extent
Search
Reset
Plan
H60B2 / Example1
Budget
Budget1
Year
1
View
Costs
Low
High
Clr
Close

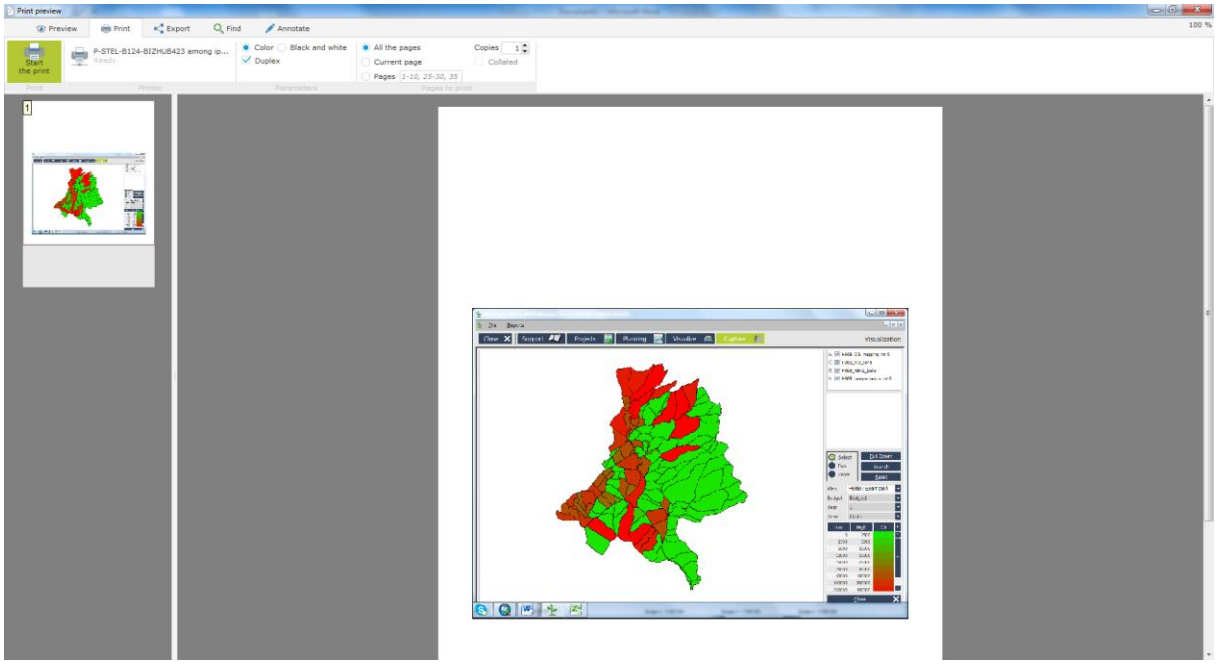
4.5 Capture Module

The capture function allows the user to capture and print any image displayed in the Visualize window (Section 4.4) or any other window that was active at the time.

A pop-up window appears when the user clicks on the Capture tab.



If the "Yes" option is selected a further window is displayed allowing the user to preview, print or export the image.



The print preview function allows the user to print the image or using the export function to a MS Word document or PDF file.

SECTION 5. OPERATING THE MUCP TOOL

5.1 Input Data

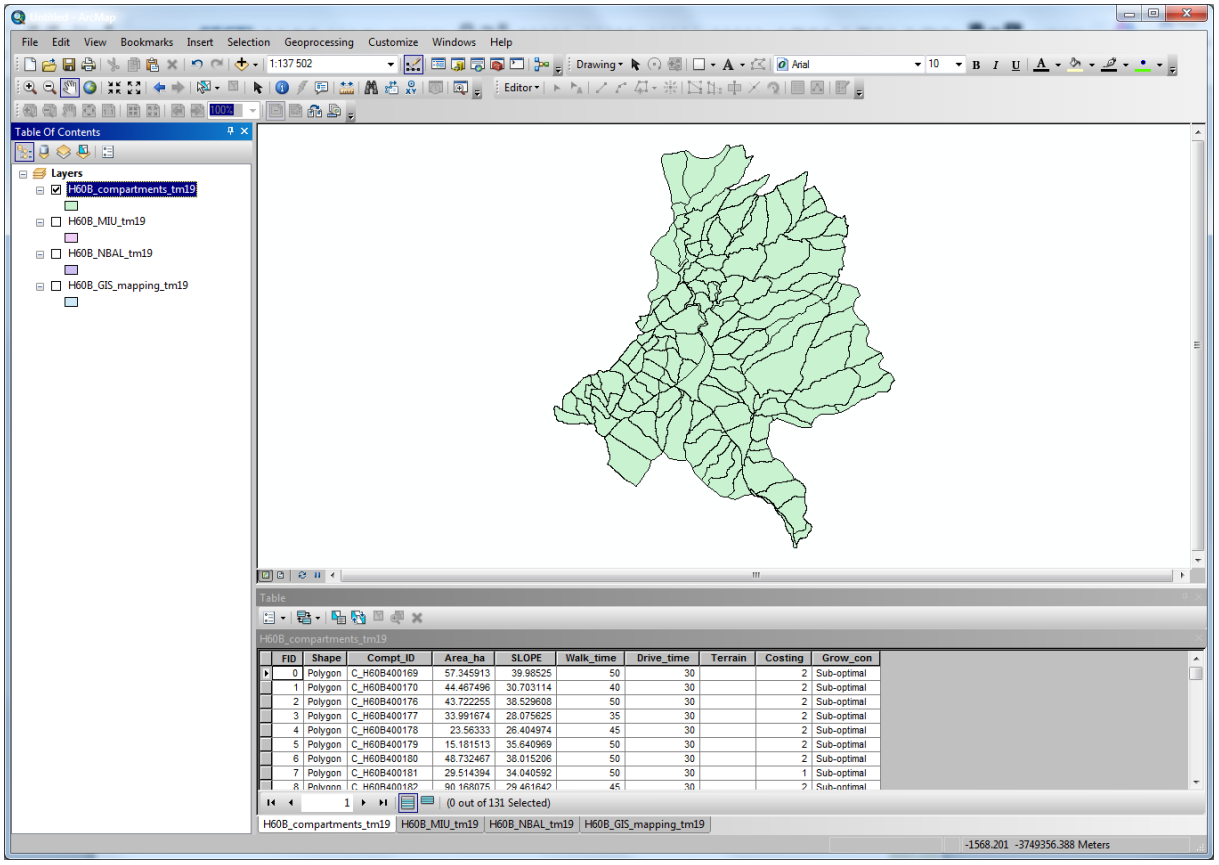
Various input shapefiles and spreadsheets need to be prepared for loading into the MUCP tool. In this example of quaternary catchment H60B, the data are in the Traverse Mercator 19 degrees East projection.

Type	Description	Filename
Delimited	Compartment Priority	D:\ECBD000 (NRM 2018)\H60B\H60B_compartments_priorities.csv
Excel	MIU Linked Species	D:\ECBD000 (NRM 2018)\H60B\H60B_MIU_linked_species.xlsx
Excel	Nbal Linked Species	D:\ECBD000 (NRM 2018)\H60B\H60B_NBAL_linked_species.xlsx
Shape	GIS Mapping	D:\ECBD000 (NRM 2018)\H60B\H60B_GIS_mapping_tm19.dbf
Shape	Mapped Invaded Units	D:\ECBD000 (NRM 2018)\H60B\H60B_MIU_tm19.dbf
Shape	Nbal Treatments	D:\ECBD000 (NRM 2018)\H60B\H60B_NBAL_tm19.dbf
Shape	Compartments	D:\ECBD000 (NRM 2018)\H60B\H60B_compartments_tm19.dbf

5.1.1 Compartment layer

Compartments are the permanent management units used to assign priorities and track progress (see Appendix A for further details).

The compartment layer needs to be prepared as a shapefile with a set of attribute fields that need to be populated by the user.



These attribute fields are described below:

Variable mnemonic	Description
Compt_ID	Unique compartment identifier
Area_ha	Area in hectares
SLOPE	In degrees using a floating point number displayed with at least one decimal place (e.g. 9.0 degrees)
Walk_time	In minutes
Drive_time	In minutes
Terrain	This variable would describe the conditions under foot. It is provided for in the WfW standards. As there are no norms for these at present the field is inactive and no values need to be entered
Costing	The code for linking the cost model to the compartment
Grow_con	The growing conditions for the dominant plant species in the MIU or NBAL

Deriving the slope classes:

Create a DEM in ArcGIS and then classify areas into the slope classes for the slope adjustment factor, where:

0-10° = 1
10-20° = 1.2
20-30° = 1.4
30-40° = 1.6
40-50° = 1.8
>50° = 2

Extract cells that are in the 1.8 and 2 categories and converted it to a simplified "steep areas" polygon. Aggregate the polygons that are within 500 m of one another. The rest of the area is flat.
Use those layers, the re-classed raster, and the zonal histogram tool in the ArcGIS toolbox, to get a frequency distribution of cells in each flat and steep category in each compartment. The adjustment value that occurred most frequently was the flat or the steep adjustment value.

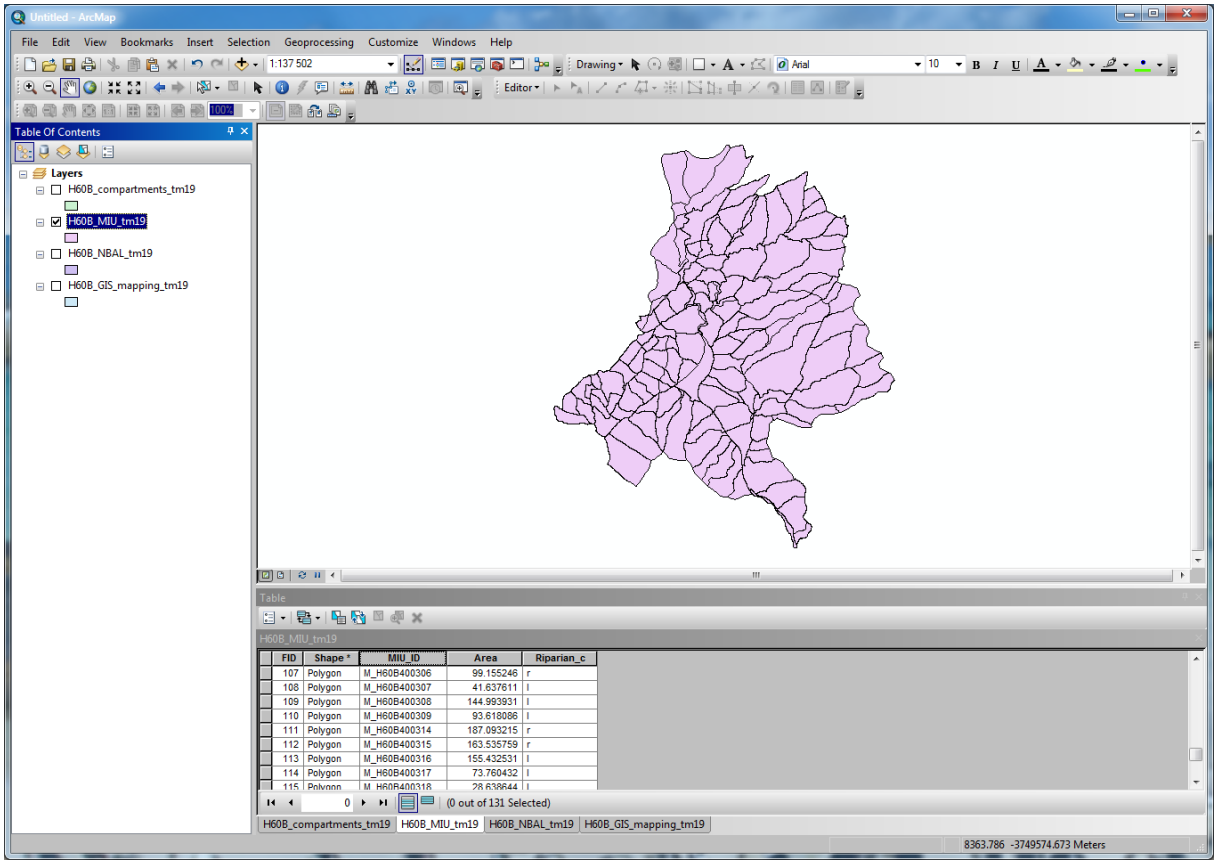
Deriving walking and driving distances:

To get walking distance use the centroid of each compartment and the roads layer to get the nearest point on the road to each centre ("generate near table" in ArcToolbox). Generate another near table with those road points and the nearest town to get driving distance.

