User Manual

for

OASIS WITH OCL™

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HYDROLOGICS

Advancing the management of water resources

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CHAPTER 1
INTRODUCTION

1.0.0 ORGANIZATION OF THIS MANUAL

OASIS is a very powerful program, and there is a lot that you can learn about it. It is very unlikely that you will need to use all of OASIS's features. We intend that you will use the reference chapters selectively, looking up information only as you need it. The text contains extensive cross-references, telling you where you can look up supporting information if you need it.

Before you begin using OASIS, we recommend you review the ideas presented in Chapter 2. Chapter 2 should also be your starting point when you want to look up an OASIS feature. It introduces all the main ideas in OASIS, without going into all of the details.

Chapters 3 and after are *reference* chapters. They give all of the details about the various OASIS features without necessarily presenting the ideas behind the features. You should not need to look in the reference chapters until you have a specific problem to look up.

1.1.0 OASIS WITH OCL™

OASIS with OCL™ is a generalized program for modeling the operations of water resources systems. OASIS simulates the routing of water through a system represented by nodes and arcs. The routing may account for both human control and physical constraints on the system.

We cannot emphasize enough that OASIS is a **generalized** program. It is not a model of California's State Water Project system, New York City's watershed, or the canals of South Florida. Rather, it is a program that allows you to model all of these and virtually any other system in the world. We often refer to OASIS as being completely *data-driven*. That is to say that you specify the features and operating rules of your system through OASIS's input data, not by altering OASIS's source code.

1.1.1 LINEAR PROGRAM ROUTING

One of OASIS' most powerful, innovative features is that it simulates the routing of water by solving a **linear program**. What this means for you, the user, is that all operating rules are expressed as *operating goals* or *operating constraints*. What this does *not* mean is that you must be trained in linear programming in order to use OASIS. To model a system, you simply need to approach the problem as a set of goals and constraints. Let us be clear about these terms:

> A **constraint** is a rule that OASIS must obey.
>
> A **goal** is a rule that OASIS tries to meet. By their nature, goals are in competition with other goals, so typically all goals cannot be satisfied. You specify which goals take precedence over others by giving them relative *weights*. Think of this as ranking the goals.

With these goals and constraints, you tell OASIS **what** to do. For the most part, you do not have to tell it **how** to do it, because the linear-program solver does that for you.

Some modelers in the water resources field have used linear programming to optimize the operation of a system over a period of record with a single optimization. OASIS works very differently. OASIS simulates a period of record by optimizing the operations for a single time step, then going on to the next time step. Thus a 60-year record with a monthly time step would result in 720 separate optimizations. In the other modeling approach, the model has "perfect future knowledge," where the inflows and demands are known for the entire record at the start of the run. This allows the system to respond, for example, to a flood a year before it occurs. OASIS's running from time step to time step is much more realistic since it's more like how the operators, who are not blessed with perfect future knowledge, control the system.

(OASIS now has the ability to optimize more than one time step at a time. However, this is considered an advanced feature that is beyond the interest of most users.)

1.1.2 OCL

OCL is short for *operations control language*, and it gives tremendous power to you, the modeler. The role of OCL is similar to that of a "scripting language" or "macro language" in other kinds of computer programs. Let us be clear that *OCL is not the source code for OASIS*. Rather, it is a form of *input* to OASIS, in which you enter special operating rules. You write rules in OCL using various *simulation commands*. The source code of the model *never* has to be modified or recompiled. This introduction will have more to say about OCL below.

1.1.3 THE ADVANTAGES OF OASIS

OASIS has evolved from HydroLogics' work modeling water resources systems all over the United States and elsewhere. That experience has guided us to develop OASIS with the following criteria:

FLEXIBILITY

HydroLogics has found that building effective computer models of water resources systems can be a time-consuming, expensive job. After a new model is built, modifications often must be made to the source code in order to study the alternatives. Often, the alternatives may be very complicated. In order to build new models and modify existing ones, OASIS has been designed to be very flexible. For example, you decide how many nodes and arcs are in the system, and how they connect. Also, your input data can come from different sources, such as time-series databases or time patterns (whose values cycle every year), or the values can be computed with OCL.

Flexibility is the strength of OCL. In the modeling programs of yesterday, a model would follow certain rules of pre-specified form, and you would only supply certain parameter values for these rules. Although you can still do this with OASIS, OCL frees the modeler from the limitations of pre-specified rule forms. Because it is extremely difficult to foresee every type of rule that you might want to model, OCL allows you to write new rules where you can design the *form* of the rule, as well as the parameter values. OCL also allows you to add *conditional* ("if-then"-type) logic to your rules.

STANDARDIZED FEATURES

Standardized features are the complement to flexibility. After all, there is nothing more flexible than starting from scratch and writing your own program in FORTRAN or another programming language, but such flexibility comes at a steep price. OASIS is designed specifically to model the operations of water resources systems, and it relies on many standardized features that are appropriate to that kind of modeling. For example, OASIS knows how to compute evaporation from a reservoir. It knows how to handle flow capacities and minimum flow targets. It automatically ensures that the continuity of flow is not violated. Furthermore – and very importantly – model input and output are handled entirely by OASIS. These standardized features are not limiting to OASIS because the OCL allows you to go beyond these forms whenever you need to. However, the job is made easier because the most common tasks are already handled.

INTUITIVE, REALISTIC FORMS FOR OPERATING RULES

Because OASIS simulates routing decisions through linear programming, all simulation rules are represented as either goals or constraints. The fact that rules can be modeled as goals is particularly important (and novel), because goal-seeking behavior is an *efficient* modeling approach which corresponds very well to the way real world operators and planners think of a water resources system. For example, reservoir storage targets, in-stream flow requirements, and off-stream deliveries are typical goals for a water resources system. Furthermore, these goals are often in competition with each other. The goal-seeking behavior of OASIS handles these rules very elegantly. With other modeling approaches, these competing goals would have to be modeled with a complex set of "if-then" type rules. OASIS's approach greatly cuts down on the "if-then" rules.

Furthermore, the rules that you write in OCL usually look just like the rules that planners, operators, and policy-makers use.

For example, an agreement between water users might say that the diversion at point *A* plus the diversion at point *B* must be less than 70% of the flow at point *C*. In OCL, you would write a constraint which is instantly recognizable as the mathematical form of that statement.

INTEGRATION WITH OTHER MODELS

OCL allows you to send and receive data between OASIS and other programs, *while the programs are running*. We can thus say that OASIS and the other programs are **running in parallel**. To OASIS, the other programs are “external modules.” These external modules can be created from scratch, or existing programs can be fitted to communicate with OASIS. This creates virtually unlimited possibilities for modeling water resources systems. Some tasks that are perfect for external modules are groundwater flow and contaminant transport, biology or ecology, rainfall runoff, snow pack, variable demand, agricultural return flow, river temperature, lake stratification, and tidal mixing. The list goes on.

Because all modules are running in parallel, they can react to each other. For example, OASIS could pass the flows that it has just computed to a water quality model. The water quality model would then compute water quality data using the flow data that it received from OASIS. The water quality data are passed back to OASIS, and using OCL, OASIS would then set flow targets contingent upon the data it obtained from the water quality model.

External modules might share input and output databases, or they might use their own input and output. To OASIS, it does not matter what computer language is used for the source code of the external modules. Also, the modular nature of this approach allows different specialists to develop and maintain each module.

DATABASE STORAGE

OASIS input and output are stored in databases: static data is kept in Microsoft Access and time-series data is kept in HEC-DSS databases. (DSS was developed specifically for hydrologic time series data.) Unlike ASCII files, which often have quirky formatting rules, database files are always labeled and properly formatted. Databases also provide an effective storage system through which modules can share input data, and are perfect for interaction with an OASIS graphical user interface (GUI).

OASIS stores all model output to a database, so there are no secrets in the operation. While you *may* interact with the databases directly, you never *need* to. Instead, you use post-processor programs to report output in exactly the form you need. There is one post-processor program for generating text tables and one for graphical plots. The post-processing is fully configurable — you specify what output to display (and it may be the result of complex formulas), and how to format it.

GRAPHICAL USER INTERFACE

The OASIS graphical user interface, or *GUI*, is the user-friendly computer program that you use to control OASIS. Some of the GUI's most significant features are:

Controls for entering data into the database tables
Graphical *schematic* control in which you build your system by drawing it
Organized management of simulation runs
Easy access to output files, including post-processor output

For maximum flexibility, the OASIS simulation program and post-processor programs can stand alone – they can be used without the GUI. However, most users will find that the GUI makes it easier and faster to use OASIS.

CHAPTER 2
USER GUIDE

2.0.0 INTRODUCTION

This chapter is your comprehensive guide to using OASIS. It covers the **concepts** involved in modeling with OASIS. This chapter is not a reference for input and output, but it does contain detailed references to sections in the reference chapters 3 through 9.

2.1.0 REPRESENTATION OF THE PHYSICAL SYSTEM

Before any model input can be created, you must plan a **system schematic**. The schematic is composed of the generalized building-blocks of the system: **nodes** and **arcs**. A diagram of the schematic shows how the nodes and arcs fit together to form the system. Figure 2.1.0 is an example schematic diagram.

The schematic clearly shows what is in the system, and by implication, what is not. As the modeler, you must decide what needs to be included in the system and what should be excluded. You cannot model everything, and you should generally only try to model what you need to. Within the system, water is neither created or destroyed. However, it can enter and leave

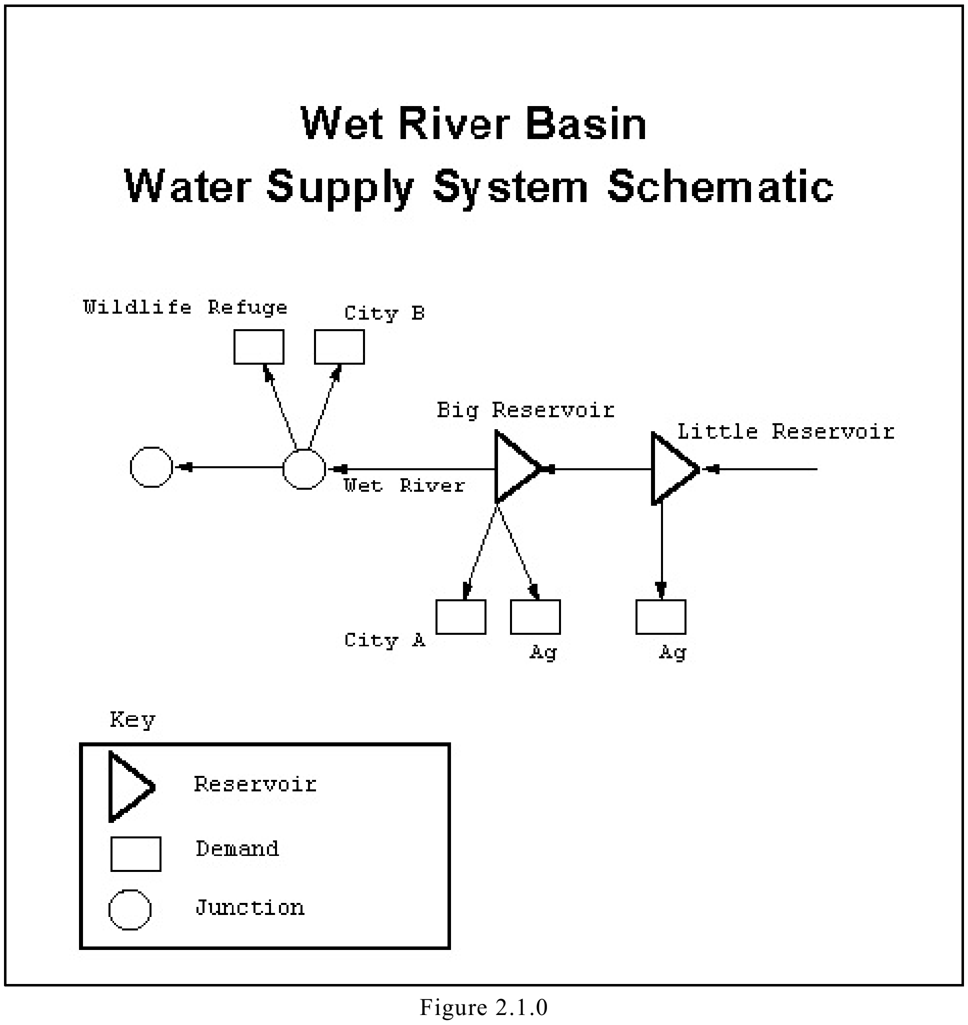


Figure 2.1.0
Example Schematic

the system.

With OASIS, the schematic is always user-defined and modular. You build the schematic out of nodes and arcs. You may add new nodes or arcs, remove any nodes or arcs, or modify the descriptive information associated with a node or arc. All this information is recorded in OASIS's input files. The OASIS GUI contains controls that make if easy to build and modify the schematic graphically (section 3.7.1)

In the sections that follow, we will discuss the following components of the schematic:

Nodes — points of interest in the system.

Arcs — which convey water from one node to another.

Inflows — the water that enters a node from outside the system (or leaves a node to go outside the system), not subject to the LP router's control.

Terminal nodes — at which water can leave the system, subject to the LP router's control.

2.1.1 NODES

A **node** represents a *point* of interest in the system. The complement of the node is the **arc**. Arcs represent *conveyance* from one node to another. In OASIS, every node must have at least one arc connecting to it.

Nodes are basic building blocks of an OASIS model. You specify how many nodes there are, and the descriptive information about each, by editing OASIS input.

To add a new node to the system, add a record for the node to the *Node* table (section 4.5.3 part B). There will have to be at least one arc connecting to this node in the *Arc* table (section 4.5.3 part C). Depending upon the node type, you may need to add information to other database tables and OCL.

To remove a node from the system, delete the record for the node from the *Node* table in the system database (section 4.5.3 part B). Any reference to this node needs to be deleted from all other OASIS input.

Any node can have **inflow**. If it has positive value, inflow is water entering the node from outside the system. If it has negative value, it is water leaving the system from the node, and it may be referred to as ***outflow***. See section 2.1.3 and section 2.4.0 part E for more about inflow.

Every node is identified by a unique **node number**, and every node has one of three **node types**: **junction**, **demand**, or **reservoir**. The node type of every node is given in the *Node* table.

A. JUNCTION NODES

Junction nodes are the simplest type of nodes. Unlike demand or reservoir nodes, junction nodes are **not** automatically associated with any special operating rules. Therefore, there are no special input tables for junction nodes. Junction nodes are shown in Figure 2.1.0 as circles.

Some of the reasons to use a junction node are:

To model a point in the system where inflow (or outflow) occurs.

To model a point where there is a water-quality boundary condition.

To model a point where conveyance features (represented by arcs) meet.

B. RESERVOIR NODES

Reservoir nodes are nodes at which water can be stored. OASIS computes the storage at the end of every time step, which is the storage at the beginning of the next time step. Maintaining storage at a reservoir node is a basic, built-in operating goal. OASIS has built-in features to model many types of rules associated with a reservoir node, including:

Evaporation (section 2.4.0 part G).

Rule curves or storage targets (section 2.4.0 part H).

Storage-Area-Elevation relationships (section 2.4.0 part F).

Input needed for a reservoir node: For every reservoir node in the system, there must be a record in the *Reservoir* table (section 4.5.3 part H) and the *Initial Conditions* table (section 4.5.6). Though not strictly required, you may also need information in the *Reservoir S-A-E* table (section 4.5.3 part J), the *Evaporation* table (section 4.5.3 part K), and the *Weight: Storage* table (section 4.5.7 part B). Note that the *Reservoir* table and *Evaporation* table may refer to additional static, time-series, or OCL input.

Reservoir nodes are shown in Figure 2.1.0 as triangles.

Reservoir nodes would be used to model any storage point in the system, including natural or man-made lakes or ponds, groundwater basins, or tanks.

C. DEMAND NODES

Demand nodes are nodes to which water is delivered. **Delivery** to a demand node is a basic, built-in operating goal (section 2.4.0 part D). The delivery may meet, but never exceed, a specified target value referred to simply as the **demand**. The deficit between delivery and demand is called **shortage**.

It is assumed that water delivered to a demand node leaves the system. Consistent with this assumption, it is assumed that there are no arcs leaving a demand node. However, you *are* permitted to create arcs that leave a demand node. The water that flows through these arcs back into the system is called **return flow**, and it does not have to be equal to the delivery. See section 2.5.2 for more information about return flow.

Input needed for a demand node: For every demand node in the system, there must be a record in the *Demand* table (section 4.5.4 part A). Though it is not strictly required, you should also enter a record in the *Weight: Demand* table (section 4.5.7 part C). Note that the *Demand* table may refer to additional static, time-series, or OCL input.

Demand nodes are shown in Figure 2.1.0 as rectangles.

2.1.2 ARCS

An **arc** represents a *conveyance feature* in the system. The complement of the arc is the **node**. Nodes represent *points* where conveyance features may join. In OASIS, every arc starts at one node (the **upstream node**) and ends at another node (the **downstream node**). Any node may have more than one arc entering and more than one arc leaving.

Arcs are basic building blocks of an OASIS model. You specify how many arcs there are, and the descriptive information about each, by editing OASIS input.

To add a new arc to the system, add a record for the arc to the *Arc* table (section 4.5.3 part C). The arc is identified by its upstream and downstream nodes. There must be records for both nodes in the *Node* table (section 4.5.3 part B).

To remove an arc from the system, delete the record for the arc from the *Arc* table in the system database (section 4.5.3 part C). Any reference to this arc needs to be deleted from all other OASIS input.

The LP router decides the **flow** in an arc. Encouraging flow in an arc is a basic, built-in operating goal. Every arc is **directional**. That is, the flow is positive when water goes from the upstream to the downstream node. The flow is negative when it goes from the downstream to the upstream node. This is called **reverse flow**. The default assumption for an arc is that there can be no reverse flow -- flow cannot be less than zero. However; you may enable reverse flow by specifying a **maximum reverse flow** for the arc. See section 2.4.0 part C for more information.

For each arc, you have the options of specifying three operating criteria:

> **minimum (target) flow** (section 2.4.0 part B): a value of flow which the LP router tries to meet. There is no default minimum (target) flow in an arc— you must specify if there is one.
>
> **maximum flow** (section 2.4.0 part A): an upper bound on the flow in the arc. The default is that there is no maximum flow in an arc— you must specify if there is one.
>
> **maximum reverse flow** (section 2.4.0 part C): a lower bound on the flow in the arc. The default is that the lower bound on flow is zero— you must specify if the lower bound is anything different.

Arcs are represented in Figure 2.1.0 by arrows that connect nodes.

2.1.3 INFLOW

Inflow is water entering the system at a node, not subject to control by the LP router. If the value of the inflow is negative, then the water is actually leaving the system from a node, not subject to control by the LP router. This negative inflow could be called *outflow*, but in OASIS the term *inflow* is used to mean both positive and negative inflows. At any node, the inflow could be positive at some time steps and negative at others.

There can be no more than one inflow value given for each node.

The inflow is not controlled by the LP router, but is computed *before* the routing problem is solved. The value of inflow is thus incorporated into the continuity-of-flow constraint (section 2.2.4) at any node that has inflow. See section 2.2.0 for discussion of the LP router. The inflow values can be given in a database, or computed in OCL.

To apply inflow at a node: Edit the *Inflow* field for the node in the *Node* table (section 4.5.3 part B). The entry in this field tells OASIS how to find the inflow values. Depending upon the entry, you need to enter supporting information in a pattern table, a time-series table, or in OCL. If the *Inflow* field is blank, there will be no inflow at the node.

Inflows are shown in Figure 2.1.0 by arrows that end at nodes but do not originate at other nodes.

2.1.4 TERMINAL NODES

A **terminal node** is a node where the router can send water out of the system. That is, all water that enters a terminal node is leaving the system. This is to be distinguished from the **inflow** discussed in section 2.1.3, because the LP router decides how much water leaves the system at a terminal node. Of course, the router's decision is determined by the operating rules that you give to it. See section 2.2.0 for more on the LP router.

A terminal node is not a node type like junction, reservoir, and demand. Either junction nodes or reservoir nodes may be terminal nodes. Demand nodes are not referred to as terminal nodes, although a demand node without return flow does behave similarly to a terminal node.

A terminal node is any junction or reservoir node that has

no arcs leaving it.

no arcs entering that can have reverse flow.

To create a terminal node, add a record for the node to the *Node* table (section 4.5.3 part B). There has to be at least one arc *entering* this node listed in the *Arc* table (section 4.5.3 part C), but no arcs leaving the node. None of the arcs that enter this node may be capable of reverse flow.

OASIS does not write a continuity-of-flow constraint (section 2.2.4) to the LP for terminal nodes, and it does not display a balance sheet for a terminal node in the balance-sheet output (section 5.2.0).

It is good practice to have only one terminal node in a system, so that it is easily recognized as *the* terminal node. However, you may create as many terminal nodes as you like.

2.2.0 DECIDING HOW WATER IS ROUTED

OASIS is designed so that the decisions in a water system are simulated by a **linear-programming (LP) router**. The design of OASIS is intended so that you do not need previous experience with LP in order to use OASIS, and this documentation strives to minimize reliance on LP terminology. Chapter 7 provides a more technical reference for those who need better understanding of the LP.

Within this LP router is the mixed-integer LP-solving package called *XA*, developed by Sunset Software Technology. The LP router consists of XA, plus those routines in OASIS that write out the LP problem set, feed it to XA to solve, and receive the results from XA. The results that XA gives to OASIS comprise a simultaneous solution of all the decision variables (the unknowns).

The LP problem set (or just the *LP*) is a set of mathematical statements that are **linear** with respect to the unknowns, or decision variables. Non-decision variables go into the LP as values, *so the rules do not have to be linear with respect to any non-decision variables*.

We have divided the operating rules that the LP expresses into two categories: **goals** and **constraints**. Every rule is either a goal or a constraint, as we will explain in the following sections.

2.2.1 DECISION VARIABLES

Decision variables are the unknown variables whose values the LP router solves, or "decides". The principal decision variables are:

Flow in an arc. For every arc you enter into OASIS, the LP router automatically creates a flow variable.

Storage at a reservoir node. For every reservoir node you enter into OASIS, the LP router automatically creates a storage variable.

Delivery at a demand node. For every demand node you enter into OASIS, the LP router automatically creates a delivery variable.

There are other decision variables which are documented in section 7.2.0, although you should not need to know about them until you have some experience with OASIS. You may create new decision variables with the OCL *udef* command (section 2.5.1 part A).

2.2.2 OPERATING CONSTRAINTS

Operating **constraints** are rules that the LP router can not violate. They may be expressed as equalities, such as:

```
QT100101 + QT400101 = QT101333 + 456.7
```

Or they may be inequalities, such as:

```
QT101333 < QT500600 - 300.33
```

In these examples, the *QT* variables are actual names for flow variables that could be written to the OASIS LP. Although most users should not need to refer to the LP in this form, there is a complete description of the *QT* variables and other parts of the LP in Chapter 7.

When the LP router solves, it must comply with all of the constraints in the LP. If a solution cannot be found that satisfies all of the constraints, then the LP is **infeasible**. An infeasible LP causes a fatal error in an OASIS run.

Constraints are often used to define physical rules in the system, or to define the relationships between variables. A constraint would **not** be used to model such rules as "deliver water to node 300", "maintain in-stream flow in arc 120.670", or "keep at least 400 million gallons of water in reservoir node 346". These are rules which can not be met under all circumstances, so they should be modeled as **goals**.

OASIS models many of the standard operations as constraints or parts of constraints that it automatically adds to the LP. For example, the model never loses or "creates" water in its accounting because every node has a continuity-of-flow constraint (section 2.2.4). Inflow and evaporation are two of the terms in the continuity-of-flow constraint. You may define a standard maximum flow for an arc, which constrains that flow from being more than an upper limit. Another standard constraint is the fact that the delivery to a demand node can never be more than the demand. You can create new constraints of your own design with OCL commands (section 2.5.0).

When developing a new rule, you must determine whether to enter it into OASIS as a goal or a constraint. If the rule is not a relationship that absolutely must be obeyed, then it probably should be a goal, not a constraint.

2.2.3 OPERATING GOALS AND WEIGHTS

Operating **goals** are rules that express routing decisions the LP router should *try* to make. Meeting a goal is not a matter of violating or not violating a rule. Furthermore, we don't think of the router as being "forced" to meet a goal. Some examples of goals are:

Deliver as much as possible to demand node 340

Route as much flow as possible through arc 901.234

Do not route any flow through arc 901.234 unless absolutely necessary.

Prefer to route flow through arc 320.100 before routing any through arc 600.200, but prefer routing flow through arc 600.200 over arc 789.123.

Operating goals are a *very powerful* tool in OASIS, and you *must* appreciate this in order to use OASIS effectively. Note that all of the above examples express operations that might not always be possible to satisfy. If we wanted to express these rules as constraints, we would have to write lots of conditions to compute things like "how much is possible", "is absolutely necessary", "the first one is full, so we can put some into the second one", and "the second one is not full, so none goes into the third one". But with OASIS we simply and easily express *what* the goals are, and we let the LP router determine *how* to meet the goals.

The last of the above examples illustrates the important fact that *goals are by their very nature in competition with other goals*. It is expected that sometimes some goals will have to be met at the expense of others. Therefore, we rank the goals by giving each one a **weight** or **penalty**. A penalty is simply another word for a negative weight.

One place you provide weight values is in the weights database file (section 4.5.7). The weights given in this file are assigned to standard decision variables, such as storage, flow, and delivery. As the LP router solves, we can think of it as scoring points for each decision variable. The score is equal to the weight value times the value of the decision variable. For example, if the weight on the flow through an arc is 50 points, and the value of the flow is three volume units, then the router receives 150 points. The router *will* solve the LP routing problem so that it receives the maximum possible points. *This is what LP solvers do*, and you do not need to know *how* it does it.

To help understand weights, consider the following facts:

> Positive weight on a decision variable encourages the LP router to maximize the value of that variable as much as it can.
>
> Negative weight on a decision variable encourages the LP router to minimize the value of that variable as much as it can.
>
> The LP router is indifferent to the value of a variable whose weight is zero.
>
> The router does what it can to move water from lower weight to higher weight.
>
> When there is more than one possible routing decision, the router makes the decision that gets the highest *net* number of points.
>
> When there is more than one possible routing decision that get the same number of *net* points, the router is indifferent as to which one is chosen. This results in **alternate optima**. See section 2.2.5 for more discussion of alternate optima.

Remember that what is *possible* for the router is defined by the set of constraints. See section 2.2.2 for a discussion of constraints.

Besides the weights database file, you can apply weights through OCL. With the *target* command (section 2.5.1 part E), you apply a penalty to the deviation of a user-defined *target value* from a user-defined *target expression*. With the *minimax* command (section 2.5.1 part F), you apply a penalty to a *minimax variable*, which will tend to equalize two or more user-defined quantities.

In summary, you can define the following goals for OASIS:

> Weight entered in the weights database file (section 4.5.7) encourages the router to maximize or minimize standard decision variables: **flow**, **storage**, and **delivery**. For example, weight on a storage variable defines a goal of keeping or increasing water in storage.
>
> The OCL *target* command (section 2.5.1 part E) defines a goal of making a user-defined *target value* equal to a user-defined *target expression*.
>
> The OCL *minimax* command (section 2.5.1 part F) defines a goal of equalizing two or more user-defined quantities. It does this by minimizing the largest of those quantities.

All of these goals are defined by their weights. If you forget to apply a weight, or make it zero, it is as if the goal did not exist.

2.2.4 CONTINUITY-OF-FLOW CONSTRAINTS

There is one especially important constraint that we must discuss now. This is the **continuity-of-flow** constraint, which OASIS automatically generates for every node in the system (except terminal nodes) and enters into the LP. Once you understand that the continuity-of-flow constraints are being automatically generated, you can usually take them for granted. However, it is useful to understand some things about them.

The continuity-of-flow constraints ensure that the model obeys the physical truth that mass (or volume) is conserved as water flows. At a **junction node**, the continuity-of-flow constraint has this form:

```
(sum of arc-flow in) + (inflow) = (sum of arc-flow out)
```

The arc-flow in and the arc-flow out are decision variables, but the inflow is a known quantity. This constraint assures that if a volume of water goes into a node, the same volume of water comes out — it can not leave the system, unless you specifically create a negative inflow value at the node.

At a **reservoir node**, the continuity-of-flow constraint has this form:

```
  (sum of arc-flow in) + (inflow) - (evaporation)
+ (beginning-of-period storage)
                = (sum of arc-flow out) + (end-of-period storage)
```

The arc-flow in, the arc-flow out, and the end-of-period storage are decision variables, but the inflow, evaporation, and beginning-of-period storage are known quantities.

At a **demand node**, the continuity-of-flow constraint has this form:

```
(sum of arc-flow in) + (inflow) = (delivery)
```

The arc-flow in and the delivery are decision variables, but the inflow is a known quantity. *Note that arc-flow out is not part of this constraint.* It is assumed that you will not create arcs that come out of a demand node. However, if you do, they will still not be written into the continuity-of-flow constraint. See section 2.5.2 for more on how to handle this.

At a **terminal node**, no continuity-of-flow constraint is written. Thus, water that goes into a terminal node does not stay in the system.

Notice that the evaporation and inflow terms are part of the continuity-of-flow constraints, and they are known quantities. Thus, we can say that the system is constrained to these exchanges with the outside world, and the router can not change the value of the exchanges. Therefore, if the inflow or evaporation can not be accommodated in the system (that is, in conflict with other constraints), then you could have an **infeasible LP**, and OASIS would experience a fatal error.

2.2.5 ALTERNATE OPTIMA

We said in section 2.2.3 that the LP router always finds the maximum number of points that can be earned from the weight values. However, there may be more than one way to earn that maximum number of points. If so, then we say there are **alternate optima**. Consider this simple example of a system with only three nodes:

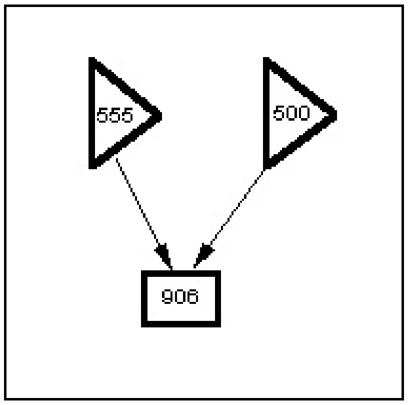


Figure 2.2.5
Example of Alternate Optima

Initial volume stored in each reservoir node: 100 AF
Demand at node 906: 20 AF
Maximum flow through arc 500.906: 8 AF/period
Maximum flow through arc 555.906: 16 AF/period

Weight on storage in each reservoir node: 2
Weight on delivery to node 906: 10

No inflow or evaporation.

The maximum number of points that the LP router can earn is 200 points for a full delivery to node 906 plus 360 points for leaving the rest of the water in storage in the two reservoir nodes (560 points total). This could be accomplished by taking 8 AF from node 500 and 12 AF from node 555. It could also be done by taking 4 AF from node 500 and 16 AF from node 555, and there are a infinite possibilities between these two options! These are the alternate optima.

Which of the infinite ways will the LP router choose? In fact, there is no way to predict what the LP router will do here. By making the weights equal on the two reservoirs, you are effectively telling the LP router that it doesn't matter!

Usually, you should try to avoid alternate optima, because it may lead to inconsistent results. However, when using multiple **priority levels,** you will actually want alternate optima in the early priority levels, so that the LP router can choose from among the alternate optima in later priority levels. That is, you will want to create alternate optima on purpose. See section 2.2.6 for more about priority levels.

In the above example, we could avoid alternate optima by giving different weights to the two reservoir nodes. Suppose the water from reservoir 555 is more desirable. We could change the weight on reservoir node 500 to 3, and the weight on reservoir node 555 remains at 2. Now there is only one way for the LP router to maximize the points earned. It will take 16 AF from node 555, and 4 AF from node 500, to earn a total of 656 points.

What if we want to model a rule that specifies equal use of the two reservoirs? This rule could be a goal to try to make the flow out of the reservoirs equal, or to try to make the storage in the two reservoirs equal. Either way, we could model the situation by using the equal storage weights from the original example, and adding a ***minimax*** command. The *minimax* command allows you to model a goal of keeping two or more quantities equal. Furthermore, the addition of a *minimax* command would mean that there are no longer alternate optima. See section 2.5.1 part F for more about minimaxes. Please note that without the *minimax* command, there is nothing in the original example that tells OASIS to try to balance its use of the two reservoirs.

2.2.6 PRIORITY LEVELS

Multiple **priority levels** are an advanced feature that are usually not needed for models of small systems. However, they are a powerful tool in OASIS, and they make it possible to model some very complex operational rules.

In OASIS, every weight value is associated with a priority level 1-6. You specify what the priority level is when you enter the weight or penalty input. Therefore, it can be said that every *operating goal* is associated with a particular priority level. OASIS calls the LP solver at least once for each priority level. In general, priority 1 is the first call to the solver, priority 2 is the second, and so on.

OASIS determines how many priority levels there are by the largest priority number that you enter in the input. For example, if the highest priority number that you have assigned to any weights is 3, then there are three priority levels.

The process of solving each priority level involves these steps:

1. OASIS solves the LP, using only the weights of the current priority level.

2. OASIS adds a constraint which restricts the decisions to the **alternate optima** (section 2.2.5) of the priority level that was just solved.

3. For each additional priority level, OASIS returns to step 1.

If there is only one priority level, then this process is trivial, and you do not need to worry about how the LP router handles multiple priority levels.

To make sure there is only one priority level, make sure that all of the priority level entries in the weights database (section 4.5.7) are “1", and all of the *priority* fields in the OCL *target* (section 2.5.1 part E) and *minimax* (section 2.5.1 part F) commands have “1" in them.

Notice that step 2 constrains the solution of the next priority level to the alternate optima of the priority level that was just solved. *In order to use priority levels effectively, you must design your weights so that there are alternate optima within the earlier priority levels*. If well designed, your set of weights and priorities “close in” on a single, correct solution by reducing the alternate optima. Thus, you would not want alternate optima in the last priority level. See section 2.2.5 for discussion of alternate optima.

Since many models do not need them, why would you ever want to use multiple priority levels? There are two very good reasons.

Avoid excessive scaling of weights. If you have a very complicated system, with a very large number of competing operating goals, you could develop a large range of weights. For example, some of your weight values might be 20000, 3000, 500, 100, 20, 5, and 1. It can be confusing to keep track of these different scales. Furthermore, *it may strain the computational precision of the LP solver*. Therefore, a complicated system may be easier to model with multiple priority levels.

Weights in one priority level do not have additive effects with weights in another priority level. Within a priority level, each potential routing decision must be considered by the *net* number of points that the router would earn from that decision. When there are a large number of operating goals involved in a decision, you have to add together the points contributed by each goal in order to understand where the water will go. Sometimes you want the weights to add together, sometimes you do not. If you want the weights to add together, put them in the same priority level. If you do not want them to add together, you may be able to put them into different priority levels. This can reduce a great deal of confusion.

A third use of multiple priority levels relies on an alteration of the definition of a *priority level*.

> **Use the LP router to compute "what-if" information.** That is, you need information about how the system would operate if there were a different set of goals than those that ultimately determine the routing decision. This is a very advanced use of OASIS. In order to do this, you must use the OCL ***cancel*** command (section 2.5.1 part H). If a priority level has been *canceled*, then subsequent priority levels are *not* constrained to the alternate optima of that priority level.

Multiple priority levels cannot be combined with multiple-period-optimization (MPO) (section 2.2.7).

2.2.7 MULTIPLE-PERIOD OPTIMIZATION (MPO)

OASIS supports **multiple-period optimization (MPO)**, meaning that the LP router is able to compute decisions for more than one time step in a single solve. You may also use MPO to have OASIS do *no* LP solve during particular time steps. Solving for one time step at a time is considered the standard mode of operation for OASIS, and we consider MPO to be a very advanced feature which most users do not need. We recommend you skip reading this section unless you plan to use MPO.

To understand the discussion of MPO steps, you probably need to understand how OASIS simulates a *time cycle* (section 2.8.1).

In order to do MPO, you must be using the *Steps* input table (section 4.5.2 part D). For each step of the time cycle, you assign a number of time steps to solve through the *Solve* field of the *Steps* table. An entry of zero means do not do any LP solve. An entry of 1 means solve an LP for the current step (as in the standard case). An entry of 2 means that a single LP solve is done for the current step and the first step after it. In the latter case, we say there are two **MPO steps**. An entry of 3 means that a single LP solve is done for the current step and the next two steps after it. In this case, we say there are three MPO steps. OASIS does not have a strict upper limit on the number of MPO steps.

Note that MPO cannot be combined with multiple priority levels (section 2.2.6). If you use multiple priority levels, all time steps in the *Steps* table must have an entry of 1 in the *Solve* field. If you are doing MPO, then all weights must have a priority level of 1.

To do MPO, edit the *Solve* field of the *Steps* table (section 4.5.2 part D). Entries greater than 1 indicate that more than one time step is solved during the given time step. Make sure that there is only one priority level (section 2.2.6).

To make sure that you are not doing MPO, make sure that all entries in the *Solve* field of the *Steps* table (section 4.5.2 part D) are "1". If you are not using a *Steps* table, then you can be sure you are not doing MPO.

There are different ways to use MPO. One is to simulate a decision-making process where decisions that span several steps are made at one time, and are not changed. For example, suppose our time cycle is one week, and our time step is one day. Thus, there are seven steps in the cycle. Using the *Solve* field of the *Steps* table, we can assign seven MPO steps to the first day of the week, and zero to the rest. Refer to the table below, which contains *some* of the information from the *Steps* table. This would mean that all routing for the entire week is decided at the start of the week, and it is not changed as the week goes on. The decisions for days two through seven were solved on day one. When OASIS evaluates days two through seven, it does not change any decision variables, because the number of MPO steps assigned to those days is *zero*.

Step Number	**Number of MPO steps (*Solve* field)**
1	7
2	0
3	0
4	0
5	0
6	0
7	0

Another way to use MPO is to simulate a process where current decisions account for future decisions, but the decisions can always be updated using current information. For example, suppose our time step is one day. Our time cycle only contains one step, and we assign that step with *three* MPO steps. Refer to the table below, which contains *some* of the information from the *Steps* table. Thus, every time step of the simulation, OASIS will make decisions for the current step plus the next two future steps. The information for decisions of these future steps remains in memory *until the next solve*. When these steps become the current step, that information can be put to use, but the new solve of the current step overwrites the values that were given during the previous step. This differs from the previous example, where no overwriting was done.

Step Number	**Number of MPO steps (*Solve* field)**
1	3

When doing MPO, you should be mindful of the assumptions about future knowledge, and whether they are appropriate to your analysis. You do have alternatives to assuming perfect future knowledge. When evaluating a time step that uses MPO you can use the OCL *Set* command (section 2.5.1 part C) to set the future value of a variable such as inflow. This future value could be computed using the assumptions and available information of a real-world forecast. In subsequent steps, you can overwrite these future values as the information improves.

When OASIS creates the LP for a time step that contains MPO:

There is a separate instance of each decision variable (section 7.2.0) for each MPO step. For example, if there is a reservoir with node number 100, and there are two MPO steps, then the LP contains one variable for storage in reservoir 100 at the end of the current step, and another variable for storage in reservoir 100 in the following step. See section 7.4.0 for more on the multiple copies of each variable.

For weights entered in the weights database (section 4.5.7), each instance of a given variable receives the same weight. This rule is applied differently to weights on reservoir storage – see section 4.5.7 part B.

There is a separate instance of each LP constraint (section 7.3.0) for each MPO step. See section 7.4.0 for more details.

All OCL commands (section 2.5.1) that precede the command *solve* (section 2.5.1 part G) are evaluated *once for each MPO step*. First, OASIS evaluates all OCL commands for the first MPO step. When the *solve* command is encountered, it repeats the entire list of OCL commands for the second MPO step, and so forth. During this iteration, the value of the OCL variable *MPO_step* (section 4.7.4) changes to reflect the MPO step currently under evaluation. When this process has been finished for all MPO steps, the LP is solved. Those OCL commands that follow the *solve* command are *not* evaluated multiple times for MPO steps.

As mentioned above, there is an instance of each decision variable for each MPO step. In OCL, you distinguish between the different instances of decision variables by using time indices (section 4.7.4 part A). If you are not doing MPO, then the time indices cannot be applied to decision variables.

In OCL, you can apply the flag *NoMultiple* to the *Udef* (section 4.7.2 part B), *Target* (section 4.7.2 part E), and *Constraint* (section 4.7.2 part D) commands. This flag tells OASIS to evaluate the particular command or variable *only once* per time step. In other words, it suppresses the default rule to evaluate a separate instance of the command or variable for each MPO step. When *NoMultiple* is used, the evaluation is done during the first MPO step of the time step.

Some of OASIS' standard computations are more difficult with MPO. Reservoir elevation (section 2.4.0 part F), area, and evaporation (section 2.4.0 part G) are always computed after the LP has been solved. However, when evaluating for MPO, this means that these values cannot be evaluated until all of the steps have been solved. Thus, OASIS assumes that these variables are equal to their values at the beginning of the first MPO step.

2.3.0 MODEL INPUT

With OASIS, your model is completely user-defined. You define the model by entering its description in input files. Every time OASIS is run, it reads the information from the input files. The input includes files in different formats, including MS Access, ASCII (plain text), and HEC-DSS.

The input files are managed by the OASIS GUI. The GUI provides controls for editing the input that is stored in text files and MS Access files. For OCL files, the GUI passes control to a program called *VEDIT*. For HEC-DSS files, the GUI passes control to a program called *HecDssVue*. See Chapter 3 for complete documentation of the GUI.

For users who are comfortable with managing computer files and working with OASIS, the input files can be edited with third-party software – working outside the GUI. For example, MS Access files can be edited with MS Access. ASCII files can be edited with a text editor, such as VEDIT, Windows WordPad, or a word processor program. HEC-DSS files must be edited with DSS utility programs.

There are certain input parameters that can be specified in the command line. See section 4.1.0 for more information.

2.3.1 RUN DIRECTORY

OASIS input is organized so that all input files belonging to a particular simulation run can be found in a single directory, called the *run directory*. All output files are written to this directory as well. This way, all the files that belong to a particular simulation run are contained in one place, distinct from the files of any other run.

You tell OASIS what the run directory is by entering its name in the model pointer file, which is always named *directry.nam* (section 4.3.0). Alternatively, you can specify the name of the run directory with the command-line parameter *DIR* (section 4.1.0).

When you provide the names of input files, you can give them with relative or absolute path information. Thus, you can easily organize your files into subdirectories of the run directory. These paths can also use the "directory up" symbol, a pair of dots, to locate files outside of the run directory. An absolute path can also be used to locate files outside of the run directory. For example, you might wish for several different runs to rely on a single copy of a certain input file. This way, a change to that one input file will automatically be changed for all of those runs. It would be logical to place this file outside of the individual run directories.

The OASIS GUI has many features that make it easy to manage run directories (section 3.4.0). However, the GUI also imposes more rigid requirements on the format of the run directory. Consult with HydroLogics staff if you wish to locate certain files outside the run directory but aren't sure whether it will work with the GUI.

2.3.2 FILES THAT OASIS READS

The simulation program *model.exe* reads several different input files, which are listed below. Chapter 3 tells how these files are organized for use with the GUI. Chapter 3 also lists other files that are not necessarily read by *model.exe*, but by other programs in the OASIS package.

Note that the static databases (items D through I and item L below) can be combined together. For example, the seven static databases can be combined into one large database. See 4.5.0 for more information.

A. **Identity Key.** OASIS reads this file to get information about the user license, which it prints in its run window and in output files. See section 4.2.0 for reference.

B. **Pointer File.** This ASCII file is always named *directry.nam* and is located in the same directory as the OASIS executable file. OASIS reads this file to learn the name of the run directory. See section 4.3.0 for reference.

C. **Control file.** This ASCII file is found in the run directory. OASIS reads this file to learn the names and paths of the various input files, the name and path of the output file, and some output flags. See section 4.4.0 for reference.