5.1.2 Mapped Invaded Unit (MIU) layer

Mapped Invaded Units (MIUs) are based on field mapping and include all the invasions in a project area (see Appendix A) whether treated or not. Typically invasions with differing species, densities or age classes would be mapped as different MIUs. MIUs should also differentiate between landscape and riparian invasions (see Appendix A). The units are temporary in the sense that evidence that they will disappear as the invasions are cleared and the natural vegetation recovers.

The MIU layer needs to be prepared as a shapefile with a set of attribute fields that need to be populated by the user.



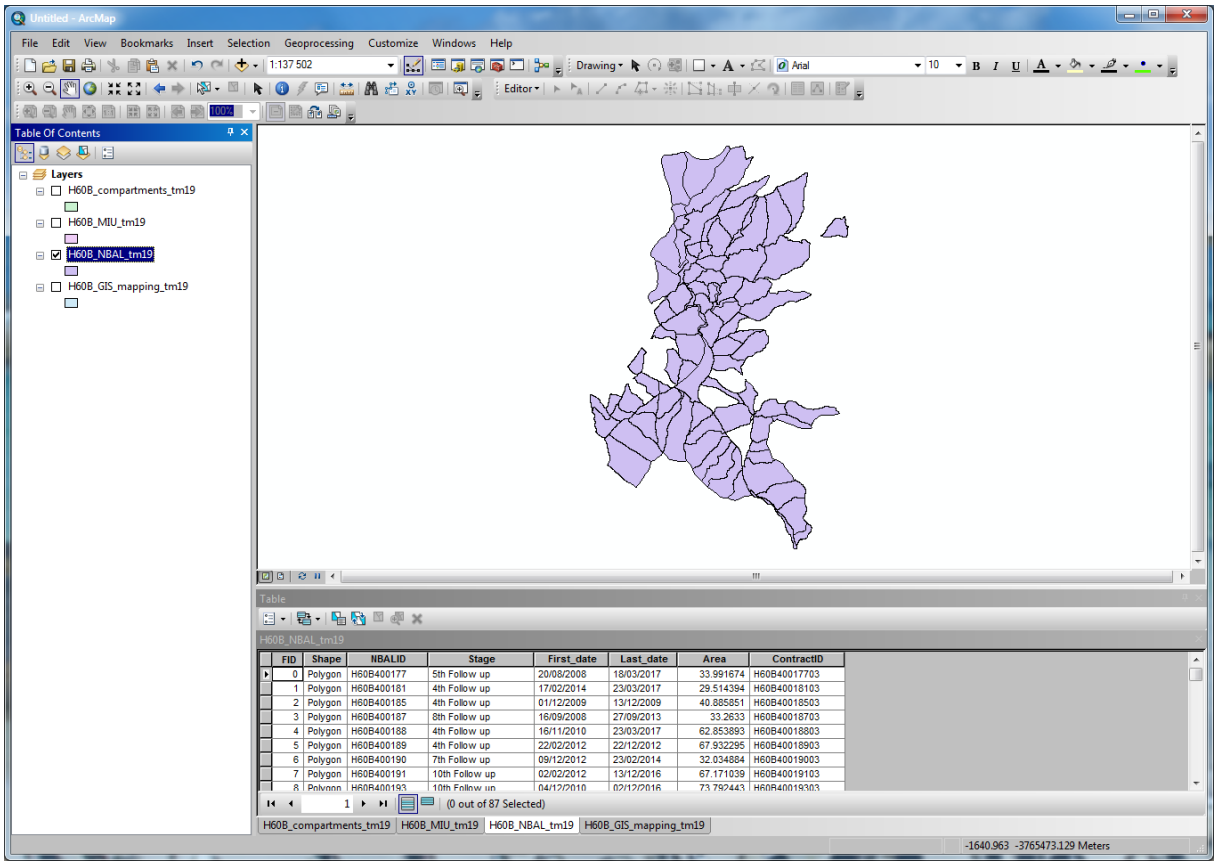
These attribute fields are described below:

Variable mnemonic	Description
MIU_ID	Unique compartment identifier
Area	Area in hectares
Riparian_c	Indication whether the area is riparian “r” or landscape “l”

5.1.3 NBAL Treatment layer

NBALs include all the invasions in the project area where there have been one or more control treatments (See Appendix A). They are temporary in the sense that evidence that they existed will disappear once the invasions are cleared and the natural vegetation recovers.

The NBAL layer needs to be prepared as a shapefile with a set of attribute fields. This data is derived from the NBAL analysis report extract from WfW information management system (WIMS).

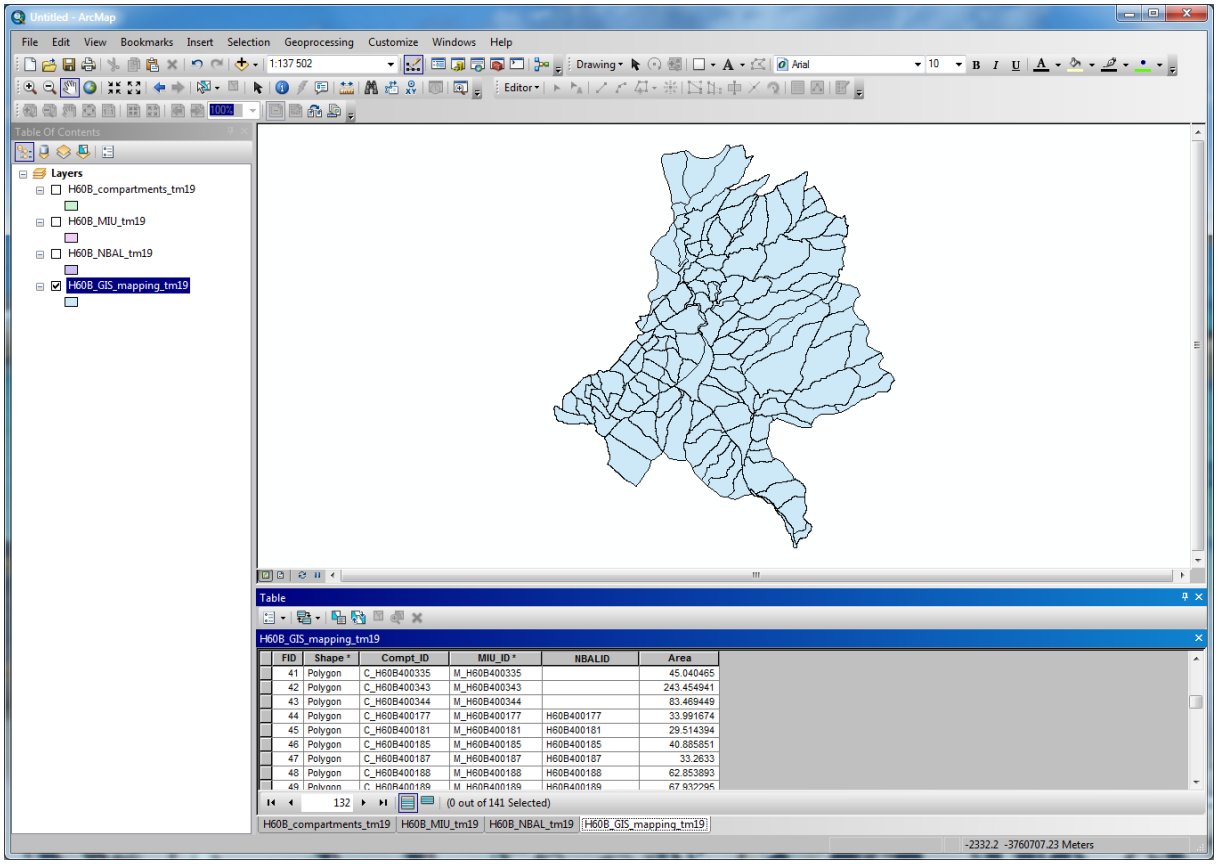


These fields are defined as follows:

Variable mnemonic	Description
NBALid	Unique NBAL identifier
Stage	This provides for a 20 character (letters and spaces) description. Stage 1 is the Initial Treatment; this is followed by 1-n Follow up treatments with provision made in the standards for 10 Follow-ups and then n; other options include maintenance and rehabilitation.
First_date	The day, month and year of the treatment initiation in a standard date format (preferably dd/mm/yyyy)
Last_date	The day, month and year of the last treatment in a standard date format (preferably dd/mm/yyyy)
Area	Area in hectares
ContractID	Unique ID which links to the WIMS contract which has 13 characters and is generated by the WIMS system

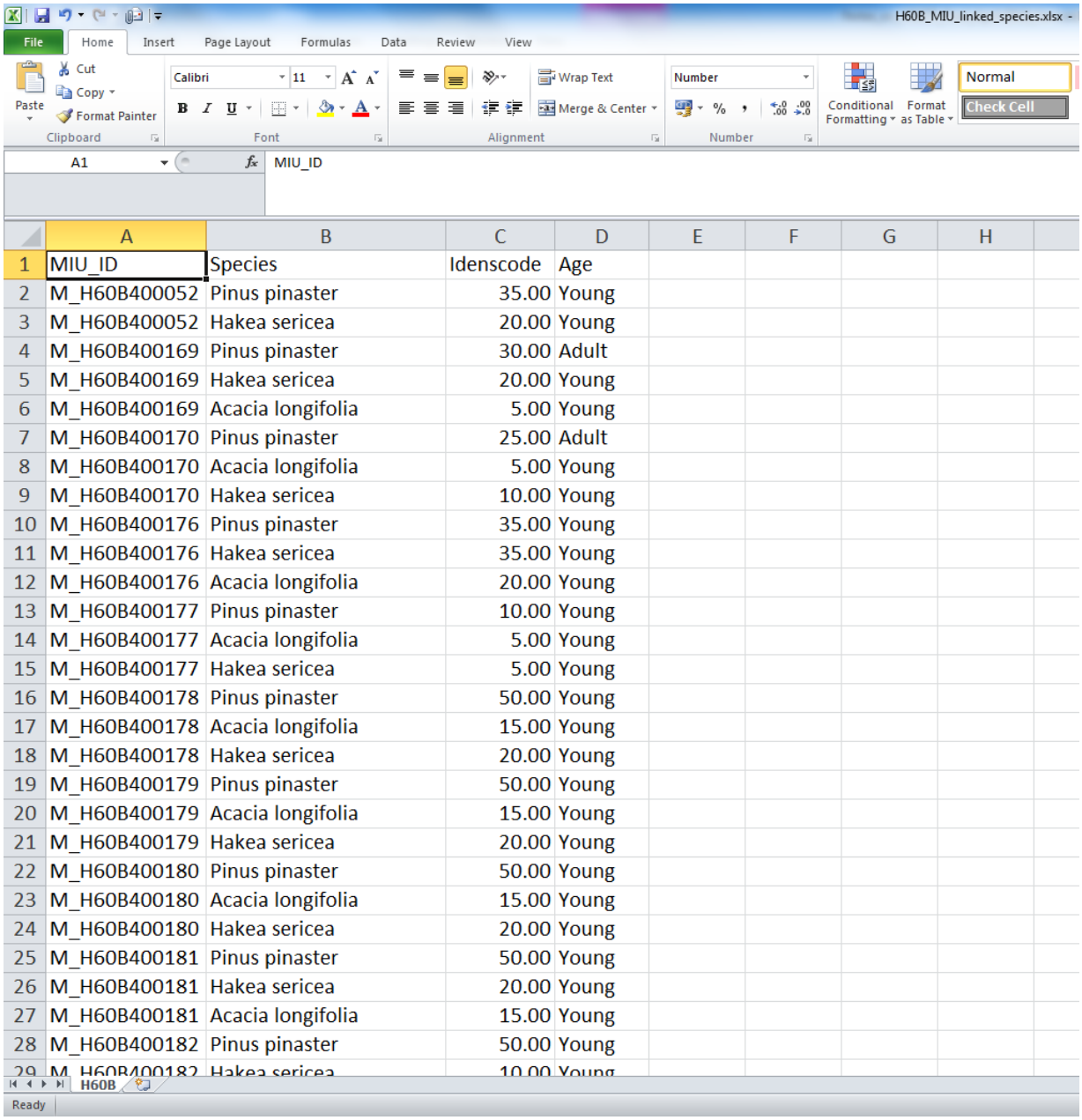
5.1.4 GIS Mapping (Union) layer

This is a GIS union of the Compartment, MIU and NBAL shapefiles and allows the MUCP tool to determine which NBAL falls within which MIU and which compartment. Compartments are used to determine the priorities for treatment and this layer allows the MUCP tool to identify which MIUs and NBALs to treat in each compartment.



5.1.5 MIU linked species spreadsheet

The Mapped Invaded Units (MIUs) linked species spreadsheet includes the information on all the species recorded in each MIU when the field mapping was done (see Appendix A). Individual MIUs can contain a number of invasive alien plant species with densities and age classes per species. The normal GIS software tools are not designed to link one MIU to many species so joining this file to the MIU shapefile will result in errors. The MUCP tool's database structures can accommodate such one-to-many relationships so it can process this dataset correctly.



H60B_MIU_linked_species.xlsx -

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A1 | MIU_ID

	A	B	C	D	E	F	G	H
1	MIU_ID	Species	Idenscode	Age				
2	M_H60B400052	Pinus pinaster	35.00	Young				
3	M_H60B400052	Hakea sericea	20.00	Young				
4	M_H60B400169	Pinus pinaster	30.00	Adult				
5	M_H60B400169	Hakea sericea	20.00	Young				
6	M_H60B400169	Acacia longifolia	5.00	Young				
7	M_H60B400170	Pinus pinaster	25.00	Adult				
8	M_H60B400170	Acacia longifolia	5.00	Young				
9	M_H60B400170	Hakea sericea	10.00	Young				
10	M_H60B400176	Pinus pinaster	35.00	Young				
11	M_H60B400176	Hakea sericea	35.00	Young				
12	M_H60B400176	Acacia longifolia	20.00	Young				
13	M_H60B400177	Pinus pinaster	10.00	Young				
14	M_H60B400177	Acacia longifolia	5.00	Young				
15	M_H60B400177	Hakea sericea	5.00	Young				
16	M_H60B400178	Pinus pinaster	50.00	Young				
17	M_H60B400178	Acacia longifolia	15.00	Young				
18	M_H60B400178	Hakea sericea	20.00	Young				
19	M_H60B400179	Pinus pinaster	50.00	Young				
20	M_H60B400179	Acacia longifolia	15.00	Young				
21	M_H60B400179	Hakea sericea	20.00	Young				
22	M_H60B400180	Pinus pinaster	50.00	Young				
23	M_H60B400180	Acacia longifolia	15.00	Young				
24	M_H60B400180	Hakea sericea	20.00	Young				
25	M_H60B400181	Pinus pinaster	50.00	Young				
26	M_H60B400181	Hakea sericea	20.00	Young				
27	M_H60B400181	Acacia longifolia	15.00	Young				
28	M_H60B400182	Pinus pinaster	50.00	Young				
29	M_H60B400182	Hakea sericea	10.00	Young				

H60B

Ready

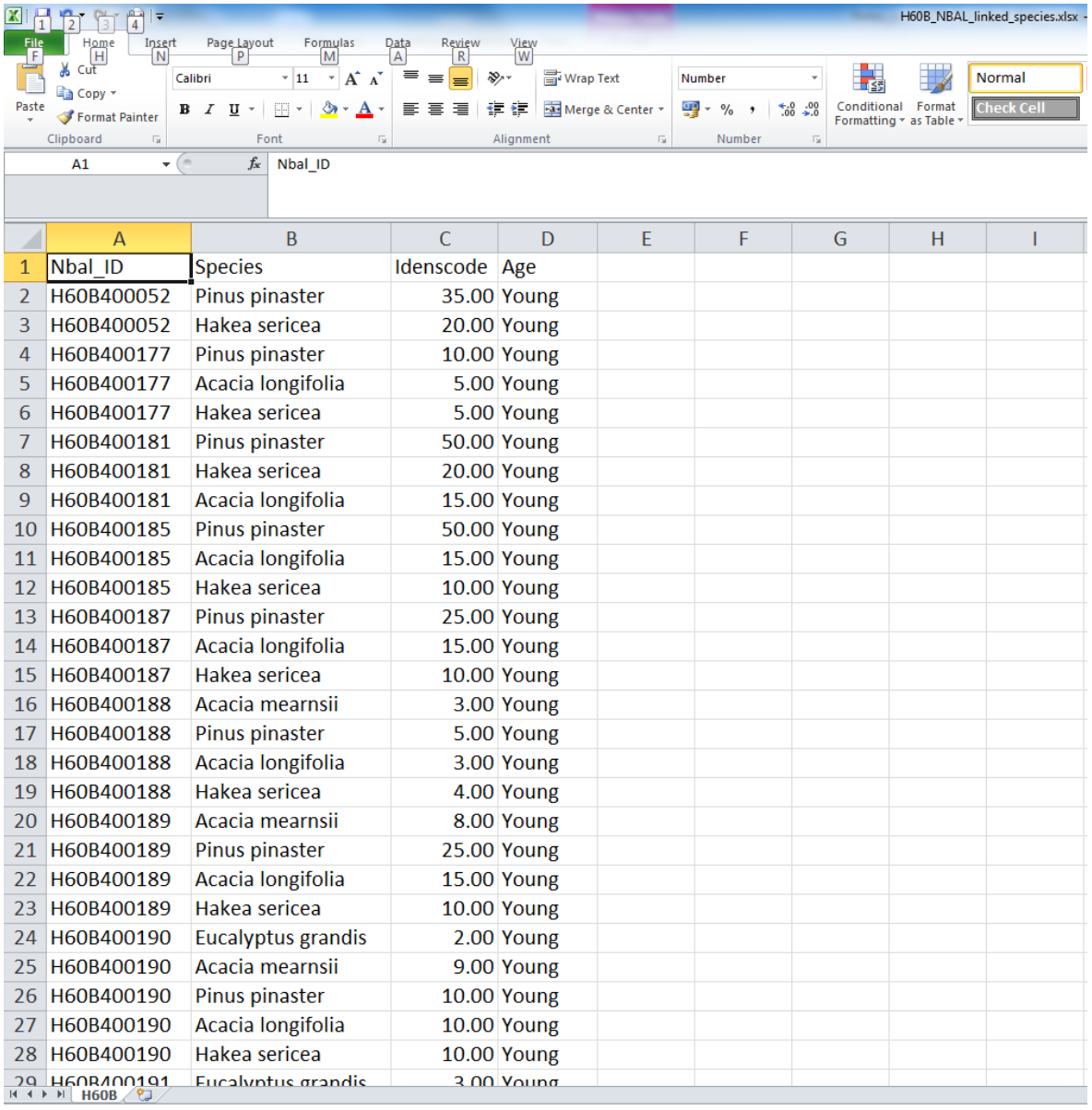
These fields are defined follows:

Variable mnemonic	Description
MIU_ID	Unique MIU identifier
Species	Scientific name (genus and species) of the IAP species
Idenscode	Density code Even though the field is called density code, the actual data indicates the IAP densities in percentage.
Age	Age class of the IAP species, such as Seedling, Young, Adult (Mature) and Coppice.

5.1.6 NBAL linked species spreadsheet

This is extracted from the NBAL history report which is one of the outputs produced by the WfW information management system (WIMS). The plan is that future versions will be able to automate this process.

Individual NBALs can contain any number of invasive alien plant species with densities and age classes per species. As noted above for the MIU linked species data, simply joining this file to the NBAL shapefile will result in errors.



	A	B	C	D	E	F	G	H	I
1	Nbal_ID	Species	Idenscode	Age					
2	H60B400052	Pinus pinaster	35.00	Young					
3	H60B400052	Hakea sericea	20.00	Young					
4	H60B400177	Pinus pinaster	10.00	Young					
5	H60B400177	Acacia longifolia	5.00	Young					
6	H60B400177	Hakea sericea	5.00	Young					
7	H60B400181	Pinus pinaster	50.00	Young					
8	H60B400181	Hakea sericea	20.00	Young					
9	H60B400181	Acacia longifolia	15.00	Young					
10	H60B400185	Pinus pinaster	50.00	Young					
11	H60B400185	Acacia longifolia	15.00	Young					
12	H60B400185	Hakea sericea	10.00	Young					
13	H60B400187	Pinus pinaster	25.00	Young					
14	H60B400187	Acacia longifolia	15.00	Young					
15	H60B400187	Hakea sericea	10.00	Young					
16	H60B400188	Acacia mearnsii	3.00	Young					
17	H60B400188	Pinus pinaster	5.00	Young					
18	H60B400188	Acacia longifolia	3.00	Young					
19	H60B400188	Hakea sericea	4.00	Young					
20	H60B400189	Acacia mearnsii	8.00	Young					
21	H60B400189	Pinus pinaster	25.00	Young					
22	H60B400189	Acacia longifolia	15.00	Young					
23	H60B400189	Hakea sericea	10.00	Young					
24	H60B400190	Eucalyptus grandis	2.00	Young					
25	H60B400190	Acacia mearnsii	9.00	Young					
26	H60B400190	Pinus pinaster	10.00	Young					
27	H60B400190	Acacia longifolia	10.00	Young					
28	H60B400190	Hakea sericea	10.00	Young					
29	H60B400191	Eucalyptus grandis	3.00	Young					

These fields are defined as follows:

Variable	Description
NBALid	Unique NBAL identifier
Species	Scientific name of the IAP species
Density code	Even though the field is called density code, the actual data indicates the IAP densities in percentage.
Age	Age class of the IAP species, such as Seedling, Young, Mixed, Adult, Mature.