D. **Time parameters database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn the size of the time step, the first and last time steps to simulate, whether to work in water years or regular years, and other parameters related to the computation of time. See section 4.5.2 for reference.

E. **System database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn the units-of-measurement system, nodes and arcs in the system, as well as parameters describing the arcs, reservoir nodes, and water quality. It may read formatting information for the balance sheet output. See section 4.5.3 for reference.

F. **Demand database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn parameters describing the demand nodes. See section 4.5.4 for reference.

G. **Inflow database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn parameters describing the inflows and water quality. See section 4.5.5 for reference.

H. **Initial conditions database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn the storage and water quality values in reservoirs at the beginning of the first time step of simulation. See section 4.5.6 for reference.

I. **Weights database.** The name and path of this MS Access file is given in the control file. OASIS reads this file to learn the weights to apply to the standard decision variables. See section 4.5.7 for reference.

J. **OCL file.** The name and path of this ASCII file is given in the control file. OASIS reads this file to get special operating rules that you define with OCL commands. See section 4.7.0 for more information.

K. **OCL static database.** The name and path of this MS Access file is given in the OCL file. This file is optional. From this file, OASIS gets supplemental data referred to in the OCL file, including pattern data and look-up tables. See section 4.5.8 for reference.

L. **Time-series files.** The names and paths of these files are given in the OCL file and in the *File ID* tables of some of the MS Access databases. These files are optional. From these files, OASIS gets supplemental data referred to in the OCL file or in the static databases. See section 4.6.0 for reference.

2.4.0 STANDARD OPERATING RULES

You tell OASIS what are the operating rules of the system by editing OASIS's input files. There are two conceptual tiers to OASIS input: **standard input**, and **OCL input**. Standard input allows you to create rules of a standardized form. This is often useful, because most water resources systems have similar types of rules. With these standardized forms, you merely supply parameter values that define the rule.

OCL input allows you to create rules with forms of your own design. This makes OASIS much more flexible. Section 2.5.0 discusses OCL operating rules.

The present section discusses each of the standard operating rules. It tells you how to handle the input for the common uses of each operating rule. Each of the standard operating rules was developed to model a certain common situation in a water resources system. However, in the description of each operating rule, we note that you are free to find creative uses for the standard rules. There are also alternative ways to model almost any problem.

A. MAXIMUM FLOW IN AN ARC

By default, there is no maximum flow in an arc. You may apply a standard maximum-flow **constraint** to any arc. Because this maximum flow is a constraint, it can cause an infeasible LP if it conflicts with other constraints.

You tell OASIS whether there is a maximum-flow constraint on each arc in the *Arc* table. The code in the *Arc* table tells where the values of the maximum flow are found. You can specify the values with pattern, time-series, or OCL input. See section 4.5.3 part C for complete information.

To add, change, view, or remove a maximum-flow constraint at an arc, open the *Arc* table (section 4.5.3 part C). Find the record for the arc, and the *Max Flow* field. The code in this field tells whether the maximum-flow values are stored in a pattern table, a time series table, or in the OCL file. Go to the appropriate one of these three data sources to view or change the data. If this field is blank, then there is no maximum flow at the arc. Furthermore, you can change the source of the data from one type to another (for example, from *pattern* to *OCL*). See section 4.5.3 part C for complete information.

The maximum flow is generally used to model the physical capacity of a conveyance feature. It can also be used to model a maximum that is dictated by policy. You are free to find creative uses for the standard maximum flow — only remember that it is a constraint. Many policy maximum rules, such as flood control levels, can be violated under extreme circumstances, so they should *not* be modeled as constraints.

There are many alternatives to the standard input for maximum flow in an arc. You can use the standard minimum (target) flow to create a maximum flow *target* (goal) (section 2.4.0 part B). You can also use the OCL *constraint* command to create a maximum flow *constraint* (section 2.5.1 part D). The OCL *target* command (section 2.5.1 part E) could be used to create a maximum flow *constraint* or *target*.

B. MINIMUM (TARGET) FLOW IN AN ARC

The standard minimum-flow rule in OASIS could more appropriately be called a *target* flow. One reason is that it defines an operating goal, not a minimum-flow constraint. The other reason is that it could actually be used to model a maximum flow. However, the name *minimum flow* has long been applied to this standard rule, so the name stays for continuity.

By default, there is no minimum (target) flow at an arc. You may apply a minimum-flow **goal** to any arc. Because this minimum flow is a goal, it cannot be the direct cause of an infeasible LP.

You tell OASIS whether there is a minimum (target) flow on each arc in the *Arc* table. The code in the *Arc* table tells where the values of the minimum (target) flow are found. You can specify the values with pattern, time-series, or OCL input. See section 4.5.3 part C for complete information.

To add, change, view, or remove a minimum (target) flow at an arc, open the *Arc* table (section 4.5.3 part C). Find the record for the arc, and the *Min Flow* field. The code in this field tells whether the minimum-flow values are stored in a pattern table, a time series table, or in the OCL file. Go to the appropriate one of these three data sources to view or change the data. If this field is blank, then there is no minimum flow at the arc. Furthermore, you can change the source of the data from one type to another (for example, from *pattern* to *OCL*). See section 4.5.3 part C for complete information.

Because this is an operating goal, there must be **weight** associated with it. Thus, there must be a record in the *Weight: Arc* table (section 4.5.7 part A) for any arc that has a standard minimum-flow rule. The weight value in the *A Wt* field enforces the minimum flow. There must be an accompanying priority level in the *A Pri* field. Make sure that the weight in the *A Wt* field is higher than the weight in the *B Wt* field.

The minimum (target) flow is commonly used to model in-stream flow rules, such as the rules we often find below a dam to maintain habitat or water quality. It can be used to model any kind of policy flow target. You are free to find creative uses for the standard minimum flow — only remember that the LP router is never constrained to meet the minimum flow.

There are many alternatives to the standard input for minimum (target) flow in an arc. You can use the standard maximum-reverse-flow rule to create a minimum-flow *constraint* (section 2.4.0 part C). You can also use the OCL *constraint* command to create a minimum-flow *constraint* (section 2.5.1 part D). The OCL *target* command could be used to create a minimum-flow *constraint* or *target* (section 2.5.1 part E).

The standard minimum (target) flow rule can actually be used to model a maximum-flow target. The only trick to doing so is that the weight on exceeding the minimum-flow value would have to be negative.

To make a maximum-flow target at an arc, follow all the steps for creating a standard minimum-flow target, knowing that the values labeled as a minimum flow are really maximum-flow values. In the *Weight: Arc* table (section 4.5.7 part A) make the value in the *B Wt* field negative. There must be an accompanying priority level in the *B Pri* field. Make sure that the weight in the *A Wt* field is higher than the weight in the *B Wt* field.

C. MAXIMUM REVERSE FLOW IN AN ARC

The standard rule for maximum reverse flow is really a minimum-flow *constraint*. However, the name *minimum flow* is already used by the standard rule for minimum (target) flow. Furthermore, the name *maximum reverse flow* is quite appropriate for the most common use of this standard rule.

By default, the flow in an arc is constrained to be no less than zero, making the arc unidirectional. You may apply a standard maximum reverse flow **constraint** to any arc. If an arc has a negative value for the maximum reverse flow, then it is a two-way arc, capable of **reverse flow**. Because the maximum reverse flow is a constraint, it can cause an infeasible LP if it conflicts with other constraints.

You tell OASIS whether there is a maximum-reverse-flow constraint on each arc in the *Arc* table. The code in the *Arc* table tells where the values of the maximum reverse flow are found. You can specify the values with pattern, time-series, or OCL input; or as a **mirror** of the maximum flow. See section 4.5.3 part C for complete information.

To add, change, view, or remove a maximum-reverse-flow constraint at an arc, open the *Arc* table (section 4.5.3 part C). Find the record for the arc, and the *MaxRev Flow* field. The code in this field tells whether the maximum-reverse-flow values are stored in a pattern table, a time series table, or in the OCL file. Go to the appropriate one of these three data sources to view or change the data. If this field is blank, then the flow in the arc can be no less than zero. Furthermore, you can change the source of the data from one type to another (for example, from *pattern* to *OCL*). See section 4.5.3 part C for complete information.

To make the maximum reverse flow in an arc equal (but opposite) to the maximum flow, open the *Arc* table (section 4.5.3 part C). Find the record for the arc, and the *MaxRev Flow* field. Change the code in this field to ***MIRROR***. OASIS will automatically set the maximum reverse flow to be the negative of the maximum flow, no matter where the maximum-flow values come from. Do not try to enter values for the maximum reverse flow.

To make an arc with unlimited flow in the reverse direction, open the *Arc* table (section 4.5.3 part C). Find the record for the arc, and the *MaxRev Flow* field. Change the code in this field to ***MIRROR***. Make sure the entry in the *Max Flow* field is blank. Do not try to enter values for the maximum reverse flow.

If the maximum reverse flow has a positive value, then you do not have a two-way arc, but rather an arc where the flow is constrained to be no less than some positive value.

Specifying a maximum reverse flow is the only way to enable two-way flow in an arc. However if you have a two-way arc, you can always constrain the reverse flow further with the OCL *constraint* command (section 2.5.1 part D), or set a target or a constraint with the OCL *target* command (section 2.5.1 part E).

D. DEMAND AND DELIVERY

Every demand node has a demand value, usually referred to simply as the *demand*. The water routed into the demand node is called *delivery*. The demand minus the delivery is the *shortage*. It is a standard operating **goal** to deliver water to a demand node. As a goal, this rule can *not* be implicated as a cause of an infeasible LP. There are also standard operating **constraints** on the delivery. Specifically, the delivery can not be less than zero or more than the demand. It is possible that these constraints could contribute to an infeasible LP.

By default, OASIS assumes that water delivered to a demand node leaves the system. If you attach arcs to a demand node to return water to the system, OASIS does not automatically constrain continuity of flow between these arcs and the demand node. See section 2.5.2 for an explanation of how to handle **return flow**.

You tell OASIS where to get the demand values for each demand node through a code in the *Demand* table (section 4.5.4 part A). The code tells whether the values are specified with pattern, time-series, or OCL input. See section 4.5.4 part A for complete information.

To change or view the demand at a demand node, open the *Demand* table (section 4.5.4 part A). Find the record for the node, and the *Demand Type* field. The code in this field tells whether the demand values are stored in a pattern table, a time series table, or in the OCL file. Go to the appropriate one of these three data sources to view or change the data. You can change the source of the data from one type to another (for example, from *pattern* to *OCL*). See section 4.5.4 part A for complete information.

Because this is an operating goal, there must be **weight** associated with it. Thus, there must be a record in the *Weight: Demand* table (section 4.5.7 part C) for each demand node. The weight value in the *Wt* field enforces the demand. There must be an accompanying priority level in the *Pri* field.

The standard demand rule can be used to model any feature where water from the system is consumed. It can also be used to model features where water should be delivered, but some or all returns to the system (if you want to model delivery that returns to the system, see section 2.5.2). You are free to find creative uses for demand nodes — only remember that the LP router is never constrained to make deliveries, and it is always constrained from delivering more than the demand.

There are alternatives to using a demand node. If you want to model a demand where all of the delivery leaves the system, you can create a terminal node (section 2.1.4), and use any combination of the OCL *constraint* command (section 2.5.1 part D), OCL *target* command (section 2.5.1 part E), standard maximum flow (section 2.4.0 part A), standard minimum (target) flow (section 2.4.0 part B), and arc weights (section 2.2.3) to make rules for the flow into the terminal node. You could also use such rules at a non-terminal node, or at a combination of terminal nodes and non-terminal nodes.

E. INFLOW

By default, there is no inflow at a node. You may apply inflow to any node. A node cannot have more than one inflow value. The value of the inflow is included in the continuity-of-flow constraint (section 2.2.4), so the LP router is **constrained** to route the inflow. Therefore, it is possible that the inflow could be the direct cause of an infeasible LP. See section 2.1.3 for more discussion of inflow.

The standard inflow feature can be used to model any exchange between the system and the outside world, whether the water is coming into the system (positive inflow) or going out of the system (negative inflow). You are free to find creative uses for inflow — only remember that the LP router is constrained to send the water into or out of the system, and the value of the inflow is known before the LP is solved. Thus, the inflow can not be affected by any other LP operating goals or constraints.

There are alternatives to using the standard inflow. Evaporation from a reservoir node (section 2.4.0 part G), also a constraint, is another exchange between the system and the outside world. If you want to model an exchange with the outside world that is subject to the LP router's control, you can make use of terminal nodes (section 2.1.4). At any terminal node, the LP router can decide how much water is sent out of the system. Bringing water into the system is slightly more complicated, but it can be done by creating a virtually unlimited source of water. This source would only be a modeling artifact; it is there so the router can draw water from the source, as needed, and bring the water into the system.

F. RESERVOIR ELEVATION AND SURFACE AREA

The standard rules in the LP are all stated in terms of volume — either the volume of water stored in a reservoir node or the volume of water that flows through an arc in a period. Reservoir elevation and surface area are not directly part of the LP, but are computed after the LP has been solved. Both elevation and surface area are functions of the storage at the reservoir node.

You may supply elevation and surface area information at any reservoir node. This is done by entering a set of records for the reservoir node in the *Reservoir S-A-E* table. This table contains the three-way look-up information for storage, area, and elevation.

You are not required to supply information for elevation or surface area. If a reservoir node lacks an entry in the *Reservoir S-A-E* table, then elevation and surface area are both zero.

Because elevation and surface area are not solved by the LP router, they cannot be the direct cause of an infeasible LP.

To add, change, view, or remove a storage-area-elevation table for a reservoir node, go to the *Reservoir S-A-E* table (section 4.5.3 part C).

The reservoir surface area is needed for OASIS's standard evaporation rule (section 2.4.0 part G). If you leave the surface area at a reservoir node equal to the default of zero, then the evaporation computed by OASIS's standard evaporation rule at that node is always zero. On the other hand, if you choose to compute the evaporation at a particular node using OCL, the formula you write may or may not depend on the reservoir surface area.

The reservoir elevation is not used for any of OASIS's standard rules, but you can always use it in your OCL rules.

If you are doing multiple-period optimization (MPO) (section 2.2.7), then elevation and surface area computations are complicated slightly. For all but the first MPO step, OASIS cannot compute the elevation and area in the preferred way, because it does not yet know the storage at the beginning of the step. Thus, *for all MPO steps*, OASIS uses the storage and area at the beginning of the *first MPO step*.

As an alternative to the standard rules for reservoir elevation and surface area, you could compute the values with OCL. If you did this, you would probably want user-defined variables (section 2.5.1 part A) to hold the values. OASIS's standard elevation and surface area computations are equivalent to setting a variable with the *set* command (section 2.5.1 part C) after the LP has been solved with the *solve* command (section 2.5.1 part G).

G. RESERVOIR EVAPORATION

By default, there is no evaporation at a reservoir node. You may apply evaporation to any reservoir node. Evaporation is either computed by the standard formula or it is computed through OCL.

If a reservoir node follows the standard evaporation formula, then in each time step of simulation, OASIS computes the evaporation at that node by multiplying the beginning-of-period reservoir surface area by the **evaporation rate**. The end-of-period surface area is not considered in the evaporation calculation. You tell OASIS where the values of the evaporation rate are found through a code in the *Evaporation* table (section 4.5.3 part K). You can specify the values with pattern or time-series input. If there is no record for a reservoir node in this table, then there is no evaporation at the node. See section 4.5.3 part K for complete information.

If the evaporation is computed by a formula in OCL, then it may or may not depend on an **evaporation rate**, and it may or may not depend on the reservoir surface area.

The value of the evaporation rate may be positive or negative. Negative evaporation is usually used to model precipitation that falls directly on the reservoir. Whether it is computed by the standard formula or by OCL, the value of the evaporation is included in the continuity-of-flow constraint (section 2.2.4), so the LP router is **constrained** to route the evaporation out of the system (for negative evaporation, into the system). Therefore, it is possible that the evaporation could be a direct cause of an infeasible LP.

To add, change or view the standard evaporation rate at a reservoir node, open the *Evaporation* table (section 4.5.3 part K). There should be a record for the reservoir node. The *Evaporation Type* field tells where the evaporation-rate values are stored, either in a pattern table or a time series table. Go to the appropriate one of these data sources to view or change the data. You can change the source of the data from one type to another. See section 4.5.3 part K for complete information. You must also check the surface area input for the reservoir. This is found in the *Reservoir S-A-E* table.

To remove the standard evaporation from a reservoir node, you have several choices:

Remove the record for this node from the *Evaporation* table (section 4.5.3 part K).

If the values come from a pattern table, change the factor in the *Factor* field to zero in the *Evaporation Pattern* table (section 4.5.3 part L).

Change the surface area to zero in the *Reservoir S-A-E* table (section 4.5.3 part J).

To compute evaporation of a reservoir node in OCL, open the *Evaporation* table (section 4.5.3 part K). There should be a record for the reservoir node. In the *Evaporation Type* field, enter *OCL*. In the OCL file, create a *Set* command (section 2.5.1 part C) for the *evap* variable (section 4.7.4) of the reservoir node. You may decide to make the evaporation depend upon the *evap_rate* variable. If so, a *Set* command for the *evap_rate* variable must come before the *Set* command for the *evap* variable.

If you are doing multiple-period optimization (MPO) (section 2.2.7), then evaporation computations are complicated slightly. For all but the first MPO step, OASIS cannot compute the evaporation in the preferred way, because it does not yet know the storage at the beginning of the step. Thus, *for all MPO steps*, OASIS uses the evaporation at the beginning of the *first MPO step*.

There are alternatives to using the standard evaporation rule. You could make a standard inflow (actually an "outflow") at the reservoir node, or an arc-flow from the reservoir node to a terminal node. You could enter any combination of standard rules and/or OCL rules to provide values for the inflow or to control the arc-flow.

H. RESERVOIR OPERATIONAL ZONES OR RULE CURVES

Each reservoir is modeled with one or four standard operational zones. Thus, we refer to **single-zone** and **four-zone** reservoirs. The boundaries between the operational zones are called rule curves. They are called "curves" because they can vary with time. Figure 2.4.0 part H shows the operational zones of a four-zone reservoir:

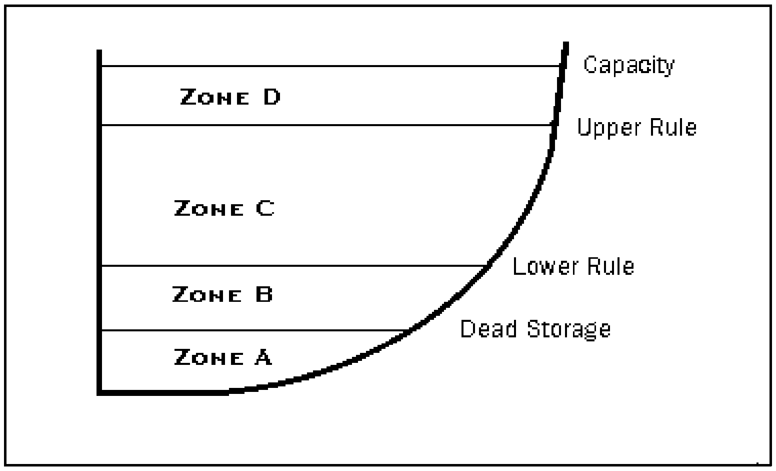


Figure 2.4.0 part H
Diagram of reservoir operational zones and rule curves

The ***upper rule*** usually models the bottom of the flood pool in a reservoir. The ***lower rule*** is usually a storage target for the reservoir. The ***dead storage*** usually means a level below which it is physically impossible to withdraw water. Although these are the typical applications of the storage zones, you can use them however it suits your modeling need. We should be especially careful to note that OASIS does *not* constrain reservoir storage from going below the dead storage.

With a single-zone reservoir, the single zone can be referred to as zone A. There is no upper rule, lower rule, or dead storage level in a single-zone reservoir.

To the LP router, the zones of the four-zone reservoir are **segments** of the total storage. This procedure is equivalent to using the OCL *segment* command (section 2.5.1 part B). If you ever want to model a two-zone or a 25-zone reservoir, you can do so with the *segment* command. In this method, each zone is represented by a unique decision variable. The four decision variables add up to equal the decision variable for the total storage. The segmentation is useful because each segment, or zone, receives a different weight. This variation in weight causes the reservoir to operate differently, depending upon which zone the water comes from.

With a single-zone reservoir, there is, of course, no need for such a segmentation.

You tell OASIS the values of the dead storage and **maximum storage** (**capacity**) in the *Reservoir* table (section 4.5.3 part H). Both are constants. In the same table, you also tell OASIS where the values for the lower rule and upper rule are stored, whether in pattern, time-series, or OCL input. By specifying that there is no lower rule or upper rule, you tell OASIS that the reservoir node is to have a single zone. See section 4.5.3 part H for complete information.

To change or view the maximum storage or the dead storage at a reservoir node, open the *Reservoir* table (section 4.5.3 part H). Find the record for the reservoir node. You may edit the values in the *Dead Storage* or *Max Storage* tables.

To change or view the upper rule or lower rule at a four-zone reservoir node, open the *Reservoir* table (section 4.5.3 part H). Find the record for the reservoir node. The codes in the *Upper Rule* and *Lower Rule* fields tell where the data for each is stored, either in a pattern table, a time-series table, or in OCL. See section 4.5.3 part H for complete information. *Make sure that neither of these fields contains the code* **NO**.

To change or view the weight on a four-zone reservoir node, open the *Weight: Storage* table (section 4.5.7 part B). Find the record for the reservoir node. Each zone: A, B, C, D; should receive a weight value, and each one should have an associated priority level. Make sure that the weight on zone A is greater than or equal to the weight on zone B, that the weight on B is greater than or equal to the weight on C, and that C is greater than or equal to D. Furthermore, it is important that the weights have this rank ordering in each priority level. Because of this, it is probably easiest to keep all four weights in the same priority level.

To make a single-zone reservoir node, open the *Reservoir* table (section 4.5.3 part H). Find the record for the reservoir node. Change the codes in both the *Upper Rule* and *Lower Rule* fields to ***NO***. If you change just one of the two fields to *NO*, you still get a single-zone reservoir, but field that does not say *NO* is misleading. Note that the value in the *Dead Storage* field is meaningless when you have a single zone reservoir.

To change or view the weight on a single-zone reservoir node, open the *Weight: Storage* table (section 4.5.7 part B). Find the record for the reservoir node. The weight on storage in this reservoir node is given in the *A Wt* field, and its priority level is given in the *A Pri* field. The other fields are not used for a single-zone reservoir node.

There are alternatives to using the standard reservoir rule curves. Most easily, the *target* command can be used to model basic storage targets. However, be aware that if there is more than one target acting on the same reservoir at the same time, there will be some overlap in the target deviations, where the penalties will have a cumulative effect. To avoid the cumulative effects, you may wish to segment the reservoir storage with the *segment* command, then apply targets to each segment with the *target* command.

2.5.0 OPERATIONS CONTROL LANGUAGE (OCL)

The standard operating rules (section 2.4.0) are tools that can be used to model the basic, most common features of a water resources system. However, if a system is complex enough that you would need a computer model, it is likely that it is too complex to be modeled with the standard rules alone. You will probably need to use OCL.

To apply standard rules, you enter parameter values, which OASIS applies to the LP in a form that you have little or no control over. OCL's great advantage is that it gives you control over the *form* of the rule, as well as the parameter values.

OCL is a **language**-based input. The concept of a language allows you to assemble complicated rules out of various syntax elements. Furthermore, you assemble the instructions in the order that they should be performed.

Because it is a language, OCL is entered as ASCII text input. The control file tells the path and name of the OCL file that OASIS is to read (section 4.4.0). However, from this file, you can refer to information in other files in the following ways:

> The OCL file can ***include*** other OCL files. These files can contain OCL commands, in ASCII form, just like the first file that was named in the control file. See section 4.7.1 part H.
>
> The OCL file can name static and time-series **databases** that store supplemental data. See 4.7.1 part E and 4.7.1 part F.
>
> Through OCL, you can instruct OASIS to exchange information with other computer programs, which we call **external modules**. See section 2.5.1 part I.

In OCL, the unit of instruction is the **simulation command**. Each simulation command contains information for OASIS to evaluate during each simulation time step. Many of the simulation commands can contain **conditions**. Conditions allow you to vary the parameters of the command according to the state of the system, using "if-then"-type logic. See section 4.7.2 part A for complete information about conditions.

OCL syntax also includes **meta commands**. These are very different from simulation commands. Meta commands affect the way that OASIS reads the OCL information as it is initializing. Once all the OCL information has been read, and OASIS begins stepping through the simulation, the meta commands have no more role. See section 4.7.0 part F for more information about meta commands.

The major uses of OCL are:

> Assign a value to a non-decision variable with the *set* command (section 2.5.1 part C). Variables that you would assign this way include user-defined variables, and standard variables for which you have told OASIS the value would come from OCL. Standard variables that can be assigned this way include inflow, demand, maximum flow, and others. See section 4.7.2 part F for a complete list of the variables.
>
> Define a new operating constraint for OASIS to enter into the LP. See section 2.2.2 for more about operating constraints. An operating constraint can be defined with the OCL *constraint* command (section 2.5.1 part D) or the OCL *target* command (section 2.5.1 part E).
>
> Define a new operating goal for OASIS to enter into the LP. See 2.2.3 for more about operating goals. There are two major types of goals that you can define with OCL. With the first, a **target**, the goal is for the router to make a target expression equal to a target value. The LP router can be penalized for letting the target deviate in either direction from the target value. See section 2.5.1 part E for more about the *target* command. The second type of goal is a **minimax**. With the *minimax* command, you tell the LP router to try to make two or more quantities equal to each other. See section 2.5.1 part F for more about the *minimax* command.
>
> Create new simulation variables, called **user-defined variables**, or **udefs**. You can create decision variables and non-decision variables. Udefs that have been declared can be used in other OCL commands, and are stored in model output. See section 2.5.1 part A.

Enter **new data** into the model. Of course, you can enter any parameter value as a constant in an expression. However, OCL also allows you to refer to pattern variables and look-up tables that are stored in a static database, as well as time-series variables stored in a time-series database. See section 4.7.1 part E and 4.7.1 part F.

Tell OASIS when and how to **solve the LP**. This allows you to evaluate variables after the LP has been solved, to change rules in between priority levels, or to iteratively re-solve a priority level until certain criteria are met. See section 2.5.1 part G and H.

Tell OASIS to pass control to another program and exchange data with that program. This enables OASIS to **run in parallel** with other models. The other programs are referred to as **external modules**. They can be written in any available computer language, and can be compiled as a dynamic link library, or as an executable application that communicates to OASIS through the Windows message queue. See section 2.5.1 part I.

2.5.1 USING OCL SIMULATION COMMANDS

The OCL simulation command is the unit of instruction that you give to OASIS. An operating rule may be composed of one or several OCL simulation commands. There are several different simulation commands. Each issues different types of instructions to OASIS, and each has its own syntax.

The order in which you enter the OCL commands is important, because in each time step, OASIS evaluates the commands in the order they were entered in the OCL file. When you change the value of a variable with the *set* command, the new value will be applied to commands that come after, but not before, the *set* command. Usually, OASIS issues an error when you try to use a variable before it has been *set*. However, this is not foolproof, for you may assign different values to the same variable with the *set* command. If another command uses the value of that variable, then which value it uses depends upon the order in which the commands appear.

Generally, you do not need to worry about the positions of the *constraint*, *target*, and *minimax* commands relative to *each other*, since it does not matter what order goals and constraints appear in the LP. Their positions relative to the *set* commands are important, as we have just described. Their positions relative to the *solve* command are also important. For example, if a *constraint* command appears after a *solve* command, OASIS does not write the constraint to the LP until after the *solve* command has been evaluated.

A. *Udef* command

The *udef* command is used to create a new simulation variable. The variable can have any meaning that helps you write operating rules in OCL. OASIS automatically records the value of the user-defined variable (**udef**) at every simulation time step, unless you tell it not to. Therefore, the value of the udef can be reported by post-processors. You should avoid creating udefs that you do not need, since time and disk space are consumed when OASIS records their values.

The udef can be a decision variable or a non-decision variable. If it is a **decision variable**, you give **bounds** for the udef in the *udef* command. There is an upper and a lower bound, which are the maximum and minimum feasible values that the LP router can assign to the udef. They function as constraints. You can tell OASIS that the variable is **unbounded** in one direction or both directions. This means that the variable can vary as high as infinity, or as low as negative infinity (In fact, $\pm 10^{23}$ is used for these bounds in place of infinity).

If the udef is a decision variable, you can also specify that it should be an **integer**. This means that the LP router can only assign it an integer value. The most common use of this option is to create a **binary** variable. A binary variable is a udef that has bounds of 0 and 1, and is an integer. Integer variables are harder for the LP router to solve, so they should be used carefully. In particular, large numbers of integer variables can make the LP solution process *very* slow.

If the udef is a **non-decision variable**, then you assign its value with the *set* (section 2.5.1 part C) or *run_module* (section 2.5.1 part I) commands.

For complete documentation of the OCL *udef* command, see section 4.7.2 part B.

B. *Segment* command

The *segment* command is used to create new simulation decision variables that are segments of another decision variable. Any decision variable can be segmented in this way. For every *segment* command, OASIS automatically writes a constraint that assures that the sum of the segments is equal to the original variable.

You decide the number of segments, and you tell OASIS the upper and lower **bounds** of each one. You express these bounds as the values of *the original, segmented variable* at each of the segment bounds. Each segment variable actually has a lower bound of zero, and an upper bound equal to the difference between the given bounds. Unlike decision variables created with the *udef* command, all variables created with the *segment* command must have finite bounds. Also note that the bounds on the segments have the effect of constraining the original, segmented variable.

The *segment* command allows you to apply different rules to different segments of the original decision variable. For example, you can use the *target* or *constraint* command to create a piecewise-linear function of the original variable. You would do this by writing different coefficients to each segment. One very important application is to enter a piecewise-linear approximation of a nonlinear function.

Unless you specifically tell it not to, OASIS automatically creates binary variables and special constraints for the *segment* command. The constraints force the LP router to assign value to the segments in the proper order. These constraints and binary variables are hidden from you unless you look in the file *LP.out* (section 5.5.0).

It is very important that you design the segments so that the router assigns them in the proper order. The binary variables and their associated constraints will insure that this is so. However, it is a good idea to suppress these constraints and binary variables whenever you can, because the binaries can significantly slow down the LP solution process. You can suppress the binaries if your LP rules assure that the segments will always be assigned in order. Generally, this means that the LP router gets more *net* points (from weights) for the first segment than the second, the second earns more than the third, and so on.

For complete documentation of the OCL *segment* command, see section 4.7.2 part C.

C. *Set* command

The *set* command is used to assign a value to a **non-decision variable**. The **value** that is assigned is the result of evaluating an expression that you provide. Furthermore, you may define **conditions**, which allow you to vary the value according to the state of the system using "if-then"-type logic. See section 4.7.2 part A for complete information about conditions.

Many standard input variables can be set with this command, as can any non-decision variable udef. In fact, *all* non-decision variable udefs *should* be set with either the *set* command or the *run_module* command (section 2.5.1 part I). For standard variables, the *set* command (or the *run_module* command) is your alternative to entering the values of the variable in a pattern table or a time-series table. In order to set any of the standard variables with this command, you must tell OASIS that the particular variable will be computed in OCL. For example, you can set the inflow to a node with the *set* command using the OCL *inflow* variable. To do this, you must enter *OCL* into the *Inflow* field in the *Node* table in the record for the particular node.

There are advantages and disadvantages to assigning a value with the *set* command. You should consider the following when deciding how to enter an input variable:

Advantages to using the OCL *set* command for standard input variables:

The value comes from an OCL expression, so it can be dependent upon other state variables that are part of the expression.

The conditions of the *set* command allow you to use “if-then”-type logic when determining the value.

The expression for the variable’s value makes it explicit how the value was derived, while it may not be clear how values in the database were derived. Furthermore, suppose you want to derive the values with some new method, or based on some new parameters. With OCL you could modify your expressions and then just re-run OASIS. If your values are stored in a database, you would have to recompute them and then enter the new values into the database — an extra step.

Disadvantages to using the OCL *set* command for standard input variables:

OASIS does not compute the value of the variable until the *set* command is performed. Therefore, you can never refer to the *future* value of the variable (except when doing MPO, see section 2.2.7). If the value of the variable is stored as a pattern or time series in a database, then you can always refer to the future value.

OASIS stores every variable that is computed with the *set* command in time-series output, consuming time and disk space. OASIS does not record the values of pattern or time-series input variables, because the post-processors can read the input files to get their values.

For complete documentation of the OCL *set* command, see section 4.7.2 part F.

D. *Constraint* command

The *constraint* command is used to enter a user-defined operating constraint into the LP. See section 2.2.2 for an explanation of operating constraints.

The constraint that you create must have at least one decision variable, it must be linear with respect to the decision variables, and it must include exactly one **comparison operator** *between decision variable terms*. The comparison operators are =, <, >, <=, and >=. The comparison operator != can not be used as the comparison operator that defines the constraint (You can include as many comparison operators as you please, including the not-equal operator, *within the coefficients*). You do not have to distribute the expression.

The *constraint* command can have one **condition**. If the condition expression evaluates true, then the constraint applies in the LP for the time step. If the condition expression does not evaluate true, then the constraint expression does not apply in the LP for the time step. You can enter the *constraint* command without a condition, in which case the constraint always applies in the LP. See section 4.7.2 part A for complete information about conditions.

The *constraint* command is often used to model a physical rule or a policy that could *never* be violated. It is also used to define a decision variable udef. Consider this example:

```
Constraint define_stor_gain :
{    dStor_gain = dStorage450 - Storage450 - Evap450    }

Constraint water_right :
{    dStor_gain < RemainingWaterRight    }
```

The first *constraint* command is simply defining a decision variable udef, *dStor_gain*, as being equal to a combination of other decision variables and non-decision variables. In this case, the storage gain variable, *dStor_gain*, is equal to the end-of-period storage, *dStorage450*, a decision variable; minus the beginning-of-period storage *Storage450*, a non-decision variable; minus the evaporation, *Evap450*, a non-decision variable.

The second *constraint* command models a policy that could never be violated. It says that the storage gain, *dStor_gain*, a decision variable, must be less than the remaining water right*, RemainingWaterRight*, a non-decision variable udef. Notice that the two constraints could be combined into one *constraint* command:

```
Constraint water_right :
{    dStorage450 - Storage450 - Evap450  <  RemainingWaterRight   }
```

However, most people would probably find the example with two *constraint* commands easier to read. Furthermore, there may be uses for *dStor_gain* in other commands, and you may desire it to be recorded as a system performance measure.

See 4.7.2 part D for complete documentation of the *constraint* command.

E. *Target* command

The *target* command is used to enter a user-defined operating goal or constraint into the LP. See section 2.2.2 for an explanation of operating constraints and section 2.2.3 for an explanation of operating goals.

The target always consists of a **target expression** and a **target value**. The target expression is a linear expression of one or more decision variables, while the target value cannot include any decision variables. The LP router may decide to make the target expression equal to the target value, or it may let the target expression **deviate** from the target. The target could deviate in one of two ways: greater than the target value or less than the target value.

In the *target* command, you tell OASIS how to behave toward the two potential deviations by assigning **penalties**. A positive penalty discourages deviation because the LP router loses points for deviating. A negative penalty (which is a positive weight) encourages deviation. A zero penalty leaves the LP router indifferent toward the deviation. And furthermore, you can put a **bound** on the deviation instead of a penalty. This *prevents* any deviation, and defines a **constraint**.

Since there are two potential deviations, and a different penalty can be applied in each direction, the target can be defined in many different ways. For example, you could discourage deviation in either direction. You could discourage positive deviation and encourage negative deviation. You could bound one deviation and discourage the other deviation. You could discourage one deviation and have it indifferent to the other direction. Thus, the *target* command can define a goal, a constraint, or a rule that is part goal, part constraint!

The *target* command can have many **conditions**. Conditions allow you to vary the target value, penalties, and priority levels according to the state of the system, using "if-then"-type logic. See section 4.7.2 part A for complete information about conditions. Consider that the target could be a constraint under one condition, but a goal under another condition!

The *target* command can do anything that the *constraint* command can do (except coordinate with the *minimax* command, see section 2.5.1 part F). Therefore, let's compare the differences between the two.

***Target* command**	***Constraint* command**
Frames the rule as a target expression and a target value.	Simply a constraint expression.
Can model an operating goal, operating constraint, or a hybrid of the two.	Only models constraints.
Can have multiple conditions.	Can have no more than one condition.
May be awkward for stating a constraint, since all decision variables must be in the target expression (the left-hand side).	Straightforward. Can move terms to whichever side of the constraint expression seems more natural.
Deviations are reported in *OCL.out* (section 5.3.3).	No reporting in *OCL.out*.

For every condition in a target, you provide a priority level. Both penalties apply to the same priority level. If the penalty is bound or indifferent (zero penalty), then the priority level is moot.

See section 4.7.2 part E for complete documentation of the *target* command.

F. *Minimax* command

The *minimax* command is used to enter a user-defined operating goal into the LP. See section 2.2.3 for an explanation of operating goals.

The *minimax* command defines a goal of making two or more user-defined decision variable quantities equal to each other. Usually, a shared quantity is distributed among these quantities. For example, several reservoir nodes release water for a common delivery, and we want the amounts they release to be distributed evenly. Or, several demand nodes receive water from a common source, and if they cannot get a full delivery, we want the shortage to be distributed evenly among them.

This is a very powerful operation for what looks like a small command. However, the *minimax* command never works alone. For every instance of the *minimax* command, you must have:

> A *udef* command (section 2.5.1 part A) defining the **minimax variable**. It must be a decision variable, and it is usually suitable to have an unbounded variable. The *udef* command does not include any special information indicating to OASIS that this is a minimax variable. OASIS knows that it is a minimax variable because it is used in the *minimax* command.
>
> For each of the quantities that are to be equalized together, a *constraint* command (section 2.5.1 part D) making the minimax variable greater than the individual quantity. We'll call these the **minimax constraints**. The *constraint* command does not include any special information indicating to OASIS that this constraint is part of a minimax operation. OASIS detects that the command contains a minimax variable, and internally it marks the constraint for special treatment. *You can not use a target command for this purpose.*

In the *minimax* command, you specify which minimax variable to use, and a penalty and priority level for minimizing the variable. This is a simple task — one that could easily be done with the *target* command. However, there is more to the minimax than that.

Because of the penalty, the LP router tries to make the minimax variable as small as possible. However, the minimax constraints force the minimax variable to be no less than each of the quantities to be equalized. Therefore, the smallest possible value of the minimax variable is the largest of the quantities. Thus, as the LP router tries to minimize the minimax variable, it is also minimizing the largest of the quantities. If all the quantities are equal, then the minimax variable is truly as small as possible.

Now, suppose that the largest of the quantities is "hung up". That is, this quantity is larger than the other quantities, but the LP router can not make it any smaller because of a constraint or a goal with a higher weight than the minimax penalty. At this point, the LP router is indifferent to the values of the smaller quantities — they have alternate optima.

Now we see why the *minimax* command is so powerful, doing things that can not be accomplished with the *target* command, for the *minimax* command tells OASIS to check for minimax constraints that are "hung up", or **binding**. If any are found, OASIS temporarily rewrites them so that each binding quantity is fixed at its smallest possible value, and the minimax variable is removed from each binding constraint. Then, the LP is solved again with the smaller set of active minimax constraints. If any are still binding, then OASIS repeats the process until there are no binding minimax constraints left.

See section 4.7.2 part H for complete documentation of the *minimax* command.

G. *Solve* command

The *solve* command tells OASIS to solve the LP. If there are *constraint*, *target*, or *minimax* commands following a *solve* command, then OASIS does not write them to the LP until after the *solve* command has been evaluated. A simple model does not need the *solve* command, because if you do not enter one, then OASIS automatically creates one as the last OCL command. The *solve* command is an advanced feature, and we don't recommend working with it until you are comfortable with the LP concepts in OASIS.

In the *solve* command, you specify a **priority level** to solve. See section 2.2.6 for more about priority levels. To evaluate the *solve* command, OASIS solves this and *all earlier priority levels that have not already been solved*. The *solve* command can have many **conditions**. The priority level and convergence criteria can vary by condition. See section 4.7.2 part A for complete information about conditions.

One of the great advantages of the *solve* command is that it allows you to evaluate information after the LP has been solved. For example, suppose there is a complicated water quality parameter that you are modeling with OCL (not with OASIS's standard water quality abilities). In order to compute the parameter, you need to know the flow in an arc. Since the flow is a decision variable, you can not compute the parameter until after the LP has been solved.

The *solve* command also allows you to modify the LP in between priority levels. Consider this example:

```
Solve : { priority : 1 }

constraint DELTA_XS_FLAG :
{   Dxs_flag = ( flow140.999 > ( min_flow140.999 + .1 ) )    }

Solve : { priority : 2 }
```

In the example, a new constraint is added after priority 1 has been solved. Thus, a constraint can depend upon the results of an LP solve. In this case, the variable *flow140.999* was determined by the LP solve.

With the *solve* command, you can **re-solve** any priority level that has already been solved. You can also solve **iteratively**, which means OASIS automatically re-solves again and again until certain criteria have been met. An iterative *solve* command must be matched with an *:ITERATE:* marker. Each time OASIS does another *solve* iteration, it backtracks to re-evaluate all the commands that follow the matching *:ITERATE:* marker. The commands that come between the *:ITERATE:* marker and the *solve* command should change the LP in some way so that the LP router converges upon the desired solution.

The *solve* command is used when an operating rule is too difficult to handle within a pure LP framework. You should be aware that the LP solution process can consume a lot of time on a large system, so it is advantageous to avoid excessive LP solves.

See section 4.7.2 part I for complete documentation of the *solve* command.

H. *Cancel* command

The *cancel* command tells OASIS to cancel the results of a previously solved priority level. This command can only be issued after a *solve* command. The results (the solved decision variables) of the priority level that is canceled remain in memory until the next *solve* command is evaluated, and you can apply them as you like. However, *the succeeding priority levels are no longer constrained to the alternate optima of the priority level that was canceled.* See section 2.2.6 for more about priority levels.

In the *cancel* command, you specify a single **priority level** to cancel. OASIS cancels only that one priority level. The *cancel* command can have many **conditions**. The priority level can vary by condition. See section 4.7.2 part A for complete information about conditions.

The *cancel* command is certainly an advanced feature that most modelers will not need to use. However, it comes in handy when you want the LP router to provide a "what-if" answer. You can create a priority level which contains goals that do not exactly reflect the true operation of the system. For some reason, it is important to know what the system would do if those particular goals (and not others) were driving the system. After issuing a *solve* command for the "what-if" priority level, you can apply the results, issue the *cancel* command, and then proceed to write and solve the priority levels that reflect the true operation.

See section 4.7.2 part J for complete documentation of the *cancel* command.

I. *Run_module* command

The *run_module* command tells OASIS to pass data to another program, called an **external module**, then to wait for that program to execute and pass information back. This allows OASIS to run in **parallel** with another model.

OCL is a language specialized for giving instructions to OASIS's LP router. It is not a fully featured procedural language, like FORTRAN or C++. You can do many things with OCL, but there are some tasks that are not appropriate. Therefore, if you wish to add iterative loops or specialized input and output to your water resources model, you may want to use an external module. The external module can act as a new function or subroutine that you write in the computer language of your choice, and plug right in to OASIS.

The external module can also be a complete, previously existing program — a model of stream temperature or groundwater flow, for example. Before such a program can work as an external module for OASIS, there have to be some changes to the code of the program, so that it can "talk" to OASIS. These changes are fairly minor, and HydroLogics staff are experienced with the process. The external module is compiled into a **DLL** file (Dynamic Link Library). A DLL contains functions residing in a library file. Any Windows program can call the functions in this file. When OASIS calls an external module in a DLL, it is just like calling a new subroutine within OASIS.