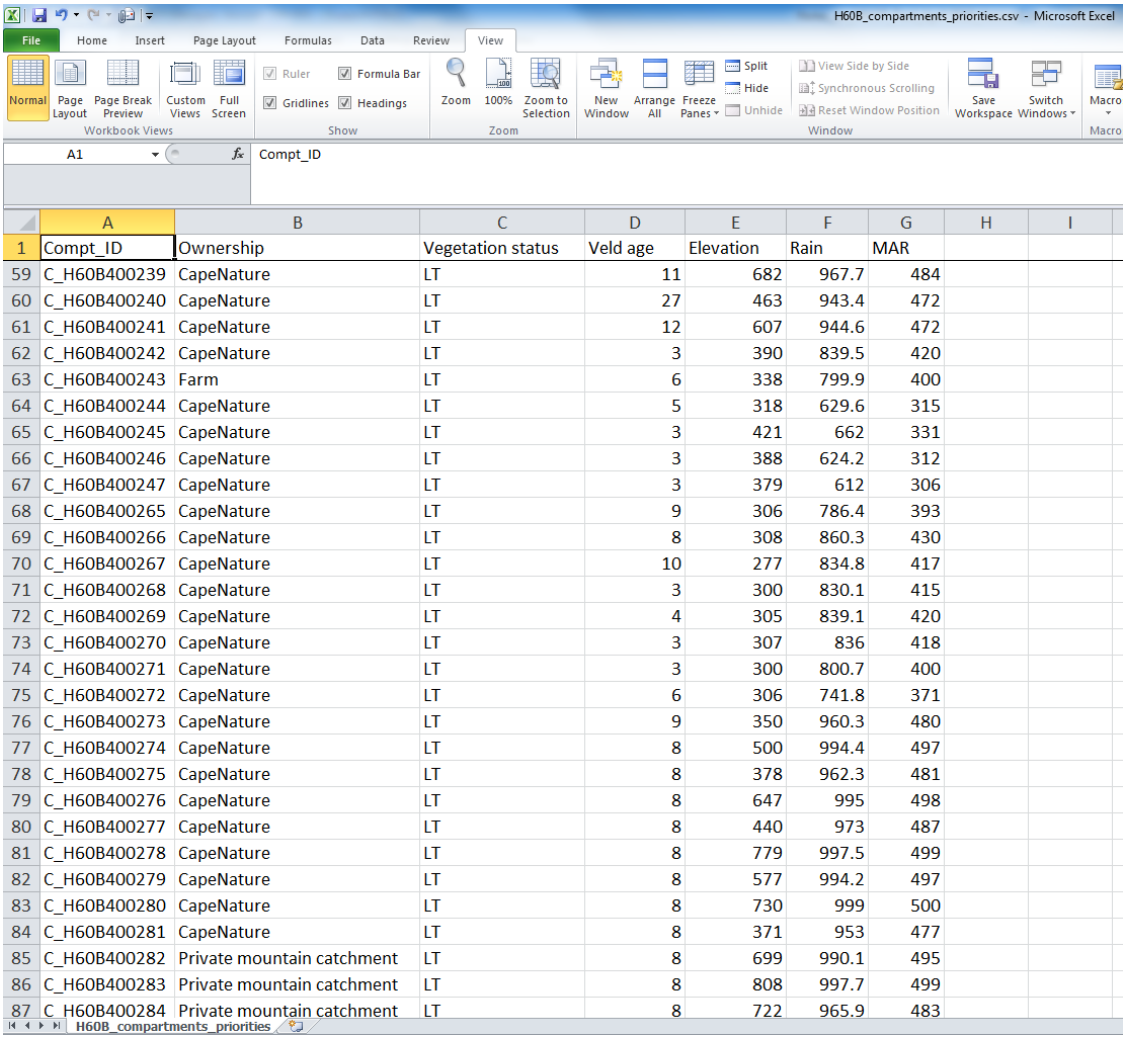
5.1.7 Compartment priority dataset

Various categories (fields) of information must be generated for each compartment to enable them to be prioritised correctly. This information must be stored in a CSV file[4]. The system currently has a default or pre-defined list of 26 categories or fields which were derived from those used in prioritisation workshops for a number of different projects. The user does not need to provide data for all the default field and should only use the categories that are applicable to their project.

If the user wishes to estimate flow reductions using the MUCP tool, they need to include the mean annual runoff (MAR) as a column headed "MAR" in the "Proiritisation.csv" file. If this column is missing or not populated the tool will use a default value of zero and there will be no values to display in the Flow Reduction graph in the Planning section.

Headings in the "Prioritisation.csv" table are not case sensitive and the order of the variables in the table is also not important. However the column headings in the "Priorisation.csv" file must correspond with the headings listed in the "Import Column" in the "Prioritisation Fields" window. The data types must also be the same as the type defined in "Prioritisation Fields" window (see section 4.1.11).

[4] A "comma" delimited text file format which can be created with a spreadsheet using "Save as" or using a text editor



H60B_compartments_priorities.csv - Microsoft Excel

	A	B	C	D	E	F	G
1	Compt_ID	Ownership	Vegetation status	Veld age	Elevation	Rain	MAR
59	C_H60B400239	CapeNature	LT	11	682	967.7	484
60	C_H60B400240	CapeNature	LT	27	463	943.4	472
61	C_H60B400241	CapeNature	LT	12	607	944.6	472
62	C_H60B400242	CapeNature	LT	3	390	839.5	420
63	C_H60B400243	Farm	LT	6	338	799.9	400
64	C_H60B400244	CapeNature	LT	5	318	629.6	315
65	C_H60B400245	CapeNature	LT	3	421	662	331
66	C_H60B400246	CapeNature	LT	3	388	624.2	312
67	C_H60B400247	CapeNature	LT	3	379	612	306
68	C_H60B400265	CapeNature	LT	9	306	786.4	393
69	C_H60B400266	CapeNature	LT	8	308	860.3	430
70	C_H60B400267	CapeNature	LT	10	277	834.8	417
71	C_H60B400268	CapeNature	LT	3	300	830.1	415
72	C_H60B400269	CapeNature	LT	4	305	839.1	420
73	C_H60B400270	CapeNature	LT	3	307	836	418
74	C_H60B400271	CapeNature	LT	3	300	800.7	400
75	C_H60B400272	CapeNature	LT	6	306	741.8	371
76	C_H60B400273	CapeNature	LT	9	350	960.3	480
77	C_H60B400274	CapeNature	LT	8	500	994.4	497
78	C_H60B400275	CapeNature	LT	8	378	962.3	481
79	C_H60B400276	CapeNature	LT	8	647	995	498
80	C_H60B400277	CapeNature	LT	8	440	973	487
81	C_H60B400278	CapeNature	LT	8	779	997.5	499
82	C_H60B400279	CapeNature	LT	8	577	994.2	497
83	C_H60B400280	CapeNature	LT	8	730	999	500
84	C_H60B400281	CapeNature	LT	8	371	953	477
85	C_H60B400282	Private mountain catchment	LT	8	699	990.1	495
86	C_H60B400283	Private mountain catchment	LT	8	808	997.7	499
87	C_H60B400284	Private mountain catchment	LT	8	722	965.9	483

The 26 prioritisation categories (fields) are defined as follows:

Category Mnemonic	Description	Import column headings in csv file	Type[1]
Compt_ID	Unique compartment identifier	Compt_ID	Category
Aggressiveness	How aggressive the invading species (e.g. rate of spread, ease of establishment and whether a transformer species or not). Typically this will be a value between 1 and 5)	Aggressiveness	Range
Biodiversity	Biodiversity index	Biodiversity index	Range
Density	Canopy cover as a %	Density	Range
Elevation	Metres above mean sea level	Elevation	Range
Erosion	Estimated actual soil erosion based on the soil's inherent erodibility, slope and vegetation condition	Erosion	Range
Flood	A measure of the ability of the landscape to retain flood waters	Flood regulation	Range
Forage	The quality of the vegetation for livestock or game and is often expressed as a stocking rate	Forage	Range
Fuel	Fire intensity estimated from the pre-fire fuel loads especially coarse (> 50 mm) fuels	Fuel load	Range

Category Mnemonic	Description	Import column headings in csv file	Type[1]
Invasion	A measure of the impact of the indigenous plant and animal community	Invasion status	Range
Ownership	This indicates the ownership of the compartment. It could be generic (e.g. farm, municipality, private mountain catchment, urban or CapeNature) or specific (e.g. names of owners)	Ownership	Category
Products	Natural products derived from the indigenous community (e.g. Honey bush tea or wild flowers)	Natural products	Category
Quality	The ability of the vegetation to regulate water quality (e.g. sediment retention)	Water quality	Category
Rain	Mean annual rainfall estimated from a spatial dataset	Rain	Range
Riparian	What proportion of the compartment is riparian habitat	Riparian	Range
River	The National Freshwater Ecosystem Protection Assessment (NFEPA) status	River status	Range
Runoff	Mean annual runoff (MAR) derived from the strategic water source areas mean annual run-off dataset (B-GIS)	MAR	Range
Seepage	What proportion of the compartment comprises seepage zones based on the mapped wetlands	Wetlands	Range
Siltation	Estimated soil loss	Siltation	Range
Slope	In percent or degrees using a floating point number displayed with at least one decimal place (e.g. 9.0%) and it must be clear which unit is used	Slope	Range
Soil	Agricultural potential of the soils	Land capability	Range
Status	Indication of the vegetation status as per SANBI's threatened ecosystem list or the applicable provincial biodiversity conservation plan status	Vegetation status	Category
Stress	A measure of the water stress (i.e. degree of utilisation) in a catchment	Water stress	Range
Tourism	The level of tourism activity in an area or tourism hotspots	Tourism	Category
Treatments	The number of treatments	Treatments	Range
Veld Age	The post-fire age of the vegetation, useful for prioritising clearing in fynbos	Veld Age	Range
Zone	Use zonation applicable in protected areas	Zone	Category

[1] Range values are numbers while category values are alpha-numeric (text) values.

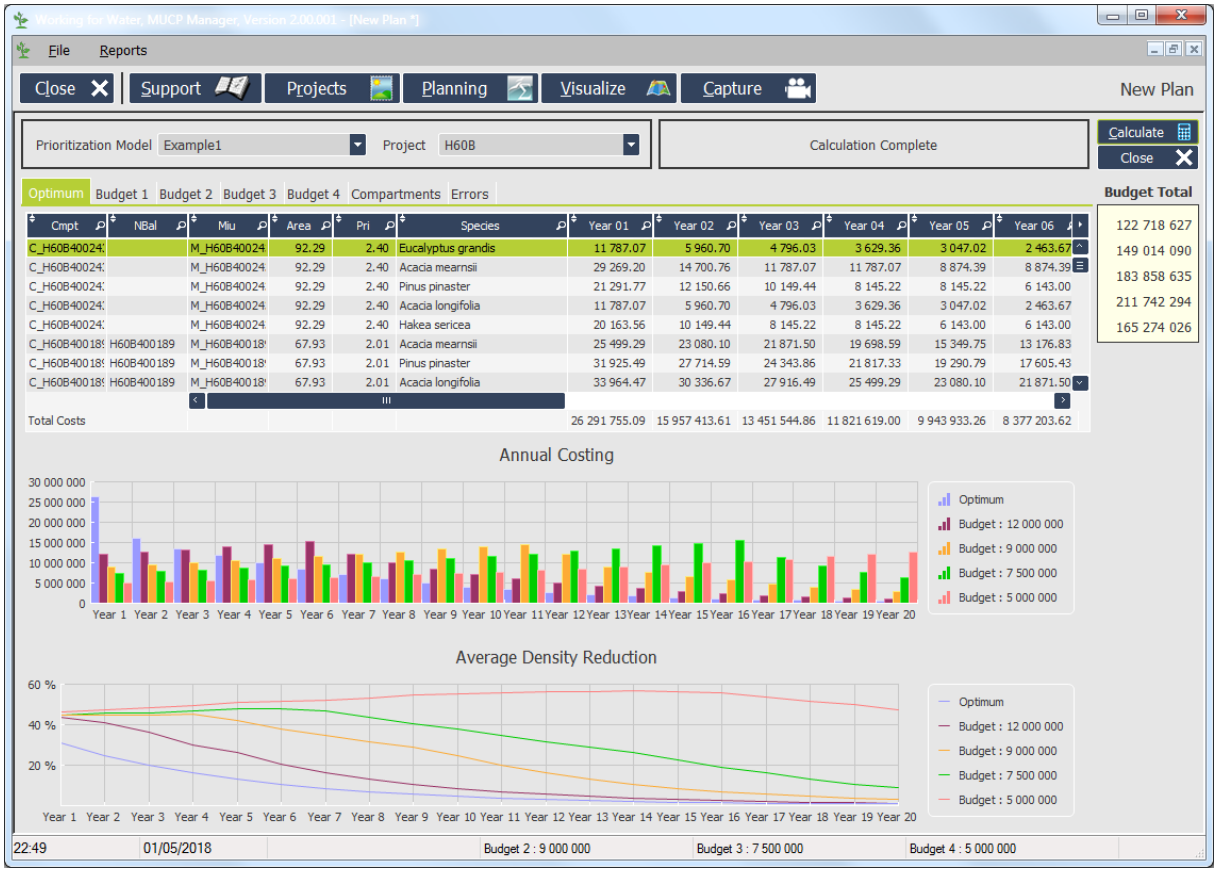
In addition, users can customise individual categories by assigning any of the 26 predefined ones an alternative name. This is done by changing names in the "Import column" and the corresponding column headings in the .CSV file. However, the sequence of the Type (Range, Category) in the table above is fixed. So, if the values for the new variable that the user wants to include are numbers, they must select one of the 26 existing variables whose Type = Range. Likewise, if the variable they want to use has values I the form of text, then they must choose an existing variables whether the Type = Category.

5.2 Running and evaluating planning scenarios

The MUCP tool is used to schedule future work based compartment priorities and cost. It uses both MUIs and NBALs when scheduling initial and follow-up treatments for MUIs and follow-up treatments for NBALs.

The MUCP tool allows different annual budgets to be applied over a period of the next 20 years. These include an optimal (i.e. unlimited) budget, which is estimated by the tool based on the number of treatments each invaded area needs to reach a maintenance level, and four additional annual budget ceilings which can be set by the user. In this example the annual budgets ranged from a ceiling of R 5 million to the unlimited (optimal) amount.

The annual cost for each treatment unit, either an NBAL or a MIU, for each species and treatment is displayed in the top panel. The bar chart (histogram) in the middle panel gives total cost per year with different colours for different annual budget ceilings. The line graph in the bottom panel shows how average species densities change over time for each of these budgets. Once the levels of invasion have been reduced to < 1% of canopy cover, then the compartment is under maintenance. Although it appears as if the budgets drop to zero after a number of years there is ongoing maintenance for the remaining years, but the maintenance amounts are too small to be apparent at this scale.

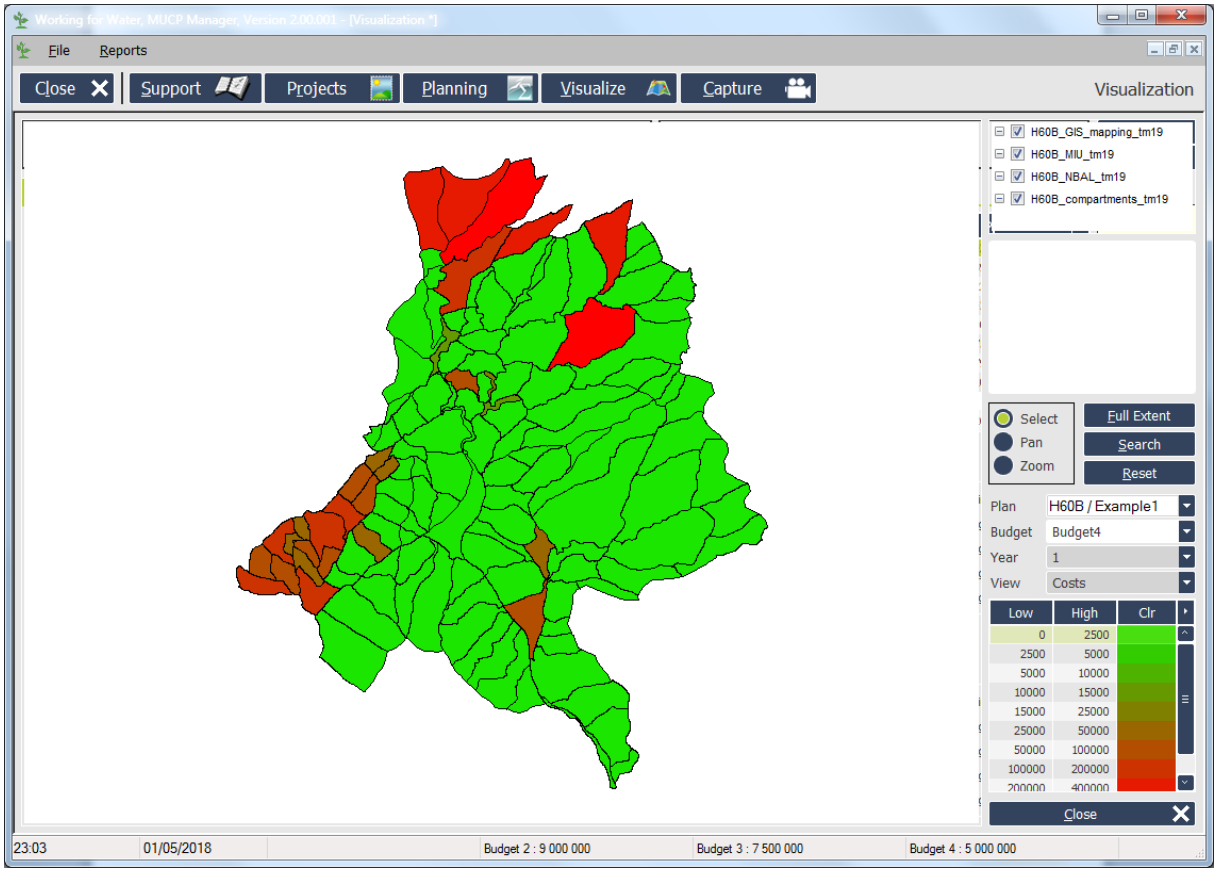


The maintenance level is reached after 11 years with a budget of R 12 million but a budget of R5 million densities allows the densities to continue to increase until about year 14 after which they begin to decline. After 20 years with this budget the densities will still be higher than when clearing started. The greatest total expenditure over the next 20 years is R 165.27 million for a budget ceiling of R 5 million, whereas a budget ceiling of R 12 million will result in expenditure of R 149.01 million, an overall saving of R 16.26 million over the 20 year period.

5.3 Visualising the outputs

The visualization displays a map of the all the spatial data based on the shapefiles that were loaded for a particular project. The map can be customised by selecting a particular plan (combination of prioritization model and project), a particular budget, year and variable. The

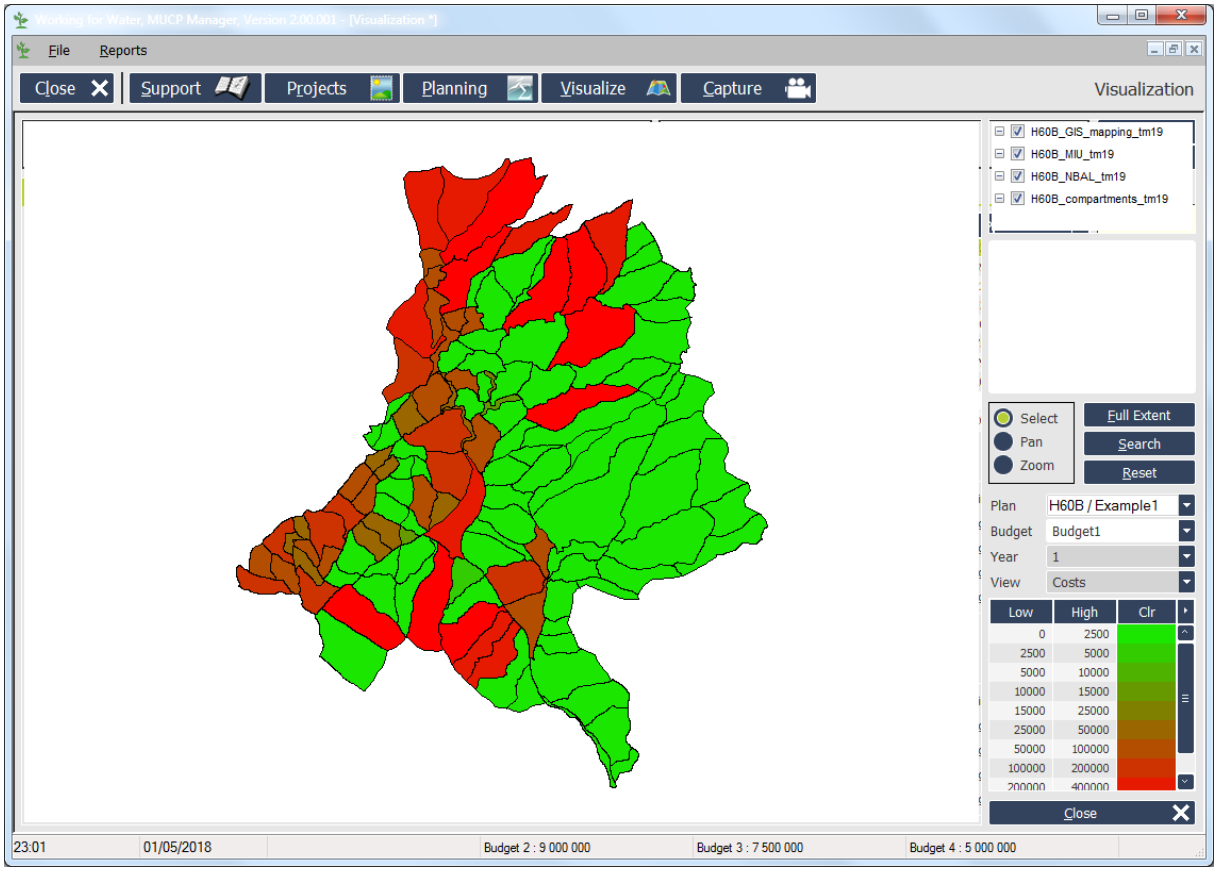
example below shows the location of the compartments that have been treated in the first year (year 1) of control with the annual budget set to R 5 million (Budget 4). The shading from green to red indicates the increasing levels of expenditure projected for the different compartments.