Every *run_module* command must refer to a module declared with the *:MODULE:* meta-command (section 4.7.1 part G). The *:MODULE:* command tells OASIS the exact pathname of the external module, and declares a shorthand **name** for the module. The *run_module* command uses this name so that OASIS knows which external module to call. You can call the same module more than once.

Note that the *run_module* command does *not* have **conditions**. OASIS calls the external module once for every use of the *run_module* command, every simulation time step.

The *run_module* command contains a list of input arguments and a list of output arguments. The input arguments are values that OASIS passes to the external module. The list of output arguments contains non-decision variables whose values are assigned by the external module. The output list cannot contain variables that cannot be assigned with the OCL *set* command (section 2.5.1 part C).

It is possible to tell OASIS to process the module in its own execution thread. This is most useful when you have multiple external modules which consume lots of run time. By running each module in its own thread, you can save run time on a multiprocessor or multicore computer.

See section 4.7.2 part G for complete documentation of the *run_module* command.

2.5.2 RETURN FLOW FROM A DEMAND NODE

OASIS assumes that all water delivered to a demand node ((section 2.4.0 part D)) leaves the system. Thus, a demand node is assumed to have no **return flow**. You can model return flow at a demand node, but OASIS has no standard rules to compute it. This only means that you must use OCL. You *must* apply some kind of rules to the return flow, because it is not included in the continuity-of-flow constraint (section 2.2.4) at a demand node. Without constraints, the LP router might give some very unrealistic simulation results.

To model return flow, simply create as many return-flow arcs as you need coming from your demand node. See section 2.1.2 for more about arcs. You do not need to tell OASIS that these are return-flow arcs – it figures that out itself. You can apply any rules to the return flow that you wish. However, the simplest and most common type of return-flow rule uses the *constraint* command (section 2.5.1 part D) to force the return flow to be a function of the delivery (a linear function, since the delivery is a decision variable). For example, the constraint says that the return flow is equal to 100% of the delivery:

```
    CONSTRAINT : { dFlow300.111 + dFlow300.115 = dDelivery300 }
```

The example has two return-flow arcs, 300.111 and 300.115. The above example would keep 100% of the flow in the system, just like the continuity-of-flow constraint at a junction node. However, you can just as easily tell OASIS that only 30% of the delivery returns to the system:

```
        CONSTRAINT : { dFlow300.111 + dFlow300.115 = 0.3 * dDelivery300 }
```

Changing the above factor from 0.3 to 1.3, would make the return flow equal to 130% of the delivery. Thus, water would actually be added to the system. Although this is legal input, it would be an unusual situation to model.

You could make a piecewise-linear function for the return flow. To do this, you would first need to segment the *dDelivery* variable with the *segment* command (section 2.5.1 part B), then use the constraint command to make the return flow a function of the segments.

You can write constraints such that the return flow is a function of the previous period's delivery. You can write constraints so that the return flow is a function of some other variable, and not a function of the delivery at all. The possibilities are endless.

2.6.0 OUTPUT

OASIS is designed so that you can analyze any model result thorough output. Several output files can be generated, and each answers a specific need. Most of the output files are optional. You control how they are written by your entries in the control file (section 4.4.0).

Normally, you should rely upon post-processors (section 2.7.0) to analyze model results. However, the output files are handy when there is an error, or when there is some question about whether an operating rule is being modeled correctly.

OASIS writes the following output files:

Debug output (*debug.out* in the run directory). When an error or warning occurs, OASIS writes a message in this ASCII file. Usually this message is the same one that appears in the error box on the screen. However, sometimes there is more detailed information in the debug file. You cannot change the way this file is written. See section 5.1.0 for more information about this file.

Balance sheet output (*balance.out* in the run directory) is very useful when you need to carefully track where the simulated water is going. The balance sheet is an ASCII file containing a report of every inflow and outflow, for every node in the system, for every time step of simulation. Notice that all of this information is also being written to time-series (HEC-DSS) output, and is therefore available to the post-processors. However; the balance sheet presents the information in a different, comprehensive format that you may find useful. The balance sheet also reports special information such as minimum flows, maximum flows, deliveries, shortages, evaporation, elevation, and water quality. You can turn the balance output on or off with a flag in the control file (section 4.4.0). Furthermore, you can customize the format and content of the balance sheet. See section 5.2.0 for more information about this file.

LP output (*LP.out* in the run directory) is an ASCII file generated by XA, the proprietary LP solver that is called by OASIS. For every time step and at every priority level, XA writes an algebraic representation of the constraints, bounds, and objective function that comprise the LP. It then writes the solution of the LP. This information is rarely needed, not to mention that it is very redundant and somewhat difficult to read. In addition, it slows OASIS down perhaps more than any other option available to you. Therefore, it is usually best to turn this output *off*. You control whether this output is written with a flag in the control file (section 4.4.0). See section 5.5.0 for more information about this file.

OCL output (*OCL.out* in the run directory) is an ASCII file containing reports on the evaluation of OCL commands. There are two different reports that can be written to this file. The first is a report of the results of evaluating the OCL expressions. This report also tells you which condition was found to be true for each command. The second report tells you the results of your OCL-defined goals. This includes a summary of the deviations on each *target* command. You control what is written to this file with a flag in the control file (section 4.4.0). See section 5.3.0 for more information about this file.

Weight output (*weight.out* in the run directory) is an ASCII file containing a report of every weight that goes into the LP router. See section 5.4.0 for more information about this file.

Time-series output (filename and path given in the control file) is a HEC-DSS file designed to be read by the post-processor programs. It contains the value of every simulation variable that is not given directly in the input files. For example, a minimum flow given in time-series input does not need to be saved in output, because the post-processors can retrieve its value from the input files. A minimum flow given in OCL *does* need to be recorded in output, because the post-processor does not re-evaluate the OCL commands. All decision variables are recorded in this file. You can tell OASIS not to write certain variables to this file, saving time and disk space. You can retrieve results directly from this file using HEC-DSS utility programs. These utilities contain extensive analytical tools that you may find useful. We recommend you work with the OASIS post-processors (Chapter 6) rather than access the HEC-DSS databases directly. You can turn this file on or off with a flag in the control file (section 4.4.0). Only in rare cases would you turn it off. See section 5.6.0 for more information about this file.

2.7.0 POST-PROCESSING

OASIS stores all simulation results in a single time-series database (section 5.6.0). If you prefer, you can retrieve results directly from this database. However, it is generally most convenient to use OASIS post-processor programs. **Onevar** (section 6.1.0) is the OASIS post-processor which presents values in text tables. **Plot** (section 6.2.0) is the OASIS post-processor that presents results in graphical X-Y plots. Both of these programs are designed so that you have complete control over the format and content of the presentation. You can easily load the post-processor report into a spreadsheet or other software for analysis.

You give instructions to the post-processors in input files specifically designed for the post-processors. The post-processor commands are an extension of OCL. Because you write OCL expressions (section 4.7.3) for the post-processor content, you can report a single variable, or a complicated formula of many variables. All OASIS input and output variables are available to the post-processor.

The post-processor input files can be stored as libraries of model outputs sets that you can quickly generate and view. The OASIS GUI makes it easy to run the post-processor programs with these stored post-processor input files. The GUI also contains the helpful **Quick View** feature (section 3.6.4 part I) that makes it easy to get model output from a new post-processor input file. With Quick View, you design the new post-processor input through a friendly interface.

See Chapter 6 for complete documentation of post-processor programs.

2.8.0 TIME IN THE SIMULATION

OASIS was designed to be very flexible in handling time. You can choose the sizes of the time steps; the start and end times of the simulation are user-defined; and you can define the year so that it starts at an irregular time, such as October 1 for a water year.

2.8.1 TIME STEPS AND THE TIME CYCLE

OASIS allows you to choose any size of time step that you wish (except OASIS will not allow time steps that are smaller than 5 minutes or larger than 1 year). Furthermore, the size of the time step can vary from one step to the next. There are three basic ways to specify the time step:

Pre-defined step types: for backwards compatibility, OASIS allows you to name one of the three different time-step sizes that were available before version 3.0. The pre-defined types are **DAILY**, **WEEKLY**, and **MONTHLY**. A fourth pre-defined step type, **ANNUAL**, is available for post-processing but not for simulation time steps. When you specify one of these types, OASIS automatically generates the appropriate time-step cycle information.

Steps in a Cycle: this is the most general way to define time steps. The cycle is a series of steps that continuously repeats from the beginning of the simulation until the end. Each step within the cycle may have a different length than the others, but a step at a given position in the cycle has the same length from cycle to cycle. The cycle may have two different forms:

- **Cycle fixed to the year.** The length of the cycle is one year. A given step in the cycle begins at exactly the same day of the year, every year. During leap year, the step that includes leap day is one day longer than it is in non-leap years. This type of cycle cannot have steps that are less than one day long or steps that include a partial day. The pre-defined MONTHLY step type is a classic example of a time-step cycle that is fixed to the year. The cycle of a MONTHLY scheme consists of 12 steps.

- **Cycle not fixed to the year.** The cycle can have any length. During leap year, none of the steps change in length. The first step of the simulation is always the first step of the cycle. The pre-defined WEEKLY and DAILY steps types are examples that follow this type of cycle. Both the DAILY and WEEKLY cycles consist of only 1 step each. The weekly time step nicely illustrates what it means that the cycle is not fixed to the year, since if a year begins on Sunday, the next year usually begins on Monday (and the next on Tuesday and so forth).

Steps defined by a DSS record. The end times of the simulation time steps are determined by the end times of the time steps in a user-specified DSS record. This gives you complete freedom to choose an irregular combination of time steps. This is a special case designed to handle those steps which do not fit into the cycle format.

Ideally, when you change the time step scheme, you do not have to change your system input. When OASIS reads pattern and time-series input, it internally converts the data to the time steps that it needs. This is so you do not have to duplicate input development or keep track of separate sets of input files. However, you would be well advised to check the assumptions when attempting to switch time-step sizes. For example, pattern variables in a monthly simulation might have been developed with simplifications that would not be appropriate to a daily simulation.

To use one of the pre-defined time-step sizes, open the *Run* table in the time-parameters database (section 4.5.2 part B). In the *time step* field, enter *DAILY*, *WEEKLY*, or *MONTHLY*. Remember that OASIS ignores the *Steps* table when you use the pre-defined time-step sizes, but it does use the entry in the *Year Scheme* table (section 4.5.2 part C) to determine the first day of a year. You can not do MPO (section 2.2.7) when using one of these pre-defined time-step sizes.

To use a time-step cycle that is fixed to the year, in the *time step* field in the *Run* table (section 4.5.2 part B), enter *CYCLE*. In the *Steps* table (section 4.5.2 part D), enter a record for each time step in one cycle. Enter values into the *month* and *day* fields to define the end of each time step. Do not enter anything into the *Length* field. Remember that OASIS ignores the *Year Scheme* table when you use the *Steps* table in this way. It determines the beginning of the year as the beginning of the first time step in the cycle.

To use a time-step cycle that is *not* fixed to the year, in the *time step* field in the *Run* table (section 4.5.2 part B), enter *CYCLE*. In the *Steps* table (section 4.5.2 part D), enter a record for each time step in one cycle. Enter values into the *Length* fields to define the end of each time step. Do not enter anything into the *Month* and *Day* fields. When you use the *Steps* table in this way, OASIS uses the *Year Scheme* table to determine the first day of the year (section 4.5.2 part C).

To use a time-step cycle that is defined by a DSS record, in the *time step* field in the *Run* table (section 4.5.2 part B), enter *DSS*. This tells OASIS that the lengths and end-times of the time steps are the same as the steps in a DSS record. Specify which record with the *DSS Steps* table (section 4.5.2 part E). OASIS still uses the *Steps* table (section 4.5.2 part D) to determine labels and MPO information. However, do not enter anything into the *Length*, *Month*, or *Day* fields of the *Steps* table. When you use the *Steps* table in this way, OASIS uses the *Year Scheme* table (section 4.5.2 part C) to determine the first day of the year.

Time steps are always identified by the time on which they end. For example, a week is always identified by the seventh day, and months are always identified by the last day of the month.

Some time-step systems use time steps that are not of uniform length. For example, when using the pre-defined MONTHLY time-step scheme, the months are of different lengths: 28, 29, 30, or 31 days. This causes a problem when converting from flow units to volume units per period, since the conversion factor varies with the length of the time step. OASIS always uses the exact length of the step for its conversions. Correspondingly, the OCL *convert_units* function (section 4.7.6 part C) is aware of the varying time-step lengths and does the appropriate conversion.

2.8.2 START AND END

You tell OASIS at exactly what time steps to start and end the simulation. Since a time step is always labeled by the time at the end of the time step, you enter the *time at the end of the first time step* and the *time at the end of the last time step*.

To change or view the starting and ending time steps, open the *Range* table in the time-parameters database (section 4.5.2 part A). The identities of the records (rows) in this table are fixed, and you cannot change their order. The starting time step is entered in the first record, and the ending time step is entered in the second record.

The starting and ending time steps are independent of the year scheme (*e.g.* water year or regular calendar). For example, it is perfectly legal to be using a water year, but start the simulation in February and end it in July. In other words, just because the year begins in October does not mean the simulation has to start in October.

If your time steps are fixed to the year, then OASIS starts the simulation with the first cycle step that ends *on or after* the time that you enter as the start time. Thus, OASIS corrects the start time for you, if what you entered does not coincide with the fixed end time of a step. Also, it is possible to start the simulation in the middle of the time-step cycle.

If your time steps are not fixed to the year, then OASIS always starts the simulation with the first cycle step. It is not possible to start the simulation in the middle of the time-step cycle.

If the end time that you enter does not coincide with the end time of a time step, then OASIS chooses the first time step that ends after the time that you entered. The simulation does not have to end on the last step of the time-step cycle.

2.8.3 CONTINUATION MODE

You can tell OASIS to start from the middle of a simulation run that has already been run. This is known as **continuation mode**. The time step at which you start the new run is the **continuation point**. To run in continuation mode, the run must already have been completed up to the time step before the continuation point. If some or all of the run was already completed after the continuation point, then OASIS overwrites the old results that come after the continuation point. The results that come before the continuation point are always preserved. The post-processor programs are unaware of the continuation point, and treat all the output as uninterrupted series.

To run in continuation mode, open the *Range* table in the time-parameters database (section 4.5.2 part A). The identities of the records (rows) in this table are fixed, and you cannot change their order. Enter the time of the continuation point in the fourth record.

As long as the time given in the fourth record falls between the start time and the end time (section 2.8.2), OASIS runs in continuation mode. To do a normal run, change the value in the fourth record to a time that comes before the start time..

Continuation mode is primarily used when debugging. If OASIS stops with an error, you could change the input, then re-run in continuation mode to see if the error was fixed. Continuation mode is most useful when run times are long. If your run time is short, then it is unlikely you would need to use continuation mode.

When initializing a continuation run, OASIS reads the time-series output file (section 5.6.0) to get the proper initial conditions. However, if your external modules (section 2.5.1 part I) have not been programmed to handle continuation mode, they might not use the correct initial values and time coordinates.

2.8.4 LEAP YEAR

OASIS always accounts for leap years. In pattern input, if you enter February 28 followed by March 1, OASIS assumes that February 29 has the same value as February 28. The algorithm for determining leap year is:

```
The year is not a leap year; except
if the year number is divisible by 4, the year is a leap year; except
if the year number is divisible by 100, the year is not a leap year; except
if the year number is divisible by 400, the year is a leap year.
```

In pattern input (section 4.5.1), OASIS checks whether you have entered a value for February 29. If you have entered a value for February 28 and a value for March 1, but no value for February 29, then OASIS assumes that you have forgotten about the existence of leap day. It then makes some assumptions for you (section 4.5.1 part B). If you do not agree with these assumptions, you should explicitly enter a value for February 29 whenever you enter a value for February 28.

2.8.5 YEAR SCHEME

For most situations, we think of the year as beginning on January 1. However, due to cycles of wet and dry seasons, many hydrologists find it more convenient to work with a year that begins October 1 and ends September 30, known as the **water year**. Furthermore, there are many instances of water delivery contracts that begin accounting at some time other than January 1.

The way in which a year is defined is important for analysis, because it is common to look at **annual summaries** of data. Therefore, OASIS gives you the flexibility to choose the date that you want for the start of the year. The date on which your year begins defines your **year scheme**.

Using a year scheme other than the January 1 year scheme brings a few complications to the labeling of dates. OASIS observes the following rules:

> When using a special year scheme, the year number of a year is always the same as the year number of the regular-calendar year *in which it ends*. For example, the water year is a special year scheme, beginning on October 1 and ending on September 30. Therefore, September 1950 in the regular-calendar year is labeled September 1950 in the water year. However, October 1950 in the regular-calendar year becomes October 1951 of the water year.
>
> Unlike OASIS, HEC-DSS (section 4.6.1) will not handle special year schemes. In HEC-DSS, dates must always be labeled according to the regular calendar. For example, October of water year 1951 must always be labeled October 1950 in DSS. OASIS recognizes this problem and knows how to convert from the year scheme in DSS to the year scheme of simulation.
>
> OASIS does not change the month numbers or the day numbers of the month when handling special year schemes. These numbers always reflect the identity of the date under the regular calendar. For example, suppose that you are using a year scheme that begins on March 15. Under this scheme (or any other), the date 1/1 is still January 1 of the regular calendar, and 6/30 is still June 30 of the regular calendar.

The year scheme is independent of starting and ending times of simulation. For example, the year might start in October, but you are free to start your simulation in January or any other time.

Using the *:STEP:* field in the Onevar header (section 6.1.7 part I), it is possible to generate post-processor output that uses a different year scheme than the simulation. For example, you may simulate on a water-year basis, but you might wish to see certain variables averaged or totaled over a contract year that begins March 1.

To set the year scheme:

If you are using a time-step cycle that is fixed to the year (section 2.8.1), then the year scheme is defined by the entries in the *Steps* table (section 4.5.2 part D). Each step in the cycle is identified by the date on which it ends. Thus, the last day of the year is the date identified with the last step. The *first day* of the year is not directly given in this table, but clearly it is the day following the last day of the year. If you need to change the year scheme, re-order the steps in this table.

If you are *any other* time-step scheme, then the year scheme is defined by the entry in the *Year Scheme* field of the *Year scheme* table (section 4.5.2 part C). The entry must be the name of a month. The first day of the year is the first day of the given month.

When you switch to a new year scheme, it is possible that your pattern tables are not ready for the change. Every pattern table must have an entry for the first and last day of the year.

You may want to check your OCL rules, to see that none of them carry the wrong assumption about the beginning of the year.

2.9.0 UNITS OF MEASUREMENT

All measurement units for flow rate, volume, and elevation are user-defined, so you are perfectly free to work in metric, English, or ancient Egyptian units -- or any hybrid system you like. You only need to tell OASIS the names of the units and how to convert between them. This information is specified in the *Units* table in the system database (section 4.5.3 part A). The best way to view or edit the units information is through the *Units Wizard* in the OASIS GUI (section 3.7.7). The units for measuring water quality parameters are specified in the *Concentration* table (section 4.5.3 part D).

If the *Units* table is omitted, then OASIS relies on a default system of units, where volumes are measured in acre-feet (AF) and the flow rate units are cubic feet per second (CFS). This default system assures compatibility with earlier versions of OASIS that did not have user-defined units. The default units are displayed in the example in section 4.5.3 part A.

In the *Units* table, you identify **primary** units and **alternate** units that can be used for each units category. **Primary units are the units in which OASIS works**. Internally, all values are measured in primary units. If any input values are supplied in alternate units, OASIS converts them to the primary units for internal storage. **The primary units are the default measurement for output values.**

OASIS tries to convert the measurement units of values that it reads from DSS. This means that you should always use the *UNITS* field in the DSS records (section 4.6.1).

A. Volume units

The dimensions of these units are volume, or cubic length. Internally, all volumes are measured in the **primary volume units**, and all flows are measured in primary volume units per time step. Therefore, you can assume that all flow and volume values are measured in primary volume units in:

OCL expressions

DSS output

Balance sheet output

LP output

B. Big volume units

The dimensions of these units are volume, or cubic length. The big volume units are automatically treated as alternate units for volume units, and as OASIS reads input, it converts values entered in big volume units into volume units. This units category was created because it is sometimes more convenient to measure reservoir volumes in larger units than one would use to measure flows. It is perfectly legal for volume units and big volume units to be identical. If the units of the input are not labeled, the *database input* for reservoir storage values is assumed to be measured in the **primary big volume units**, though it is highly recommended that you always label your units. The reference for each input table tells what the default units assumptions are.

C. Flow rate units.

The dimensions of these units are a volume (cubic length) over a time interval of constant size (a month does not have constant size, but a week, day, hour, or second does). Flow rate units are useful because they are independent of time step size. Furthermore, it is customary for engineers to use different units when talking about volumes and flows. For example, in the United States, many engineers use CFS to describe flow rates, and AF to describe volumes. The *database input* for arc flows is assumed to be measured in the **primary flow units** if the units of the input are not labeled, though it is highly recommended that you always label your units. The reference for each input table tells what the default units assumptions are.

D. Reservoir Surface Area units

The dimensions of these units are area, or squared length. The surface area of a reservoir is measured in the **primary area units**.

E. Elevation units

The dimensions of these units are length. Internally, OASIS measures all reservoir elevations and evaporation rates in the **primary elevation units**. Reservoir elevation is always displayed in the primary elevation units.

F. Evaporation units

The dimensions of these units are length. The evaporation units are automatically treated as alternates for the elevation units, and as OASIS reads input, it converts values entered in evaporation units into primary elevation units. These units are available because it is common to measure evaporation rate in smaller units than reservoir elevations. It is legal for the elevation units to be identical with the evaporation units.

2.10.0 WATER QUALITY

Although it is foremost a water quantity model, OASIS also has the ability to compute the concentrations of different water quality constituents. You can define between zero and three different constituents in the system database. Each constituent is independently modeled. The constituents are all assumed to be conservative, and all concentrations are computed by assuming perfect mixing at every node. You may be able to simulate a non-conservative constituent through your boundary conditions.

In each time step, OASIS computes water quality ***after*** all water quantity values have been solved by the LP router. Concentration can not be used as a decision variable. In general, the perfect-mixing equation is nonlinear with respect to flow, so the constraints or operating goals cannot be written with concentration. To work around this, you might be able to assume a constant value for certain flows. It may also be possible to use the *solve* command in an iterative manner to simulate a water quality rule.

Concentration is controlled by the flows and the concentration **boundary conditions**. There are different types of boundary conditions, but all types require **concentration input**, which are known values for the boundary conditions.

The water quality algorithm is a simple process that you could easily – if tediously – do by hand. With all flows known, it starts at the most upstream nodes, and carries the results of perfect mixing to all the downstream nodes. Boundary conditions may change or override the concentration that results from perfect mixing.

Concentration is computed and recorded at nodes. It is not recorded at arcs. By default, the concentration in any arc is equal to the concentration in the node that the arc leaves. However, you may also specify boundary conditions at arcs.

OASIS handles water quality in a very simple fashion, so if your water quality problems are at all complicated — particularly if you can't assume perfect mixing — then you may have to go beyond OASIS. OASIS is flexible enough that it can do some of the water quality computation, while the more complex parts are handled by an external module (section 2.5.1 part I). Or you may not find OASIS's water quality abilities to be of any use. In this case, it is still easy to let OASIS handle all water quantity problems, while an external module handles all water quality problems.

To model a new water quality constituent, add a record for your new constituent in the *Concentration* table (section 4.5.3 part D). Here you give a **name** and **number** which are very important — they are be used elsewhere to identify the constituent. You must also provide the name of the units for measuring the concentration of the constituent.

If they do not already exist, you will have to create three new fields for this constituent in the *Node* table (section 4.5.3 part B). These three fields all begin with *C*x, where *x* is the number of the constituent from the *Concentration* table. In these fields, you will provide boundary conditions (section 2.10.1) at nodes for this constituent, you provide reference to the concentration input values, and you can suppress the output for this constituent (see section 2.10.3).

If they do not already exist, you will have to create two new fields for this constituent in the *Arc* table (section 4.5.3 part C). These fields both begin with *C*x, where *x* is the number of the constituent from the *Concentration* table. In these fields, you will provide boundary conditions (section 2.10.1) at arcs for this constituent, and you provide reference to the concentration input values.

If it does not already exist, you will have to create a new field for this constituent in the *Initial Conditions* table (section 4.5.6). This field begins with *C*x, where *x* is the number of the constituent from the *Concentration* table. In this field, you provide the initial concentration at each reservoir node (see section 2.10.2).

There must be a *Conc Assumption* field in the *Reservoir* table (section 4.5.3 part H). There is only one field for the concentration assumption, which applies the same to all water quality constituents (see section 2.10.2).

If you are storing concentration input for this constituent in pattern tables, then there must be a *C*x *Pattern* table in the inflow database (section 4.5.5 part B).

2.10.1 WATER QUALITY BOUNDARY CONDITIONS

Each constituent has its own boundary conditions, and is not affected by the boundary conditions of the other constituents. At any point where a boundary condition is needed but none is given, OASIS assumes that the concentration is zero.

Generally, when a boundary condition is specified on an arc, OASIS tries to preserve the balance of mass and keep the mass in the system. When a boundary condition is specified on a node, OASIS may ignore the balance of mass or let the mass leave the system. For each of the individual boundary condition types below, an exact description is given how each one works for a node and for an arc.

Boundary conditions are given in the *Node* and *Arc* tables (section 4.5.3 part B and 4.5.3 part C). Only one type of boundary condition can be specified at any node or arc. The boundary conditions can be used in the following ways:

> The concentration input can be the **known value for concentration in the node or arc**. This code for this option is either ***NODE*** or ***ARC***.
>
> **At a node:** the boundary condition sets the concentration at the node, regardless of the balance of mass of the constituent from upstream. OASIS does *not* compute the upstream concentrations in order to satisfy the boundary condition, but simply lets the balance of mass be violated between this node and upstream points.
>
> **At an arc:** the boundary condition sets the concentration in the arc, regardless of the balance of mass of the constituent from upstream. If there are other arcs leaving the upstream node *that do not have boundary conditions*, then OASIS tries to preserve the balance of mass among arcs leaving this node by distributing the constituent in the arcs without boundary conditions. If there are no arcs leaving the upstream node that do not have boundary conditions, then OASIS simply lets the balance of mass be violated between the upstream node and the arcs that leave it. *If the upstream node is a reservoir node*, then the preservation of mass is guaranteed because the mass of the constituent that did not flow out through the arcs remains in the reservoir node.
>
> The concentration input can be the known value of the **concentration in the inflow** to a node. The code for this option is ***INFLOW***, and obviously it can only be applied to nodes. This boundary condition is not capable of violating the balance of mass of the constituent. If there is an inflow to a node, but this type of boundary condition is not supplied at the node, then the concentration of the constituent in the inflow is assumed to be zero.
>
> The concentration input can be the **fraction of the constituent that is removed** from the node or arc. The code for this option is ***TREAT***. If the value of the concentration input is negative, then the "negative removal" means the boundary condition *increases* the concentration of the constituent at the node or arc.
>
> **At a node:** All arcs that leave a node with this boundary condition have the same concentration. The mass of the constituent that is removed *is removed from the system*.
>
> **At an arc:** If there are other arcs leaving the upstream node *that do not have boundary conditions*, then OASIS tries to preserve the balance of mass and keep the mass of the constituent that came into the node *in the system*. It does this by adjusting the concentration in the arcs that do not have boundary conditions (they will all have the same concentration). This can be used to simulate reverse osmosis or evaporation. If there are no arcs leaving the upstream node that do not have boundary conditions, then the mass of the constituent that is removed *is removed from the system*. *If the upstream node is a reservoir node*, then the preservation of mass is guaranteed because the mass of the constituent that did not flow out through the arcs remains in the reservoir node.
>
> The concentration input can be a value to **add** to the concentration at the node or arc. The code for this option is ***ADD***. If the value of the concentration input is negative, then the boundary condition is subtracting a value from the concentration at the node or arc. This option works the same way as the *TREAT* option, it just computes a new concentration by addition instead of multiplication. See the description of the *TREAT* option just above for more details.

To add or change a boundary condition at a node, find the record for the node in the *Node* table (section 4.5.3 part B). You will edit the fields whose names begin with *C*x, where *x* is the number of the constituent from the *Concentration* table. In the *C*x*_type* field, you specify the type of boundary condition (one of the types described above). In the *C*x*_type* field, you specify the source of the concentration input that is used for this boundary condition. Depending upon the code in the *C*x*_field*, you will need to enter the concentration input in a pattern table, a time-series table, or in OCL.

To add or change a boundary condition at an arc, find the record for the node in the *Arc* table (section 4.5.3 part C). You will edit the fields whose names begin with *C*x, where *x* is the number of the constituent from the *Concentration* table. In the *C*x*_type* field, you specify the type of boundary condition (one of the types described above). In the *C*x*_type* field, you specify the source of the concentration input that is used for this boundary condition. Depending upon the code in the *C*x*_field*, you will need to enter the concentration input in a pattern table, a time-series table, or in OCL.

2.10.2 WATER QUALITY AT RESERVOIR NODES

Just as reservoir nodes have beginning-of-period and end-of-period storage values, they also have beginning-of-period and end-of-period concentration values for each water quality constituent. You must supply **initial conditions**, the concentrations of each constituent in each reservoir node at the beginning of the first time step of simulation. This information is given in the *Initial Conditions* table (section 4.5.6).

Please note that OASIS is only designed to model reservoirs as being uniformly mixed. If you need better assumptions for your water quality simulation, you may need to create special rules with OCL or use an external module. OASIS's water quality abilities may not even be useful for you at all.

The algorithm for computing concentration is very simple. It begins with the upstream nodes and works its way downstream, computing the concentration at each node with the perfect mixing assumption. Sometimes a model may experience water that follows a circular route (This is somewhat uncommon. It can occur when there is recycling of water). The circular route can cause problems for the water quality algorithm, because every node in the circular path is upstream of every other node! If you have circular flows, you can modify the assumption at reservoir nodes in order to break the circle.

Every reservoir node must use one of two water quality computation methods:

> **Outflow concentration equals concentration in the reservoir at the *beginnin*g of the time step.** The ending concentration in the reservoir is computed by perfectly mixing the starting storage minus the outflow with the inflow. This assumption is fine if the storage in the reservoir is very large compared to the flow through the reservoir. It is a very poor assumption if the flow through the reservoir is larger than the storage. This option is useful for preventing "vicious circles" in the water quality computation.
>
> **Outflow concentration equals concentration in the reservoir at the *end* of the time step.** The ending concentration is computed by perfectly mixing the starting storage with the inflow. This option is more robust than the other option, but it does not help break "vicious circles".

You tell OASIS which assumption to use at each reservoir in the *Reservoir* table (section 4.5.3 part H). The same assumption is applied for every water quality constituent. We recommend you use the end-of-time-step assumption, unless you need to overcome a circular flow problem.

To change the water quality computational method at a reservoir node, find the record for the reservoir node in the *Reservoir* table (section 4.5.3 part H). The computational method is specified in the *Conc Assumption* field.

2.10.3 WATER QUALITY OUTPUT

Each water quality constituent can increase the amount of DSS output that OASIS must write by a very large amount. Furthermore, writing to DSS is one of OASIS's slowest tasks. This is why water quality output is never written for arcs. Furthermore, it is recommended that you suppress the output at every node where you do not need to see the output.

To suppress or enable water quality output at a node, find the record for the node in the *Node* table (section 4.5.3 part B). There is a field that flags whether the output is written for this constituent at each node. The name of the field is *C*x*_output*, where *x* is the number of the constituent. If the field contains *NO*, then no output is written for this constituent at this node. If the field is blank or *Yes*, then output is written.

CHAPTER 3
REFERENCE: GRAPHICAL USER INTERFACE

3.0.0 INTRODUCTION

The OASIS graphical user interface, or ***GUI***, makes OASIS user-friendly by using windows and controls for entering input, running the simulation, and displaying output. The OASIS package actually consists of several computer programs. Almost all of the work of actually simulating a system is done by *Model.exe* and *PosAnalysis.exe*. Almost all of the work of retrieving, processing, and displaying output is done by *Onevar.exe* and *Plot.exe*, the post-processor programs. These programs can be run independently of the GUI, which is represented by *GUI.exe*. The role of the GUI is to provide a convenient interface for controlling *Model.exe*, *PosAnalysis.exe*, *Onevar.exe*, and *Plot.exe*.

We believe that few users will find any reason to run OASIS outside of the GUI. There may be special situations where you might enter data outside of the GUI program, but in general, we strongly recommend that you stay inside the GUI framework as much as possible. The GUI carefully tracks the status of a run, and making changes outside the GUI may cause confusion in that process.

The very purpose of the GUI is to be easy to understand and easy to use. We expect most users to be able to use the GUI with minimal reference to the user manual. We recommend that you skim this chapter to be aware of what's in it, and refer to it when you have a problem.

3.1.0 INSTALLATION

We have created an installation package which automatically handles the complex tasks of installing OASIS for you. This installation package installs all files necessary for the OASIS package, including the following:

OASIS GUI program
OASIS *model.exe*
OASIS post-processor programs
Third-party software, including XA and Quinn-Curtis libraries, VEDIT, and HEC-DSS utilities.
Library files that go into the Windows system folders
Auxiliary software (such as *forecast.exe*) that vary by project
Control files
Input describing model runs – varies by project
Post-processor input – varies by project
An Adobe Acrobat (*PDF*) version of the OASIS user manual
model output – for some projects

(Installing the OASIS package is not as simple as copying a few files to your hard drive, because the programs rely on *library files* (such as files with the *DLL* filename extension) which must be put into the Windows system folder and *registered*. These tasks are handled automatically by the installer program)

OASIS may be installed by the following steps:

Please note that the names indicated by the installer my be customized, for example "OASIS" may be replaced by "Duck River OASIS", "Roanoke River Basin Reservoir Operations Model", "OASIS Lite", or other project-specific name. Here we will simply cite the general name, "OASIS".

The installer program may automatically skip steps such as installing VEDIT or HEC-DSS if the necessary installation files are not present.

A. Close any programs that are running, then Click on *Setup.exe*. This starts the installer.

B. The installer displays a blue screen and the dialog box that says: "Welcome to the OASIS installation program". Click on *OK*.

C. The installer looks in the Windows Registry to see if VEDIT is already installed. If it does not find VEDIT, then it will prompt you to install VEDIT. If it does find VEDIT, then it will skip to step F.

D. The installer displays a dialog box asking "Do you want to install VEDIT now?". If you click *Don't install now*, then the installer skips to step F. Note that you might have an unregistered copy of VEDIT already installed, which the installer does not detect. If you know that VEDIT is already installed on your computer, then you can safely click *Don't install now*, and skip to step F.

E. Click *INSTALL VEDIT NOW,* and follow the prompts for VEDIT installation. These prompts are generated by the VEDIT installer, which was originally created by Greenview Data Inc (creator of VEDIT), but customized by HydroLogics.

When the VEDIT installer asks, "Do you want the compiler support files installed?", we recommend you click *No* unless you foresee a need for those files. It is quite safe to select *Skip* on the prompt that asks if you want to register VEDIT. However, registering VEDIT will allow the OASIS installer to detect VEDIT in the future. It is also perfectly safe to select *Skip* on the prompts that ask whether to print or display certain documents.

F. The OASIS installer displays a dialog box titled *HEC-DSS-Utility Installation.* HEC-DSS is the database format of all of OASIS's time-series input and output. You can safely skip the installation of HEC-DSS utilities by unchecking any or all of the check boxes on this dialog box. HEC-DSS utilities are not required for OASIS to run. However, we recommend that you install these programs so that you can edit HEC-DSS files if the need arises.

Click *OK* when you have made your selection.

G. The installer displays a dialog box with a large button labeled *INSTALL* and another button labeled *Change Directory*. In the box labeled *Directory* is the name and path of the ***Home folder*** (section 3.3.1) where the programs will be installed. If you wish, you may change the name or path of the home folder by clicking on *Change Directory*. When the name and path of the folder are to your satisfaction, click on the large button labeled *INSTALL*.

H. The installer displays a dialog box labeled *Choose Program Group*. The program group is the folder that can be accessed through the Windows *Start* menu under *Programs*. In most cases, you shouldn't need to change the program group, so just click *Continue*.

I. At this point, the installer will take time to install the library files that are needed for the OASIS package. It is likely that you will not be prompted for any input while this happens. First, it displays a box that says "Installing Data Access Components". Then it displays a progress bar while it installs several library files into the Windows system folders.

The installer next unzips several OASIS files, and then briefly a box appears that says "Updating your system". When that is done, you should see a box that says "OASIS setup was completed successfully." Click on *OK*.

J. If you clicked *Don't Install Now* in step D, then you must manually correct an entry in the file *directry.nam* (section 3.3.4) before you can run the GUI. Open *directry.nam* using VEDIT or another text-editing program. Find the field labeled *_exe_VEDIT* and modify it so that it shows the file and path of the VEDIT executable (*VPW.EXE*).

3.1.1 UNINSTALLATION

Instructions for uninstalling the OASIS package can be found in the file *README.rtf*. If you need to uninstall OASIS, please follow the instructions in the *readme* file. If you merely delete the home folder, the uninstall will be incomplete.

3.1.2 COMPONENTS OF THE INSTALLATION PACKAGE

The most important components of the installation package are:

***GUI.cab*:** This is a compressed archive that mainly contains library files which the installer writes into the Windows system folder. This file can be opened with WinZip or other file-compression programs.

***DCOM* folder:** This folder contains components that the installer uses when installing to Windows 95 or Windows 98 systems. This folder is of no value to computers that are not running Windows 95 or Windows 98.

***HEC-DSS* folder:** This folder contains zip files for DOS-based HEC-DSS utilities and an installer program for HecDssVue. You may install DOS-based HEC-DSS utilities yourself by simply unzipping the files into an appropriate folder. You may install HecDssVue by running *DssVueSetup.exe*.

***VEDIT* folder:** This folder contains the files needed to install the text-editing program VEDIT, made by Greenview Data Inc. You can install VEDIT yourself by running the command shown below. The command must be executed in the *VEDIT* folder.

```
VPW.EXE -z -v -e -g -k -ixxx -crs(81,"c:\d.txt") -xoasis_installw.vdm
```

Then when the VEDIT installer is done running, you should copy the files listed below from the *VEDIT* installer folder to the folder where VEDIT was installed on your hard drive. Overwrite any existing copies of these files.

```
vedit.cfg
startup.vdm
ocl.syn
```

Installing VEDIT manually in this way will *not* create a program group for VEDIT in the Windows *Start* menu.

***ZIP* folder:** This folder contains the main OASIS executables, the libraries for XA and Quinn-Curtis, the OASIS user manual in Adobe Acrobat (*PDF*) format, any auxiliary executables, and all data files that are to be installed with the project. The files are all compressed and archived in a set of ZIP files. The ZIP files and their contents vary by project. **These files are preserved here in the form from the original installation, and can be selectively extracted from the ZIP files if needed.** Extracting the files from these ZIP files is not sufficient to install OASIS on your computer, because OASIS relies on library files which must be installed in your Windows system folders and entered into the Windows registry.

3.2.0 VEDIT

VEDIT is text-editing software produced by Greenview Data Inc. VEDIT is very efficient and has much more powerful features than Windows WordPad. The OASIS GUI relies on VEDIT to display ASCII files, such as OCL files and table outputs, and make them available for editing. One of VEDIT's best features is *syntax highlighting*, which allows it to display an OCL file with different types of keywords in different colors.

Like many Windows programs, VEDIT allows you to open more than one file in the same instance of the program. This feature can be very useful when analyzing OASIS output files from different runs. If two documents are open in a VEDIT window, you can press the *F5* key to toggle between them. If you toggle quickly between two documents, the differences and similarities in the files are readily visible.

Anyone who receives a license to use OASIS receives a license to use VEDIT. The licensing is handled by HydroLogics. For information about installing VEDIT for use with OASIS, see section 3.1.0.

VEDIT has excellent online documentation, which you can access from the *Help* menu.

The GUI must be told where the VEDIT executable can be found. This is done in the *_exe_VEDIT* field in the file *directry.nam* (section 3.3.4).

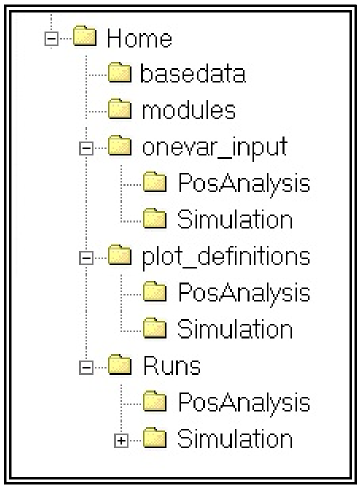
3.3.0 FILES AND DIRECTORY STRUCTURE

The files and folders needed by the OASIS GUI are automatically copied onto your hard drive by the installation process (section 3.1.0). Although you will surely spend more time managing input and output through the GUI interface, it is useful to have at least some familiarity with the files that are involved.

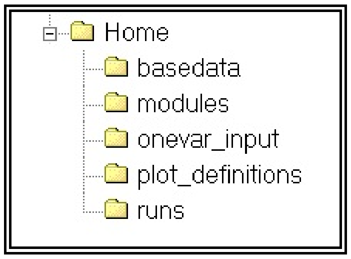
3.3.1 STANDARD DIRECTORY STRUCTURE

Although the GUI can be configured for different directory structures, we have developed standard structures that are preferred. The preferred structure is automatically created when OASIS is installed (section 3.1.0).

The GUI is designed to handle projects that include both long-term model runs (called *simulation* by convention) and position-analysis model runs. If a project does include both types of studies, the following directory structure is preferred:



If a project does not include the two different types of studies (*Position Analysis* and *Simulation*), and you are certain that you won't ever want to include both types of studies in the project, then the preferred directory structure can be simplified as shown:



The folders in the directory structure have the following purposes:

Executables — This is the folder where the main executable files are stored. See section 3.3.3 for information about the files that are kept in this folder. The folder is not shown on the directory trees above because usually it fits in one of two situations:

When OASIS is run on a remote server, the executables folder is on a separate computer

When OASIS is run on your own computer (not from a remote server), the executables folder is the same as the home folder.

Home — This folder is often named *OASIS*, but it may be given a more project-specific name. For generic purposes, we refer to it as the "home folder", for it is where the main control files are located, and it is the top-level folder. See section 3.3.2 for information about the files that are kept in this folder. Commonly, the home folder and the executables folder are the same folder, so the home folder also contains all of the main executables. If the home folder and the executables folder are *not* the same folder, then the home folder is still the folder that the executables run in (i.e., the *current working directory*).

Basedata — This folder is not strictly required by any function of the GUI. However, it is used for most projects as a place to keep time-series data or other data that is common to more than one run.

Modules — This folder is not required by every project. It is used to contain extra programs and program modules that integrate with OASIS.

Onevar_input — Generally, this folder should only contain Onevar-input files (section 6.1.3). All Onevar-input files that you wish to access through the GUI must be located here. If your project includes both simulation runs and position-analysis runs, then this folder should be divided into two sub-folders, *PosAnalysis* and *Simulation*. The *PosAnalysis* sub-folder must contain the file *QuickViewTraceFilter.txt* in order for the GUI's Quick View feature to be fully functional (section 3.6.4 part I).

Plot_definitions — Generally, this folder should only contain plot-definition files (section 6.2.3). All plot-definition files that you wish to access through the GUI must be located here. If your project includes both simulation runs and position-analysis runs, then this folder should be divided into two sub-folders, *PosAnalysis* and *Simulation*. The plot definitions folder (or its sub-folders) must contain the file *QuickView-DoNotErase.zmdb* in order to use the GUI's Quick View feature (section 3.6.4 part I).

Runs — The GUI assumes that all sub-folders in this folder are run directories. All run directories that you wish to access through the GUI must be located here. If your project includes both simulation runs and position-analysis runs, then this folder should be divided into two sub-folders, *PosAnalysis* and *Simulation*.

Although we describe the preferred directory structure here, the names and paths of all these folders are user-definable in the file *directry.nam*. See section 3.3.4 for details. The directory structure may be more complicated if your project uses subgroups (section 3.3.8).

3.3.2 HOME FOLDER

For the GUI to function, certain files must be found in the **home folder**. The list of required files does not change even if you have multiple subgroups (section 3.3.8). Except for special cases, you should not have to handle these files directly because the GUI handles them for you. The required files are listed below.

If you are running OASIS from your local computer, the home folder and the **executables folder** are usually the same folder, so all the files listed in section 3.3.3 should also be considered to be in the home folder. However, if you are running OASIS from a remote server, the executables folder is usually kept separate from the home folder.

Directry.nam – (section 3.3.4) This is an ASCII text file that tells the GUI what the basic directory structure is. The GUI automatically records the identity of the currently open run in this file. The other information in this file must be changed manually. It is uncommon that the information in this file would need to be changed manually, except when first installing the software.

GUI.ini – This is an ASCII text file that stores configuration information for the GUI. You may manually make changes to this file using a text editor. Many parameters in this file can be changed through the GUI itself using the *Preferences* dialog box (section 3.6.2 part C). See section 3.3.5 for a complete list of the parameters in this file.

Record_dates.dat – This is an ASCII text file that records the date at the beginning and end of the historical hydrologic record. This information is needed if you are running the update-record process. Otherwise, the file does not need to be present.

Plot.cf – (section 6.2.1) This is an ASCII text file that tells *Plot.exe* what run directories and plot-definition files to read. The GUI automatically writes this file when you click on *Plots* and select plot-definition files. Therefore, you should never have to look at this file unless you execute *Plot.exe* outside of the GUI.

Onevar.cf – (section 6.1.2) This is an ASCII text file that tells *Onevar.exe* what Onevar-input file to read. This file is not used by the GUI. It is only needed if you execute *Onevar.exe* outside of the GUI.

Template.mdb – When the GUI is started, it immediately attempts to connect to a database file. *Template.mdb* must be present so that there is a database file to connect to. After some processing, the GUI connects to the database file in the currently open run and disconnects from *Template.mdb*. The contents of *Template.mdb* are unimportant, and there is no reason you should ever need to open it.

OASIS.idKey – (section 4.2.0) This is an ASCII text file that contains encrypted information identifying the licensee of the OASIS project. *Model.exe* will not execute if this file is not present, or if it has been tampered with. If you open this file with a text editor or text viewer program, you can see a short description of the licensee. If you have a problem with this file, contact HydroLogics to have it replaced.

3.3.3 EXECUTABLES FOLDER

If you are running OASIS from your local computer, the **home folder** and the **executables folder** are usually the same folder, so all the files listed below should also be considered to be in the home folder (section 3.3.2). However, if you are running OASIS from a remote server, the executables folder is usually kept separate from the home folder.

GUI.EXE – This is the program file for the GUI. Execute this file to begin working with OASIS.

OASISGUI_Plugin.ocx – This file contains components of *GUI.exe* that can be customized by HydroLogics. Different projects use different versions of this file. *GUI.exe* can not run if this file is not present in the home folder.

MODEL.EXE – This is the program file for the OASIS model. This file can be executed to simulate the system. This file is executed automatically by the GUI when you click on *Run* (if the GUI is in simulation mode).

ONEVAR.EXE – This is the program file that post-processes table outputs. This file is executed automatically by the GUI after you click on *Tables* and select Onevar inputs.

PLOT.EXE – This is the program file that post-processes plot outputs. This file is executed automatically by the GUI after you click on *Plots* and select plot-definition files.

PosAnalysis.EXE – This is the program file for the that manages the position-analysis process. This file is executed automatically by the GUI when you click on *Run* (if the GUI is in position-analysis mode).

SplashScreen.EXE – This is the program file that displays a splash screen identifying the project. The splash screen is customized for clients. Every time you start the GUI, this program is executed. Clicking on the splash screen terminates the program. You may execute this file outside of the GUI to see the splash screen.

AXA32.DLL – This is the program file for XA, a linear-program solver produced by Sunset Software. XA is proprietary software, so HydroLogics arranges for each client to receive a license to use XA. Every copy of XA is customized to identify the licensee. Unless special arrangements are made, the license specifies that XA may only be used in conjunction with OASIS. *Model.exe* calls upon the library routines in *AXA32.DLL* during simulation. You cannot execute *AXA32.DLL* in any other context. *Model.exe* cannot run if *AXA32.DLL* is not present.

WCT32FR3.DLL and **WRT32FR3.DLL** – These are library files called upon by *Plot.exe*. The files were originally written by Quinn-Curtis Inc., and subsequently customized by HydroLogics. *Plot.exe* cannot run if these files are not present.

3.3.4 POINTER FILE *Directry.nam*

The file *directry.nam* is the pointer file used by *model.exe* to identify the current run folder (section 4.3.0). The GUI uses *directry.nam* for the same purpose, but it also reads the location of important files and folders. *Directry.nam* must always be in the home folder (section 3.3.1). If you rearrange the directory structure of your project, you will need to reflect those changes in this file. Refer to the example below:

Example of *Directry.nam*

```
This is the pointer file used by OASIS and its graphical user interface.

 |  runs\Run1

 ------------------------------
_runs_Sim      | runs\Simulation       // The folder containing Sim runs
_runs_PosAnal  | runs\PosAnalysis       // The folder containing PosAnal runs
_tables_Sim    | onevar_input\Simulation  // The folder containing Sim Table inputs
_tables_PosAnal| onevar_input\PosAnalysis  // The folder containing PosAnal Table inputs
_plots_Sim     | plot_defs\Simulation  // The folder containing Sim Plot defs
_plots_PosAnal | plot_defs\PosAnalysis // The folder containing PosAnal Plot defs
_exe_VEDIT     | C:\PROGRA~1\VEDIT\vpw.exe  // The full path to VEDIT executable
_exe_Modules   | modules       // The folder containing external module programs
```

Each entry is preceded by a pipe character (a vertical bar). The first entry, which is used by both the GUI and *model.exe* is the path of the current run folder. For all entries except the first entry, the pipe character is preceded by a field name. The entry in the field is followed by a comment which begins with two slashes. The path information in the these fields is either absolute or relative to the home folder. The following fields are required:

_runs_Sim	This field contains the path of the subdirectory of the *Runs* folder (as described in section 3.3.1) which contains all run directories for simulation mode (section 3.4.7). If there is no position-analysis mode in your project, then it may be convenient for this entry to simply be the *Runs* folder. If there is no simulation mode in your project, then the entry in this field is unimportant.
_runs_PosAnal	This field contains the path of the subdirectory of the *Runs* folder (as described in section 3.3.1) which contains all run directories for position-analysis mode (section 3.4.7). If there is no simulation mode in your project, then it may be convenient for this entry to simply be the *Runs* folder. If there is no position-analysis mode in your project, then the entry in this field is unimportant.
_tables_Sim	This field contains the path of the subdirectory of the *Onevar_input* folder (as described in section 3.3.1) which contains all Onevar-input files for simulation mode (section 3.4.7). If there is no position-analysis mode in your project, then it may be convenient for this entry to simply be the *Onevar_input* folder. If there is no simulation mode in your project, then the entry in this field is unimportant.

_tables_PosAnal	This field contains the path of the subdirectory of the *Onevar_input* folder (as described in section 3.3.1) which contains all Onevar-input files for position-analysis mode (section 3.4.7). If there is no simulation mode in your project, then it may be convenient for this entry to simply be the *Onevar_input* folder. If there is no position-analysis mode in your project, then the entry in this field is unimportant.
_plots_Sim	This field contains the path of the subdirectory of the *plot_definitions* folder (as described in section 3.3.1) which contains all plot-definition files for simulation mode (section 3.4.7). If there is no position-analysis mode in your project, then it may be convenient for this entry to simply be the *plot_definitions* folder. If there is no simulation mode in your project, then the entry in this field is unimportant.
_plots_PosAnal	This field contains the path of the subdirectory of the *plot_definitions* folder (as described in section 3.3.1) which contains all plot-definition files for position-analysis mode (section 3.4.7). If there is no simulation mode in your project, then it may be convenient for this entry to simply be the *plot_definitions* folder. If there is no position-analysis mode in your project, then the entry in this field is unimportant.
_exe_VEDIT	This field contains the path of the VEDIT executable (section 3.2.0). The GUI will not run if the path to the VEDIT executable is invalid.
_exe_Modules	This field contains the path of the *modules* folder (as described in section 3.3.1).

3.3.5 CONFIGURATION FILE *GUI.ini*

You can change many features of the GUI by editing the file *GUI.ini*. Many of the configuration settings stored in *GUI.ini* can be set through the *Preferences* dialog box (section 3.6.2 part C), but others can only be set by editing the file in a text editor program.

The file is in ASCII format (plain text), and it follows the conventions of other Windows *ini* files. Some of the conventions are:

All parameters for configuring the GUI appear after the heading *[OASISGUI]*. Other headings can be put in the file but they are ignored by the GUI.

Each parameter appears on its own line.

The parameters are entered like so:

ParameterName=ParameterValue

No white space is needed. If *ParameterValue* is a file path or other text string, it should have quotation marks, like so:

```
_AcrobatUserManual="MANUAL\OASIS_Manual.pdf"
```

A semicolon at the beginning of a line or a semicolon with a space before it is treated as a comment marker. The semicolon and everything after it is not read by the GUI. Thus, explanatory comments can be entered into the file. However, *if a semicolon has text other than a space before it, it is not treated as a comment marker.*

The tokens *$(ExeDir)* and *$(HomeDir)* can be used in any parameter that contains a path name. When the GUI reads a parameter containing these tokens, it internally reads them as the path of the executables folder (see section 3.3.3) and the home folder (see section 3.3.2). For example, if the path of the home folder is *C:\OASIS* and we have this parameter:

```
_WinHelp=$(HomeDir)\MANUAL\OASIS_Manual.pdf
```

Then the GUI recognizes this to mean

```
_WinHelp=C:\OASIS\MANUAL\OASIS_Manual.pdf
```

The parameters that can be entered in the file are:

_ModeSim - If 1, the GUI can do Simulation Mode (section 3.4.7). If 0, the GUI does not make Simulation Mode available.

_ModePosAnal - If 1, the GUI can do Position-Analysis Mode (section 3.4.7). If 0, the GUI does not make Position-Analysis Mode available.

TbVis_Schematic - If 1, the *Schematic* tab is visible. If 0, the *Schematic* tab is invisible.

TbVis_Setup - If 1, the *Setup* tab is visible. If 0, the *Setup* tab is invisible.

TbVis_Time - If 1, the *Time* tab is visible. If 0, the *Time* tab is invisible.

TbVis_Node - If 1, the *Node* tab is visible. If 0, the *Node* tab is invisible.

TbVis_Arc - If 1, the *Arc* tab is visible. If 0, the *Arc* tab is invisible.

TbVis_OCL - If 1, the *OCL* tab is visible. If 0, the *OCL* tab is invisible.

TbVis_Misc - If 1, the *Misc* tab is visible. If 0, the *Misc* tab is invisible.

IDf_NNumbers - If 1, tables on the *Node* tab show a column for node numbers. If 0, node numbers are not shown.

IDf_NNodeNames - If 1, tables on the *Node* tab show a column for node names. If 0, node names are not shown.

IDf_ANumbers - If 1, tables on the *Arc* tab show a column for node numbers. If 0, node numbers are not shown.

IDf_ANodeNames - If 1, tables on the *Arc* tab show a column for node names. If 0, node names are not shown.

IDf_AArcNames - If 1, tables on the *Arc* tab show a column for arc names. If 0, arc names are not shown.

_SplashScreen - If 1, the splash screen is shown when the GUI starts. If 0, no splash screen is shown.

_SetupGame - If 1, the GUI shows controls for gaming parameters (section 3.7.2) and configures the run based on the gaming parameters. If 0, gaming parameters are not shown or used.

_SetupInitCond - If 1, the *Initial Conditions* table appears on the Setup tab. If 0, the *Initial Conditions* table does not appear on the *Setup* tab.

_SetupOCLFiles - If 1, the list of OCL files appears on the Setup tab. If 0, this list-box does not appear on the *Setup* tab.

_CopyNotesFile - If 1, the GUI propagates the text in the notes file (section 3.4.5) from the existing run to the new run when you copy a run. If 0, the GUI applies a blank notes file when a new run is created.

_DeleteOutput - If 1, the GUI deletes output files every time the run is saved. If 0, the GUI does not delete output files.

_RunDirAbsPath - If 1, the GUI writes the path of the current run folder in *directry.nam* (section 3.3.4) as an absolute path. If 0, the GUI writes this path relative to the home folder.

_HydUpdate - If 1,the GUI displays the *Update Record* tab. If 0, the *Update Record* tab is invisible and you can not run the record-updating process.

_HydUpdateDBFile - The file path (relative to the home folder) and name of an MS Access (MDB) file in which the update-record table is stored. If this parameter is not present, then the file name *basedata\hydrologic_update.mdb* is used. This parameter is ignored if *_HydUpdate* is not present.

_HydUpdateCommand - The command to be executed to update records. The command may include command-line paramters for the executable. The path to the executable is relative to the home folder. This parameter is ignored if *_HydUpdate* is not present.

_HydUpdateWorkDir - The file path (relative to the home folder) where the command for updating records should be executed. This parameter is ignored if *_HydUpdate* is not present

_NumSubGroups - The number of subgroups (section 3.3.8). If 0, there are no subgroups. If more than 0, then there must be parameters *_SubGroup*XX to match.

_SubGroup*XX* - (where *XX* is a two-digit number) The name of subgroup folder number *XX* (section 3.3.8).

Plot_Filter - The filter for filenames in the plot-definitions folder (section 3.3.1). If this parameter is not present, the GUI allows you to select any file in the plot-definitions folder. If the parameter is present, only files that match the filter can be selected. See notes about filters below.

Table_Filter - The filter for filenames in the Onevar-input folder (section 3.3.1). If this parameter is not present, the GUI allows you to select any file in the Onevar-input folder. If the parameter is present, only files that match the filter can be selected. See notes about filters below.

OCL_Filter - The filter for filenames in the OCL folder (section 3.3.7). If this parameter is not present, the GUI allows you to select any file in the OCL folder. If the parameter is present, only files that match the filter can be selected. See notes about filters below.

DSS Path - The full path and file name of the HecDssVue executable (section 4.6.0).

_AutoDeleteNodes - If 1, then when you delete a node or arc from the schematic, all records for that node or arc are deleted from all static-database tables. If -1, then deleting a node from the schematic only causes deletion of the node from the *Node* table and deleting and arc only causes deletion of the arc from the *Arc* table. If 0, then the GUI prompts you whether you want to delete the records for the node or arc from the other tables.

_SortByYearScheme - If 1, pattern-type tables (section 4.5.1) are sorted according to the OASIS year scheme (section 2.8.5). If 0, pattern-type tables are with January 1 at the beginning regardless of the OASIS year scheme.

_OCLConstants - If 1, the *OCL Constants* table (section 4.5.9 part C) is visible on the *OCL* tab; the GUI saves the constants to the file specified by the parameter *_OCLConst_fName*; and the table *Constants* must be present in the file *statdata.mdb*. If 0, the table is not visible; the GUI does not save constants to an OCL file; and the table *Constants* is not required in the file *statdata.mdb*.

_OCLConst_fName - The name of an OCL file in which the constants from the *OCL Constants* table (sec 4.5.9 part C) are written. The file is written to the OCL subfolder of the run folder (section 3.3.7). No path information should be given. If the parameter *_OCLConstants* is 0, then this parameter is ignored. If *_OCLConstants* is 1 but this parameter is not given, then the default name of *constants_inc.ocl* is used.

_WinHelp - The path (relative to the home folder) and file name of a help file in WinHelp (HLP) or HTMLHelp (CHM) format. If this parameter is present, the help file can be called from the menu *Help > Help* (section 94). If the parameter is not present, *Help > Help* is not available in the menu.

_AcrobatUserManual - The path (relative to the home folder) and file name of the OASIS user manual in Adobe Acrobat (PDF) format. If this parameter is present, the manual file can be opened from the menu *Help > User Manual* (section 94). If the parameter is not present, *Help > User Manual* is not available in the menu.

CustomMenu_Help*X* - Defines a custom item in the *Help* menu (section 94). *X* is a number from 1-8, so that there may be up to 8 custom items in the *Help* menu. The parameter consists of two pieces of information, separated by a pipe character. The first part contains the label of the custom menu item. The second part contains the system command that is automatically executed when this custom menu item is clicked. The second part can be a full command including command-line parameters. Alternatively, it can be the path of a file that should be opened, and the operating system will open the file with the appropriate software according to the registered file types. For example:

```
    CustomMenu_Help1=Project Notes | MANUAL\Project_Notes.pdf
```

Causes the creation of an item in the *Help* menu labeled *Project Notes*. When this menu item is clicked, the GUI automatically opens the file *Project_Notes.pdf* using whatever software is registered to open a file with *PDF* extension.

AddnlCopyFiles - The names (with path relative to the home folder) of additional files and folders that should be copied from an old run to a new run when a new run is created (section 3.4.2). The file names can include wildcards (? and *) and they should be separated by semicolons. Do not put space before the semicolons.

_IHA_PostProc - If 1, the IHA post-processing feature is enabled (section 3.6.4 part C). If 0, this feature is disabled. If this parameter is not present, then IHA post-processing is disabled.

_IHA_ProjTemplate - The path (relative to the home folder) of a folder that serves as the template for a new project folder when doing IHA post-processing (section 3.6.4 part C). If IHA post-processing is disabled, then this parameter is ignored.

_IHA_EXE - The command (including path) that launches the IHA GUI when doing IHA post-processing (section 3.6.4 part C). If IHA post-processing is disabled, then this parameter is ignored.

FatalMissingVarSet - If 1, then when the model runs, any variables that require an OCL *SET* command (section 4.7.2 part F) but lack an OCL *SET* command will trigger a fatal error message. If the parameter is missing or if its value is 0, then missing OCL *SET* commands will be listed in *debug.out*, but there is no fatal error.

Notes:

File Filters - The parameters *Plot_Filter*, *Table_Filter*, and *OCL_Filter* are used to store ***filename filters*** for displaying lists of files in list boxes.

For example, the *OCL Command Files* list box (section 3.7.6) lists files in the OCL subfolder that the user can select. If a filename filter is entered with the *OCL_Filter* parameter, this can limit the filenames that are shown in the list box. The filter is created with wildcard characters * and *?*. Typically, you want to only display files with certain filename extensions. If you only want files with the *OCL* extension to show up in the list, then the parameter can be entered as:

```
OCL_Filter=*.ocl
```

However, if you want to display files with the *OCL* and *DAT* extension, you can separate multiple filters with a semicolon. Do not put space before the semicolon. For example:

```
OCL_Filter=*.ocl;*.dat
```

3.3.6 DETERMINING FILE VERSION

HydroLogics frequently updates the OASIS software to add new features or to fix program bugs. Each update of the software is assigned a version number. There are three sets of version numbers:

Model.exe, PosAnalysis.exe, Onevar.exe, and *Plot.exe* all share source code in common, so they are all assigned a single version number.

GUI.exe has its own version number. It also has a two-letter code (example: *AC*) that must match the two-letter code in *OASISGUI_Plugin.ocx*

OASISGUI_Plugin.ocx has its own version number. It also has a two-letter code (example: *AC*) that must match the two-letter code in *GUI.exe*. Finally, the plugin has a name that tells what project it is customized for. If it is not customized for a specific project, this name is *NO CUSTOM*.

There are two principal ways of checking the version number of your copy of the software

Through Windows: Right-click on the executable file from Windows Explorer. A dialog box will pop up. Click on the tab labeled *Version*. The version number will be displayed. For *GUI.exe* and *OASISGUI_Plugin.ocx*, the two-letter code for plugin compatibility and the plugin name are under *Comments*.

Through the OASIS GUI: Click on the menu *Help*, then *About (File Version)*. A display window appears which reports the version number of the executable files. It tells the two-letter code for plugin compatibility (*GUI.exe* and *OASISGUI_Plugin.ocx* should have the same two-letter code). It also displays the project name of *OASISGUI_Plugin.ocx*. Click on this window to close it.

If there is a problem that causes the GUI to crash before it finishes opening, you should still be able to get it to report the version number. Execute this command (from DOS, from the *Run* command, or using a Windows shortcut):

```
GUI.EXE VerInfo
```

The command-line option *VerInfo* causes the GUI to run without doing anything more than displaying the version information window. When you click on the window, the GUI closes.

3.3.7 FILES IN THE RUN DIRECTORY

In order for the GUI to function properly, certain files must be present in the run directory (section 2.3.1). In most cases, you should not have to directly access files that are in the run directory, because the GUI handles these files for you.

Model.cf – (section 4.3.0) This is an ASCII text file that tells the software which files contain input and output data. You should never have to look at this file unless you are running the model outside of the GUI.

StatData.mdb – This is an MS Access database file that contains the standard model input (section 4.5.0). You should not need to access this file directly except in rare cases, because the GUI provides an interface to the data.

Notes.dat – (section 3.4.5) This is an ASCII text file that contains notes describing the model run. You should not need to access this file directly because the GUI provides an interface for you to read and edit the notes.

OCL folder – This folder contains all the OCL files (section 4.7.0) for the run which are accessible to the GUI. If any OCL file is located outside this folder, it is not accessible for viewing and editing through the GUI.

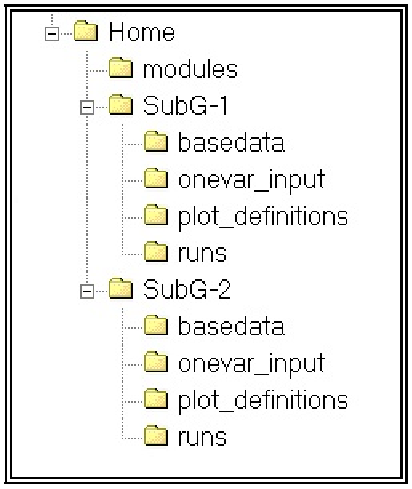
Output folder – (Position-Analysis runs only) This folder contains all the time-series output databases (section 5.6.0) generated by *model.exe* during a position-analysis run. You should not need to access these files directly.

Other files – Output files generated by *model.exe* go into this folder, as well as post-processed tables generated by *Onevar.exe*. If you are doing special processing of data in spreadsheets or other software, you may find it appropriate to save your files into the run directory.

3.3.8 SUBGROUPS

You can divide your runs and post-processor files into subgroups. Only one sub-group is open at a time, and while that sub-group is open, the GUI only accesses the runs and post-processor files that are specific to that sub-group. Therefore, the GUI prevents you from mixing the files that belong to different subgroups. Sub-groups can be useful if you need to model separate systems or if you have sets of runs that do not need to be compared between sets. By using subgroups, you can avoid dealing with long lists of runs or post-processor files when only a few are relevant to you at a time.

To create subgroups, you must manually configure the GUI while *GUI.exe* is not running. Each subgroup must have a subfolder of the home folder. A directory structure with two subgroups is illustrated below. Compare this directory structure with the standard structure described in section 3.3.1. Note that in this example the GUI is configured for Simulation mode only (no Position Analysis mode).



When there are subgroups, the home folder (section 3.3.2) should contain the all same files as it would otherwise. Each subgroup folder contains a version of the folders *basedata*, *onevar_input*, *plot_definitions*, and *runs*. The names of the subgroup folders are completely user-defined -- we have assigned the names *SubG-1* and *SubG-2* only as examples. There is no reason to put copies of the files from the home folder into the subgroup folders. The only file that must be in the subgroup folder is an ASCII text file called *SubDir.nam*.

When you tell the GUI to open a new subgroup, it first overwrites *SubDir.nam* in the currently open subgroup with *Directry.nam* (section 3.3.4) from the home folder. Then it overwrites *Directry.nam* in the home folder with *SubDir.nam* from the subgroup that is being newly opened. Thus, the files named *SubDir.nam* simply serve as auxiliary copies of *Directry.nam*. For illustration, here is the text that should be in *SubDir.nam* in the folder *SubG-1*:

Example of *SubDir.nam*

```
This is the pointer file used by OASIS and its graphical user interface.

 |  SubG-1\runs\Run1

 ------------------------------
_runs_Sim      | SubG-1\runs       // The folder containing Sim runs
_runs_PosAnal  | SubG-1\runs       // The folder containing PosAnal runs
_tables_Sim    | SubG-1\onevar_input  // The folder containing Sim Table inputs
_tables_PosAnal| SubG-1\onevar_input  // The folder containing PosAnal Table inputs
_plots_Sim     | SubG-1\plot_definitions  // The folder containing Sim Plot defs
_plots_PosAnal | SubG-1\plot_definitions    // The folder containing PosAnal Plot defs
_exe_VEDIT     | C:\PROGRA~1\VEDIT\vpw.exe  // The full path to VEDIT executable
_exe_Modules   | modules       // The folder containing external module programs
```

As the example shows, each instance of *SubDir.nam* could become the new *Directry.nam*, and so it contains path references that should be applied when the associated subgroup is opened. The instance of *SubDir.nam* in the folder *SubG-2* would look the same except it would refer to the subfolders of *SubG-2* instead of *SubG-1*.

Note that the directory structure is user-defined, and the example we have given is just one possible configuration. If you wish, you could configure it so that the runs are held in common between the subgroups, while the post-processor files are distinct for each subgroup. Conversely, the post-processors could be held in common and the runs could be distinct. You may also choose put the *BaseData* folder into the home folder so that it is held in common by all subgroups. In short, you can configure the subgroups in the way that is most convenient for your project.

The subgroup configuration should be reflected in the file *preferences.cf*. In our example with two subgroups, the following lines should be found in *preferences.cf*.

```
_NumSubGroups      |  2
_SubGroup01        | *SubG-1
_SubGroup02        |  SubG-2
```

If the file does not contain the field *_NumSubGroups*, then the GUI assumes that there are no subgroups.   Otherwise, the field *_NumSubGroups* must contain the number of subgroups. For each subgroup, there must be a field named *_SubGroup*XX, where *XX* is the number of the subgroup (from 1 to the number of subgroups). The field *_SubGroup*XX contains the name of the subgroup folder. One of the subgroup folder names must be preceded by an asterisk (*). This denotes which of the subgroups are currently active.

Once the directory structure is created, and the files *Directry.nam*, *SubDir.nam*, and *preferences.cf* contain the appropriate text, you can open a different subgroup through the GUI controls and you do not need to handle these files directly.

To open a different subgroup, click on the *Edit* menu, then on *Preferences*. Next click on the tab *SubGroups*. Then you can highlight the subgroup you want to open, and click *OK*. See section 3.6.2 part C for more information.

3.4.0 HANDLING RUN DIRECTORIES

See section 2.3.1 for an explanation of the run directory concept. The OASIS GUI is designed to make it easy to deal with run directories.

3.4.1 OPEN RUN

Only one run at a time can be the open run. The open run is identified on the title bar of the main GUI window. You may also verify the name of the open run by clicking on the *Edit* menu, then on *Notes* (section 3.6.2 part B).

All model **input** displayed by the GUI is the input of the open run. To see or edit the input of another run, you must open that run. If you run the model, it is the open run and no other that is executed. To execute another run, you must open that run. When you open model **output** through the GUI, you may open the output of any run (within the same mode - simulation or position analysis (section 3.4.7), and within the same subgroup), but the open run is offered as the default for the output.

To open a new run, click on the *File* menu, and then click on *Open Run*. See section 3.6.1 part B.

To open a run in a different subgroup, you must first open that subgroup. See section 3.6.2 part C.

When you select *Save*, all changes made to the open run are saved. See section 3.4.6.

3.4.2 CREATING A NEW RUN

To create a new run, you must start by copying one of the currently existing runs. Once that is done, you can modify the input of the new copy to fit your new modeling scenario.

To copy an existing run, click on the *File* menu, then on *Copy Run*. See section 3.6.1 part A.

When the GUI creates a new run in this way, it copies the files *model.cf*, *statdata.mdb*, *notes.dat*, the *ocl* subfolder, files and subfolders that might be determined by the GUI plugin, and the additional files and subfolders specified in the preferences (3.6.2 part C). Any other files or subfolders in the source run folder are not copied. Thus, as a general rule, model output files and post-processor output files are not transferred to the newly created run.

To create a run in a different subgroup, you must first open that subgroup. See section 3.6.2 part C.

Although we don't recommend it for most situations, you can create a new run outside the GUI. Simply copy an existing run folder to and paste it into the folder where the other runs are found (in our examples, these folders are named *Runs*, *Runs/Simulation*, or *Runs/PosAnalysis*). As long as the new folder contains the necessary files (Section 3.3.7), the GUI will recognize it as a run that can be opened and executed.

3.4.3 DELETING A RUN

To delete a run, click on the *File* menu, then on *Delete Run*. See section 3.6.1 part C. You may delete the open run or any other run (within the current subgroup). You can only delete one run at a time. When the run is deleted, it is *not* saved in the Windows Recycle Bin.

To delete a run in a different subgroup, you must first open that subgroup. See section 3.6.2 part C.

Deleting a run folder outside of the GUI is an effective way to delete a run. However, you must be careful not to delete the open run if you do this. To be safe, we suggest you only delete runs through the GUI.

3.4.4 CHANGING THE NAME OF A RUN

If you wish to change the name of a run, you must do so outside of the GUI. Do not try to change the name of a run while it is the open run. To change the name, simply rename the run folder.

3.4.5 NOTES FILE

Every run folder must contain an ASCII text file named *Notes.dat*. The GUI maintains the format of this file for you. Normally, you view or change this information through the GUI by clicking on the *Edit* menu, then on *Notes* (section 3.6.2 part B). We do not recommend that you edit this file outside the GUI. However, if you open the file with a text editor or text viewer, outside the GUI, you can see the following information:

Example of *Notes.dat*

```
RUN PATH :   C:\OASIS\Runs\Alt_2G
MODIFIED BY :   Jill X.
EXECUTION TIME :  Thu Oct 03 2002 13:24

This run is fictitious.  It is identical to fictitious run "Alt_2F" except the target
flows below Reservoir 1 have been increased to 30 CFS in August.
```

The first field of information, labeled *RUN PATH*, is automatically maintained by the GUI. It is the full path of the run folder. The second field, *MODIFIED BY*, corresponds to an input field that you should fill whenever you enter the notes file. The third field, *EXECUTION TIME*, tells the last time *model.exe* was executed for this run. The GUI automatically maintains this field. The remainder of the file is a free-format description of the run that you write. See section 3.6.2 part B for more information about maintaining the notes.

If the notes file is missing, simply create a blank file named *Notes.dat* in the run folder. The next time you click on *Edit* and then *Notes*, the GUI will create the necessary fields.

When you use the GUI to copy a run, the notes file is transferred to the newly created run. However, the GUI automatically erases the *MODIFIED BY* field and the description field. This is to prevent these fields from being propagated when they might contain false information. You must enter fresh text into these fields with every run that you create (although copy-and-paste is always possible). However, it is possible to configure the GUI so that the description field is automatically copied with the rest of the file. See section 3.6.2 part C for information about setting this preference.

The GUI automatically writes the name of the folder name of the run (not the complete path) and the entry from the *MODIFIED BY* field into the second line of the *model.cf* control file (section 4.4.0). Thus, this becomes the run description which can be written to Onevar output by using the *[RunDesc]* substitute name (section 4.7.1 part I).

3.4.6 SAVING THE RUN

When a run is saved, all data represented in the GUI tables and other controls is saved to file. Until the data is saved, the changes only exist in computer memory and are not recorded in the file on disk. Therefore, if you close the run (by opening another run, or by closing the GUI) without saving, the changes will be lost.

When you run the model (Section 3.4.8), the GUI automatically saves your changes without prompting you for confirmation. You can save your changes at any time by selecting the *File* menu, then *Save Run* (Section 3.6.1 part D).

OCL files open in a VEDIT window do not get saved by this process. When you open an OCL file, the GUI opens VEDIT (section 3.2.0) and then has no more control of what happens in the VEDIT interface. To save your OCL files, you must select *Save* in the VEDIT menu.

Changes to the notes file (section 3.4.5) are immediately saved any time you click *OK* in the *Edit Notes* dialog box (section 3.6.2 part B). In other words, the GUI does not wait for you to click *Save Run* before it saves the notes file.

The GUI can be configured so that output files are deleted every time the run is saved. This can prevent confusion when a run has been executed, and then further changes are made to the input after execution (the red light with the message *OUTPUT NOT CURRENT* always appears on the status bar to warn you if input data has been changed after a run was executed).

Specifically, the GUI deletes the following files that are found in the run folder:

all files with the extensions *TXT* and *OUT* in their file names.

the DSS output file as listed in *model.cf*.

(in position-analysis mode only) all files in the folder *output*.

If the GUI is configured for auto-deletion, then the auto-deletion occurs at the following times

An OCL file that appears in the OCL files list has been modified and saved.

The run has been saved.

To configure the GUI to automatically delete output files, check the *Auto Delete Output* box in the preferences dialog box (section 3.6.2 part C). It is conceivable that a file that you do not want deleted could be automatically deleted in this process, so you should consider whether using this option is really of benefit to you or not.

3.4.7 SIMULATION MODE AND POSITION-ANALYSIS MODE

The GUI can be configured to handle two different modes. In ***simulation*** mode, the model generally runs for the period of historical record in a single trace. This is the simpler type of study used for long-term planning. In ***position-analysis*** mode, the model generally runs for a short period in multiple traces. This type of study is more often used for short-term planning. See Chapter 9 for more info about position analysis.

The type of study makes a difference in

the type of input that should be handled
the procedures handled when the model executes
the format of the output that is created
the matching of runs to post-processor input files
the procedures handled for post-processing

Therefore, the two GUI modes exist to handle the different sets of procedures for the two different study types. Also, the run folders and post-processor inputs of the two modes are segregated to avoid confusion. Section 3.3.1 shows the preferred directory structure with the segregated run folders and post-processor folders.

The GUI makes it easy to handle the two different modes. Whenever you open a run or create a new run, you may select from either the simulation runs or the position-analysis runs. Whichever type you select, the GUI automatically sets itself into the mode of the run that you selected or created. When you request table or plot output, the GUI only allows you to match simulation post-processor files with simulation runs, and position-analysis post-processor files with position-analysis runs. The current mode is displayed in the title bar of the main GUI window after the name of the open run.

The GUI can also be configured to handle only one of these modes. See section 3.6.2 part C for details about how to set preferences. If only one mode type is selected, then the GUI does not offer you the choice of different mode types when you select a run directory, and it does not display the mode type in the title bar of the main GUI window.

3.4.8 RUNNING THE MODEL

To run the model, click on *Run*, then *Execute OASIS Model* (section 3.6.3). If the GUI is in simulation mode, then it will execute *model.exe*. If the GUI is in position-analysis mode, then it will execute *PosAnalysis.exe*. See section 3.4.7 for more information about the two modes. The open run is the only run that can be executed. If you wish to execute another run, you must first open it. If you are using the GUI at all, then you are strongly discouraged from running the model outside of the GUI.

3.4.9 LOCKING RUNS

If a run has been executed, you can ***lock*** the run folder in the GUI to protect the input data from further changes. When the run is locked, the input tables displayed by the GUI will not accept any user changes, and the GUI opens the OCL files in VEDIT in read-only mode. The model cannot be executed on a locked run. It is possible to make graphical changes to the schematic (section 3.7.1) and to change the notes (section 3.4.5) on a run that has been locked because such changes are superficial – they can't affect the simulation results.

To lock a run, select the *File* menu, then *Lock Run* (section 3.6.1 part E). Once the run is locked , a check mark is displayed next to *Lock Run* in the menu. The GUI does not allow a run to be unlocked once it has been locked.

Locking a run in the GUI does nothing to prevent the input data from being modified outside the GUI.

If you create a new run by copying a locked run, the new run will not be locked.

3.5.0 VIEWING OUTPUT

One of the GUI's most important functions is to make it fast and easy for you to display model output. All varieties of the model output are displayed through the *Output* menu (section 3.6.4). After you select one of the output types under this menu, the GUI presents you with a dialog box that allows you to select one or more runs whose output you can display.

The first two choices in the *Output* menu are *TABLES* and *PLOTS*. To view these types of output, post-processor programs (Chapter 6) must be run. If you select *TABLES*, the GUI automatically runs *Onevar.exe* and then displays the files it creates in a VEDIT window. If you select *PLOTS*, the GUI automatically runs *Plot.exe*.

The GUI also contains the powerful **Quick View** feature. This feature automatically creates post-processor input files for you before running *Onevar.exe* or *Plot.exe*. The Quick View dialog box provides a friendly interface for selecting which variable you want to see in the output, as well as the format of the output. See section 3.6.4 part I for a complete description of Quick View. You can access the Quick View dialog box in the following ways:

Click *Quick View* in the *Output* menu (section 3.6.4 part I).

In the schematic (section 3.7.1), right-click on a node or arc and then click *Quick View* in the menu. The node or arc that you clicked on will be selected by default in the Quick-View dialog box.

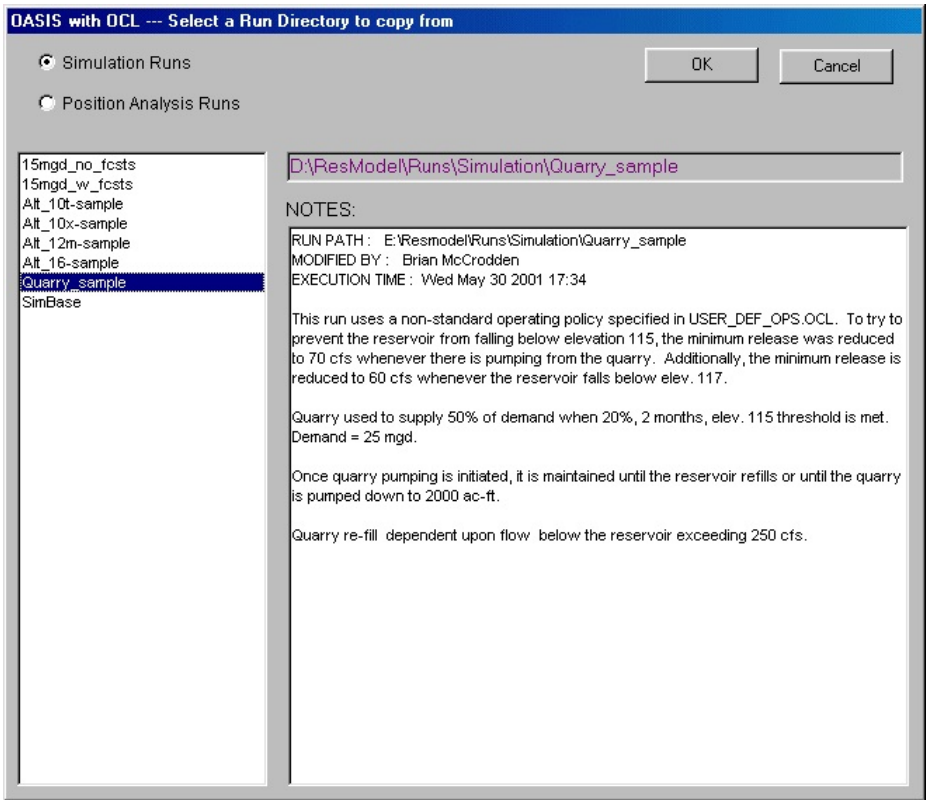
In the *Node Settings* dialog box (section 3.8.1) or the *Arc Settings* dialog (section 3.8.2), click the *Quick View* button. The node or arc that you were viewing will be selected by default in the Quick-View dialog box.

3.6.0 MENU INTERFACE DETAILS

3.6.1 *File* MENU

A. *Copy Run*

Click on *Copy Run* in the *File* menu to create a new run by copying an existing one. After you click on *Copy Run*, this dialog box appears:



D:\ResModel\Runs\Simulation\Quarry_sample

RUN PATH : E:\Resmodel\Runs\Simulation\Quarry_sample
MODIFIED BY : Brian McCrodden
EXECUTION TIME : Wed May 30 2001 17:34

This run uses a non-standard operating policy specified in USER_DEF_OPS.OCL. To try to prevent the reservoir from falling below elevation 115, the minimum release was reduced to 70 cfs whenever there is pumping from the quarry. Additionally, the minimum release is reduced to 60 cfs whenever the reservoir falls below elev. 117.

Quarry used to supply 50% of demand when 20%, 2 months, elev. 115 threshold is met. Demand = 25 mgd.

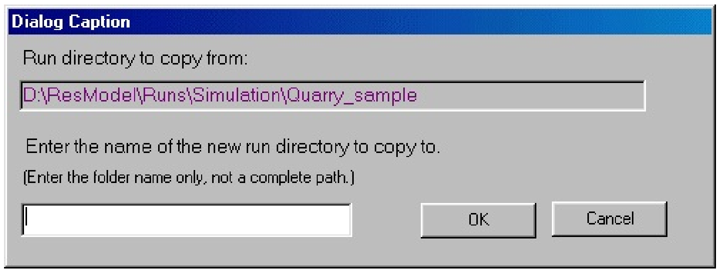
Once quarry pumping is initiated, it is maintained until the reservoir refills or until the quarry is pumped down to 2000 ac-ft.

Quarry re-fill dependent upon flow below the reservoir exceeding 250 cfs.

On the top left of the dialog box are two option buttons, labeled *Simulation Runs* and *Position Analysis Runs*. When you click on *Simulation Runs*, the box in the lower left lists all of the runs in simulation mode. When you click on *Position Analysis Runs*, the box in the lower left lists all of the runs in position-analysis mode. If you are not running the GUI with two modes available, then these option buttons do not appear. See section 3.4.7 for explanation of the two modes.

When you click on one of the runs in the box in the lower left, the full path of that run folder is displayed in purple text in the box on the right. The entire notes file (section 3.4.5) for that run is displayed in the large box in the lower right. This is to help you identify which run you want to copy.

After you have selected (in the box on the left) the run that you want to copy, click the *OK* button. After you click *OK*, the following dialog box appears:


Dialog Caption

Run directory to copy from:

D:\ResModel\Runs\Simulation\Quarry_sample

Enter the name of the new run directory to copy to.

(Enter the folder name only, not a complete path.)

In this dialog box, the folder that you are copying is displayed in purple text as a reminder. If you decide at this point that this is the wrong folder to copy, click the *Cancel* button and you will return to the previous dialog box. Otherwise, enter the name of the new run you are creating into the box on the lower left. Do not include path information in this name (enter the name of a single folder only). Click *OK* when you are done.

After you click *OK*, the GUI makes a copy of the existing run that you selected. Specifically, it creates the new folder, and copies the following files from the existing folder to the new folder: *StatData.mdb*, *Model.cf*, *Notes.dat*, and the subfolder *OCL* and every file within it. GUI users do not necessarily have to understand what these files are, but it *is* important to recognize that no output files are copied in this process, nor are any other files that you might have placed into the existing run folder for your own reasons. See section 3.3.7 for some description of these files.

After the GUI creates the new files, the new run that you created becomes the open run. Before it closes the previously open run, it asks you whether you want to save your changes. The GUI automatically corrects the identifying fields in the notes file (section 3.4.5) of the new run. Also, if the run that you copied from had been locked (section 3.4.9), the GUI ensures that the newly created run is *not* locked when it is first created. In all other aspects, your newly created run starts out as an exact duplicate of the run that you copied from.

B. *Open Run*

Click on *Open Run* in the *File* menu to open a different existing run. After you click on *Open Run*, you see a dialog box that is virtually identical to the first dialog box that you see when you click *Copy Run* (section 3.6.1 part A).

On the top left of the dialog box are two option buttons, labeled *Simulation Runs* and *Position Analysis Runs*. When you click on *Simulation Runs*, the box in the lower left lists all of the runs in simulation mode. When you click on *Position Analysis Runs*, the box in the lower left lists all of the runs in position-analysis mode. If you are not running the GUI with two modes available, then these option buttons do not appear. See section 3.4.7 for explanation of the two modes.