Similarly the visualization of the location of the compartments identified for treatment first year (year one) of control if the annual budget is set at R 12 million. The shading from green to red indicates the increasing costs of the treatments per compartment.More compartments can be treated compared to the smaller budget of R 5 million.

With a budget ceiling of R12 million per year, it would take about 11 years to reach maintenance and the total expenditure over the 20 years would be R149.01 million.

The window with the tick boxes indicates the spatial dataset(s) being displayed, with the lowest ticked one being the one currently on display. The user can switch each of them on and off by clicking on the tick symbol and they can also use the mouse to change the sequence of the datasets. The display defaults to costs but can also show the density, priority or flow reduction estimated for each compartment.


File
Reports
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Support
Projects
Planning
Visualize
Capture
Visualization
H60B_GIS_mapping_tm19
H60B_MIU_tm19
H60B_NBAL_tm19
H60B_compartments_tm19
Select
Pan
Zoom
Full Extent
Search
Reset
Plan
H60B / Example1
Budget
Budget1
Year
1
View
Costs
Low
High
Clr
0 2500
2500 5000
5000 10000
10000 15000
15000 25000
25000 50000
50000 100000
100000 200000
200000 400000
Close
23:01
01/05/2018
Budget 2 : 9 000 000
Budget 3 : 7 500 000
Budget 4 : 5 000 000

SECTION 6. REFERENCES

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APPENDIX A:
Developing the datasets for use in the MUCP Tool

1 Introduction

The Natural Resources Management programmes have developed two software packages (tools) to help project managers with the planning and execution of control operations. The one is for Annual Plans of Operations and does the scheduling of activities and detailed estimation of the associated resource requirements. The other is for longer-term planning and is known as the MUCP tool. This tool uses the datasets described in this document, together with a set of priorities and budgets to develop a plan for the next 20 years with the annual costs and a schedule for each year's activities.

The primary purpose of the tool is to enable the various parties intending to implement the plan to get a realistic estimate of what its execution will entail so that they can make informed, strategic choices and reach consensus on a long-term plan of action. They will also be able to use outputs from this tool to assess whether or not its implementation is going according to plan, and to adjust their planning where necessary. The estimate of the resources required to execute the plan can only be as good as the data going into it. Users need to be aware that although the norms it uses are widely used, conditions in the field can result in deviations from these norms which will change the resources required.

This document introduces some preparatory steps required before you use the tool, and the datasets needed to use the tool. You will need software to create and add data to shapefiles (i.e. a Geographical Information System [GIS]) and software to create and fill in spreadsheets in an Excel format and save them as comma-delimited files. The next section briefly describes the steps to follow in making sure that the tool can be used effectively.

2. Preparatory steps

Successful invasive alien plant control is based on adopting a systematic approach and taking a long-term view. Even if all the resources were available to completely clear an invaded area within a year, there have to be follow-ups and ongoing maintenance which will generally take several years. This requires long-term planning of those resources, as well as ongoing monitoring to make sure that the operations are progressing as planned.

There are guidelines on the development and content of control plans[5], but they do not provide information to help those developing the plan to estimate the resources that will be required over time. The role of the tool is to help estimate the amounts of resources that will be required and to schedule them.

There are a number of things that need to be done to prepare all the information that will be needed before this tool can be used effectively. Some can be done in parallel with others to save time. Those described below assume that the plan is being developed for an area that includes various landowner's properties or has some other natural or cadastral boundaries. Single land owner's just need to follow the general approach outlined below:

- Identification of the area that will be covered by the plan. This can be any area with well-defined boundaries such as a water catchment, a protected area or a conservancy. The plan should ideally be developed for the entire area because clearing of small areas within more extensively invaded areas is not effective in the long-term.
- Identification of the people who will be involved in that clearing plan as implementers and as stakeholders.
- A workshop involving these people to decide on an objective or goal for the plan and to establish priorities for clearing operations.
- The definition and mapping of the permanent and well-defined management units called compartments. This is best done in a session involving the land holders and people who have practical experience in invasive plant management. These units will be used with spatial data representing the priorities to determine which compartments will be controlled first.

[5] http://invasives.org.za/legislation/what-does-the-law-say#control-guidelines

- Mapping of all the invasions in the area using the Working for Water Standards and creation of a Mapped Invaded Units (MIU) shapefile and the associated spreadsheet with the species information. Invaded areas typically have more than one invading species and Geographical Information Systems generally do not support linking many species to one spatial unit. So the species information is stored separately from the shapefile data.
- Mapping of all the areas that have been cleared in the recent past to create a shapefile of all the treatments (the Working for Water convention is that treated areas are called NBALs) and a spreadsheet with the species information. If treatments have been recorded in the Working for Water Information System (WIMS), then the shapefile and the associated treatment data can be obtained from this database but some work needs to be done to get this in the right format for the planning stage. Ideally, all NBAL boundaries should be aligned with compartment boundaries to avoid complicating the management, and so that the NBAL can be easily relocated in the field when the effectiveness of clearing treatments is being assessed. In some cases there may not have been any past alien plant control operations, or they may have ended several years ago and are not applicable. In this case there will be no NBAL datasets.
- The development of a draft long-term plan based on these inputs which can be evaluated against the goal in a workshop and against the budgets which will be required to achieve effective control. The draft plan can then be revised or modified as necessary until there is agreement and consensus on the plan, the resources and time required, and its implementation.

3. How the MUCP tool operates

The MUCP tool calculates the person days required to clear an invaded unit based on the characteristics of the invasions, travel and walk times, the slope and the Working for Water Norms and Standards (which are built in). Those person days are then converted into teams and the team's expenses are estimated and summarised in the form of an annual budget over 20 years. The basic approach is to progress from a state with no treated invasions to a state where all the invaded areas have been treated and reached a maintenance level, usually below a predetermined density. Where an area has been treated (i.e. there is an NBAL), then the system will continue treatments till the density reaches maintenance level. For its projections of the costs, the MUCP tool will work its way systematically through the compartments based on their priority ranking and existing treatments. The system does not create NBALs and treat them, it treats the whole compartment including any NBALs and MIUs that are in them. However, it does distinguish between NBALs and MIUs and calculate the costs separately for each MIU or NBAL; where an NBAL occurs within an MIU it only uses the NBAL data and ignores the MUI data for the same area.

4. Mapped data required for the Management Unit Control Plan tool

This tool requires the shapefiles, spreadsheets and dataset on priorities to be captured in specific formats which are described in detail in the following report[6]:

Le Maitre, D and Forsyth, G 2016. Developing a new mapping standard for Natural Resource Management Programmes with the emphasis on Working for Water. Report No. CSIR/NRE/ECOS/ER/2015/0018/B, Natural Resources and the Environment, CSIR, Stellenbosch.

This section summaries that information. For more detail on how to map invasions for the Mapped Invaded Units there is a report which outlines a mapping approach. It was designed for visual mapping of invasions over large areas, often spanning catchments, such as CapeNature's Protected Areas, and is well-suited to recording Mapped invaded Units at this spatial scale:

Le Maitre, DC and Versfeld, DB 1994. Field manual for mapping populations of invasive plants for use with the Catchment Management System. Report FOR-DEA, Department of Environment Affairs, Pretoria.

It is also well-suited to the role of the MUCP tool which is to provide a long-term scenario for the clearing of an area and not a precise estimate of the resources required. A different approach is needed when mapping

[6] Copies of these reports are available from Andrew Wannenburgh in Operational Support and Planning, Natural Resource Management Programmes, Department of Environmental Affairs, Cape Town (awannenburgh@environment.gov.za)

at the spatial scale of a single property where the mapping intensity and detail would be like those required for treatments contracts. In this case more detailed data are required because they are used in contracts and inaccurate data can lead to ineffective clearing and the wastage of scarce resources. Working for Water have developed a hand-held system for recording such data and suggestions on mapping methods for contracts can be found in this report:

Le Maitre, D and Forsyth, G 2016. Mapping guidelines for contract-based invasive alien plant treatment units (NBALs). Report No. CSIR/NRE/ECOS/ER/2016/0017/B, Natural Resources and the Environment, CSIR, Stellenbosch.

There are some private companies that have experience in doing mapping for invasive alien plant control projects and they could be contracted for this work if the participants in the plan decide this is the best way to source the MUCP datasets.

The current version of the tool does not use the cadastral (property boundary) information but future versions will include these datasets to make it easier to identify owners and responsibilities for clearing.

4.1 Mapping of invasions for Mapped Invaded Units

The boundaries of MIUs should be defined by the properties of the invasions and not by other biophysical features (Figure 1) except for boundary of the management plan (e.g. the watershed defining a quaternary catchment). There is one exception to this rule which is that landscape (upland or dryland) and riparian invasions must be kept separate even where they do not differ from those in the adjacent areas. There are two reasons for this: (a) riparian invasions often differ in their characteristics, workloads and treatment methods (e.g. herbicide restrictions); and (b) riparian invasions generally differ in their water-use which is used in calculating their hydrological impacts and in the prioritisation of compartments for treatment. Otherwise the extent (i.e. the boundary) of the invasion is determined by the characteristics of the invasion and not by the estimated workload. An MUI boundary should be used to distinguish areas with different densities or where the species composition changes or both. It is both practical and sensible to map the compartments either before or at the same time as mapping the invasions. Once they have been mapped they need to be reviewed by the participants in the plan and adjusted where necessary.

Determining the boundary of a riparian invasion is not always straightforward. Ideally the boundaries should be based either on the visible extent of the floodplain and/or river banks or, where this is not possible, on a suitable buffer width around the rivers. The riparian zones should be mapped in the field where possible to make use of field observations when defining the invasion unit boundaries. Where buffers are the logical route, the most detailed river data that are available as a spatial data layer are the 1:50 000 river lines derived from the standard quarter degree topographic map sheets. Unfortunately they are not continuous as they are often broken where they crossed other features such as roads, dams or wetlands and so will require editing. Where rivers are used as the compartment boundary then separate NBALs should be created on each side of the river with the river as their joint boundary. The two NBALs this creates can then be treated as a single contract where appropriate.