When you click on one of the runs in the box in the lower left, the full path of that run folder is displayed in purple text in the box on the right. The entire notes file (section 3.4.5) for that run is displayed in the large box in the lower right. This is to help you identify which run you want to open.

After you have selected (in the box on the left) the run that you want to open, click the *OK* button. After you click *OK*, the GUI opens the run that you selected. Before it closes the previous run, it asks you whether you want to save your changes. The mode of the GUI (simulation mode or position-analysis mode -- see section 3.4.7) is automatically set to the mode of the run that you opened.

C. *Delete Run*

Click on *Delete Run* in the *File* menu to delete an existing run. After you click on *Delete Run*, you see a dialog box that is virtually identical to the first dialog box that you see when you click *Copy Run* (section 3.6.1 part A).

On the top left of the dialog box are two option buttons, labeled *Simulation Runs* and *Position Analysis Runs*. When you click on *Simulation Runs*, the box in the lower left lists all of the runs in simulation mode. When you click on *Position Analysis Runs*, the box in the lower left lists all of the runs in position-analysis mode. If you are not running the GUI with two modes available, then these option buttons do not appear. See section 3.4.7 for explanation of the two modes.

When you click on one of the runs in the box in the lower left, the full path of that run folder is displayed in purple text in the box on the right. The entire notes file (section 3.4.5) for that run is displayed in the large box in the lower right. This is to help you identify which run you want to delete.

After you have selected (in the box on the left) the run that you want to delete, click the *OK* button. After you click *OK*, the GUI deletes the run that you selected. If you selected the open run, then the GUI prompts you for another run to open before it can delete the open run. When the GUI deletes the run, it deletes the entire run folder and everything in it, including any files you might have placed in the folder for your own reasons. The deleted files cannot be recovered from the Windows Recycle Bin.

D. *Save Run*

Click on *Save Run* in the *File* menu to save (to file) the changes that you made through the GUI. See section 3.4.6 for more information.

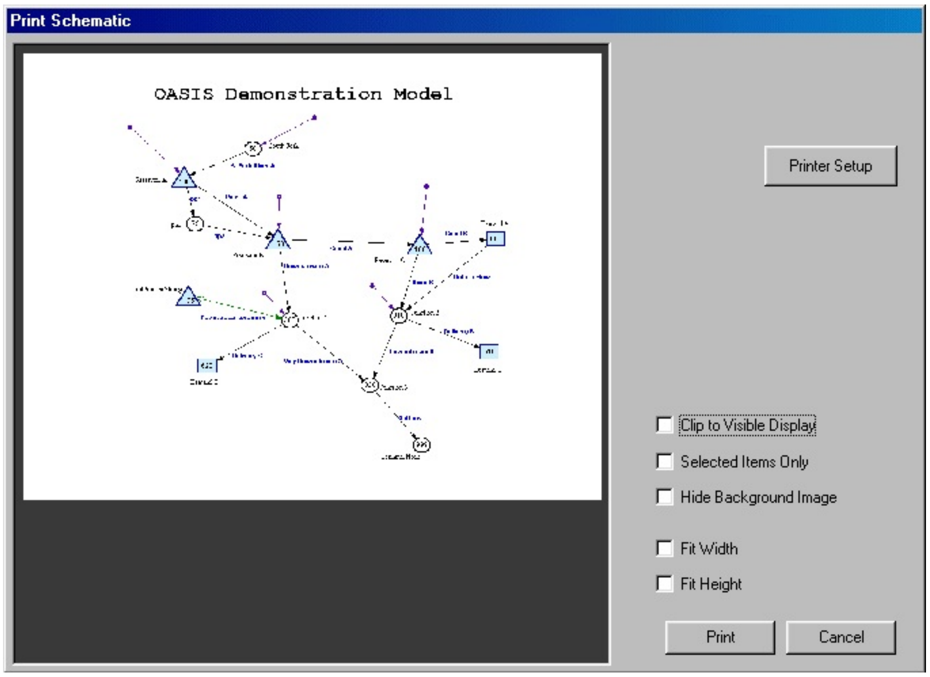
E. *Lock Run*

See section 3.4.9 for information about locking runs. A check mark is displayed in front of *Lock Run* in the *File* menu if the run is locked. If the run is not locked, no check mark is displayed. The GUI will not let you lock a run that has not been executed. Once you have locked a run, you cannot unlock it.

F. *Print Schematic*

Click on *Print Schematic* in the *File* menu to print a copy of the schematic (to a printer or to a virtual printer such as Adobe Acrobat). *Print Schematic* appears in the menu only when the *Schematic* tab (section 3.7.1) is selected.

After you click on *Print Schematic*, this dialog box appears:



On the left is a preview of the image that would be sent to the printer, on a scale representation of the paper. If you click on the *Printer Setup* button, you can change the destination printer and the assumed paper size and orientation, along with any other available printer settings.

A series of check boxes appear in the lower right. If you change your options through these check boxes, the preview image will change to reflect your selection. The check boxes are:

Clip to Visible Display: If you check this box, the printed image will be limited to what is currently visible in the GUI's display of the schematic. If you wish, you can zoom into a particular portion of the schematic, then click on *Print Schematic* and check this box, in order to print an enlarged but selected portion of the schematic. When this box is unchecked, the entire schematic page is sent to the printer.

Selected Items Only: If you check this box, the printed image will be limited to the items that are currently selected in the GUI's display of the schematic. Objects that are not selected are invisible. This option would most likely be used in combination with the *Clip to Visible Display* check box to print an enlarged but selected portion of the schematic. When this box is unchecked, all items on the schematic page are sent to the printer.

Hide Background Image: If there is a background image on your schematic, it is sent to the printer *unless* this box is checked.

Fit Width: When this box is checked, the GUI resizes the printed image so that it has exactly the same width as the paper. If the *Fit Height* box is unchecked, then the aspect ratio of the image is preserved. If both the *Fit Width* and *Fit Height* boxes are checked, then the aspect ratio is generally not preserved.

Fit Height: When this box is checked, the GUI resizes the printed image so that it has exactly the same height as the paper. If the *Fit Width* box is unchecked, then the aspect ratio of the image is preserved. If both the *Fit Width* and *Fit Height* boxes are checked, then the aspect ratio is generally not preserved.

After selecting the appropriate options, click *OK* to send the image to the printer.

G. *Export Schematic*

Click on *Export Schematic* in the *File* menu to save the image of the schematic to an image file. *Export Schematic* appears in the menu only when the *Schematic* tab (section 3.7.1) is selected..

After you click on *Export Schematic*, this dialog box appears:

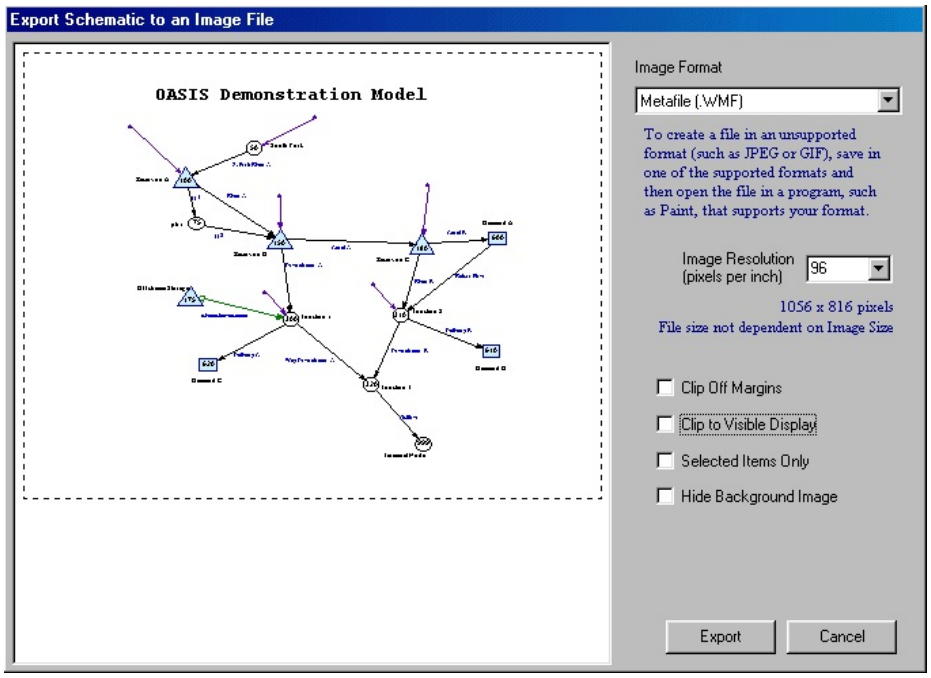


Image Format
Metafile (.WMF)

To create a file in an unsupported format (such as JPEG or GIF), save in one of the supported formats and then open the file in a program, such as Paint, that supports your format.

Image Resolution (pixels per inch) 96

1056 x 816 pixels
File size not dependent on Image Size

☐ Clip Off Margins
☐ Clip to Visible Display
☐ Selected Items Only
☐ Hide Background Image

In the upper right is a drop-down control that allows you to select the type of image file you want to save. The choices are bitmap (*.*bmp*), metafile (*.*wmf*), and enhanced metafile (*.*emf*). Some popular formats such as JPEG and GIF are not offered. If you want a file in a format that the GUI does not support, you must first save the file in a format that the GUI does support, then open that file in another program that does support your desired format. Windows Paint is one such program and it is usually installed with any copy of Windows.

This dialog box also contains a drop-down control in which you can specify the image resolution. This is primarily useful for bitmap files. At low resolution, a bitmap appears grainy. At high resolution, the image is sharp but the file size can be quite large. If you select the bitmap (*.*bmp*) file type, then the GUI automatically displays an estimate of the file size below the *Image Resolution* box.

On the left is a preview of the image that will be saved in a file. A series of check boxes appear in the lower right. If you change your options through these check boxes, the preview image will change to reflect your selection. The check boxes are:

Clip off Margins: If you check this box, the image that is saved to the file will have the margins "clipped" or "cropped" off. If the box is not checked, then the entire schematic area is included.

Clip to Visible Display: If you check this box, the saved image appears like what is currently visible is the GUI's display of the schematic. If you wish, you can zoom into a particular portion of the schematic, then click on *Export Schematic* and check this box, in order to save the image of a selected portion of the schematic. When this box is unchecked, the area of the entire schematic page is shown in the image file.

Selected Items Only: If you check this box, the saved image is limited to the items that are currently selected in the GUI's display of the schematic. Objects that are not selected are invisible. This option would most likely be used in combination with the *Clip to Visible Display* check box to save the image of a selected portion of the schematic. When this box is unchecked, all items on the schematic page appear in the image file.

Hide Background Image: If there is a background image on your schematic, it is saved in the image file *unless* this box is checked.

After selecting the appropriate options, click *OK*. The GUI will then prompt you for the name and location of the image file to save.

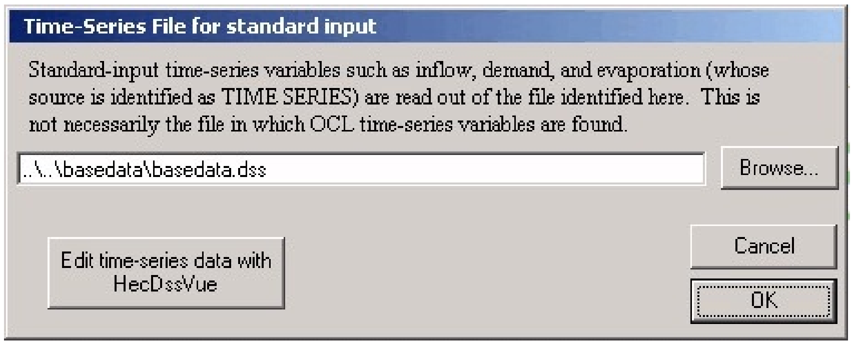
H. *Exit*

Click on *Exit* in the *File* menu to close the GUI program. The GUI will ask whether you want to save your changes before it closes. If you opened any VEDIT windows from the GUI, they are not affected when the GUI closes.

3.6.2 *Edit* MENU

A. *Time Series Data*

Click on *Time Series Data* in the *Edit* menu to view or edit the time-series data for the open run. When you click on *Time Series Data*, this dialog box is displayed:


Time-Series File for standard input

Standard-input time-series variables such as inflow, demand, and evaporation (whose source is identified as TIME SERIES) are read out of the file identified here. This is not necessarily the file in which OCL time-series variables are found.

..\..\basedata\basedata.dss

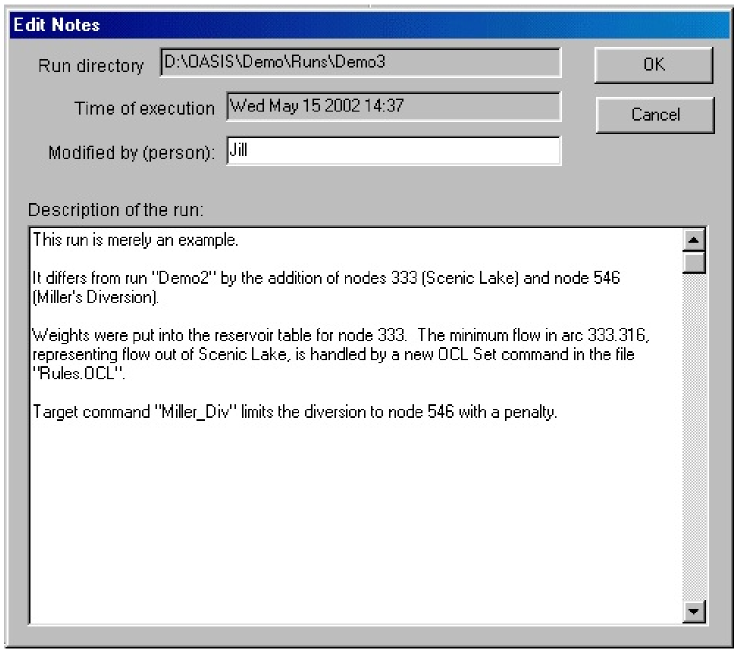
The upper part of the dialog box shows the name and path of the time-series file that contains all time-series variables for standard input (section 4.6.2, section 4.6.3, and section 4.6.4). This is the same as the entry in the *File ID* table (section 4.5.3 part M, section 4.5.4 part C, and section 4.5.5 part C). To change the file that is associated with this run, you can type a different file name (with path relative to the run folder) into the box, or click *Browse* to navigate through the directories and select a file by clicking on it. It is common to use a *basedata* folder (section 3.3.1) as the location of time-series input, but you can locate these files anywhere else you find appropriate. Note that the file identified here is not necessarily used for OCL input. OCL time-series input files are only identified with the *:TIMEDB:* field in an OCL file (section 4.7.1 part F).

You can click the button in the lower left to open a time-series database file using HecDssVue (section 4.6.0). When you click the button, you are first shown a dialog box that gives you the option of which time-series file to open. The file shown above is highlighted by default, but you can select any other file. Once you select a file, it is opened in HecDssVue.

See section 4.6.0 for more information about time-series input data.

B. *Notes*

Click on *Notes* in the *Edit* menu to view or edit the notes that for the open run. When you click on *Notes*, this dialog box is displayed:



Run directory: D:\OASIS\Demo\Runs\Demo3

Time of execution: Wed May 15 2002 14:37

Modified by (person): Jill

Description of the run:

This run is merely an example.

It differs from run "Demo2" by the addition of nodes 333 (Scenic Lake) and node 546 (Miller's Diversion).

Weights were put into the reservoir table for node 333. The minimum flow in arc 333.316, representing flow out of Scenic Lake, is handled by a new OCL Set command in the file "Rules.OCL".

Target command "Miller_Div" limits the diversion to node 546 with a penalty.

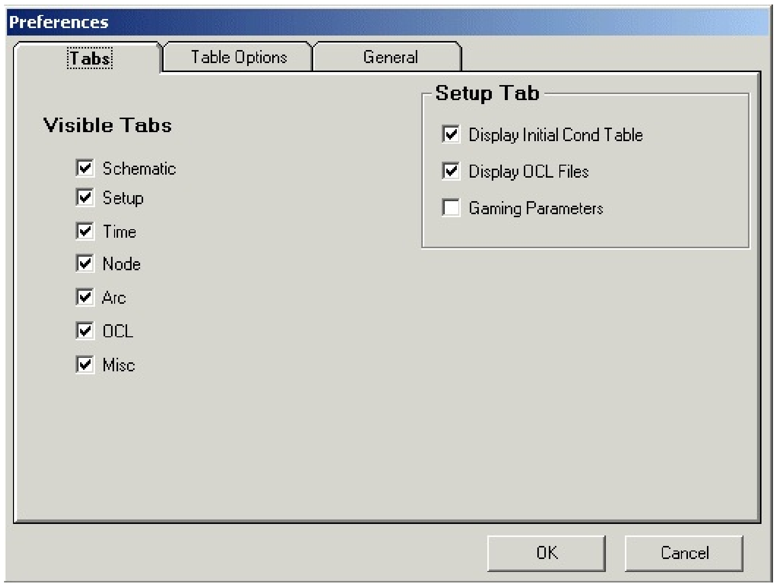
The first two fields, *Run directory* and *Time of execution*, cannot be edited. The GUI automatically ensures that the data in these fields is correct. The third field, *Modified by*, is one that you should fill in every time you create a run. When more than one person is viewing or working on a project, knowing who put together the data can help avoid confusion. You are welcome to include group affiliations and make the name as long as you find appropriate.

The last field is the large text box labeled *Description of the run*. We suggest that you use this field to tell what run was copied to create the open run, and describe all changes that make the open run different from its predecessor. You should include any other description of the purpose of the run, the input of the run, and maybe even the results of the run, that are appropriate to your needs. This description can be as long or short as you like.

See section 3.4.5 for more information about the notes file.

C. *Preferences*

Click on *Preferences* in the *Edit* menu to change the preference settings of the GUI. If you click on *Preferences*, the GUI displays a dialog box with four tabs on it. Each of the tabs is shown and described below.



Visible Tabs

- [✓] Schematic
- [✓] Setup
- [✓] Time
- [✓] Node
- [✓] Arc
- [✓] OCL
- [✓] Misc

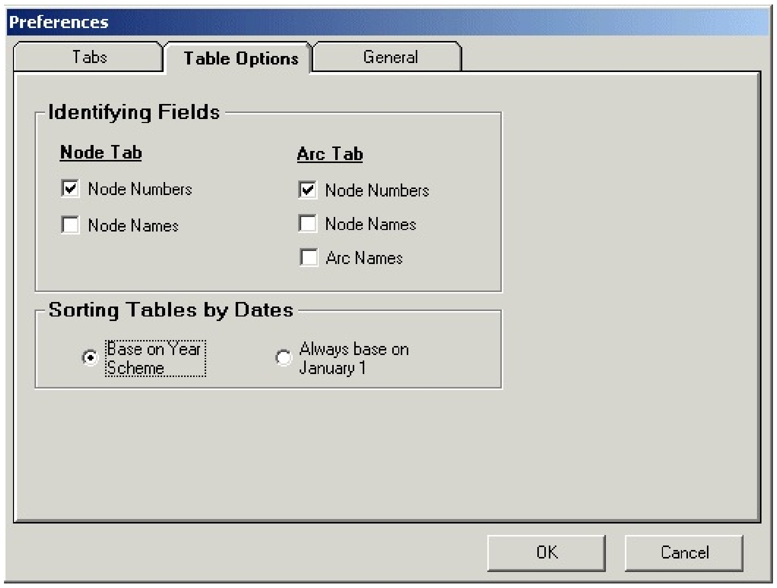
Setup Tab

- [✓] Display Initial Cond Table
- [✓] Display OCL Files
- [ ] Gaming Parameters

The first tab is labeled *Tabs*. On this tab is a list of the tabs that are displayed in the main GUI window. You may choose to have any of these tabs be visible or invisible. If the box for the tab is checked, then the tab will be visible. Otherwise, it will be invisible.

Under the heading *Setup Tab* are several options for displaying special information on the *Setup* tab:

> **Display Initial Condition Table:** If this box is checked, then a copy of the *Initial Conditions* table appears on the *Setup* tab (section 3.7.2). Otherwise, this table does not appear on the *Setup* tab.
>
> **Display OCL files:** If this box is checked, then a copy of the list of OCL files appears on the *Setup* tab. Otherwise, this list-box does not appear on the *Setup* tab (section 3.7.2).
>
> **Gaming Parameters:** If this box is checked, then controls for the gaming parameters appear on the *Setup* tab (section 3.7.2). Otherwise, the controls do not appear.



Identifying Fields

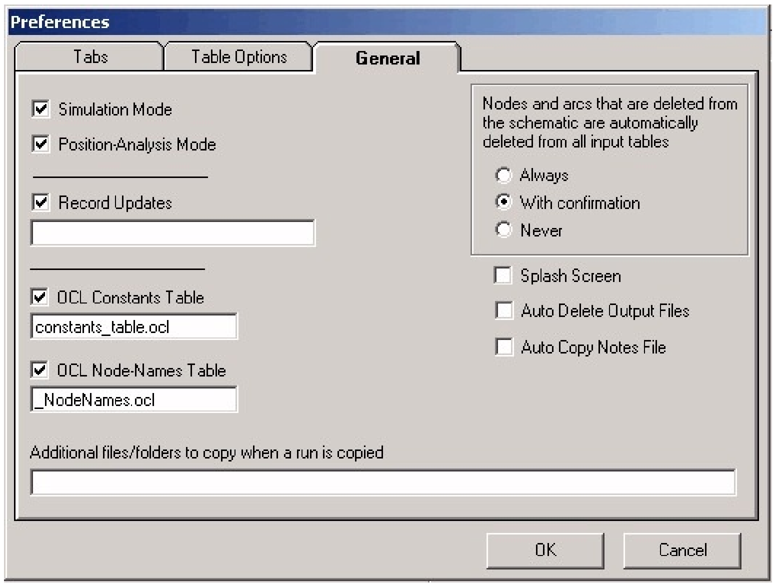
Node Tab
- [✓] Node Numbers
- [ ] Node Names

Arc Tab
- [✓] Node Numbers
- [ ] Node Names
- [ ] Arc Names

Sorting Tables by Dates
- (●) Base on Year Scheme
- ( ) Always base on January 1

On the tab labeled *Table Options*, under the heading *Identifying Fields*, you can control the identifying fields that appear in tables on the *Node* tab (section 3.7.4) and the *Arc* tab (section 3.7.5). Every record in every table on the *Node* tab is identified by either a node number, a node name, or both. Every record in every table on the *Arc* tab is identified by either upstream and downstream node numbers, upstream and downstream node names, arc names, or a combination of two or more of those identifiers. Place a check mark in front of the types of identifiers that you prefer.

Under the heading *Sorting Tables by Dates* are two options for how the pattern-type tables (section 4.5.1) are sorted. If the first option, *Base on Year Scheme*, is selected, then the pattern-type tables are all sorted such that the first day of the year scheme is first. If the second option, *Always base on January 1*, is selected, then the pattern-type tables are all sorted such that the January 1 is first, whether or not it is the first day of the year scheme. See section 2.8.5 for more information about the year scheme.



- [✓] Simulation Mode
- [✓] Position-Analysis Mode
- [✓] Record Updates
- [✓] OCL Constants Table: constants_table.ocl
- [✓] OCL Node-Names Table: _NodeNames.ocl

Additional files/folders to copy when a run is copied

Nodes and arcs that are deleted from the schematic are automatically deleted from all input tables
- ( ) Always
- (●) With confirmation
- ( ) Never

- [ ] Splash Screen
- [ ] Auto Delete Output Files
- [ ] Auto Copy Notes File

On the tab labeled *General* are an assortment of options:

> **Simulation Mode** and **Position-Analysis Mode:** Put a check in front of the mode type, in order to enable the GUI to run in that particular mode. You may check one or both of these options. If a mode type is unchecked here, the GUI does not expect there to be separate folders for the runs and post-processor inputs for that mode. If a mode type *is* checked here, then the GUI requires that the runs folder and post-processor folders for that mode (as listed in the

directry.nam file; see section 3.3.4) be present. See section 3.4.7 for more about the simulation mode and position-analysis mode.

.

Record Updates: If this box is checked, then the *Update Record* tab appears in the main GUI window, allowing you to add updates to time-series records. On the *Update Record* tab are recently acquired time-series input values that are stored in the MS Access database named in the text box. If this box is not checked, then the *Update Record* tab does not appear.

OCL Constants Table: If this box is not checked, then the OCL Constants table (section 4.5.9 part C) is not shown in the GUI, and no OCL file is written for the OCL constants. If this box is checked, then the OCL Constants table is shown on the *OCL* tab, and whenever the run is saved, the contents of the table are written to the file named in the text box. The file is always written to the OCL subfolder of the run folder (section 3.3.7).

OCL Node-Names Table: If this box is not checked, then no OCL file is written for the node names. If this box is checked, then whenever the run is saved, the file named in the text box is rewritten with one OCL substitute (section 4.7.1 part I) for the name of every node in the schematic. The file is always written to the OCL subfolder of the run folder (section 3.3.7).

Additional files/folders to copy when a run is copied: The names (with path relative to the home folder) of additional files and folders that should be copied from an old run to a new run when a new run is created (section 3.4.2). The file names can include wildcards (? and *) and they should be separated by semicolons.

Splash Screen: If this box is checked, then the splash screen is displayed every time the GUI starts up. If the box is unchecked, the splash screen is not displayed when the GUI starts up.

Auto Delete Output Files: If this box is checked then the GUI deletes output files every time the run is saved. If this box is not checked, then the GUI does not delete output files. See section 3.4.6.

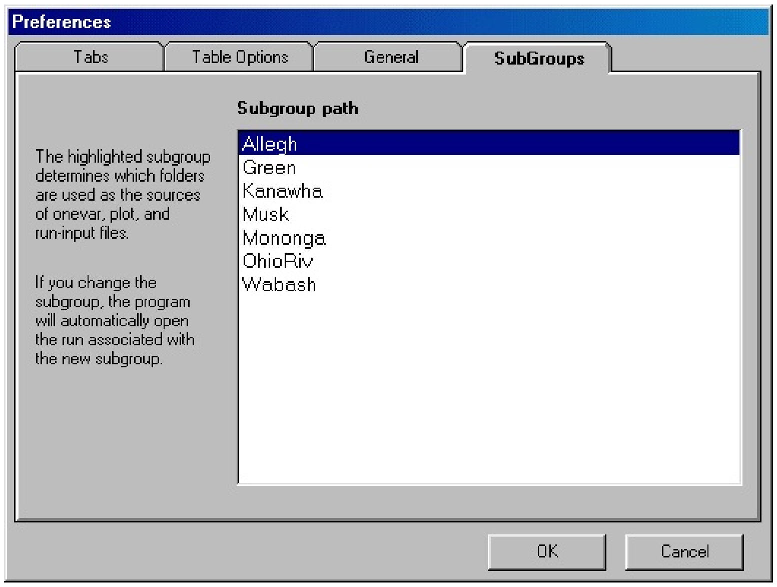
Auto Copy Notes File: If this box is checked, then the GUI propagates the text in the notes file (section 3.4.5) from the existing run to the new run when you copy a run. If the box is not checked, then the GUI erases the text in the notes file when a new run is created. When this box is checked, there is the risk that you will forget to modify the notes file after copying a run, and false information will be recorded with the run.

Finally, the *General* tab contains a box with three option buttons that determine what happens when you delete a node or arc from the schematic (section 3.7.1):

Always: When you delete a node or arc, it is automatically deleted from all input tables, and the GUI does not ask for your confirmation.

With confirmation: When you delete a node or arc, it is automatically deleted from all input tables, but the GUI prompts you for confirmation first.

Never: When you delete a node or arc, the GUI does not delete it from any tables except the *Node* or *Arc* table.



Subgroup path

The highlighted subgroup determines which folders are used as the sources of onevar, plot, and run-input files.

If you change the subgroup, the program will automatically open the run associated with the new subgroup.

Allegh
Green
Kanawha
Musk
Mononga
OhioRiv
Wabash

On the tab labeled *SubGroups* is a list box which lists all of the subgroups that are defined for your project. See section 3.3.8 for an explanation of subgroups. The currently active subgroup is highlighted. To open a different subgroup, click on that subgroup and then click *OK*. When you open a different subgroup, the GUI opens the run that is currently open for that subgroup.

The *Preferences* dialog box does not provide any way for you to add or delete subgroups from the list. To do that, you must close the GUI, edit the file *preferences.cf*, and then run the GUI anew (See section 3.3.8).

If your project does not contain any subgroups, then the *SubGroups* tab does not appear in the *Preferences* dialog box.

3.6.3 *Run* MENU

C. *Run OASIS Model*

Click on *Run OASIS Model* in the *Run* menu to execute the model. If the GUI is in simulation mode, it performs the following steps:

All input data is saved. See section 3.4.6.
Execute *model.exe*.
Change the indicator on the status bar (section 3.9.0) to green with the message *Output CURRENT*.

If the GUI is in position-analysis mode, it performs the following steps when you click *Run OASIS Model*:

All input data is saved. See section 3.4.6.
Execute *PosAnalysis.exe*.
Change the indicator on the status bar (section 3.9.0) to green with the message *Output CURRENT*.

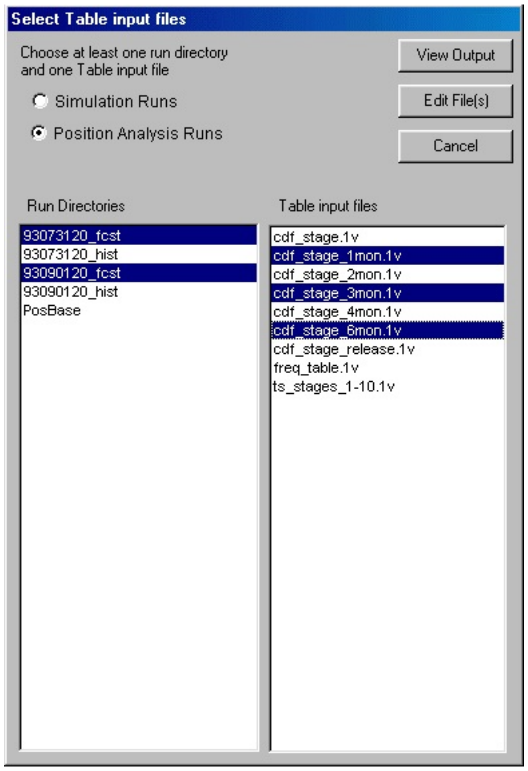
See section 3.4.7 for information about the two modes.

You cannot execute the model if the run has been locked (section 3.4.9).

3.6.4 *Output* MENU

A. *TABLES*

Click on *TABLES* in the *Output* menu to generate table output with the Onevar program. See section 6.1.0 for details about Onevar. When you click on *TABLES*, the GUI displays the following dialog box:



The option buttons on the left allow you to select either position-analysis or simulation runs. In the lower left is a list of all the runs. That is, it is a list of all the simulation runs or all the position-analysis runs, depending on which of the option buttons is selected. If your project does not include both simulation mode and position-analysis mode, then the option buttons do not appear. See section 3.4.7 for explanation of the two modes. If a run has not been executed, then it does not appear in the list.

In the lower right is a list of all the table-input files (Onevar-input files). Each table-input file in the list defines a particular table-output file. The list shows all of the simulation table-input files or all of the position-analysis table-input files, depending on which option button is selected.

Select a run from the list on the left and table-input file from the list on the right, and then click the *View Output* button to generate the corresponding table output for the run. The GUI generates the table output by running *Onevar.exe*, then it opens the output file in a VEDIT window. See section 3.2.0 for information about VEDIT.

For your convenience, the open run is selected as a default whenever this dialog box opens. More often than not, the output you wish to see is from the open run. Of course, if the open run has not been executed, then it cannot be selected.

You may select more than one run and/or more than one table input file. If you do this and then click the *View Output* button, the GUI runs *Onevar.exe* to generate a table output for every combination of runs and table-inputs. It then opens all of the table outputs in a single instance of VEDIT, with each output file having its own document window.

If you select a table-input and then click the *Edit File(s)* button, the GUI will open the input file (*not* the output file) in a

VEDIT window. This is a convenient way to modify your table inputs. You can also use this feature to create new table inputs by clicking *Save As* in VEDIT.

B. *PLOTS*

Click on *PLOTS* in the *Output* menu to generate graphical output with the Plot program. See section 6.2.0 for details about Plot. When you click on *PLOTS*, the GUI displays a dialog box which is virtually identical to the dialog box displayed when you click *TABLES*. The only difference is that the dialog box displays plot-definition files instead of table-input files. You may wish to refer to the picture of the dialog box used for the *TABLES* menu option in section 3.6.4 part A.

The option buttons on the left allow you to select either position-analysis or simulation runs. In the lower left is a list of all the runs. That is, it is a list of all the simulation runs or all the position-analysis runs, depending on which of the option buttons is selected. If your project does not include both simulation mode and position-analysis mode, then the option buttons do not appear. See section 3.4.7 for explanation of the two modes. If a run has not been executed, then it does not appear in the list.

In the lower right is a list of all the plot-definition files (all of the simulation plot-definition files or all of the position-analysis plot-definition files, depending on which option button is selected). Each plot-definition file in the list file defines a particular plot display.

Select a run from the list on the left and plot-definition file from the list on the right, and then click the *View Output* button to generate the corresponding plot output for the run. The GUI generates the plot by running *Plot.exe*.

For your convenience, the open run is selected as a default whenever this dialog box opens. More often than not, the output you wish to see is from the open run. Of course, if the open run has not been executed, then it cannot be selected.

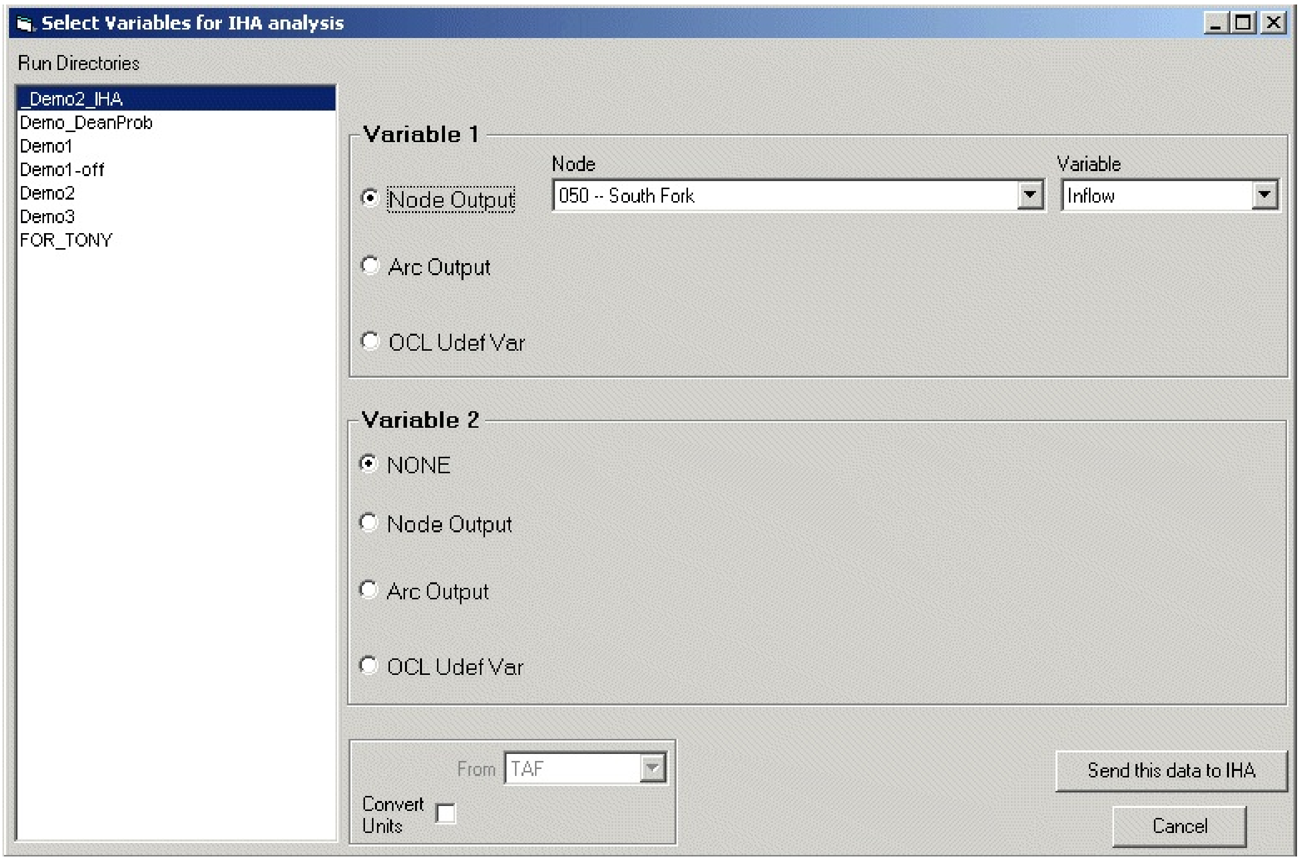
You may select more than one run and/or more than one plot-definition file. If you do this and then click the *View Output* button, the GUI runs *Plot.exe* to generate each of the plots you selected. The plots are all displayed as separate document windows in a single instance of *Plot.exe*. Each of the plots displays multiple runs – the complete list of runs that you selected. See section 6.2.0 for more information about displaying multiple runs and multiple plots.

If you select a plot-definition and then click the *Edit File(s)* button, the GUI will open the plot-definition in MS Access. This is a convenient way to modify your plot-definition files. (However, most changes to a plot definition file can be made directly to the plot output displayed in a session of *Plot.exe* and then saved, so you shouldn't need to use MS Access very often.)

C. *IHA Analysis*

Click on *IHA Analysis* in the *Output* menu to analyze a single variable using The Nature Conservancy’s IHA Software. The OASIS GUI creates special post-processor output for the variables you select. It prepares this output as input to IHA, and then starts the IHA GUI. When the IHA GUI opens, it automatically reads the OASIS post-processor output. It is then up to you to use the IHA GUI to reconfigure the project and/or run the analyses of your choice on this data. IHA Analysis is only available in simulation mode.

When you click on *IHA Analysis*, the OASIS GUI first presents a dialog box that appears like this:



On the left is a list of all the simulation-mode runs. If a run has not been executed, then it does not appear in the list. You may select one or two runs. There is more discussion of multi-variable analysis below.

In the frame at the upper-right of the dialog box, you select which variable you want to see. Variables are selected from three main groups: *Node Output*, *Arc Output*, or *OCL Udef Var*. If you click *Node Output*, you can then select which node the variable is associated with in the *Node* box. Then you select the specific variable in the *Variable* box. If you click *Arc Output*, you can then select which arc the variable is associated with in the *Arc* box. Then you select the specific variable in the *Variable* box. If you click *OCL Udef Var*, you can then select which Udef variable in the *Variable* box.

The frame in the middle-right of the dialog box is used to select a second variable in exactly the same way as the box above it. If you only wish to analyze one variable, you can select *NONE* in this box. There is more discussion of multi-variable analysis below.

In the frame at the bottom of the dialog box, you can choose to convert the units of the variable (section 2.9.0 and section 4.7.6 part C). If you do not check *Convert Units*, then the units of the variable remain unconverted (Arc and node variables thus remain in primary units. OASIS software does not explicitly assign units to OCL udef variables.). If you do check *Convert Units*, then you can use the *From* and *To* boxes to specify how to do the conversion. Note that the only units handled by IHA are CFS, CMS, FT, and M. If you direct OASIS to produce output in units other than these four options, then IHA will display incorrect unit labels in its plots and tables. Besides the problem of mislabeled units, we can not guarantee that analyses performed by IHA will be correct if the units dimension is different than IHA's built-in assumption. Therefore, it is recommended that you always convert units to CFS, CMS, FT, or M. Note that the OASIS GUI will only be able to do units conversions that are identified in the *Units* table (section 4.5.3 part A). If you select more than one variable, the same units conversion is done on both variables.

Every time you send data to IHA, the OASIS GUI freshly copies the IHA project template folder into the OASIS run folder. The project template is copied into a subfolder of the run folder, under *IHA/Projects*. The copied folder is assigned a name reflecting the OASIS variable that you selected. The GUI then creates a Onevar input file in *IHA/HydroData*. Then, it executes Onevar so that two output files (an *INI* file and an *IHB* file) are created in the *IHA/HydroData* folder. These two files comprise "hydro data" input for IHA. The Onevar input file and the hydro data file are also named to reflect the OASIS variable that you selected. If only one output variable is selected, then the project name and the name of the hydro data file both follow the form *RunName==VariableName*. For information about multi-variable analysis, see the discussion below.

Next, the OASIS GUI modifies the IHA Project's INI file, such that the freshly generated hydro data file will be associated with the freshly created IHA Project. Finally, the OASIS GUI executes IHA. The OASIS GUI passes command-line parameters to IHA, such that:

> IHA automatically treats the *IHA* subfolder of your OASIS run as the working directory. (If you subsequently open IHA without the OASIS GUI, the IHA working directory will be normal again.)
>
> IHA starts with the newly created project (the one using the post-processed OASIS output) automatically open.

Once IHA is open, it is up to you to run IHA analyses. You may create, delete, or edit analyses, and you may edit the project as appropriate.

If the time range of the IHA analysis in the template extends beyond the time range of the OASIS run, then the OASIS GUI modifies the newly created *analysis.ini* file so that the time range of the IHA analysis does not extend beyond the OASIS run. This prevents troubles when running IHA. However, if the time range of the OASIS run extends beyond the time range of the IHA analysis in the template, the OASIS GUI does not extend the time range in the *analysis.ini* file. Thus, you may choose to set up your template to analyze a portion of the output of the OASIS run.

There are three possible combinations of data to send to an IHA project:

> one variable from one OASIS run, for a total of one variable
> one variable from two OASIS runs, for a total of two variables
> two variables from one OASIS run, for a total of two variables

Regardless of the number of variables that are sent to an IHA project, the hydro data file is always named with the form *RunName==VariableName*. However, the name of the IHA project reflects all the variables that are in the project. Thus, if the project contains variables from two runs, the project name has the form *RunName1~~RunName2==VariableName*. If the project contains two variables from one run, the project name has the form *RunName==VariableName1~~VariableName2*.

When using OASIS post-processors, it is typical to display multiple variables side by side or on the same axis. IHA does not display multiple variables in this way. If you send two variables to an IHA project, one variable is always displayed as "pre-impact" and the other variable is always displayed as "post-impact". On an IHA-generated plot, the pre-impact variable is shown on the first part of the x-axis. The post-impact variable is shown on the second part of the x-axis. If the date range of both runs is the same, then the x-axis of the IHA-generated plot simply repeats the same date range. You may use the IHA GUI to specify which variable is pre-impact and which is post-impact.

The *IHA Analysis* menu item does not appear if the parameter *_IHA_PostProc* in *GUI.ini* (section 3.3.5) is missing or if its value is zero. The parameter *_IHA_ProjTemplate* in *GUI.ini* should correctly identify a folder that the GUI can copy to create a fresh IHA Project folder. We suggest that this template folder be located under the OASIS *BaseData* folder (section 3.3.1), but it can be located wherever you find appropriate. The template folder must contain a *Project.ini* file. Ideally, the template also contains one or more analysis folders. If you set up these analysis folders appropriately beforehand, then they will require no changes when you send OASIS data to IHA. Finally the *GUI.ini* parameter *_IHA_EXE* must correctly identify the path and file name of the *IHA7.exe* file. The OASIS GUI has been designed to work with version 7.1 of IHA.

See section 6.1.7 part C for information about the *:FILEIHB:* parameter used in the Onevar input file to generate hydro data files for IHA.

D. *Balance Output*

Click on *Balance Output* in the *Output* menu to view the file *balance.out* that is generated every time *model.exe* runs. See section 5.2.0 for information about this file. When you click on *Balance Output*, a dialog box appears that is almost the same as the dialog box that appears when you click *Debug Output*. See section 3.6.4 part H for a picture and description of this dialog box and an explanation of how it works.

E. *OCL Output*

Click on *OCL Output* in the *Output* menu to view the file *OCL.out* that is generated every time *model.exe* runs. See section 5.3.0 for information about this file. When you click on *OCL Output*, a dialog box appears that is almost the same as the dialog box that appears when you click *Debug Output*. See section 3.6.4 part H for a picture and description of this dialog box and an explanation of how it works.

F. *Weight Output*

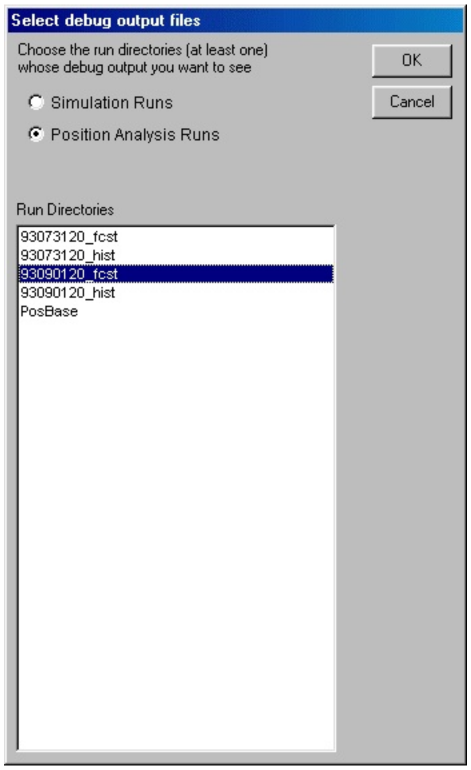
Click on *Weight Output* in the *Output* menu to view the file *weight.out* that is generated every time *model.exe* runs. See section 5.4.0 for information about this file. When you click on *Weight Output*, a dialog box appears that is almost the same as the dialog box that appears when you click *Debug Output*. See section 3.6.4 part H for a picture and description of this dialog box and an explanation of how it works.

G. *LP Output*

Click on *LP Output* in the *Output* menu to view the file *LP.out* that is generated every time *model.exe* runs. See section 5.5.0 for information about this file. When you click on *LP Output*, a dialog box appears that is almost the same as the dialog box that appears when you click *Debug Output*. See section 3.6.4 part H for a picture and description of this dialog box and an explanation of how it works.

H. *Debug Output*

Click on *Debug Output* in the *Output* menu to view the file *debug.out* that is generated every time *model.exe* runs. See section 5.1.0 for information about this file. When you click on *Debug Output*, the following dialog box appears:



Select debug output files

Choose the run directories (at least one) whose debug output you want to see

( ) Simulation Runs
(•) Position Analysis Runs

Run Directories

93073120_fcst
93073120_hist
93090120_fcst
93090120_hist
PosBase

The option buttons on the left allow you to select either position-analysis or simulation runs. In the lower part of the screen is a list of all the runs. That is, it is a list of all the simulation runs or all the position-analysis runs, depending on which of the option buttons is selected. If your project does not include both simulation mode and position-analysis mode, then the option buttons do not appear. See section 3.4.7 for explanation of the two modes. If a run has not been executed, or if the output file is not present in the run folder, then the run does not appear in the list.

Select a run from the list and then click the *View Output* button to view the output for the run. The GUI opens the output file in a VEDIT window. See section 3.2.0 for information about VEDIT. For your convenience, the open run is selected as a default whenever this dialog box opens. More often than not, the output you wish to see is from the open run. Of course, if the open run has not been executed, then it cannot be selected.

You may select more than one run. If you do this and then click the *View Output* button, the GUI opens all of the output files in a single instance of VEDIT, with each output file having its own document window.

I. *Quick View*

Click on *Quick View* in the *Output* menu to view a single variable in plot or table form. The Quick-View feature generates post-processor output, similar to when you click *TABLES* (section 3.6.4 part A) or *PLOTS* (section 3.6.4 part B), except that there does not need to be a pre-existing Onevar-input file or plot-definition file. Instead, you use the Quick-View dialog box to select a single variable you want to see, and then the GUI automatically creates the Onevar-input file (section 6.1.3) or plot-definition file (section 6.2.3) for you before it generates the table or plot.

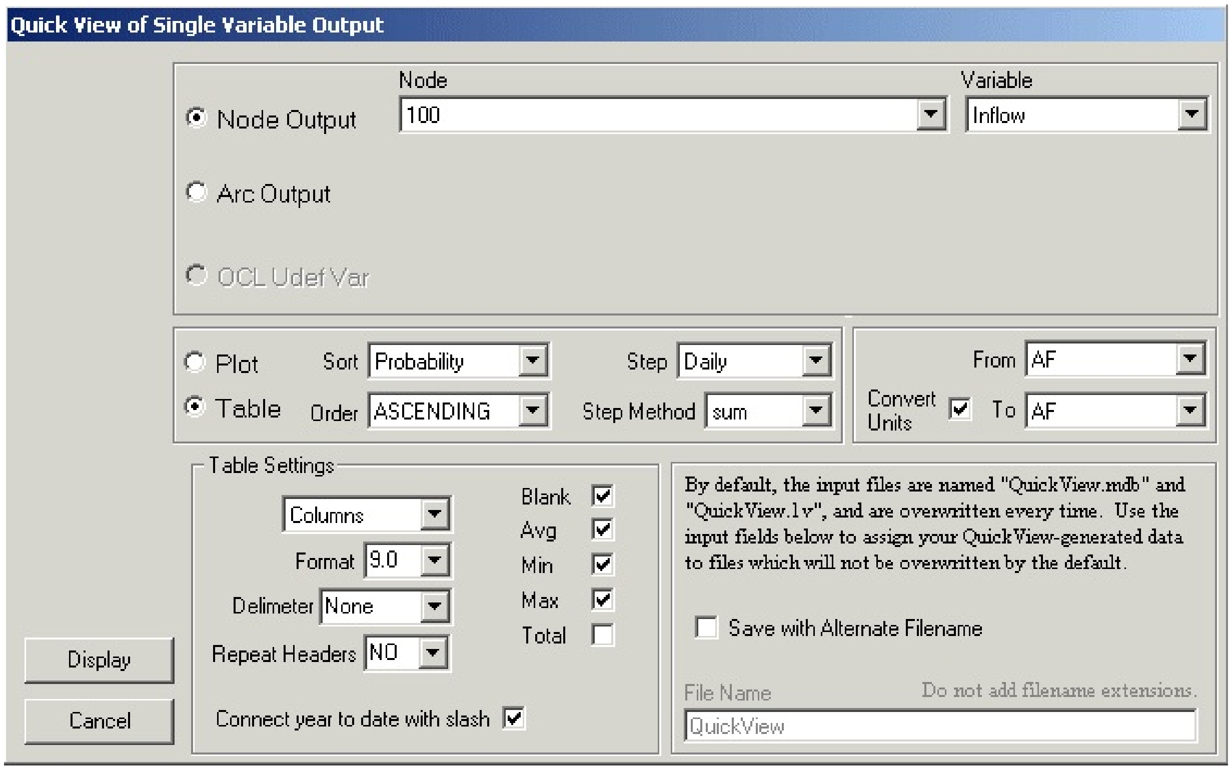
There is more than one way to call the Quick-View dialog box:

Click *Quick View* in the *Output* menu.

In the schematic (section 3.7.1), right-click on a node or arc and then click *Quick View* in the menu. The node or arc that you clicked on will be selected by default in the Quick-View dialog box.

In the *Node Settings* dialog box (section 3.8.1) or the *Arc Settings* dialog box (section 3.8.2), click the *Quick View* button. The node or arc that you were viewing will be selected by default in the Quick-View dialog box.

Regardless of how you access it, the dialog box appears like this:



[✓ Node Output] Node: 100 Variable: Inflow

Plot [✓ Table] Sort: Probability Order: ASCENDING Step: Daily Step Method: sum

From: AF Convert Units ✓ To: AF

Table Settings: Columns; Format 9.0; Delimeter None; Repeat Headers NO; Blank ✓; Avg ✓; Min ✓; Max ✓; Total ☐; Connect year to date with slash ✓

By default, the input files are named "QuickView.mdb" and "QuickView.1v", and are overwritten every time. Use the input fields below to assign your QuickView-generated data to files which will not be overwritten by the default.

☐ Save with Alternate Filename

File Name: QuickView   Do not add filename extensions.

In the frame at the top of the dialog box, you select which variable you want to see. Variables are selected from three main groups: *Node Output*, *Arc Output*, or *OCL Udef Var*. If you click *Node Output*, you can then select which node the variable is associated with in the *Node* box. Then you select the specific variable in the *Variable* box. If you click *Arc Output*, you can then select which arc the variable is associated with in the *Arc* box. Then you select the specific variable in the *Variable* box. If you click *OCL Udef Var*, you can then select which Udef variable in the *Variable* box.

In the center-left frame, you can choose to view either a plot or a table of the variable. By default, the *Sort* box has selected *TimeSeries* sorting. If you choose instead to do *Probability* (frequency) sorting (section 6.1.7 part G), then the *Order* box appears and you should choose to sort the variable either *ASCENDING* or *DESCENDING* (section 6.1.9 part C). By default, the *Step* box has selected *None*. If you want to view the variable at a time step other than the model time step, select another time step in the *Step* box, and a step method in the *Step Method* box (section 6.1.9 part C).

There are some limitations when you do a Quick View on a position-analysis run. When you use Quick View to generate a plot for a position-analysis run, if the *Sort* box says *Probability* then the GUI will not let you enter anything but *WholeRun* in the *Step* box. When you use Quick View to generate a table or plot for a position-analysis run, if the *Sort* box says *TimeSeries* then the GUI expects a pre-defined trace filter (section 9.4.3) to be applied. This trace filter is contained in a file named *QuickViewTraceFilter.txt* which must be found in the position-analysis subfolder of the onevar-input folder (section 3.3.1). The GUI does not write a trace-filter section into *QuickView.1v*, but it uses an :INCLUDE: statement (section 4.7.1 part H) to include *QuickViewTraceFilter.txt*. The file *QuickViewTraceFilter.txt* should contain a trace-filter section (including keyword *:TRACEFILTER:*) as described in section 6.1.10. It is legal if the file is empty, which would mean that there is no trace-filter section, and therefore all traces would be presented in output. Any time you wish to apply a different trace filter to the Quick View output, you can modify this file.

In the center-right frame, you can choose to convert the units of the variable (section 2.9.0 and section 4.7.6 part C). If you do not check *Convert Units*, then the units of the variable remain unconverted (Arc and node variables thus remain in primary units. OASIS software does not explicitly assign units to OCL udef variables.). If you do check *Convert Units*, then you can use the *From* and *To* boxes to specify how to do the conversion.

The lower-left frame, labeled *Table Settings*, only appears if you select the table button *Table* in the center-left frame. The *Table Settings* frame contains options for how to present the table output. In these boxes:

Select either *Columns* or *Tables* for the Onevar-output format (section 6.1.7 part F).

Select a width and number of decimal places in the *Format* box (section 6.1.9 part C). You can either select an item for the list or type in a value that is not in the list.

Select a delimiter character (section 6.1.7 part H) in the *Delimiter* box, or type in a character that is not in the list.

In the *Repeat Headers* box, choose to number of lines between repeated headers (section 6.1.7 part M). You may select a number from the list or type in a different one.

Choose whether or not to connect the date to the year with a slash (section 6.1.7 part R).

On the right side of this frame are check boxes for *Blank*, *Min*, *Max*, *Avg*, and *Total*. Check the items which you would like to appear in the summary rows at the bottom of the table (section 6.1.9 part C).

The lower-right frame gives you the option of saving your Quick-View generated Onevar-input file and/or Plot-definition file under an alternate file name. If you do not check the box, then the files are always named *QuickView.1v* and *QuickView.mdb*. They are saved in your Onevar-input and Plot-definitions folders (section 3.3.1), but they are overwritten each time you do a Quick View. If you check the box, then you can type in a file name that will not get overwritten. Type in the file name without the file name extension (such as *.mdb* or *.1v*). This new file can subsequently be accessed by selecting the *PLOTS* or *TABLES* menu items. You can also edit the new files. For example, you could add new tables or expand the value expression in the table.

Every time you do a Quick View, the GUI writes the onevar-input file (default name: *QuickView.1v*) from scratch. In contrast, it never writes the plot-definition file (default name: *QuickView.mdb*) from scratch. Rather, it creates the plot-definition file by copying the file *QuickView-DoNotErase.zmdb* and modifying only a few values in the new file. Therefore, *QuickView-DoNotErase.zmdb* must be present in the plot-definitions folder or folders (section 3.3.1). This is an MS Access database file, but the filename extension is changed from *MDB* to *ZMDB* in order to prevent careless editing of the file and to prevent the file from being recognized by the GUI when you click *PLOTS* (section 3.6.4 part B). The file *QuickView-DoNotErase.zmdb* is like a template for all plots generated by Quick View. Therefore, if you want all plots generated by Quick View to have certain characteristics, you can configure *QuickView-DoNotErase.zmdb* appropriately by following these steps:

Change the filename extension of *QuickView-DoNotErase.zmdb* so that it becomes *QuickView-DoNotErase.mdb*.

Modify *QuickView-DoNotErase.mdb*. You may do this by running Plot or by editing the values with MS Access (section 6.2.0).

Change the filename back to *QuickView-DoNotErase.mdb*.

Quick View only allows you to view variables of the currently open run. However, if you save the Onevar-input file or plot-definition file with an alternate filename, you may then view the variable in multiple runs by selecting the new file from the *PLOTS* or *TABLES* menu items.

3.6.5 *Help* MENU

A. *Help*

If you click *Help* in the *Help* menu, the GUI opens the OASIS user manual as a Help document. This document can be navigated with hypertext and a table of contents. Once it is opened, the Help document is a separate application from the GUI, and you can close it at any time. The *Help* item is not available in the menu if the *GUI.ini* file does not contain the *_WinHelp* parameter (section 3.3.5).

B. *User Manual (Adobe Acrobat)*

If you click *User Manual (Adobe Acrobat)* in the *Help* menu, the GUI opens the OASIS user manual as an Adobe Acrobat (PDF) document. You must have installed the Adobe Acrobat Reader to access this form of the user manual. Once it is opened, the Acrobat-based user manual a separate application from the GUI, and you can close it at any time. The *User Manual (Adobe Acrobat)* item is not available in the menu if the *GUI.ini* file does not contain the *_AcrobatUserManual* parameter (section 3.3.5).

C. Custom Help menu items

Clicking on a custom menu item issues a system command defined by a parameter in the *GUI.ini* file. Both the text shown in the menu and the system command that results from a click are defined in *GUI.ini*. There may be from zero to eight of these custom menu items. See documentation on the *CustomMenu_Help*X parameter in *GUI.ini* (section 3.3.5).

D. *About (Application)*

If you click *About (Application)* in the *Help* menu, the GUI displays the splash screen. The splash screen is custom-designed for different clients, and it is used to identify what application OASIS is being used for. Click on the splash screen to close it.

E. *About (File Version)*

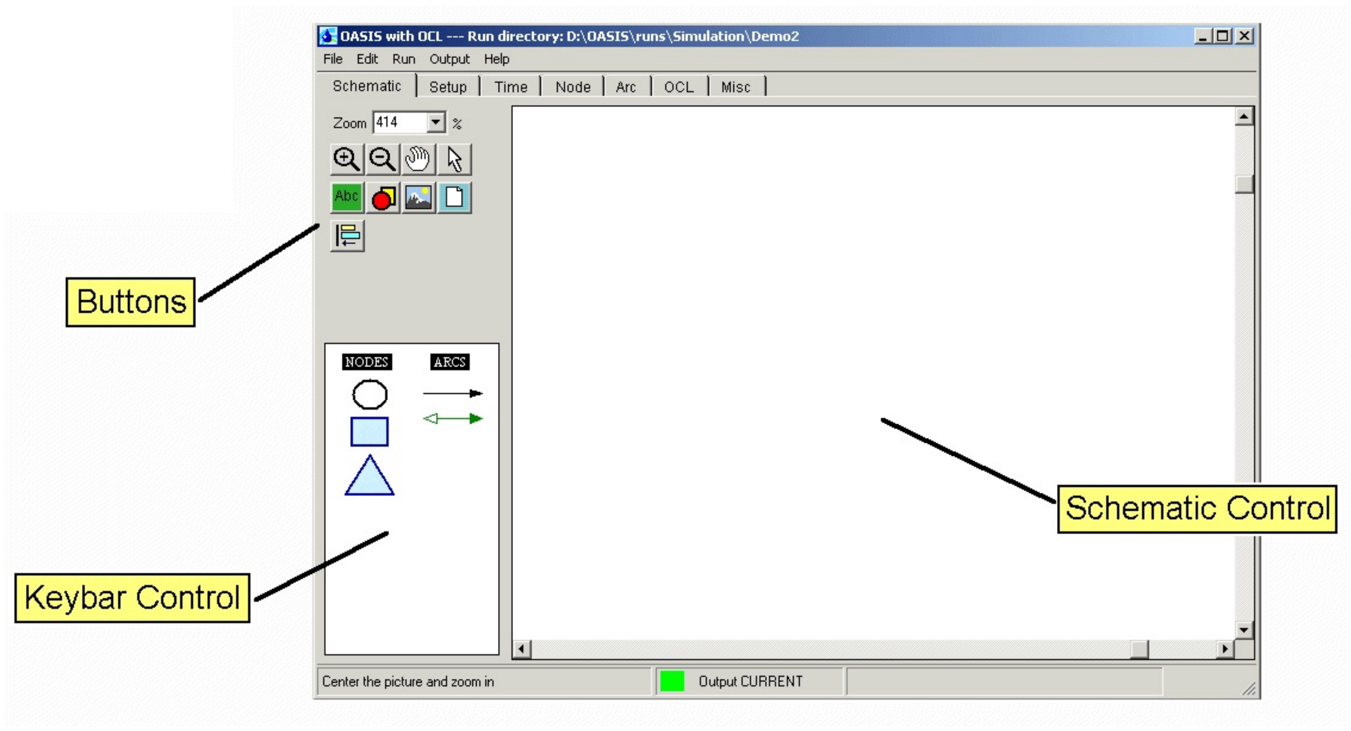
If you click *About (File Version)* in the *Help* menu, the GUI displays a window that tells the version numbers of most important executables in the OASIS package. See section 3.3.6 for more information about file versions. Click on the window to close it.

3.7.0 MAIN-WINDOW INTERFACE DETAILS

3.7.1 *Schematic* TAB

The schematic is a picture that shows how the system is represented by OASIS (section 2.1.0). In the GUI, the *Schematic* tab shows the schematic in an interactive window. You actually change OASIS input when you add, delete, or modify elements of the interactive schematic. Of course, some elements of the drawing are superficial. For example, the position of a node in the schematic does not affect model results. You can also add simple drawing objects, text boxes, and images from file to enhance the appearance of your schematic. The schematic is easily sent to a printer or saved to an image file.

The main controls on the *Schematic* tab are shown below:


OASIS with OCL --- Run directory: D:\OASIS\runs\Simulation\Demo2
File Edit Run Output Help
Schematic Setup Time Node Arc OCL Misc
Zoom 414 %
Abc
NODES
ARCS
Buttons
Keybar Control
Schematic Control
Center the picture and zoom in
Output CURRENT

The **schematic control** is where the schematic is actually displayed. The **keybar control** is a window from which you can select symbols to add to the schematic. The **buttons** are used to edit the schematic.

A. SCHEMATIC BUTTONS

Zoom in and center – After you click this button, you can click on any spot in the schematic to zoom in (make the picture larger). The spot that you click becomes the center of the view. While the mouse is in this state, the mouse pointer appears like a magnifying glass with a plus symbol. The mouse remains in this state until you select another option.

Zoom out and center – After you click this button, you can click on any spot in the schematic to zoom out (make the picture smaller). The spot that you click becomes the center of the view. While the mouse is in this state, the mouse pointer appears like a magnifying glass with a minus symbol. The mouse remains in this state until you select another option.

Scroll with hand tool – After you click this button, the mouse can be used to drag the entire schematic page in the schematic control. While the mouse is in this state, the mouse pointer appears like a hand. The mouse remains in this state until you select another option.

Select tool – After you click this button, the mouse can be used to select objects on the schematic, and then move, edit, or delete them, etc. This is the default state of the mouse. While the mouse is in this state, the mouse pointer appears like an arrow.

Add a new text box – After you click this button, the mouse pointer appears like a vertical bar. Click on the schematic at the location where you want to add a text box. After you click at a location on the schematic, you see a dialog box in which you can edit the text and its settings. When you have configured the text the way you want, click the *OK* button in the dialog box, and the text will then appear in the schematic. When this is done, the mouse returns to select mode and appears like an arrow. If the text or the text settings are not exactly the way you want, you can always change them.

Add a new shape – After you click this button, the mouse pointer appears like a cross hair. Click on the schematic at the location where you want to add a geometric shape, and without releasing the mouse button, drag the selection box to the desired size of the shape. When you release the mouse button, you see a dialog box in which you set the type of shape and other parameters. The choices of shape types include ***rectangle***, ***ellipse***, ***polyline*** and ***polygon***. When you have configured the shape the way you want, click the *OK* button in the dialog box, and the shape will then appear in the schematic. When this is done, the mouse returns to select mode and appears like an arrow. If the size of the object or its settings are not exactly the way you want, you can always change them.

Add a new image – After you click this button, the mouse pointer appears like a cross hair. Click on the schematic at the location where you want to add an image, and without releasing the mouse button, drag the selection box to the desired size of the image. When you release the mouse button, you see a dialog box in which you can select an image file to load. After you have selected the appropriate file, click the *OK* button in the dialog box, and the image will then appear in the schematic. When this is done, the mouse returns to select mode and appears like an arrow. If the size of the image or the image file are not exactly what you want, you can always change them.

Page setup – After you click this button, a dialog box appears with numerous parameters for configuring the schematic page. The dialog box allows you to set parameters for the paper size, the margins, and the paper color.

The schematic is represented on a virtual sheet of paper. For best results, you should set the size of the schematic page equal to the size of the sheet of paper you intend to print it on. Note that *Custom* is one of the size options. If you select *Custom*, you can enter the size of the paper in pixels, where there are 1440 pixels per inch (567 pixels per centimeter).

There are margins from the top, left, bottom, and right edges of the paper. You can enter the distance of the margin from the edge of the paper. You can also set the margin color. The margins appear on the schematic as thin dotted lines. These dotted lines never show up in a printed version of the schematic. If you uncheck the *Margins Visible* box, then the margins will be invisible in the schematic control (although they are still in effect). Note that the GUI does not prevent you from drawing objects outside of the margins. However, anything outside of the margins will not be sent to the printer when you print the page.

The dialog box also allows you to select the page color. The page color will be seen as the background color in the schematic control, although no matter how dark it is, the color does not show up when you send the schematic to a black-and-white printer.

Align objects – Before clicking this button, you should select the objects in the schematic control (and only those objects) that you want to align. After clicking the button, a dialog box allows you to select from four horizontal alignment methods and four vertical alignment methods (if you click *None* for either horizontal or vertical, then the objects are not moved along that axis). You may combine vertical and horizontal alignment at the same time. After you have selected your desired alignment methods, click *OK* and the GUI will reposition the objects into alignment.

B. NODE AND ARC CATEGORIES AND THE KEYBAR CONTROL

The keybar is a special control that appears on the lower left of the schematic tab. The keybar displays the node and arc symbols that you can add to the schematic.

The keybar displays one symbol for every ***arc category*** and one symbol for every ***node category***. The node-category symbols are lined up in a column under the word *NODES*, and the arc-category symbols are lined up in a column under the word *ARCS*. Please note that we are using the word ***category*** here to mean a slightly different concept than the ***node types*** that are defined in section 2.1.1. Usually, there is at least one category for every node type. There can be more than one category corresponding to a node type. Furthermore, OASIS does not recognize any *arc types*, but you can have multiple arc categories in your schematic.

Node and arc categories are superficial elements of the schematic. They may have important meanings in differentiating parts of the system, but assigning a node or arc to a particular category does not affect model input (other than determining the node type). Thus, *model.exe* has no automatic means of differentiating the junction nodes of one category from the junction nodes of another category.

Node and arc categories are user-defined, so you can divide your nodes and arcs into the categories that are appropriate to your system.

Here is just one possible way to define node and arc categories:

Symbol	**Category Name**	**Node Type (not applicable to arcs)**
○ *(black & white)*	Junction	Junction
🟦 *(blue)*	Urban Demand	Demand
🟨 *(black & yellow)*	Ag Demand	Demand
△ *(blue)*	Large Reservoir	Reservoir
⏢ *(black & green)*	Small Reservoir	Reservoir
→ *(blue)*	Natural channel	
→ *(purple)*	Man-made channel	

This example shows 1 category of junction nodes, and 2 categories each for demand nodes, reservoir nodes, and arcs. Presumably, the example set of node and arc categories above has been defined in a way that is meaningful and important to the modeler or other people who will view the schematic.

Let's suppose you are working on a project that has this set of node and arc categories, and you need to add a demand node to the system. You can choose either the "Urban Demand" category with the blue symbol, or the "Ag Demand" category with the yellow symbol. Whichever one you choose will communicate something to people who look at the schematic. However, it will not make a difference in model input. *If there is some universal property (or properties) that distinguishes the "Urban Demand" nodes from the "Ag Demand" nodes, merely assigning the node category on the schematic will not ensure that property is entered into OASIS input.* For example, the "Urban Demand" nodes may be part of a particular OCL constraint command, and the "Ag Demand" nodes may be part of a different OCL constraint command. Your use of the different categories (and therefore different symbols) on the schematic may signify this distinct relationship between different demand nodes. However, you must ensure that the new node is entered into the OCL constraint that corresponds to its category, because the GUI will not do it for you.

To add a node or arc to the schematic, you click on the desired symbol in the keybar and then click on the desired location in the schematic. See section 3.7.1 part C for more information.

The node and arc categories are defined by the database tables described in section 4.5.9. The GUI does not provide a user-friendly way of redefining the node and arc categories. Please consult with HydroLogics staff if you need to redefine the categories.

C. SPECIFIC SCHEMATIC TASKS

To change the size of the page, page margins, or page color: use the *Page Settings* dialog box. You can do this by clicking on the *Page Setup* button (section 3.7.1 part A) or by right-clicking on the schematic control and then clicking *Page Setup*.

To change the displayed size of the symbols in the keybar control: right-click on the keybar control (section 3.7.1 part B) and click *Zoom key bar*. The zoom level of the keybar does not affect the size of the symbols drawn in the schematic.

To zoom in or out on the schematic: you can use the *Zoom in and center* and *Zoom out and center* buttons (section 3.7.1 part A), or you can enter a value into the control box labeled *Zoom*.

To move the view of the schematic in the schematic control: you can use the *Scroll with hand tool* button (section 3.7.1 part A). You can also click on the scroll bars on the right and bottom of the schematic control. You can also use the following keys on the keyboard:

Key	**Scrolling Motion**
[Home]	scroll to left edge of the page
[End]	scroll to right edge of the page
[Page Up]	scroll to the top edge of the page
[Page Down]	scroll to the bottom edge of the page
Cursor-Arrow keys	move in a small step in the direction indicated

To move any object on the schematic: drag the object with the mouse. You may select multiple objects and then move them together. The endpoints of arcs move with the nodes they are connected to, but arc bendpoints do not move unless they are selected. You cannot move an arc without moving the nodes it is connected to. The *background image* cannot be moved unless you bring it out of the background by clicking *float background image*.

When you move the *name* of an arc or node, you are changing the position of the name object *relative* to the arc or node. If the arc or node is moved, then the name is automatically moved with it to stay in the same relative position.

To delete an object: right-click on the object and then select delete. Or you may select the object and then hit the *Delete* key. You may select multiple objects and delete them all at once. The *background image* cannot be deleted unless you bring it out of the background by clicking *float background image*. The symbol that represents inflow to a node cannot be deleted as such, but it will appear or disappear depending on whether there is inflow specified at the node. If you delete a node or an arc then the record is automatically deleted from the *Node* or *Arc* table. The node or arc might also be deleted from every other database table, depending on what is entered on the *General* tab of the *Preferences* dialog box (section 3.6.2 part C).

To align objects: select the objects to be aligned together, then click the *Align objects* button (section 3.7.1 part A).

To add a simple geometric shape: click on the *Add a new shape* button (section 3.7.1 part A) These objects do not affect the model input, but are for presentation only.

To change the shape type, outline, or fill area of a simple geometric shape: right-click on the shape object and select *Edit*.

To change the size of a simple geometric shape: right-click on the shape object and select *Resize shape*. Markers appear on the corners and edges of the object. You can drag these markers to resize the object. When you are done resizing, click on any part of the schematic except the shape you have been resizing, and the mouse will return to select mode.

To reshape a simple geometric shape: (polygon or polyline only) right-click on the shape object and select *Move/Add/Delete Points*. Markers appear on the corners and edges of the object.

> To move a corner, move the mouse over the marker on the corner. When the mouse pointer changes into an *X*, you can click and drag the corner.
>
> To add a corner, move the mouse over the edge of the object to which you want to add a corner. When the mouse pointer changes into a cross with a square center, you can click and drag to the point where you want the new corner.
>
> To eliminate a corner, move the mouse over the marker on the corner. When the mouse pointer changes into an *X*, click and hold down the mouse button. The mouse pointer should change into a cross. At this point you can hit the *Delete* key to eliminate the corner.

When you are done editing, click on any part of the schematic except the shape you have been resizing, and the mouse will return to select mode.

To add a floating image from an image file: click on the *Add a new image* button (section 3.7.1 part A). Note that the GUI does not make its own copy of this image. The image file must remain at the path you select.

To change a floating image: right-click on the image object and select *Edit*.

To change the size of a floating image: right-click on the image object and select *Resize Image*. Markers appear on the corners and edges of the object. You can drag these markers to resize the object. When you are done resizing, click on any part of the schematic except the image you have been resizing, and the mouse will return to select mode. Note that you may distort the aspect ratio.

To apply the original aspect ratio of a floating image: right-click on the image object and select *Restore Aspect Ratio*.

To turn a floating image into the background image: right-click on the image object and select *Send to background picture*. After that, the image cannot be selected, moved, deleted or edited unless you bring it out of the background. The background image preserves the size and position it had when you clicked *Send to background*, so you should set the size and position of the image before you send it to the background. The background image is behind all other objects. Only one image can be the background image, so if there is already a background image, you must bring it out of the background before another image can be sent to the background.

To bring an image out of the background: right-click on the background image or any part of the schematic control that is not on an object. Select *Float background image*. After that, the image becomes a floating image object like any other.

To add a floating text: click on the *Add a new text box* button (section 3.7.1 part A).

To change a floating text: right-click on the text object and select *Edit*.

To add a new node to the system, click on the symbol in the keybar control (section 3.7.1 part B) that corresponds to the category of the new node. The symbol that you clicked in the keybar is temporarily highlighted in pink to denote its status as the node category you are adding. The mouse pointer appears like a cross hair. Click on the location in the schematic control where you want the new node located. Then a dialog box appears with controls for some of the basic parameters for the new node. You must enter a node number and a node name. After you have set the appropriate parameters, click *OK* and the new node will appear on the schematic. The GUI automatically adds the new node to the *Node* table (section 4.5.3 part B) and sets the fields in that table, but it does not add the node to any other input tables. The mouse returns to select mode and the pointer appears like an arrow.

To add a new arc to the system, click on the symbol in the keybar control (section 3.7.1 part B) that corresponds to the category of the new arc. The symbol that you clicked in the keybar is temporarily highlighted in pink to denote its status as the arc category you are adding. The mouse pointer appears like a cross hair. Click on the node in the schematic control that is to be the upstream node of your new arc. This node is then highlighted in pink to denote its status. Next, click on the node that is to be the downstream node of your new arc. Then a dialog box appears with controls for some of the basic parameters for the new arc. You must enter an arc name. After you have set the appropriate parameters, click *OK* and the new arc will appear on the schematic. The GUI automatically adds the new arc to the *Arc* table (section 4.5.3 part C) and sets the fields in that table, but it does not add the arc to any other input tables. The mouse returns to select mode and the pointer appears like an arrow.

To create a dummy arc: add an arc as described above, but in the dialog box, check the box labeled *Dummy Arc*. When this box is checked, the arc is for display only and is ignored by the model.

To change the parameters of a node or arc: double-click on the node or arc, or on the text object of the *name* of the node or arc. Note that the parameters controlled through the dialog boxes here are limited to the parameters in the *Node* and *Arc* tables. If you change the number of a node, the GUI does not change the node number in tables other than the *Node* table and the *Arc* table. For example, if you have reservoir node 130, and you change its number to 134, then you will have to change the number from 130 to 134 in the *Reservoir* table because the GUI does not do it for you.

To hide an arc: double-click on the arc, and check the *Hide Entire Arc* box. The arc is still in the model, but it is not drawn on the schematic.

To unhide an arc: When the arc is hidden, it cannot be selected on the schematic, so you must go to the *Arc* table on the *Arc* tab (section 3.7.5). Find the row in the table for the arc, and then uncheck the box in the *Hide* column.

To add or remove the arrow representing inflow to a node: inflow to a node from outside the system (section 2.1.3) is represented by an arrow that points into the node symbol. If there is inflow at the node, then the GUI draws this arrow, and if there is no inflow, then the GUI does not draw an arrow. To remove the arrow, double-click on the node and then select *None* in the *Data Source of Inflow* box. To add the arrow, select one of the other options in the *Data Source of Inflow* box.

To reposition the arrow representing inflow to a node: At the foot of the arrow is a small circle that can be dragged with the mouse. In fact, you can select this small circle along with other objects to move them together or to align them. We have found that it is sometimes difficult to select the small circle, and have been unable to correct the problem. If you have difficulty selecting the object, try zooming into the schematic until the circle is large enough to click on.

To change the order in which objects appear on top of each other: right-click on one of the objects in question and select either *Move to Front* or *Move to Back*.

To keep an existing arc but connect it to a different node or nodes: right-click on the arc, and select *Change upstream node* or *Change downstream node*. The arc and the node that won't change are temporarily highlighted in pink. Click on the node that you want the arc to be connected to. When that is done, the GUI redraws the arc and changes the entry in the *Arc* table. The GUI does not change the node number in tables other than the *Arc* table. For example, if you have arc 130.155 and you reconnect the arc so that 222 is the downstream node, then you will have to change the number from 155 to 222 in the *Minimum Flow* table because the GUI does not do it for you.

To add a bend in an arc: right-click on the arc, and select *Add a bend in arc*. The mouse pointer changes to a black circle with a plus sign in the center. Click on the spot where you want the corner of the bend. The GUI then redraws the arc with a new bend, and the mouse pointer changes back to an arrow. If the corner is not exactly where you want it, you can always move it. An arc can have up to three bends.

To remove a bend from an arc: right-click on the arc, and select *Delete a bend in arc*. The mouse pointer changes to a black circle with a minus sign in the center. Click on the corner of the bend that you want to remove. The GUI then redraws the arc without the bend, and the mouse pointer changes back to an arrow.

To rotate the name of an arc: double-click on the arc, and enter the desired angle into the *Name Rotation* box. The rotation value is degrees counter-clockwise from horizontal

To rotate the name of a node: double-click on the node, and enter the desired angle into the *Name Rotation* box. The rotation value is degrees counter-clockwise from horizontal.

To quickly identify a node or arc: let the mouse pointer rest over the node or arc. The name and number of the node or arc will appear in the status bar at the bottom of the screen. This can be useful if the schematic is zoomed out such that text on the schematic is hard to read.

3.7.2 *Setup* TAB

The *Setup* tab contains a miscellany of features that were conceived as a sort of "control center" for the GUI. For some applications, the controls on the *Setup* tab are the controls that are used for the most common tasks, so the controls on other tabs need to be accessed only infrequently. However, because of the wide range of applications for OASIS, the *Setup* tab is not such an effective command center in all cases. Some users will find it very useful, while others might not.

A. TIME RANGE OF RUN

There are text boxes in the upper left of the *Setup* tab, with the labels *Start of Run* and *End of Run*. This is an interface to the *Range* table in the input database (section 4.5.2 part A). The same data may also be entered in the *Simulation Time Range* box on the *Time* tab (section 3.7.3).

B. CONTROL BUTTONS

A series of buttons appear on the right-hand side of the *Setup* tab. They are:

Edit Notes. Clicking this button is exactly the same as selecting *Notes* in the *Edit* menu (section 3.6.2 part B).

RUN. Clicking this button is exactly the same as selecting *Execute OASIS Model* in the *Run* menu (section 3.6.3).

Tables. Clicking this button is the same as selecting *TABLES* in the *Output* menu (section 3.6.4 part A). However, the *Edit Files* button and the option buttons do not appear in the dialog box.

Plots. Clicking this button is exactly the same as selecting *PLOTS* in the *Output* menu (section 3.6.4 part B). However, the *Edit Files* button and the option buttons do not appear in the dialog box.

Balance Sheet. Clicking this button is exactly the same as selecting *Balance Output* in the *Output* menu (section 3.6.4 part D). However, the option buttons do not appear in the dialog box.

Quick View. Clicking this button is exactly the same as selecting *Quick View* in the *Output* menu (section 3.6.4 part I).

C. OCL FILES

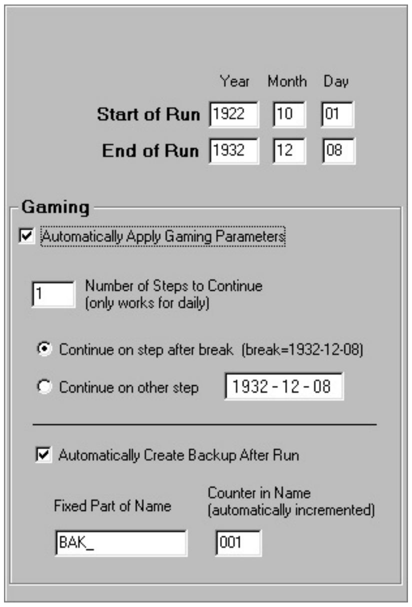
A control box listing all of the files in the *OCL* files can appear on the *Setup* tab. This is an exact duplicate of the box that appears on the *OCL* tab (section 3.7.6). You determine whether or not this control appears by setting an option in the *Preferences* dialog box (section 3.6.2 part C).

D. INITIAL CONDITIONS

An input control for the initial conditions table can appear on the *Setup* tab. This is an exact duplicate of the control that appears on the *Node* tab (section 3.7.4). The control is an interface to the *Initial Conditions* table in the input database (section 4.5.6). You determine whether or not this control appears from the *Preferences* dialog box (section 3.6.2 part C).

E. GAMING PARAMETERS

If the *Gaming Parameters* check box in the *Preferences* dialog box (section 3.6.2 part C) is checked, then the GUI displays controls for gaming parameters in the lower left of the *Setup* tab. These controls are illustrated below, along with the *Start of Run* and *End of Run* parameters.



	Year	Month	Day
Start of Run	1922	10	01
End of Run	1932	12	08

Gaming

[✓] Automatically Apply Gaming Parameters

1 Number of Steps to Continue (only works for daily)

[✓ ●] Continue on step after break (break=1932-12-08)

○ Continue on other step 1932 - 12 - 08

[✓] Automatically Create Backup After Run

Fixed Part of Name: BAK_

Counter in Name (automatically incremented): 001

Gaming is a process where water managers and/or other interested parties can step through the operation of the simulated system *one time step at a time*. After executing the model for one time step, they can analyze the state of the simulated system and the decide specific operations for the coming time step. The model input is then set accordingly and the model is executed for the next time step.

The principles behind gaming are still valid for running several time steps that span a small time period between decision points. For example, if the time-step is daily, it might make sense to set the operating decisions and let the model run for 7 days (7 time steps) before setting new decisions.

Gaming with OASIS can be done by setting the proper parameters in the *Range* table (section 4.5.2 part A), including use of ***continuation mode*** (section 2.8.3). In between time steps, the game participants can change model input. The gaming-parameter controls displayed in the GUI are designed to manage this process and make it easier for the modeler.

The gaming-parameters controls in the GUI are only capable of handling **daily-time-step** modeling. If you wish to do gaming runs at weekly, monthly, or other time-step sizes, you should not use these gaming parameters controls, but rather edit the *Range* table input directly.

If the box labeled *Automatically Apply Gaming Parameters* is unchecked, then the GUI does no special handling for gaming runs. In other words, it runs as if the gaming parameters were not displayed. Furthermore, the rest of the gaming parameter controls are invisible when the box is unchecked. If the box labeled *Automatically Apply Gaming Parameters* is checked, then the rest of the gaming parameters are enabled, and the GUI will automatically manipulate the start and end times of the run every time you execute the model.

Use the option buttons to tell the GUI when the continuation run begins. The idea of gaming is that you will resume simulation on the time step after the last step of the previous execution. To do this check the button labeled *Continue on step after break*. For your convenience, the step that will be used to as the start of the continuation run is displayed in parentheses. If you wish to begin the continuation run on a step other than this, check the *Continue on other step* button and enter the date (in *year - month - day* format) into the box. Your selection in these buttons determines what the GUI writes into the *CONTINUE* record of the *Range* table.

The GUI automatically sets the end of run based on an entry in the box labeled *Number of Time Steps to Continue*. When you execute the model, the continuation run will run for the given number of steps, and then stop so that you can evaluate the decision for the next execution. This control and the selected option button (*Continue on step after break*/*Continue on other step*) determine what the GUI writes into the *STOP* record of the *Range* table.

We recommend you create backups as you do to gaming process, in case you find a mistake or simply want to try a different operating scenario from some earlier stage of the process. If the box labeled *Automatically Create Backup After Run* is checked, then the GUI makes a copy of the run folder after *model.exe* has finished executing. The name of the backup folder is composed of the entries in the two boxes, *Fixed Part of Name* and *Counter in Name*. For example, if the entries are *Bak_SeriesA_* and *020*, then the backup folder is named *Bak_SeriesA_020*. You may change either of these entries any time. Whatever number is in the box *Counter in Name* will be incremented after the backup has been created. You may wish to keep notes of what is in each backup. If you want to go to one of the backup gaming runs, simply open it by clicking on *File*, then *Open Run* (section 3.6.1 part B).

F. CUSTOM FEATURES

Some applications of OASIS include custom controls in the GUI. It is common for such custom controls to be shown on the *Setup* tab. The custom controls are determined by the GUI plugin file, *OASISGUI_Plugin.ocx*, which must be in the executables folder (section 3.3.3). Different projects may use different versions of *OASISGUI_Plugin.ocx*. Section 3.3.6 describes how you can determine what version of *OASISGUI_Plugin.ocx* you have.

Custom features are not described in this user manual.

3.7.3 *Time* TAB

The *Time*, *Node*, *Arc*, *OCL*, and *Misc* tabs provide control interfaces to the database tables of the open run. These controls can be used instead of editing the tables with MS Access. The details of these tables are covered in Chapter 4, so in this section we only note the reference to the section in Chapter 4 and any features of the control in the GUI that are not explained in Chapter 4.

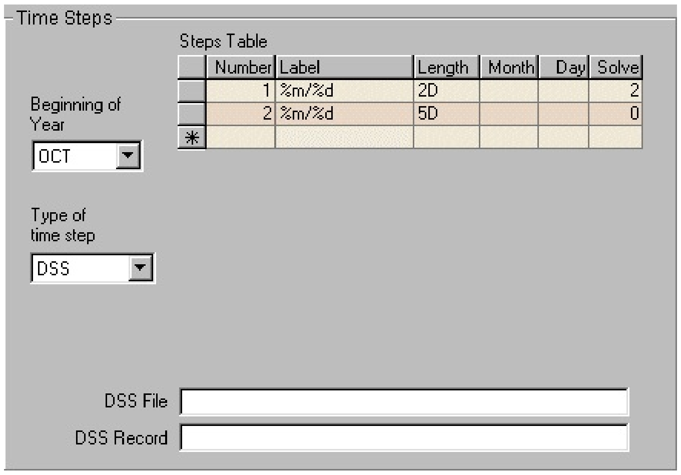
A. SIMULATION TIME RANGE

On the left side of the *Time* tab is the frame labeled *Simulation Time Range*. This frame contains the interface control to the *Range* table (section 4.5.2 part A). The start and stop times and the continuation time can all be edited in this table. Ordinarily, you should not edit the break time. Note that the start and stop time can also be controlled with the time range controls on the *Setup* tab. Also, the continuation time and stop time may be controlled by the gaming controls on the *Setup* tab (section 3.7.2). Many users will find the controls on the *Setup* tab to be easier to use for most purposes.