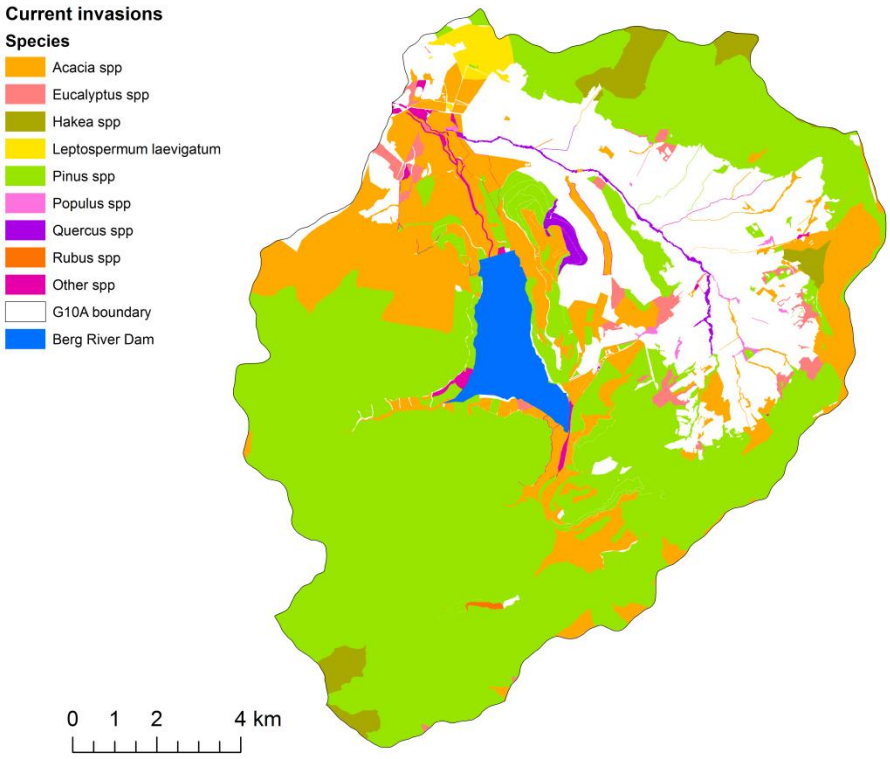

Figure 1. Mapped invaded units (MIUs) for the Upper Berg River quaternary catchment (G10A). This map is illustrative and does not show the actual MIUs as it is based only on the dominant species. For example, if the density was included as well, the extensive pine invasions would be divided into a number of MIUs.

In cases where there is a history of clearing in the project area and NBAL information is available, the existing NBAL information (shapefile and species list) should be supplied to the staff or contractors doing the mapping (see Figure 2 for an example). This will enable them to use this information so that, for example, where one or more boundaries of an MIU can be used for an NBAL, the same boundaries are used. This will also enable the NBAL data and treatment history to be imported into the MUCP tool described in the main document and taken into account when estimating the resources required and setting priorities for treatments.

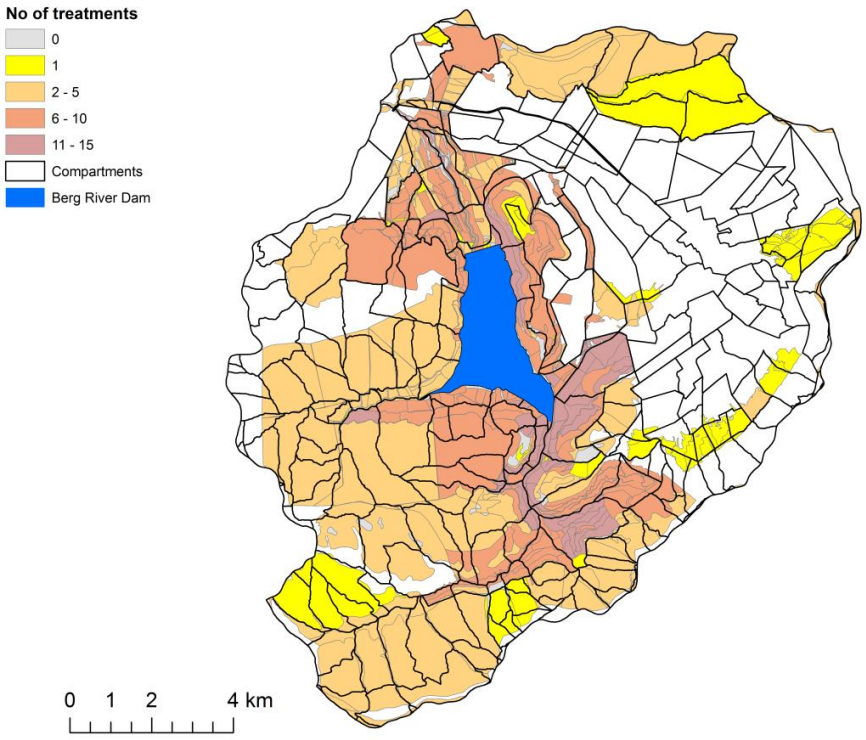

Figure 2. The NBALs of the Upper Berg River catchment (grey lines) shaded using the number of treatments they have received and overlaid with the compartments (black lines).

4.2 Mapping of compartments

Management plans are intended to cover an entire area of land to ensure that all that invaded areas are also included (Figure 3). This does not mean that all compartments will be subject to active management as there may not be any invasions that are the focus for the programme, such as invasive species in crops, cultivated lands or urban areas. In principle a compartment could contain parts of more than one homogeneous mapped invaded unit (MIU) and often will. Logical and clearly identifiable and relocatable boundaries on the ground must be used for all compartments and could include:

- Roads of various kinds, railway lines, jeep tracks and foot paths
- Rivers, streams – any kind of water course
- Lines of cliffs
- Sub-catchment boundaries such as ridge lines
- Cadastres as indicated by fence lines or other clear, reasonably permanent boundaries or by cultivated or otherwise transformed land boundaries (where this is the case the spatial cadastre data should be sourced to ensure that the correct boundary line is used)
- Formal urban areas are not where Working for Water operates so they could be mapped as compartments in which there would not be any treatments

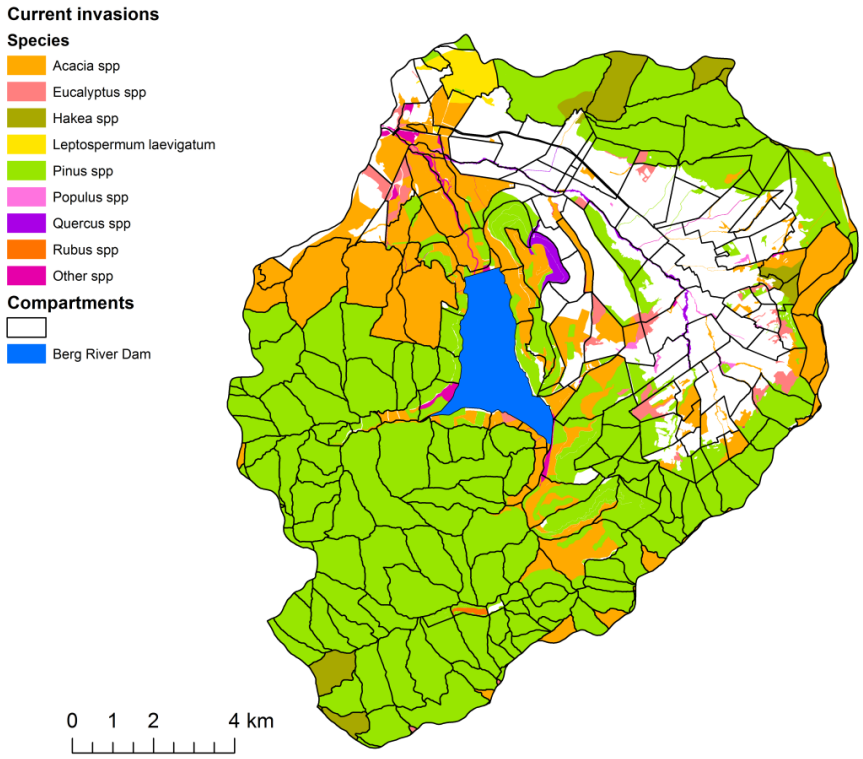

Figure 3. The management compartments overlaid on the MIUs of the Upper Berg River quaternary (G10A) which are shaded according to the dominant species in them. The compartment boundaries are based on enduring and relocatable boundaries.

In principle it is possible to have a compartment, invaded unit and NBAL (contracting unit) sharing the same boundaries, so that there is only one invaded unit and NBAL in that compartment and they fill the entire compartment. However, in the data structures used by the MUCP tool all three units should be maintained.

5. Introduction to the mapping data standards and formats

It is important to understand some of the history of the current Working for Water data standards as they determine the way data are captured and coded for the tool. When the programme was launched in 1995 the basic management unit that was chosen was the quaternary (or 4th order) water catchment because it was the basic spatial unit for water management within the then Department of Water Affairs and Forestry. Quaternary catchments are designated by a four character code, for example D10A, where the first character represents the primary catchment (D for the Orange River), the second 2nd the secondary, the 3rd the tertiary and the 4th the quaternary. This code is used in the all the mapped units used by the MUCP tool as part of the unique code for each management unit. It is not essential for all users to follow this coding system, but using the catchment coding makes collation of the data from different MUCPs much easier. For simplicity we have used this coding in the examples below. You need to use an 8-character code and remember that the last three characters are reserved for the compartment number, so you have 5 characters available for your own use.

The next unit below the level of the quaternary catchment was a management plan number. This is represented by a single numerical digit which allows for up to nine plans per quaternary catchment (e.g. D10A1-D10A9). The compartment is represented by a 3-digit code which allows for up to 999 compartments in a management plan so the full compartment code is as shown below (e.g. G10A1001 for plan 1 and compartment number 1):

Quaternary	Management Plan No.	Compartment No.	Compartment Code
G10A	1	001	G10A1001

The Mapped Invaded Unit coding is similar to that for the compartment and has an M to indicate that it is a MIU and three characters allowing for up to 999 of them per plan.

Quaternary	Management Plan No	Mapped Invaded Unit Code
G10A	1	G10A1M001

The last spatial unit defined was the NBAL, the invaded unit which combined the 5-digit quaternary catchment management plan number code and a 5-digit code.

Quaternary	Management Plan No.	NBAL No	NBAL Code
G10A	1	00001	G10A100001

The NBAL was not intended to be a permanent spatial unit because the boundaries of these units took into account the amount of work a given team could do in a given time (typically 1-3 months but sometimes longer). So the boundaries established for the contract would depend on the nature of the invasion, the terrain, accessibility and other factors. Once that operation had been done the workload for the follow-up operation would be different so it would make sense to group a number of previous NBALS under a single contract. In addition, once the invasion had been cleared it could be difficult to accurate relocate that boundary. This is why the MUCP tool makes use of well-defined compartments as its fixed management units and is why the boundaries of NBALs should not cross compartment boundaries.

There are no standards or conventions for the filenames of the different datasets described in the next section but we recommend that they are descriptive and concise.

5.1 Compartments

These shapefile attribute files should have the following variables: COMPT-ID, Area, Slope, and the measures of Accessibility. Keeping the features in the shapefile attributes to a minimum has two advantages: (a) it allows this same spatial data set to be used for planning for all the different NRM programmes by linking it to programme-specific information that they require for their planning; and (b) for the specific datasets to be used for their planning to have their own data structure without making the compartment attribute file unnecessarily complex. However, a number of the criteria for prioritisation of compartments could be supplied from datasets included in the WIMS system and this is discussed in the section on priorities (Section 6).