The *FLAG* field of the *Range* table is not shown in the table-interface control. Instead, there is a check box labeled *Interpret the Start Time as the Beginning of the time step*. This is in fact a control for the *FLAG* field, and its meaning should be clear.

B. TIME STEPS

On the right side of the *Time* tab is a frame labeled *Time Steps*. All the controls needed to define the time steps of simulation are in this frame, which is illustrated below:



Time Steps

Steps Table

Number	Label	Length	Month	Day	Solve
1	%m/%d	2D			2
2	%m/%d	5D			0

Beginning of Year: OCT

Type of time step: DSS

DSS File:

DSS Record:

The *Beginning of Year* control box is an interface to the *Year Scheme* input table (section 4.5.2 part C). Whichever month you select in this box is the month on which the year officially begins according to OASIS's year scheme (section 2.8.5).

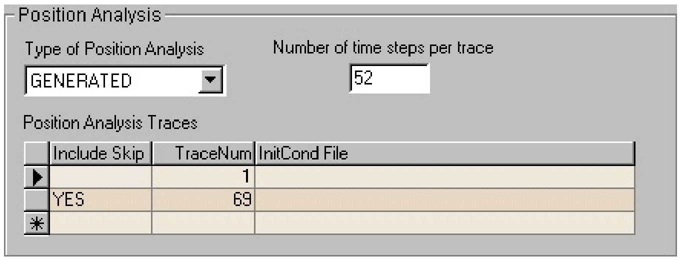
The *Type of Time Step* control box is an interface to the *Time Step* field of the *Run* input table (section 4.5.2 part B).

The control labeled *Steps Table* is an interface to the *Steps* input table (section 4.5.2 part D). This control only visible when you select *DSS* or *CYCLE* in the *Type of Time Step* box.

The controls labeled *DSS File* and *DSS Record* are only visible when you select *DSS* in the *Type of Time Step* box. These controls are your interface to the *DSS Steps* input table.

C. POSITION ANALYSIS

On the lower right of the *Time* tab is a frame labeled *Position Analysis*, is visible if and only if the GUI is in position-analysis mode (section 3.4.7). This frame contains all the controls specifically needed to define the position-analysis traces. The frame is illustrated below:



Type of Position Analysis: GENERATED

Number of time steps per trace: 52

Position Analysis Traces

Include Skip	TraceNum	InitCond File
	1	
YES	69	

The *Type of Position Analysis* control box is an interface to the *PosAnal DataSource* field in the *Run* input table (section 4.5.2 part B). The *Number of time steps per trace* control box is an interface to the *PosAnal NumSteps* field in the *Run* input table (section 4.5.2 part B).

The *Type of Position Analysis Traces* control box is an interface to the *PosAnalysis* input table (section 4.5.2 part F).

3.7.4 *Node* TAB

The *Time*, *Node*, *Arc*, *OCL*, and *Misc* tabs provide control interfaces to the database tables of the open run. These controls can be used instead of editing the tables with MS Access. The details of these tables are covered in Chapter 4, so in this section we only note the reference to the section in Chapter 4 and any features of the control in the GUI that are not explained in Chapter 4.

All of the tables on the *Node* tab have an identifying *Node Number* field in the database. The GUI allows you to view the node number, the node name, or both in identifying fields. You determine which identifying fields are shown using the *Table Options* tab of the *Preferences* dialog box (section 3.6.2 part C).

The *Node* tab includes many table-interface controls. Only one of these may be viewed at a time. Click on the option button for the table that you want to view. There are option buttons for the following tables.

Label in GUI	**Name in Database**	**Reference**	**Notes**
Node	*Node*	sec 4.5.3 part B	You can edit any existing record, but you can not add or delete records through this control. Instead, add or delete items on the schematic control (section 3.7.1). All fields can be edited from the schematic control by double-clicking on the node symbol. In the table control, the *Type* field is shown in blue text but cannot be edited directly. Instead, edit the *Category* field. The category field corresponds the categories displayed on the keybar control. Changes made in the table control are automatically updated in the schematic control.
Inflow Pattern	*Inflow Pattern*	sec 4.5.5 part A	
Demand	*Demand*	sec 4.5.4 part A	
Demand Pattern	*Demand Pattern*	sec 4.5.4 part B	
Demand Weights	*Weight: Demand*	sec 4.5.7 part C	
Reservoir	*Reservoir*	sec 4.5.3 part H	
Reservoir Rules	*Reservoir Rules*	sec 4.5.3 part I	
Reservoir SAE	*Reservoir S-A-E*	sec 4.5.3 part J	
Initial Condition	*Initial Condition*	sec 4.5.6	
Reservoir Weights	*Weight: Storage*	sec 4.5.7 part B	
Net Evaporation	*Evaporation*	sec 4.5.3 part K	
Net Evaporation Pattern	*Evaporation Pattern*	sec 4.5.3 part L	

3.7.5 *Arc* TAB

The *Time*, *Node*, *Arc*, *OCL*, and *Misc* tabs provide control interfaces to the database tables of the open run. These controls can be used instead of editing the tables with MS Access. The details of these tables are covered in Chapter 4, so in this section we only note the reference to the section in Chapter 4 and any features of the control in the GUI that are not explained in Chapter 4.

All of the tables on the *Arc* tab have an identifying *U/S Node* and *D/S Node* fields in the database. The GUI allows you to view the node numbers, the node names, the arc names, a combination of two of those, or all three. You determine which identifying fields are shown using the *Table Options* tab of the *Preferences* dialog box (section 3.6.2 part C).

The *Arc* tab includes many table-interface controls. Only one of these may be viewed at a time. Click on the option button for the table that you want to view. There are option buttons for the following tables.

Label in GUI	**Name in Database**	**Reference**	**Notes**
Arc	*Arc*	sec 4.5.3 part C	You can edit any existing record, but you can not add or delete records through this control. Instead, add or delete items on the schematic control (section 3.7.1). All fields can be edited from the schematic control by double-clicking on the arc symbol. The category field corresponds the categories displayed on the keybar control. Changes made in the table control are automatically updated in the schematic control.
Minimum Flow	*Minimum Flow*	sec 4.5.3 part E	
Maximum Flow	*Maximum Flow*	sec 4.5.3 part F	
Max Reverse Flow	*Maximum Reverse Flow*	sec 4.5.3 part G	
Arc Weights	*Weight: Arc*	sec 4.5.7 part A	

3.7.6 *OCL* TAB

The *Time*, *Node*, *Arc*, *OCL*, and *Misc* tabs provide control interfaces to the database tables of the open run. These controls can be used instead of editing the tables with MS Access. The details of these tables are covered in Chapter 4, so in this section we only note the reference to the section in Chapter 4 and any features of the control in the GUI that are not explained in Chapter 4.

The *OCL* tab includes two table-interface controls. Only one of these may be viewed at a time. Click on the option button for the table that you want to view. There are option buttons for the following tables.

Label in GUI	**Name in Database**	**Reference**	**Notes**
OCL Lookup	*Lookup*	sec 4.5.8 part A	
OCL Pattern	*Pattern*	sec 4.5.8 part B	
OCL Constants	*Constants*	sec 4.5.9 part C	The GUI only shows this table if the option is selected on the *General* tab of the *Preferences* dialog box (section 3.6.2 part C).

In the lower left of the *OCL* tab is a list control labeled *OCL Command Files*. In this tab is a list of every file in the *OCL* folder of your run folder (section 3.3.7), which matches the filter specified by the *OCL_Filter* parameter in the *GUI.ini* file (section 3.3.5). If you double-click on a file in the list, the GUI opens that file in VEDIT (section 3.2.0). You may select more than one file when you double-click, in which case the GUI opens all selected files as separate documents in a single instance of VEDIT. If you wish, you may then change the file(s) and save your changes through the VEDIT interface.

If there are any OCL files used by your run that are not in this folder or do not match the *OCL_Filter* parameter, they are not shown in the list. Any OCL files in this folder that match the *OCL_Filter* parameter will be displayed in the list, whether or not they are actively-used OCL files. Therefore, to avoid confusion, we recommend you put all active OCL files in this folder and do not put any non-OCL files or non-active OCL files in this folder.

See section 2.5.0 for more information about OCL.

3.7.7 *Misc* TAB

The *Time*, *Node*, *Arc*, *OCL*, and *Misc* tabs provide control interfaces to the database tables of the open run. These controls can be used instead of editing the tables with MS Access. The details of these tables are covered in Chapter 4, so in this section we only note the reference to the section in Chapter 4 and any features of the control in the GUI that are not explained in Chapter 4.

The *Misc* tab includes many table-interface controls. Only one of these may be viewed at a time (the *Configure Balance Sheet* button actually displays two tables). Click on the option button for the table that you want to view. There are option buttons for the following tables.

Label in GUI	**Name in Database**	**Reference**	**Notes**
Output Options	n/a		This does not show an input table. See discussion below.
Units Definitions	*Units Definitions*	sec 4.5.3 part A	See discussion of the **Units Wizard** below.
Configure Balance Sheet	*Balance Sheet Columns* and *Balance Sheet Rows*	sec 4.5.3 part N and sec 4.5.3 part O	
Declare Timeseries	*Declare Timeseries*	sec 4.5.3 part P	

The *Output Options* button displays a set of controls that determine what output is generated by *model.exe*. These controls determine what flags are written to *model.cf* (section 4.3.0). See section 2.6.0 for an introduction to the output files, and see Chapter 5 for complete documentation of the output files. If you choose to generate the optional output, it might take noticeably longer to execute the model, and the resulting files may take large amounts of disk space. If you choose not to generate an output file, then of course you will not be able to view it from the GUI's *Output* menu. As long as the run is not locked (section 3.4.9), you can always turn on a flag and re-execute the model.

When you click the *Units Definitions* button, you see the control interface to the *Units Definitions* input table. You also see a special button labeled ***Units Wizard***. When you press this button, the GUI displays a special dialog box that helps you understand the input for defining units. Because it is much easier to understand, we recommend you enter your input into this Units-Wizard dialog box rather than enter it into the basic table-interface control. See section 2.9.0 for more explanation of units of measurement in OASIS.

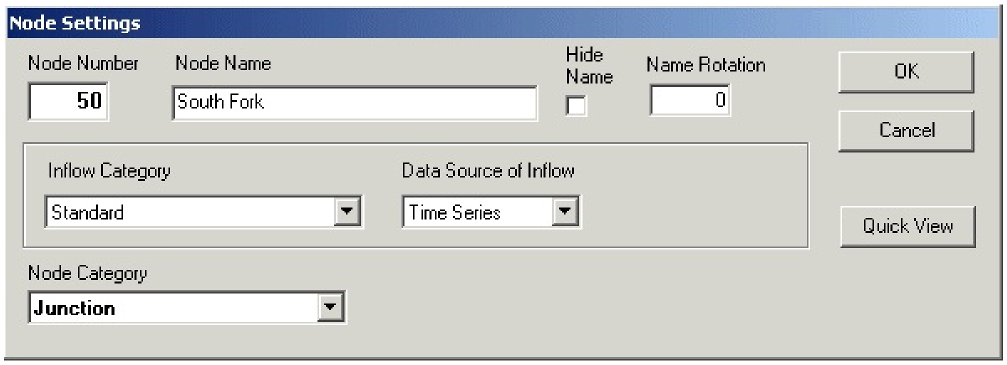
3.8.0 SPECIAL DIALOG BOXES

The special dialog boxes described below provide convenient ways of editing and analyzing input data.

3.8.1 *Node Settings* Dialog Box

The *Node Settings* dialog box provides a single view of all standard input data that is associated with a single node. It also contains settings for displaying the node on the schematic. To access this dialog box, on the schematic (section 3.7.1) find the node you want to edit or analyze and double-click on it. Alternatively, you can right-click on it and select *Edit* from the menu.

For junction nodes, the *Node Settings* dialog box appears like this:


Node Settings
Node Number: 50
Node Name: South Fork
Hide Name: ☐
Name Rotation: 0
Inflow Category: Standard
Data Source of Inflow: Time Series
Node Category: Junction

All controls on the *Node Settings* dialog box for junction nodes are also found on the dialog box for demand nodes and reservoir nodes. The controls are:

Node Number - You may assign or change the number that identifies the node. This control is linked to the *Node Number* field in the *Node* Table (section 4.5.3 part B).

Node Name - You may assign or change the name of the node. This control is linked to the *Name* field in the *Node* Table (section 4.5.3 part B).

Hide Name - The node name is shown on the schematic unless this box is checked. This control is linked to the *HideName* field in the *Node* Table (section 4.5.3 part B).

Name Rotation - The name is shown on the schematic rotated in degrees counter-clockwise from horizontal. This control is linked to the *Rotation_Angle* field in the *Node* Table (section 4.5.3 part B).

Inflow Category - The inflow category determines the appearance of the arrow on the schematic that indicates inflow to the node. Note that changing the value in this box only changes the appearance on the schematic – it does not automatically change any properties of the inflow. This control is linked to the *InflowType* field in the *Node* Table (section 4.5.3 part B).

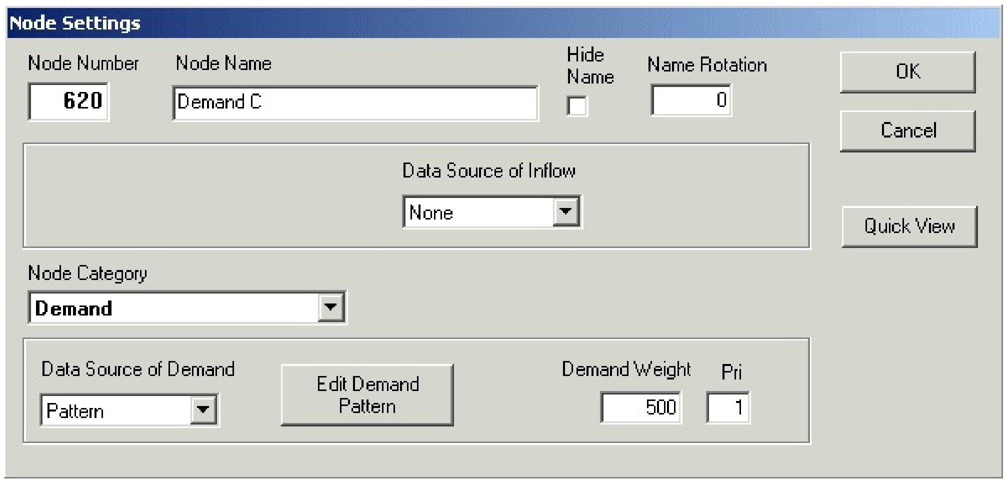
Data Source of Inflow - This box tells OASIS how to determine the value of the inflow to the node. This control is linked to the *Inflow* field in the *Node* Table (section 4.5.3 part B). If the box contains *Pattern*, then you can edit the values of inflow by pressing the *Edit Inflow Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of inflow using HecDssVue (section 4.6.0 and section 4.6.4 part A). If the box contains *OCL*, then the values of inflow are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then the inflow to the node is zero and no arrow symbolizing the inflow is drawn on the schematic.

Edit Inflow Pattern - This button is only shown if the *Data Source of Inflow* box says *Pattern*. Pressing this button opens the *Inflow Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the inflow to the current node.

Node Category - The node category determines the appearance of the node symbol on the schematic. It also determines the node type (junction, demand, or reservoir; see section 2.1.1). Note that changing the value in this box only changes the node type and the appearance on the schematic – it does not automatically change any other properties of the node. This control is directly linked to the *SubType* field and indirectly linked to the *Type* field in the *Node* Table (section 4.5.3 part B).

Quick View - Pressing this button summons the Quick View dialog box (section 3.6.4 part I), and the current node is initially selected in the dialog box.

For demand nodes, the *Node Settings* dialog box appears like this:



Node Number: 620
Node Name: Demand C
Hide Name: ☐
Name Rotation: 0
Data Source of Inflow: None
Node Category: Demand
Data Source of Demand: Pattern
Demand Weight: 500
Pri: 1

Many of the controls are also found on the *Node Settings* dialog box for junction nodes. See above for descriptions of these controls. The controls that are unique to demand nodes are:

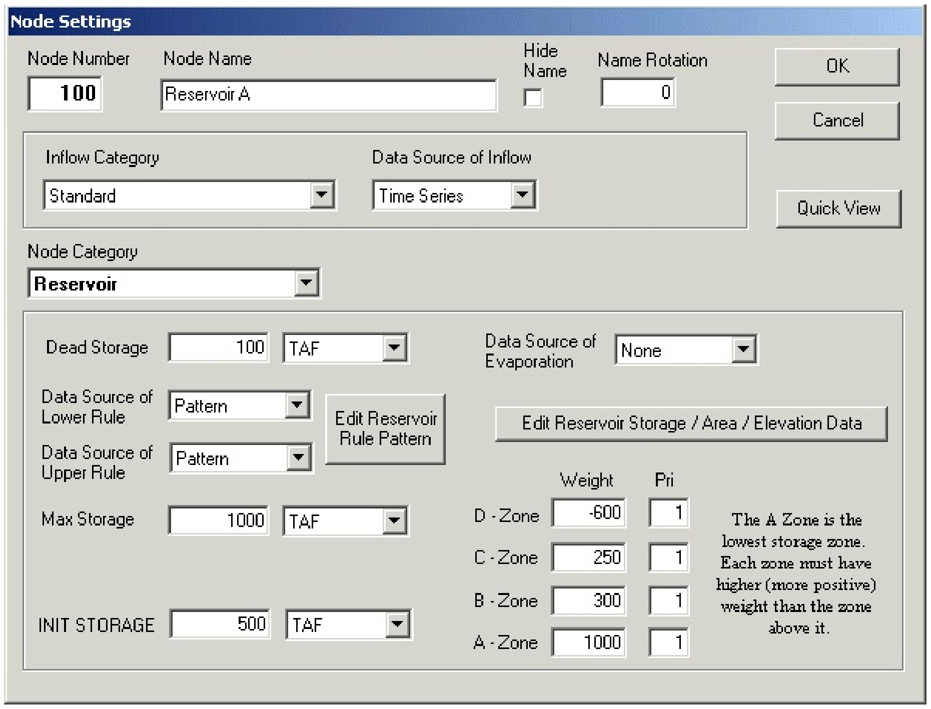
Data Source of Demand - This box tells OASIS how to determine the value of the demand at the node. This control is linked to the *Demand Type* field in the *Demand* Table (section 4.5.4 part A). If the box contains *Pattern*, then you can edit the values of demand by pressing the *Edit Demand Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of demand using HecDssVue (section 4.6.0 and section 4.6.3 part A). If the box contains *OCL*, then the values of demand are determined by an OCL *Set* command (section 2.5.1 part C).

Edit Demand Pattern - This button is only shown if the *Data Source of Demand* box says *Pattern*. Pressing this button opens the *Demand Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the demand at the current node.

Demand Weight - The weight on meeting demand at this node. This control is linked to the *Wt* field in the *Weight: Demand* Table (section 4.5.7 part C).

Pri - The priority level of weight on meeting demand at this node. This control is linked to the *Pri* field in the *Weight: Demand* Table (section 4.5.7 part C).

For reservoir nodes, the *Node Settings* dialog box appears like this:


Node Settings

Node Number: 100
Node Name: Reservoir A
Hide Name: ☐
Name Rotation: 0

Inflow Category: Standard
Data Source of Inflow: Time Series

Node Category: Reservoir

Dead Storage: 100 TAF
Data Source of Evaporation: None
Data Source of Lower Rule: Pattern
Data Source of Upper Rule: Pattern
Max Storage: 1000 TAF
INIT STORAGE: 500 TAF

	Weight	Pri
D - Zone	-600	1
C - Zone	250	1
B - Zone	300	1
A - Zone	1000	1

The A Zone is the lowest storage zone. Each zone must have higher (more positive) weight than the zone above it.

OK
Cancel
Quick View
Edit Reservoir Rule Pattern
Edit Reservoir Storage / Area / Elevation Data

Many of the controls are also found on the *Node Settings* dialog box for junction nodes. See above for descriptions of these controls. The controls that are unique to reservoir nodes are:

Dead Storage - The storage or elevation value that demarcates dead storage (the boundary of the A and B zones) in the reservoir. The first control is linked to the *Dead Storage* field and the second control is linked to the *Dead Stor Units* field in the *Reservoir* Table (section 4.5.3 part H).

Data Source of Lower Rule - This box tells OASIS how to determine the value of the lower rule curve (the boundary of the B and C zones) for the reservoir node. This control is linked to the *Lower Rule* field in the *Reservoir* Table (section 4.5.3 part H). If the box contains *Pattern*, then you can edit the values of the lower rule curve by pressing the *Edit Reservoir Rule Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of the lower rule curve using HecDssVue (section 4.6.0 and section 4.6.2 part F). If the box contains *OCL*, then the values of the lower rule curve are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then there is no lower rule and the reservoir is only modeled with a single storage zone.

Data Source of Upper Rule - This box tells OASIS how to determine the value of the upper rule curve (the boundary of the C and D zones) for the reservoir node. This control is linked to the *Upper Rule* field in the *Reservoir* Table (section 4.5.3 part H). If the box contains *Pattern*, then you can edit the values of the upper rule curve by pressing the *Edit Reservoir Rule Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of the upper rule curve using HecDssVue (section 4.6.0 and section 4.6.2 part E). If the box contains *OCL*, then the values of the upper rule curve are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then there is no upper rule and the reservoir is only modeled with a single storage zone.

Edit Reservoir Rule Pattern - This button is only shown if the *Data Source of Lower Rule* box says *Pattern*. Pressing this button opens the *Reservoir Rule Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the upper and lower rule curves at the current node.

Max Storage - The maximum storage or elevation value of the reservoir. The first control is linked to the *Max Storage* field and the second control is linked to the *Max Stor Units* field in the *Reservoir* Table (section 4.5.3 part H).

INIT STORAGE - The storage or elevation value of the reservoir at the beginning of the first simulated time step. The first control is linked to the *Storage* field and the second control is linked to the *Storage Units* field in the *Initial Condition* Table (section 4.5.6).

Data Source of Evaporation - This box tells OASIS how to determine the value of the evaporation at the node. This control is linked to the *Evaporation Type* field in the *Evaporation* Table (section 4.5.3 part K). If the box contains *Pattern*, then you can edit the values of the evaporation rate by pressing the *Edit Evaporation Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of the evaporation rate using HecDssVue (section 4.6.0 and section 4.6.2 part D). If the box contains *OCL*, then the values of evaporation are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then the evaporation rate at the node is zero.

Edit Evaporation Pattern - This button is only shown if the *Data Source of Evaporation* box says *Pattern*. Pressing this button opens the *Evaporation Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the evaporation rate at the current node.

Edit Reservoir Storage / Area / Elevation Data - Pressing this button opens the *Reservoir Storage-Area-Elevation* dialog box (section 3.8.4), allowing you to view or edit the values of the table that relates storage, area, and elevation at the current reservoir node.

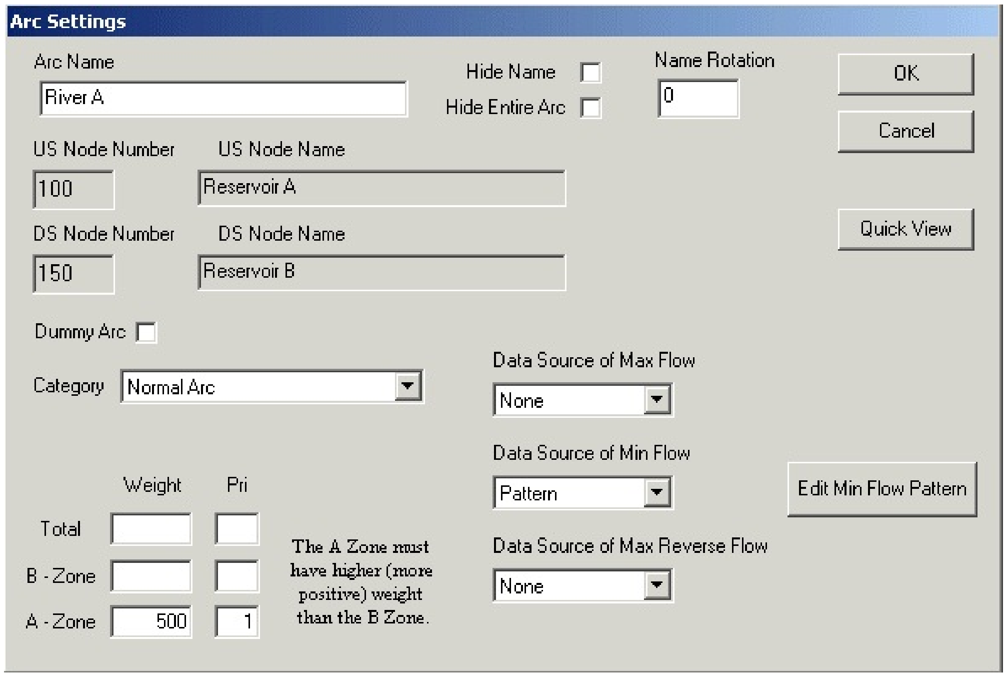
Weight - There are four boxes under the heading *Weight*, each labeled for A, B, C, or D zone. These are the weights on having water in storage in the respective zones. These controls are linked to the *A Wt*, *B Wt*, *C Wt*, and *D Wt* fields in the *Weight: Storage* Table (section 4.5.7 part B).

Pri - There are four boxes under the heading *Pri*, each labeled for A, B, C, or D zone. These are the priority levels on the weights on having water in storage in the respective zones. These controls are linked to the *A Pri*, *B Pri*, *C Pri*, and *D Pri* fields in the *Weight: Storage* Table (section 4.5.7 part B).

3.8.2 *Arc Settings* Dialog Box

The *Arc Settings* dialog box provides a single view of all standard input data that is associated with a single arc. It also contains settings for displaying the arc on the schematic. To access this dialog box, on the schematic (section 3.7.1) find the arc you want to edit or analyze and double-click on it. Alternatively, you can right-click on it and select *Edit* from the menu.

The *Arc Settings* dialog box appears like this:


Arc Settings

Arc Name: River A
Hide Name ☐
Hide Entire Arc ☐
Name Rotation: 0
US Node Number: 100
US Node Name: Reservoir A
DS Node Number: 150
DS Node Name: Reservoir B
Dummy Arc ☐
Category: Normal Arc
Data Source of Max Flow: None
Data Source of Min Flow: Pattern
Data Source of Max Reverse Flow: None

	Weight	Pri
Total		
B - Zone		
A - Zone	500	1

The A Zone must have higher (more positive) weight than the B Zone.

The controls are:

Arc Name - You may assign or change the name of the arc. This control is linked to the *Name* field in the *Arc*

Table (section 4.5.3 part C).

US Node Number, US Node Name, DS Node Number, DS Node Name - These fields identify the arc that the dialog box describes, but you can not edit them in the dialog box. If you wish to attach the arc to a different node or nodes, you must do it through the schematic control (section 3.7.1). These controls are linked to the *U/S Number* and *D/S Number* fields in the *Arc* Table (section 4.5.3 part C).

Hide Name - The arc name is shown on the schematic unless this box is checked. This control is linked to the *HideName* field in the *Arc* Table (section 4.5.3 part C).

Hide Entire Arc - The arc is shown on the schematic unless this box is checked. This control is linked to the *Hide* field in the *Arc* Table (section 4.5.3 part C).

Name Rotation - The name is shown on the schematic rotated in degrees counter-clockwise from horizontal. This control is linked to the *Rotation_Angle* field in the *Arc* Table (section 4.5.3 part C).

Category - The arc category determines the appearance of the arc symbol on the schematic. Note that changing the value in this box *only* changes the appearance on the schematic – it does not automatically change any other properties of the arc. This control is linked to the *SubType* field in the *Node* Table (section 4.5.3 part C).

Quick View - Pressing this button summons the Quick View dialog box (section 3.6.4 part I), and the current arc is initially selected in the dialog box.

Data Source of Max Flow - This box tells OASIS how to determine the value of the maximum flow at the node. This control is linked to the *Max Flow* field in the *Arc* Table (section 4.5.3 part C). If the box contains *Pattern*, then you can edit the values of max flow by pressing the *Edit Flow Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of max flow using HecDssVue (section 4.6.0 and section 4.6.2 part B). If the box contains *OCL*, then the values of max flow are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then the max flow at the arc is zero.

Edit Max Flow Pattern - This button is only shown if the *Data Source of Max Flow* box says *Pattern*. Pressing this button opens the *Max Flow Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the max flow at the current node.

Data Source of Min Flow - This box tells OASIS how to determine the value of the minimum flow at the node. This control is linked to the *Min Flow* field in the *Arc* Table (section 4.5.3 part C). If the box contains *Pattern*, then you can edit the values of min flow by pressing the *Edit Min Flow Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of min flow using HecDssVue (section 4.6.0 and section 4.6.2 part A). If the box contains *OCL*, then the values of min flow are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then the min flow at the arc is zero.

Edit Min Flow Pattern - This button is only shown if the *Data Source of Min Flow* box says *Pattern*. Pressing this button opens the *Min Flow Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the min flow at the current node.

Data Source of Max Reverse Flow - This box tells OASIS how to determine the value of the maximum reverse flow at the node. This control is linked to the *MaxRev Flow* field in the *Arc* Table (section 4.5.3 part C). If the box contains *Pattern*, then you can edit the values of max reverse flow by pressing the *Edit Max Rev Pattern* button (see below). If the box contains *Time Series*, then you can edit the values of max reverse flow using HecDssVue (section 4.6.0 and section 4.6.2 part C). If the box contains *OCL*, then the values of max reverse flow are determined by an OCL *Set* command (section 2.5.1 part C). If the box contains *None*, then the max reverse flow at the arc is zero.

Edit Max Rev Pattern - This button is only shown if the *Data Source of Max Reverse Flow* box says *Pattern*. Pressing this button opens the *Maximum Reverse Flow Pattern* dialog box (section 3.8.3), allowing you to view or edit the values of the max reverse flow at the current node.

Weight - There are three boxes under the heading *Weight*, each labeled for Total, B-Zone, or A-zone. These are the weights on water flowing through the arc in the respective zones. These controls are linked to the *Total Wt*, *B Wt*, and *A Wt* fields in the *Weight: Arc* Table (section 4.5.7 part A).

Pri - There are three boxes under the heading *Pri*, each labeled for Total, B-Zone, or A-zone. These are the priority levels on the weights on water flowing through the arc in the respective zones. These controls are linked to the *Total Pri*, *B Pri*, and *A Pri* fields in the *Weight: Arc* Table (section 4.5.7 part A).

3.8.3 Pattern Dialog Box

The pattern dialog box provides a way of viewing and editing a single pattern input variable. In most cases, this is more convenient than viewing or editing the pattern variable in the whole table with other pattern variables. The dialog box provides an easy way to change the name or association of the data, or to copy pattern values from one variable to another. See section 4.5.1 for information about pattern tables.

To access this dialog box

***Inflow Pattern* Table** (section 4.5.5 part A) - On the *Node Settings* dialog box (section 3.8.1), press the *Edit Inflow Pattern* button. Alternatively, with the *Inflow Pattern* table showing on the *Node* tab (section 3.7.4), click on the menu *Edit > Edit Single Pattern*.

***Demand Pattern* Table** (section 4.5.4 part B) - On the *Node Settings* dialog box (section 3.8.1), press the *Edit Demand Pattern* button. Alternatively, with the *Demand Pattern* table showing on the *Node* tab (section 3.7.4), click on the menu *Edit > Edit Single Pattern*.

***Reservoir Rules* Table** (section 4.5.3 part I) - On the *Node Settings* dialog box (section 3.8.1), press the *Edit Reservoir Rule Pattern* button. Alternatively, with the *Reservoir Rules* table showing on the *Node* tab (section 3.7.4), click on the menu *Edit > Edit Single Pattern*.

***Evaporation Pattern* Table** (section 4.5.3 part L) - On the *Node Settings* dialog box (section 3.8.1), press the *Edit Evap Pattern* button. Alternatively, with the *Net-Evaporation Pattern* table showing on the *Node* tab (section 3.7.4), click on the menu *Edit > Edit Single Pattern*.

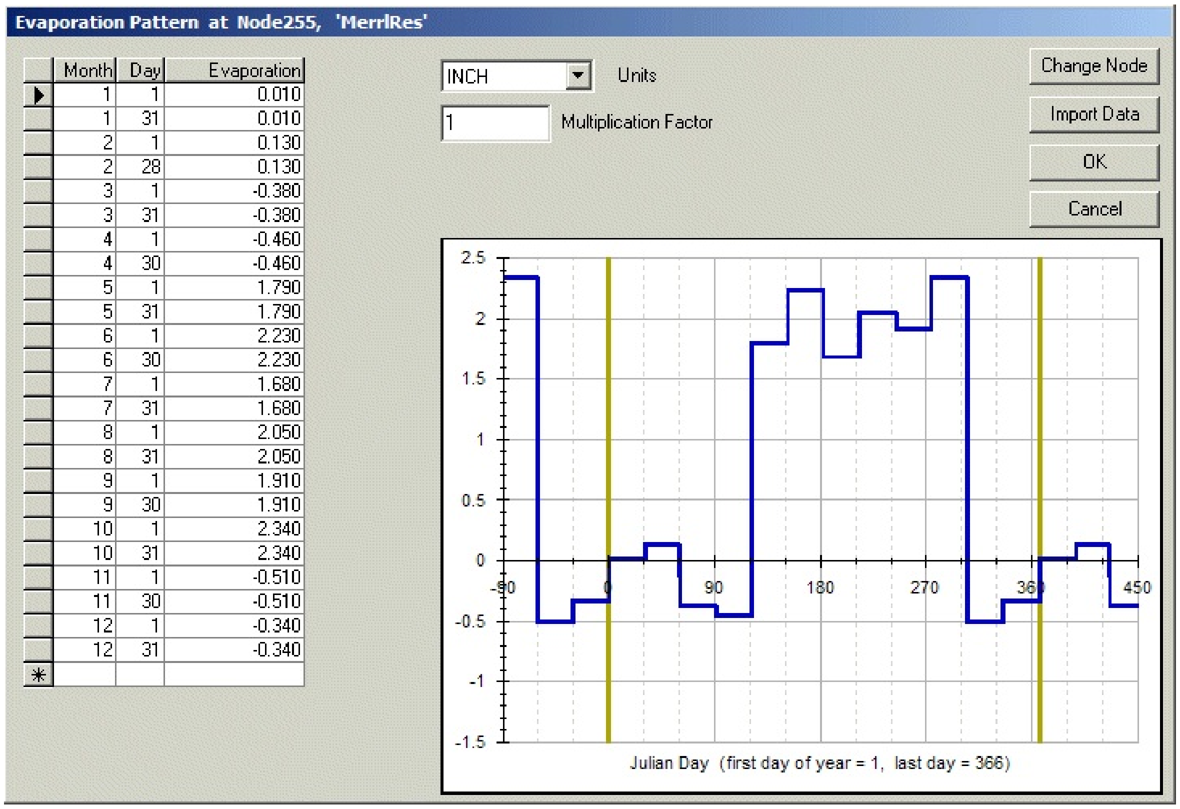
***Minimum Flow Pattern* Table** (section 4.5.3 part E) - On the *Arc Settings* dialog box (section 3.8.2), press the *Edit Min Flow Pattern* button. Alternatively, with the *Minimum FIow* table showing on the *Arc* tab (section 3.7.5), click on the menu *Edit > Edit Single Pattern*.

***Maximum Flow Pattern* Table** (section 4.5.3 part F) - On the *Arc Settings* dialog box (section 3.8.2), press the *Edit Max Flow Pattern* button. Alternatively, with the *Maximum FIow* table showing on the *Arc* tab (section 3.7.5), click on the menu *Edit > Edit Single Pattern*.

***Maximum Reverse Flow Pattern* Table** (section 4.5.3 part G) - On the *Arc Settings* dialog box (section 3.8.2), press the *Edit Max Rev Pattern* button. Alternatively, with the *Max Reverse FIow* table showing on the *Arc* tab (section 3.7.5), click on the menu *Edit > Edit Single Pattern*.

***OCL Pattern* Table** (section 4.5.8 part B) - With the *OCL Pattern* table showing on the *OCL* tab (section 3.7.6), click on the menu *Edit > Edit Single Pattern*.

Here is an example of the *Evaporation Pattern* dialog box. The pattern dialog boxes for other pattern tables have much the same form as the *Evaporation Pattern* dialog box.


Evaporation Pattern at Node255, 'MerrlRes'

Month	Day	Evaporation
1	1	0.010
1	31	0.010
2	1	0.130
2	28	0.130
3	1	-0.380
3	31	-0.380
4	1	-0.460
4	30	-0.460
5	1	1.790
5	31	1.790
6	1	2.230
6	30	2.230
7	1	1.680
7	31	1.680
8	1	2.050
8	31	2.050
9	1	1.910
9	30	1.910
10	1	2.340
10	31	2.340
11	1	-0.510
11	30	-0.510
12	1	-0.340
12	31	-0.340

Units: INCH

Multiplication Factor: 1

The important features of the dialog box are:

Window Title - Identifies the pattern by name or by its node or arc association.

Table of values on different dates of the year - The values or dates can be edited in this table control. You can add or delete rows in the table. To add a row type the values into the empty row at the bottom, and move the cursor to a different row when you have finished.   The new row will be automatically sorted. To delete a row, click on the gray “record selector” column on the left margin of the row, and then hit the DELETE key. If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph.

The table can have between 2 and 366 rows. The table must always have a row for the first date of the year and the last date of the year, as defined by the year scheme (section 2.8.5). The values of the pattern variable are equal to the values in this table multiplied by the multiplication factor.

Graph of pattern values - The graph shows the values from the table multiplied by the multiplication factor. The x-axis of the graph is the value of the julian day variable, i.e. the date of the year as a number 1 through 366. Note that 1 is the first date of the year scheme (section 2.8.5). The x-axis of the graph extends from less than 1 to more than 366. This allows you to see the pattern extending from approximately three months of the previous year to three months of the following year. This is done to give you a clearer picture of the pattern variable as a value that cycles every year. Vertical bars in dark yellow are shown at julian=1 and julian=366, to visually separate the year from the portions of the previous year and following year. If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph.

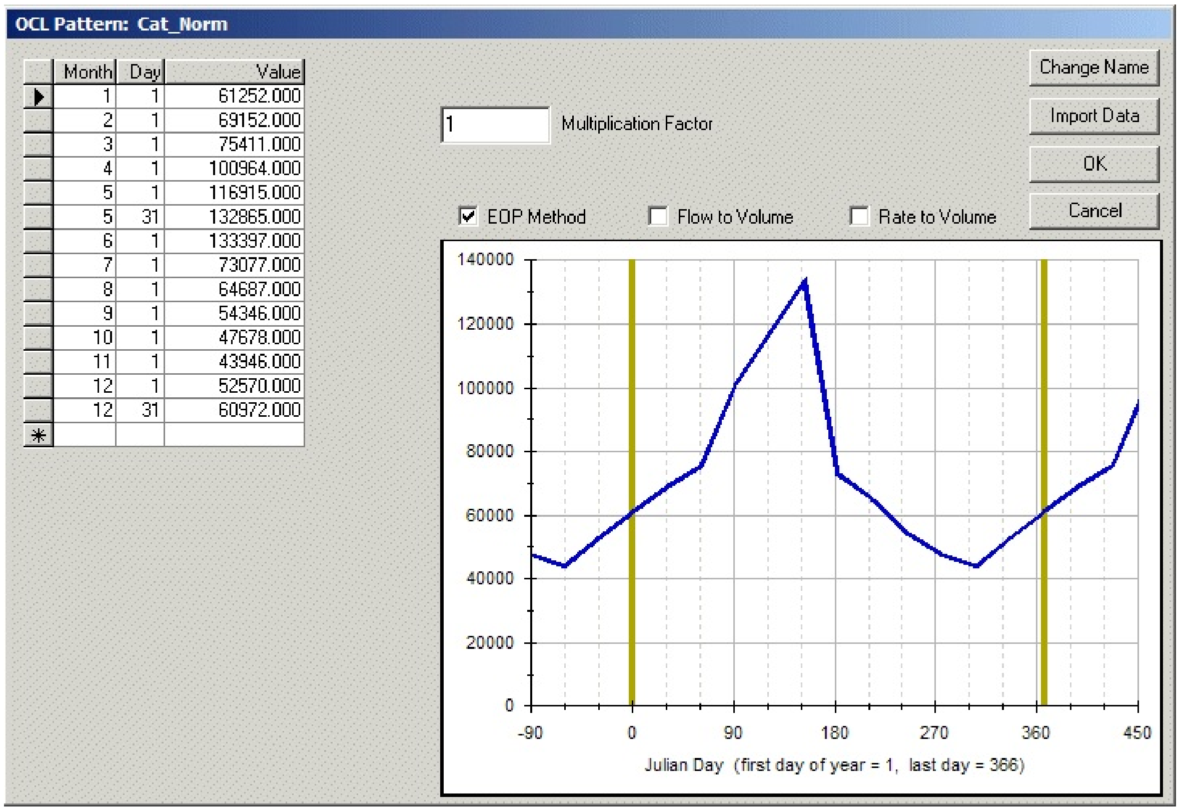
Units - This box tells what units the input values are measured in. The possible selections in the box are defined by the *Units* Table (section 4.5.3 part A). The box is linked to the *units* field in the database table of the pattern.

Multiplication Factor - The values of the pattern variable are equal to the values in the table multiplied by the value in this box. Often the value is 1. You can change this value to adjust the entire pattern at once. If the value is zero, then the entire pattern is zero. The box is linked to the *factor* field in the database table of the pattern. If you change the value in this box, and then move the cursor to a different control, the changes are immediately reflected in the graph.

Change Name, Change Node, or **Change Arc** - By pressing this button, you can select a new name for the pattern, or a different node or arc to associate the pattern with. If you make such a change, there will be no pattern associated with the previous node, arc, or name, unless you later add one.

Import Data - By pressing this button, you can select another pattern variable in the same table and copy all the values from that other variable into the current one. All the original values in the current variable are deleted.

Here is an example of the *OCL Pattern* dialog box. The *OCL Pattern* dialog box is similar to the dialog boxes for other pattern tables except for a few controls described below.



OCL Pattern: Cat_Norm

Month	Day	Value
1	1	61252.000
2	1	69152.000
3	1	75411.000
4	1	100964.000
5	1	116915.000
5	31	132865.000
6	1	133397.000
7	1	73077.000
8	1	64687.000
9	1	54346.000
10	1	47678.000
11	1	43946.000
12	1	52570.000
12	31	60972.000

Multiplication Factor: 1

[✓ EOP Method] Flow to Volume Rate to Volume

The controls that are unique to the *OCL Pattern* dialog box are:

EOP Method - This control is linked to the *EOP* field in the OCL Pattern table (section 4.5.8 part B). If the box is checked, then OASIS interprets the variable by the end-of-period method, equivalent to a value of 1 in the *EOP* field.

Flow to volume - This control is linked to the *Flow to Vol* field in the OCL Pattern table (section 4.5.8 part B). If the box is checked, then OASIS interprets the variable as a flow rate (in primary flow units) that should be converted to volume (in primary volume units), equivalent to a value of 1 in the *Flow to Vol* field.