Variable	Mnemonic	Description
COMPT-ID	Compt_ID	Alphanumeric (text) with 9 characters: the first 4 are the Quaternary catchment mnemonic (e.g. L82A); the fifth character is the management plan number (e.g. 1); the next four characters are the number (e.g. 0001) – L82A10001. This avoids confusion with the current NBAL code and allows for 9999 MIUs if just the numeric characters are used in the number.
Area	Area_ha	In hectares using a floating point number displayed with at least one decimal place (e.g. 10.1 ha)
Slope	SLOPE	In percent or degrees using a floating point number displayed with at least one decimal place (e.g. 9.0%) and it must be clear which unit is used
Accessibility	3 columns: Walk_time Drive_time Terrain	Normally comprises the following: Accessibility Index calculated from: Walking time (0-n minutes), Time to drinking water (0-n minutes) and Driving time (0-n minutes) as specified in the norms. Time to drinking water and Terrain are not specified in the norms and so are not used in

		the current version of the tool.

The norms for adjusting person days for Terrain (i.e. conditions underfoot and obstructive vegetation) have never been developed but are required for properly estimating person day adjustments for areas which require rope-work for safety reasons (the so-called *high-altitude* areas). These include many parts of the Cape Mountains and the Drakensberg among others.

5.2 Mapped invaded units

The MIU attribute files (*.dbf) of the shapefiles must include the following variables: MIU_ID, Area, Riparian code (the mnemonic is the current heading used by the tool)

Variable	Mnemonic	Description
MIU-identifier	MIU_ID	Alphanumeric (text) with 9 characters: the first 4 are the Quaternary catchment mnemonic (e.g. L82A); the fifth character is the management plan number (e.g. 1); the next character indicates that is a mapped invaded unit (M) and is followed by three characters for the number (e.g. 001) – L82A1M001. This avoids confusion with the current NBAL code and allows for 999 MIUs per management plan if just the numeric characters are used in the MIU code.
Area	Area	In hectares using a floating point number displayed with at least one decimal place (e.g. 10.1 ha)
Riparian code	Riparian_c	A single character: r for riparian, l for landscape or upland

The spreadsheet files containing the lists of species for each MIU must have the following variables in columns: MIU-ID, Species name, Density, Maturity. Other information - such as the species growth form or treatment methods it requires - is included in the norms. Identifying the species is a known problem and the development of a guide for the identification of at least the most common species among the 415 currently in the norms should be given a high priority. Ideally the guide or key should use diagrams or photographs rather than descriptions, like most field guides, and be made available as an "app" for smart phones and computers. The spelling of the species names must match those in the Working for Water Standards; all names must be the full binomials[7] and misspelt names will be flagged as an error in the data screening described in the main report.

The density currently is coded for the MUCP tool as a percentage, i.e. the actual percentage cover or the class Midpoint as in the table below.

<table>
<tr><th>Variable</th><th>Mnemonic</th><th colspan="4">Description</th></tr>
<tr><td>MIU-ID</td><td>MIU_ID</td><td colspan="4">As described above</td></tr>
<tr><td>Species name</td><td>Species</td><td colspan="4">50 character alphanumeric (text); this is the formal Latin name assigned to that species with the genus and the species epithet; all taxa have to identified to the species level as "spp" is no longer allowed in the norms.</td></tr>
<tr><td rowspan="8">Density</td><td rowspan="8">Idenscode</td><td colspan="4">The WfW mapping standards allow for 7 density classes as follows:</td></tr>
<tr><td>Class</td><td>Range of density</td><td>Midpoint</td><td>Code</td></tr>
<tr><td>Rare</td><td><0.01%</td><td>0.01</td><td>1</td></tr>
<tr><td>Occasional</td><td>0.02-1.0</td><td>0.51</td><td>2</td></tr>
<tr><td>Very scattered</td><td>1.1-5.0</td><td>3.05</td><td>3</td></tr>
<tr><td>Scattered</td><td>5.1-25.0</td><td>15.05</td><td>4</td></tr>
<tr><td>Medium</td><td>25.1-50.0</td><td>37.55</td><td>5</td></tr>
<tr><td>Dense</td><td>50.1-75.0</td><td>62.50</td><td>6</td></tr>
<tr><td>Closed</td><td>75.1-100.0</td><td>87.55</td><td>7</td></tr>
</table>

[7] Latin species names comprise two parts: the genus name and the species epithet e.g. *Pinus radiata*

Variable	Mnemonic	Description
Maturity	Age	The WfW mapping standards allow for the following maturity (size or age) codes: m – mature > 10m a – adult < 10m y – young < 5m s – seedling < .05 x – mixed ages c - coppice (resprouting) Since the treatment may differ between size codes it is preferable to record the mix of size with the density for each size class rather than as mixed age classes. For example: Pine, medium, mature – will require a chainsaw Pine, sparse, young – can be lopped

5.3 Treatment units (NBALS)

The NBAL shapefile attribute files should have the following variables: NBAL_ID, Area, Treatment stage and Treatment date (the mnemonic is the current heading used by the tool). The tool does not currently use the First (Initial) treatment date so this can be defaulted or left blank if unknown.

The current version of the tool uses the 20 character Stage description as specified in the Working for Water norms: Initial Treatment, 1st Follow up, 2nd Follow up, 3rd Follow up, 4th to 10th Follow up (for more information see below and the data standards).

Variable	Mnemonic	Description
NBAL-ID	NBALid	Alphanumeric (text) with 10 characters: the first 4 are the Quaternary catchment mnemonic (e.g. L82A); the fifth character is the management plan number (e.g. 1); the next five characters are the number of the treatment unit (e.g. 00001) – L82A100001. This allows for 99999 treatment units per management plan if just the numeric characters are used in the NBAL-ID.
Treatment stage	Stage	The standard provides for a two integer code for the stage and a 20 character (letters and spaces) description. Stage 1 is the Initial Treatment; this is followed by 1-n Follow up treatments with provision made in the standards for 10 Follow-ups and then n; other options include S (Stage 15), maintenance (Stage 21) and rehabilitation (Stage 31)
Date of first treatment	First_Date	The day, month and year of the treatment initiation in a standard date format (preferably dd/mm/yyyy)
Date of last treatment	Last_Date	The day, month and year of the last treatment in a standard date format (preferably dd/mm/yyyy)
Area	Area	In hectares using a floating point number displayed with at least one decimal place (e.g. 10.1 ha)
Contract-ID	ContractID	An ID which links to the WIMS contract which has 13 characters and is generated by the WIMS system

The spreadsheet files containing the lists of species for each NBAL must have the following variables in columns: NBAL-ID, Species name, Density, Maturity.

The density currently is coded for the MUCP tool as a percentage, i.e. the actual percentage cover or the class Midpoint as in the table below.

<table>
<tr><th>Variable</th><th>Mnemonic</th><th colspan="4">Description</th></tr>
<tr><td>NBAL-ID</td><td>NBAL ID</td><td colspan="4">As described above</td></tr>
<tr><td>Species name</td><td>Species</td><td colspan="4">50 character alphanumeric (text); this is the formal Latin name assigned to that species with the genus and the species epithet; all taxa have to identified to the species level as “spp” is no longer allowed in the norms.</td></tr>
<tr><td rowspan="9">Density</td><td rowspan="9">Idenscode</td><td colspan="4">The WfW mapping standards allow for 7 density classes as follows:</td></tr>
<tr><td>Class</td><td>Range of density</td><td>Midpoint</td><td>Code</td></tr>
<tr><td>Rare</td><td><0.01%</td><td>0.01</td><td>1</td></tr>
<tr><td>Occasional</td><td>0.02-1.0</td><td>0.51</td><td>2</td></tr>
<tr><td>Very scattered</td><td>1.1-5.0</td><td>3.05</td><td>3</td></tr>
<tr><td>Scattered</td><td>5.1-25.0</td><td>15.05</td><td>4</td></tr>
<tr><td>Medium</td><td>25.1-50.0</td><td>37.55</td><td>5</td></tr>
<tr><td>Dense</td><td>50.1-75.0</td><td>62.50</td><td>6</td></tr>
<tr><td>Closed</td><td>75.1-100.0</td><td>87.55</td><td>7</td></tr>
<tr><td>Maturity</td><td>Age</td><td colspan="4">The WfW mapping standards allow for the following maturity (size or age) codes:
m – mature > 10m
a – adult < 10m
y – young < 5m
s – seedling < .05
x – mixed ages
c - coppice (resprouting)
Since the treatment may differ between size codes it is preferable to record the mix of size with the density for each size class rather than as mixed age classes. For example:
Pine, medium, mature – will require a chainsaw
Pine, sparse, young – can be lopped</td></tr>
</table>

5.4 Cross-referencing spatial layer

The tool is built around a relational database and also has tools for visualisation of the outputs in the form of maps. However, the database does not “know” where these units are in space and needs to have the spatial relationships between the compartments, MUIs and NBALs encoded. In other words it needs to know which NBAL occurs in which MIU and in which compartment. It can then use this information to calculate costs and priorities for treatment, and to link the outputs to these spatial units in the visualisation component of the tool. These spatial relationships are encoded by creating a data layer using a function in the GIS which creates a union.

Variable	Mnemonic	Description
COMPT-ID	Compt_ID	As described under 5.3
MIU_ID	MIU_ID	As described under 5.1
NBAL_ID	NBALid	As described under 5.2
Area	Area	In hectares using a floating point number displayed with at least one decimal place (e.g. 10.1 ha)

As noted earlier, future versions of the tool will use the cadastral information and the cadastre shapefile will be included in this union to link property ownership to the other datasets.

6. Data for the prioritisation of compartments

The final dataset needed for the mapping uses information extracted from spatial datasets that represent the priorities identified during the workshop which developed the goal for the plan (see the main report and

Section 2 of this Appendix). The priority ranking calculated by the tool for each of the compartments is aimed at maximising the total benefits gained by clearing the most important areas first.

The current version of the tool has a set of criteria which were based on previous work but future versions will allow the user to specify the criteria to import. The values of those criteria need to be estimated for each of the compartments and the data exported to a comma-delimited file (*.csv).

The set of criteria shown below were provided to **illustrate** the kind of things that could be considered important for determining priorities.

Mnemonic	Description
Compt_ID	Compartment identifier
Ownership	Could be generic (e.g. farm, municipality) or specific (e.g. names of owners)
Veg_status	The threat status of natural vegetation in the compartment based on the National Biodiversity Assessment's classification of the national vegetation types
Veld_age	The post-fire age of the vegetation, useful for prioritising clearing in fynbos
Ave_MAR	Average Mean Annual Runoff estimated from a spatial dataset
Erosion_ac	Estimated actual soil erosion based on the soil's inherent erodibility, slope and vegetation condition
Siltation	Estimated soil loss
Soil_prop	Soil properties such as agricultural land capability (cropping potential)
Rain	Mean annual rainfall estimated from a spatial dataset
Fire_inten	Fire intensity estimated from the pre-fire fuel loads
Riparian_h	What proportion of the compartment is riparian habitat
Seepage_z	What proportion of the compartment comprises seepage zones based on the mapped wetlands