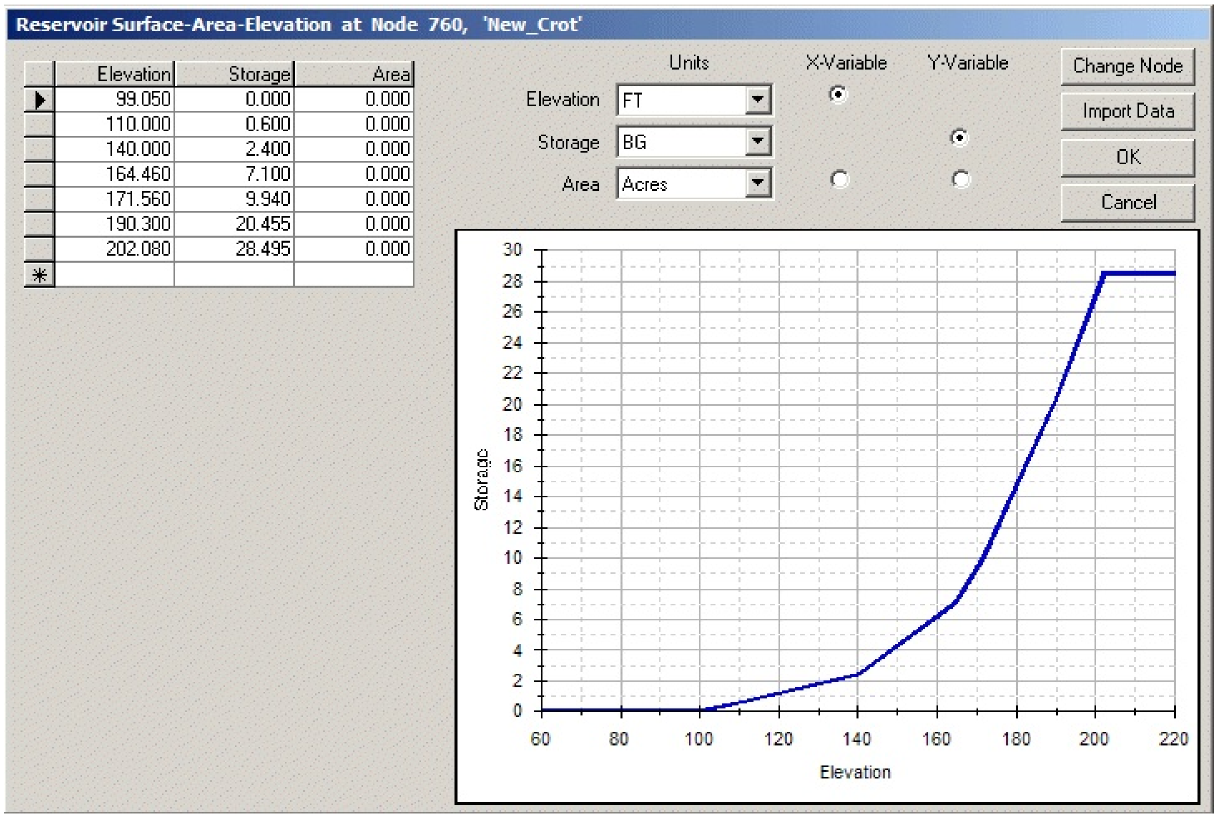
Rate to Volume - This control is linked to the *rate* field in the OCL Pattern table (section 4.5.8 part B). If the box is checked, then OASIS interprets the variable as a flow rate that should be converted to volume (no conversion factors are applied), equivalent to a value of 1 in the *rate* field.

3.8.4 *Reservoir Storage-Area-Elevation* Dialog Box

The dialog box provides a way of viewing and editing the reservoir storage-area-elevation data for a single reservoir node. The dialog box is linked to the *Reservoir S-A-E* database table (section 4.5.3 part J). In most cases, using the dialog box is more convenient than viewing or editing the data in the whole table where all nodes are represented. The dialog box provides an easy way to change the node that the data is associated with, or to copy the data from one reservoir to another. See section 2.4.0 part F for an introduction to how OASIS handles elevation and surface-area data.

To access this dialog box: on the *Node Settings* dialog box (section 3.8.1), press the *Edit Reservoir Storage / Area / Elevation Data* button. Alternatively, with the *Reservoir SAE* table showing on the *Node* tab (section 3.7.4), click on the menu *Edit > Edit Single Reservoir S-A-E*.

Here is an example of the *Reservoir Storage-Area-Elevation* dialog box:



Reservoir Surface-Area-Elevation at Node 760, 'New_Crot'

Elevation	Storage	Area
99.050	0.000	0.000
110.000	0.600	0.000
140.000	2.400	0.000
164.460	7.100	0.000
171.560	9.940	0.000
190.300	20.455	0.000
202.080	28.495	0.000

	Units	X-Variable	Y-Variable
Elevation	FT	●	
Storage	BG		●
Area	Acres	○	○

The important features of the dialog box are:

Window Title - Identifies the reservoir node that this S-A-E data is associated with.

Table of Elevation, Storage, and Area values - You can edit values or add or delete rows in the table. To add a row type the values into the empty row at the bottom, and move the cursor to a different row when you have finished. The new row will be automatically sorted. To delete a row, click on the gray "record selector" column on the left margin of the row, and then hit the DELETE key. If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph.

Graph of table values - If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph. The x-axis of the graph is determined by the selected option button under the *x-variable* heading above the graph. The y-axis of the graph is determined by the selected option button under the *y-variable* heading above the graph. Because there are three columns in the table and only two axes on the graph, you can click the *x-variable* and *y-variable* buttons to change which variables you want to see on the graph.

Units - There is one box each for elevation, storage, and area units. The possible selections are determined by the *Units* table (section 4.5.3 part A). The selected value in each box tells OASIS what units the values of the table are measured in.

Change Node - By pressing this button, you can select a different node to associate the current reservoir S-A-E data with. If you make such a change, there will be no reservoir S-A-E data associated with the previous node, unless you later add such data.

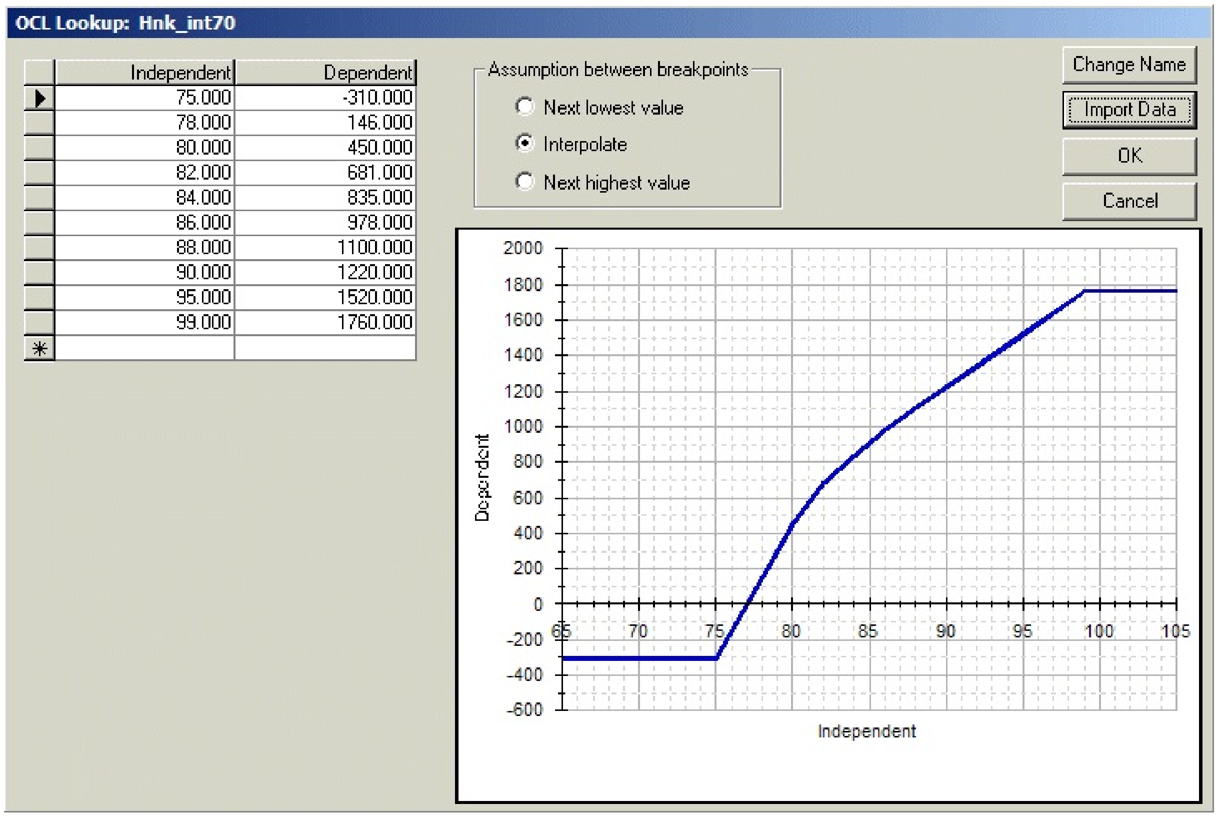
Import Data - By pressing this button, you can select another node and copy all the reservoir S-A-E data from that other node into the current one. All the original reservoir S-A-E values for the current node are deleted.

3.8.5 *OCL Lookup* Dialog Box

This dialog box provides a way of viewing and editing a single OCL lookup function. The dialog box is linked to the *Lookup* database table (section 4.5.8 part A). In most cases, using the dialog box is more convenient than viewing or editing the data in the whole table where all lookup functions are represented. The dialog box provides an easy way to change the name of the lookup function, or to copy the data from one lookup function to another.

To access this dialog box: with the *OCL Lookup* table showing on the *OCL* tab (section 3.7.6), click on the menu *Edit > Edit Single Reservoir S-A-E*.

Here is an example of the *OCL Lookup* dialog box:


OCL Lookup: Hnk_int70

Independent	Dependent
75.000	-310.000
78.000	146.000
80.000	450.000
82.000	681.000
84.000	835.000
86.000	978.000
88.000	1100.000
90.000	1220.000
95.000	1520.000
99.000	1760.000

Assumption between breakpoints: ( ) Next lowest value [✓ Interpolate] ( ) Next highest value

The important features of the dialog box are:

Window Title - Identifies the name of the lookup function.

Table of Independent and Dependent values - You can edit values or add or delete rows in the table. To add a row type the values into the empty row at the bottom, and move the cursor to a different row when you have finished. The new row will be automatically sorted. To delete a row, click on the gray “record selector” column on the left margin of the row, and then hit the DELETE key. If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph.

Graph of table values - If you change any values in the table, and then move the cursor to a different row, the changes are immediately reflected in the graph. The graph reflects the “assumption between breakpoints” setting. Thus, if you click any of the buttons under the *Assumption between breakpoints* header, changes are immediately reflected in the graph. The graph also reflects the fact that OASIS applies the smallest independent value if the dependent value is less than the first breakpoint, and the largest independent value if the dependent value is more than the last breakpoint.

Assumption between breakpoints - The selected option button under this header tells OASIS what the result of the lookup function is when the dependent value is between breakpoints. This is linked to the *Interp* field in the database table. If the *Next lowest value* button is selected, it is equivalent to an entry of *LOWER* in the *Interp* field. If the *Interpolate* button is selected, it is equivalent to an entry of *INTERP* in the *Interp* field. If the *Next highest value* button is selected, it is equivalent to an entry of *UPPER* in the *Interp* field.

Change Name - By pressing this button, you change the name of the current lookup function.

Import Data - By pressing this button, you can select another lookup function and copy all the values from that other function into the current one. All the original values for the current function are deleted.

3.9.0 STATUS BAR

At the bottom of the main GUI window is the *status bar*. The status bar is broken into a series of boxes. The GUI uses the first box (on the left) to display messages while you are working on the schematic (section 3.7.1). Mainly, it reminds you what state the mouse is in.

The third box in the status bar can be used to quick identification of a node or arc on the schematic (section 3.7.1). If you rest the mouse pointer over a node or arc, the name and number of the node or arc will appear in the status bar.

The second box in the status bar is used to remind you whether the output and input are matched. There are two possible messages displayed in this box:

> **Output NOT CURRENT:** (always accompanied by a *red* light) Either there is no output, or the input data has been edited since the last time the model was executed. Thus, if you view any output files through the *Output* menu, you should be aware that they are not matched to the input. You may still view the output files – just remember that they reflect a previous execution with different input.
>
> **Output CURRENT:** (always accompanied by a *green* light) The input has not changed since the last time the model was executed.

The GUI monitors the status of all files listed in the *OCL Command Files* box (section 3.7.6). If you save changes to any of those files, it can change the status bar to say *Output NOT CURRENT.*

If you execute *model.exe* outside of the GUI, then the GUI will not have good information about whether the output is current. Therefore, we recommend that you do not execute *model.exe* outside of the GUI. There are some things you can do to prevent any potential confusion of mismatched output and input:

> As soon as a run is done executing, lock it by clicking *Lock* in the *File Menu* (section 3.6.1 part E). If you immediately lock your runs, then you will never have a run where the output is not current after the model has been executed.
>
> Check the box labeled *Auto Delete Output Files* in the *Preferences* dialog box (section 3.6.2 part C). When the box is checked, the GUI automatically deletes output files every time a run is saved and the output is not current. Thus, you will be unable to view output that does not match the input. However, there is still the potential for confusion *before the run is saved*.

We are not suggesting that you *must* follow either of the above methods, since the message and colored light are always displayed to remind you whether the output is current. However, we have found that some users are interested in a higher level of assurance.

CHAPTER 4
REFERENCE: MODEL INPUT

4.1.0 COMMAND LINE

Several run-control parameters can be specified in the OASIS command line. All command-line parameters are optional — OASIS can be run simply by clicking on the *model.exe* file in Windows Explorer, without any special command line. If you need a special command line, there are several ways you can enter it, including:

> From MS-DOS, enter the command line at the prompt. You can also write MS-DOS batch files to run OASIS. However, DOS does not wait for OASIS to finish executing before continuing with the next command in the batch file (see Chapter 8 for more info).
>
> Create a batch file for the OASIS batch program (Chapter 8).
>
> From the Windows *Start* menu, choose the *Run* menu item. You will be presented with a text box in which you can enter the full command line.
>
> Create a Windows *shortcut* to execute OASIS. Do this from Windows Explorer. Select the file for the OASIS executable (Model, Onevar, or Plot). Click the right mouse button, and a menu will appear. Select *Create Shortcut*. A shortcut will appear in the same directory. You can move the shortcut to any location you desire, including the Windows desktop. To edit the command line, select the shortcut and click the right mouse button. A menu will appear, from which you can select *Properties*. When you do, a box will appear. Select the *Shortcut* tab. In the text box labeled *Target*, you can enter the full command line.

Note that the OASIS GUI (Chapter 3) calls OASIS with a particular command line when you click *Run*, and it does not provide any means of customizing that command line.

The first argument in a command line is always the name of the file to be executed. Subsequent arguments are the optional input parameters. Each argument must be separated from the others by a space. Some arguments consist of a parameter name, and equal sign, and a parameter value. These parts of the argument must not be separated from each other by space. An example command line is:

```
    MODEL CF=alternate.cf FATALWARN
```

The part *CF=alternate.cf* is a single argument, whose parts are not divided by spaces. However, this argument is separated from the other argument, *FATALWARN*, by a space.

The available command-line parameters are listed below.

C. KEY=*[file name]*

Tells OASIS that *[file name]* will be the identity key (section 4.2.0). *[File name]* may contain full path info, relative to the location of the executable file. By default, OASIS uses the file *OASIS.idKey* as the identity key. The command line parameter overrides the default.

D. DIR=*[directory name]*

Tells OASIS that *[directory name]* will be the run directory (section 2.3.1). OASIS's default is to retrieve the name of the run directory from the pointer file, *directry.nam* (section 4.3.0). The command line parameter overrides the entry in the pointer file.

E. CF=*[file name]*

Tells OASIS that *[file name]* will be the control file (section 4.4.0). This overrides the default name *model.cf*.

F. PARENT=*[thread ID]*

Tells OASIS that it has been spawned by another process with *[thread ID]*. When OASIS finishes simulation, normally or due to an error, it passes a message back to the parent thread. The message *WM_CHILD_DIED* means a fatal error, and the message *WM_FINISHED* means a normal shutdown.

G. FATALWARN

This parameter means that anything that normally prompts a warning becomes a fatal error.

H. NOCLICK

Normally, when there is a warning or error, a message box appears, and the program pauses until the user clicks a button. Entering this parameter suppresses the message box, so that the program continues without waiting for a user click.

I. F1=*[F-path]*

The given *[F-path]* will be used as the F-part of the DSS pathname for any record declared in the *Declare Timeseries* table (section 4.5.3 part P) with the string */F1* in the field *F Path*. *[F-path]* is not applied to any records that do not use the */F1* flag. The position analysis program (section 9.0.0) sends this command-line option to OASIS. Do not try to specify your own *F1* option in the command line if you are post-processing position analysis.

J. IN=*[file name]*

(Onevar only) The given *[file name]* will become the Onevar input file (section 6.1.3). By default, Onevar retrieves the name of the Onevar-input file from the pointer file, *Onevar.cf* (section 6.1.2). The command line overrides the entry in the pointer file.

K. POSANALYSIS

(Onevar and Plot only) The post-processor program will run in position analysis mode. This is only appropriate for OASIS output that has been generated from position analysis (section 9.0.0).

L. HIDEXA

This option tells OASIS to hide the XA window. This parameter is ignored for post-processors.

For the PA program (section 9.0.0), this option causes the OASIS window and the XA window to be invisible, so that only the main window of the PA program is showing.

M. HIDEALL

The program will run without any windows visible.

N. PLOTPF=*[file name]*

(Plot only) Tells Plot that the given *[file name]* will be the plot pointer file (section 6.2.1). This overrides the default name *plot.cf*.

O. NoRunInput

(Onevar and Plot only) The post-processor program will run without reading model input or output files. This is called *pre-processor* mode. See 6.1.6 for more information.

P. WarnXAxis

(Plot only) Tells Plot to display a warning message in a pop-up window if it detects potential for mis-labeling of the x-axis. The warning message will only be displayed if the following criteria are met:

> Multiple runs are plotted
>
> The x-values of the lines are *absolute period numbers*, as determined in the *TickLabel* field of the *Axis* table (section 6.2.3 part D).
>
> The first two time steps of each run are not identical.

Plot does *not* check the tick-label codes entered into the *TickLabel* field. Therefore, just because the warning is triggered does not mean that the x-axis is mislabeled. Consider the case where one run starts on 7/1/2000, another run starts on 7/1/2001, and both runs use a daily time step. If we do a multiple-run plot of this data using absolute period numbers as the x-values, the two lines will overlap on the x-axis.

> If the tick-label code is *%m/%d*, we might get labels such as *07/01*, *07/11*, *07/21*,... These certainly do not mislabel the data.
>
> If the tick-label code is *%m/%d/%y*, we might get labels such as *07/01/00*, *07/11/00*, *07/21/00*,... These labels are correct for the first run but not for the second.

4.2.0 IDENTITY KEY

The **identity key** is a file that contains licensing information for OASIS in an encrypted form. A file of this type uses the filename extension *idKey*. Only HydroLogics staff may create this type of file. The licensing message contained in the file is printed to the screen while OASIS runs. The message is also printed to output files.

By default, the identity key is named *OASIS.idKey* and must be located in the folder where OASIS is running. You may specify a different filename and/or path with the *KEY* command-line parameter (section 4.1.0).

4.3.0 POINTER FILE

The pointer file is an ASCII text file that must be found in the same directory as the executable file. OASIS reads this for the single task of getting the path of the *run directory* (section 2.3.1). However, the OASIS GUI reads other information from this file (section 3.3.4).

The name of the pointer file is *directry.nam*. It is read by the model program, as well as the post-processors. If the command line argument *DIR* (section 4.1.0) is used, then the name of the run directory will come from the command line, and OASIS will not read the pointer file.

The pointer file must include a pipe character "|", followed by a pathname. The pathname can be relative or absolute. The use of the pipe character allows you to put comments in the pointer file, because all text preceding the pipe and all text following the pathname are ignored. An example text from a pointer file is:

```
| runs\study8
```

4.4.0 CONTROL FILE

The control file is an ASCII text file found in the run directory (section 2.3.1). The control file tells OASIS where to find input data and what types of output should be written. Note that if you are using the GUI (Chapter 3), all information is maintained automatically and you might never need to look at this file.

Control File: "model.cf"

```
//CONTROL FILE for RUN1
This is the description for Run1.

| system_0.mdb           // system file
| dem_0.mdb         // demand file
| weigh_0.mdb           // weights file
| inflow_0.mdb           // inflow file
| time_0.mdb        // time parameters file
| init_0.mdb        // initial conditions file

| dwrsim.OCL          // OCL file
|                   // placeholder no longer used

| 1                 // balance sheet output (1=yes; 0=no)
| 0                 // LP output (1=limited; 2=full; 0=no)
| 3                 // OCL output (add: 0=no, 1=expression eval,
                                             2=solution report)
| 1                 // DSS output (1=yes; 0=no)

| output.dss        // output file
```

By default, the name of the control file is *model.cf*. This default name can be overridden with the command line parameter *CF* (section 4.1.0).

OASIS finds the information it needs in the control file by searching for the pipe character, "|". It skips over all text until a pipe is found, then it reads one entry. It then skips over all subsequent information until the next pipe is found, and so forth. This allows you to enter comments as you need, because OASIS ignores all text that is not preceded by a pipe.

The second line of the file will be read as the **run description**. The description can be up to 90 characters long, and *it does not use a pipe character*. This description will be echoed in the output files, and you can choose to include it in your Onevar outputs (see section 6.1.9 part A).

File names in the control file *can* include path information. The path is relative to the run directory, or absolute.

The first six entries in the control file are the names of Microsoft Access database files that contain static model input. These do not have to be six individual files — any number of them can be combined into larger files. However, there will still be six entries in the control file. For example, the system file and the demand file can be combined into one file. Specify this in the control file by repeating the same file name for both system and demand files. The database files listed in the control file are:

A. ***System file*** (section 4.5.3)

B. ***Demand file*** (section 4.5.4)

C. ***Weights file*** (section 4.5.7)

D. ***Time-parameters file*** (section 4.5.2)

E. ***Inflow file*** (section 4.5.5)

F. ***Initial conditions file*** (section 4.5.6)

The next two pieces of information are the names of files containing ASCII text information:

G. ***OCL file*** (section 4.7.0)

H. ***Empty placeholder*** was formerly used to contain the name of the trigger file. This type of input file is no longer used by OASIS. For backward compatibility, OASIS still expects a pipe in this position, but it ignores the information that follows the pipe.

Next are four **flags** that tell OASIS if it is to generate specific **output** files. The first three of these files are truly optional. They can help you understand and debug the model. However, the fourth file is a comprehensive record of simulation results stored in HEC-DSS format, which should always be turned on. The optional files are only meant to supplement this official log. Because the optional output slows execution time and can consume a lot of disk space, you will often want to turn these flags off. Each file is turned off with a "0" value for the flag.

I. ***Balance sheet output*** (*balance.out*) contains *balance sheets*, reports of every inflow and outflow at a node. The file contains a balance sheet for every node in the system, for every time step of simulation. The balance sheet output is described in section 5.2.0. The possible values of the flag are:

1	Write complete balance sheets for the entire run.
0	No balance sheet output will be written.

J. ***LP output*** (*LP.out*) is a file generated by XA, the LP solver that is called by OASIS. The output is described in section 5.5.0. Writing this file can cause OASIS to run *very* slowly, so we advise keeping it off unless it is needed. The possible values of the flag are:

0	No LP output will be written.
1	Write the algebraic form of the LP to the file.
2	Write the algebraic form of the LP *and* a solution report to the file.

Because the LP output can be so large and slow, there is an option for keeping LP output off until a certain time period. At the given time period it is turned on at the specified level (0, 1, or 2). To use this option, attach the date to the end of the LP output level number, separated by a colon — *no spaces.* The date should be in "M/D/YYYY" format. For example,

```
|  2:4/1/1976
```

will keep LP output off until April 1, 1976, at which time it will be turned on at level 2.

K. ***OCL output*** (*OCL.out*) contains a report on the results of OCL commands during simulation. This output is described in section 5.3.0. The possible values of the flag are:

0	Only write a summary of OCL input.
1	Write the summary of OCL input, and each time step write a report of the results of expression evaluations.
2	Write the summary of OCL input, and each time step write a report of the results of the *target* and *minimax* commands.
3	Write the summary of OCL input, and each time step write **both** a report of the results of expression evaluations and a report of the results of the *target* and *minimax* commands.
4	Same as level 3, but also write detailed "notes" on the evaluation of expressions. Although it is available, this option is somewhat experimental, and the "notes" are not organized to be user-friendly.

Because the OCL output can be so large and slow, there is an option for keeping OCL output off until a certain time period. At the given time period it is turned on at the specified level (0 through 4). To use this option, attach the date to the end of the OCL output level number, separated by a colon — *no spaces.* The date should be in “M/D/YYYY” format. For example,

```
|   3:4/1/1976
```

will keep OCL output off until April 1, 1976, at which time it will be turned on at level 3.

L. ***DSS output flag***. The name of the DSS output file is user-defined. This output contains a complete record of time-series simulation results for retrieval by post-processor programs. The file is described in section 5.6.0. Only in rare cases would you want to turn this output off – although DSS output is extremely time-consuming, it is essential for post-processing. Note that even if this flag is off, specially flagged OCL udefs (section 4.7.2 part B) may still be written. The possible values of the flag are:

0	No DSS output will be written, except specially flagged OCL udefs.
1	Write complete DSS output for the entire run.

M. ***DSS output file name.*** See section 5.6.0 for a description of this file.

4.5.0 STATIC DATABASES

The static database files are all in MS Access format. They can be viewed and edited using MS Access. Each file contains certain tables. The table contains a matrix of fields and records. When the table is displayed, the fields appear as columns and the records appear as rows.

Due to the modular nature of OASIS input, most of the tables have variable numbers of records, or rows. For example, the *Node* table contains a record for each node in the system. To add a node to the system, you add a record to the *Node* table. However, a few tables, such as the *Units* table, contain a fixed number of records. In such tables, you must not add or delete records, or try to change the order of records.

Almost all of the data in these tables can be edited through the OASIS GUI (Chapter 3), making it unnecessary for most users to have MS Access. It is faster and easier to work with the OASIS GUI than it is to edit the tables with MS Access. Most of the tables are available in the GUI through table controls that look almost identical to the tables in the database. Some of the table data is available in non-table controls (such as drop-down list boxes). A few of the tables, notably the water-quality tables, are not yet represented by any controls in the GUI.

There are seven different static database files. For convenience, you can combine these files together in any possible combination. For example, you could combine them all into a single file. Another way would be to combine the system, demand, inflow, and time-parameters files together, but leave the initial conditions and weights files separate, so that there are three static database files total. However, you can *not* break one of the six basic files apart. For example, all the tables of the weights file must appear in one file. You cannot put some of those tables in the system file and others in the demand file.

The GUI requires that all the static database files be combined into a single file, which is named ***statdata.mdb*** (section 3.3.7).

Some of the static database files employ time-series files, which are in HEC-DSS format (see section 4.6.0). Time-series database files are treated as supplements of the static database files. For example, the demand file contains a table called *File ID*, which contains the name of a time-series file. This time-series file can store time-series demand values. If you combine static databases which refer to time-series databases, then the supplemental time-series databases are automatically combined. For example, if you combine the system file and the inflow file, then the combined database will only contain one *File ID* table. The time-series file that it names will be the combined system- and inflow-time-series file.

Subsequent sections describe each of the static database files in detail. Here is a complete list of the table names and the files that each are found in.

System Database (section 4.5.3)

- ***Arc*** : listing all arcs in the system.
- ***Balance Sheet Columns*** : formatting for the balance sheet output.
- ***Balance Sheet Rows*** : formatting for the balance sheet output.
- ***Concentration*** : listing all water quality constituents.
- ***Declare Timeseries*** : listing non-standard options for DSS records.
- ***Evaporation*** : listing the source of all reservoir evaporation data.
- ***Evaporation Pattern*** : pattern input for evaporation rate.
- ***File ID*** : naming a time-series database file
- ***Maximum Flow*** : pattern input for maximum flow in arcs.
- ***Maximum Reverse Flow*** : pattern input for maximum reverse flow in arcs.
- ***Minimum Flow*** : pattern input for minimum flow in arcs.
- ***Node*** : listing all nodes in the system.
- ***Reservoir*** : listing all reservoir nodes in the system.
- ***Reservoir Rules*** : pattern input for reservoir rule curves.
- ***Reservoir S-A-E*** : look-up table of reservoir storage-area-elevation curves.
- ***Units*** : defining the units of measurement.

Demand Database (section 4.5.4)

__Demand__ : listing all demand nodes in the system.
__Demand Pattern__ : pattern input for demand values.
__File ID__ : naming a time-series database file

Weight Database (section 4.5.7)

__Weight: Arc__ : giving weights for flow in arcs
__Weight: Demand__ : giving weights for delivery to demand nodes.
__Weight: Storage__ : giving weights for storage in reservoir nodes.

Inflow Database (section 4.5.5)

__Cx Pattern__ : pattern input for water quality constituent *x*.
__Inflow Pattern__ : pattern input for unregulated inflow to nodes.
__File ID__ : naming a time-series database file

Time Parameters Database (section 4.5.2)

__DSS Steps__ : specifies a DSS record upon which to base the time steps.
__PosAnalysis__ : specifies the traces if a position analysis is being performed.
__Range__ : giving the start and stop of simulation time.
__Run__ : giving the size of the time step.
__Runtime__ : the clock time when the run was performed.
__Steps__ : defining the simulation time steps in a cycle.
__Year scheme__ : determines whether the year begins on a date other than January 1.

Initial Conditions Database (section 4.5.6)

__Initial Conditions__ : giving the initial storage and water quality values at all reservoir nodes.

OCL Static Database (section 4.5.8)

__Lookup__ : giving look-up tables for the OCL *lookup* function.
__Pattern__ : giving pattern input that can be referred to with the OCL *pattern* variable.

4.5.1 CONVENTIONS FOR TIME-PATTERN TABLES

A. General

In OASIS, ***pattern*** input refers to input that varies by period, with the values cycling every year. For instance, the March value may be different from the April value, but every March has the same value as every other March, and every April has the same value as every other April. This is more efficient than time-series, because you only need to create input for one year.

Several of the static database tables are designed especially for pattern data. OASIS applies a standard set of conventions in all these tables. The conventions allow the pattern data to be **time-step-independent**. This means that *if you design the pattern input well*, you can use the same database for runs of different time-step sizes.

This section is a reference for the conventions of the pattern tables. The following tables follow these conventions. You may refer to the reference sections for each of these tables to see examples of the pattern tables.

Minimum Flow table (section 4.5.3 part E).
Maximum Flow table (section 4.5.3 part F).
Maximum Reverse Flow table (section 4.5.3 part G).
Reservoir Rules table (section 4.5.3 part I).
Evaporation Pattern table (section 4.5.3 part L).
Demand Pattern table (section 4.5.4 part B).
Inflow Pattern table (section 4.5.5 part A).
C1 Pattern, ***C2 Pattern***, etc. tables (section 4.5.5 part B).
Pattern table (section 4.5.8 part B).

Note that the best way to edit pattern tables is using the OASIS GUI's pattern dialog box (section 3.8.3).

In all of the database tables that use the pattern conventions, there will be at least two records (rows) per pattern. Each record gives the value of the input variable at a point in time. All records that are part of one pattern must be contiguous. They form a **block**. Although they need to be contiguous, the records in the block do not need to be in any particular order. OASIS will sort the records after it has read the entire block.

The table controls in the GUI automatically distinguish each block for you by applying alternating colors: red, blue, and white; to each block. All the records of one block are the same color, and they are a different color from adjacent blocks.

All database tables that use the pattern conventions have these fields:

One or more identifying fields. For example, the *Demand Pattern* table has a *Node number* field to identify which node the pattern is to be used for. The *Pattern* table for OCL patterns has a *Name* field to give the name of the pattern. The *Minimum Flow* table has two identifying fields, *U/S Number* and *D/S Number*.

The identifying fields distinguish one block from another. Throughout the block, the identifying fields are all the same. When the identifying field changes, OASIS interprets that record as the first of a new block. However, in all tables that follow the pattern conventions, *you may leave the identifying fields blank in all but the first record of each block*. In other words, leaving the field blank is the same as repeating its value from the previous block. This serves as a visual aid, since the beginning of each block stands out clearly. *However, if you are using the GUI then you can never leave the identifying field blank.* The blank fields are legal without the GUI, but not with the GUI. The GUI provides a different visual aid: distinguishing each block by color.

***Month* field**. The *Month* field is the first part of the time coordinate of the point in the pattern which the record represents. This field is always an integer 1-12, where 1 always means January and 12 always means December. This field can never be left blank.

***Day* field**. The *Day* field is the second part of the time coordinate of the point in the pattern which each record represents. This field is always an integer 1-*n*, where *n* is the number of days in the month given by the *Month* field. This field can never be left blank.

One or more value fields. For example, the *Minimum Flow* table has a *Min Flow* field. This field gives the value of the input variable at the point in the pattern which each record represents.

Each record gives the value of the input variable at a point in time. The minimum number of points (therefore, the number of records) in any pattern, is two. There must be one record for the first day of the year, and one for the last day. The first day of the year is determined by the year scheme, as entered in the *Year scheme* table (section 4.5.2 part C). For example, if the year scheme is a water year, then the first day of the year is October 1, and the last day of the year is September 30. If the year scheme is a regular year, then the first day of the year is January 1.

Except for the first and last day of the year, the time coordinates of each point are completely user-determined. If appropriate, you may enter as many as 366 points (that is, one for every day of the year), or as few as two. *There is no requirement that the points you enter for the pattern fall on the endpoints of simulation periods*. This is part of the time-step-independent nature of the pattern input.

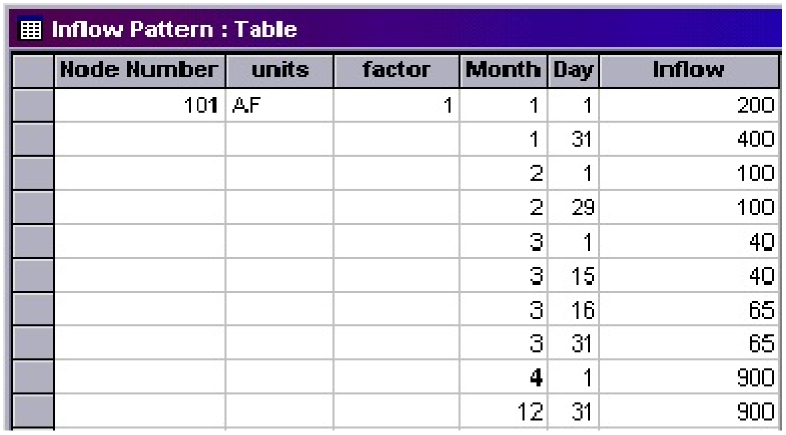
OASIS reads the block of records which define a pattern, then redistributes the data to get values for every simulation period. During simulation, OASIS' memory only contains the values distributed over the simulation periods. There are variations in the process of redistribution, depending upon the units of measurement in which the variable is stored in OASIS memory, and the units of measurement which you assign to the pattern input. Parts C through F of this section describe the different methods of redistribution. See section 2.9.0 for an overview of units of measurement. Most of the database tables for pattern input use a *Units* field, which you use to tell OASIS the units in which your input values are measured. OASIS stores each type of variable using a particular measuring system (documented in 2.9.0), except for the OCL patterns in the *Pattern* table (section 4.5.8 part B). OASIS does not make any assumptions about the units of measurement of the OCL patterns. Thus, you must specify which type of numerical integration to perform through several flag fields.

B. Leap day in pattern input

When it redistributes pattern values, OASIS checks whether you entered a value for February 29. If you did not, but there is a value for February 28 and a value for March 1, then OASIS assumes that you forgot about February 29. Therefore it automatically assigns February 29 the same daily value as February 28. This means that in **leap years** (section 2.8.4), the value of an integrated variable in February might be higher than in non-leap years. If you do not like this assumption, then you should explicitly enter a value for February 29 whenever you enter a value for February 28. Many modelers prefer to ignore the existence of leap year. If you have an integrated variable, then you may wish to omit February 29 from the computations by entering a value of zero for that day.

C. Redistributing volume input to volume per time step

If the input is entered as a **volume**, then OASIS assumes the input values **have already been integrated over time**. Most of the different types of OASIS variables are some form of flow, and they are stored in units of volume per time step. For example, demands, inflows, and maximum flows are stored in this way. Refer to the following input table to understand how OASIS handles the redistribution of volume input for one of these flow-type variables.



Inflow Pattern : Table

Node Number	units	factor	Month	Day	Inflow
101	AF	1	1	1	200
			1	31	400
			2	1	100
			2	29	100
			3	1	40
			3	15	40
			3	16	65
			3	31	65
			4	1	900
			12	31	900

The points that are given define the endpoints of a **span**. Thus, January 1 through 31 are one span, February 1 through 29 are another span, and March 1 through 15 are yet another. When using volume units for a flow-type variable, you usually enter the same value for both endpoints of the span. Note that the span for the month of January uses two different values. Thus, the flow varies linearly over the month of January, but the total is the average of 200 and 400. This is an unusual case which we present here for illustration.

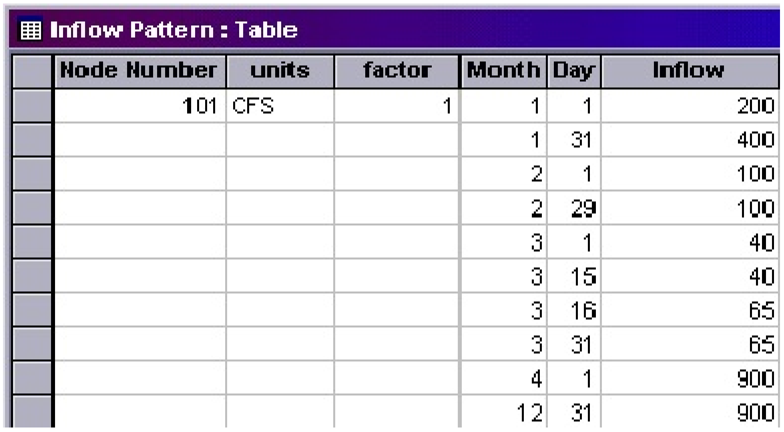
If we are simulating with a monthly time step, the values of the inflow to node 101 would be:

Month	Inflow (AF)		Month	Inflow (AF)
1	300		7	34.38
2	100 (Leap year)		8	34.38
3	105		9	33.28
4	33.28		10	34.38
5	34.38		11	33.28
6	33.28		12	34.38

In non-leap years, the value of the inflow in February would be 96.55 AF.

D. Redistributing flow-rate input to volume per time step

If the input is entered as a **flow rate**, then OASIS assumes the values **have *not* already been integrated over time**. To understand how OASIS processes this input, refer to the following table. The table uses the same numbers as the previous example but uses a different units label.



Inflow Pattern : Table

Node Number	units	factor	Month	Day	Inflow
101	CFS	1	1	1	200
			1	31	400
			2	1	100
			2	29	100
			3	1	40
			3	15	40
			3	16	65
			3	31	65
			4	1	900
			12	31	900

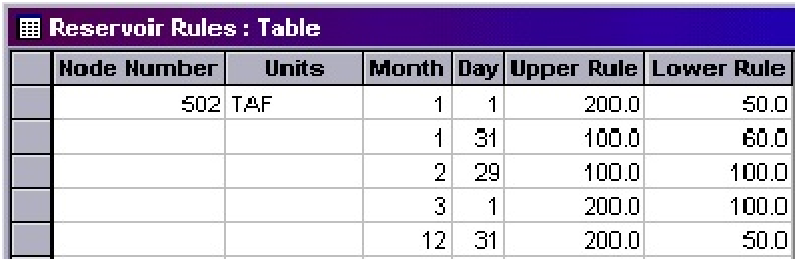
One CFS equals 1.9835 AF/day. Therefore, if we are simulating with a monthly time step, the values of the inflow to node 101 would be:

Month	Inflow (AF)		Month	Inflow (AF)
1	18447		7	55340
2	5752 (Leap year)		8	55340
3	3253		9	53555
4	53555		10	55340
5	55340		11	53555
6	53555		12	55340

In non-leap years, the value of the inflow in February would be 5554 AF. Note how much different the assumptions are when the units are a flow rate. In this case, OASIS does a numerical integration to get the values in volume units per time step. Furthermore, the input which varies linearly over the month of January is not so unusual when the units are a flow rate.

E. Redistributing volume input to volume

Unlike those variables which are stored as volumes per period, when the variable is just a volume, the input can not be entered as a flow rate. These variables usually represent reservoir storage. The values used in simulation are derived with the **end-of-period** assumption. This is consistent with the fact that operations are typically targeted on the end of the time step. Refer to this example input table:



Reservoir Rules : Table

Node Number	Units	Month	Day	Upper Rule	Lower Rule
502	TAF	1	1	200.0	50.0
		1	31	100.0	60.0
		2	29	100.0	100.0
		3	1	200.0	100.0
		12	31	200.0	50.0

If we are simulating with a monthly time step, the upper rule curve would have these values:

Month	Rule (TAF)		Month	Rule (TAF)
1	100		7	200
2	100		8	200
3	200		9	200
4	200		10	200
5	200		11	200
6	200		12	200

The lower rule curve would have these values:

Month	Rule (TAF)		Month	Rule (TAF)
1	60		7	75
2	100 (Leap year)		8	69.94
3	94.94		9	65.03
4	90.03		10	59.97
5	84.97		11	55.07
6	80.07		12	50

During February of non-leap years, the value of the lower rule curve would be 98.62 TAF.

F. Redistributing concentration input

When the input is the concentration of a water-quality constituent, OASIS assumes that the instantaneous value of the concentration is interpolated between the given points. To get the value for a simulation period, it takes the mean value.

G. Time-series input

OASIS also reads time-series input (section 4.6.0) with conventions that allow the input to be independent of the time steps of simulation. OASIS applies the same technique for redistributing the data from time-series input and time-pattern input. The only conceptual difference is that time-series input must cover the entire time range of simulation, while time-pattern input only covers one year and is implicitly repeated for the entire time range of simulation.

As with time-pattern input, you should refer to section 2.9.0 to know in what units of measurement OASIS stores the values. The units of the input values are specified in a *UNITS* field in the DSS record. For backward compatibility with previous versions of OASIS, there are assumptions about the units of measurement of time-series input. However, you may override these assumptions using the *EOP*, *Rate*, and *Avg* fields in the *Declare Timeseries* table (section 4.5.3 part P).

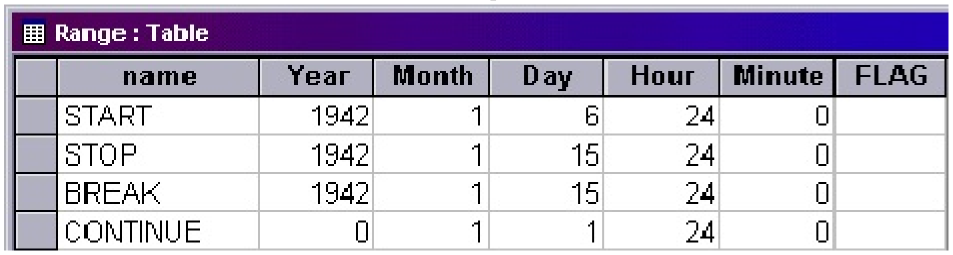
4.5.2 TIME-PARAMETERS DATABASE FILE

A. Table *Range*

Contains the start and stop times for the simulation. The identities of the records (rows) are fixed.

The OASIS GUI links to this table through two alternate places: the *Simulation Time Range* table on the *Time* tab (section 3.7.3 part A), and the *Start of Run* and *End of Run* boxes on *Setup* tab (section 3.7.2).

Example


Range : Table

name	Year	Month	Day	Hour	Minute	FLAG
START	1942	1	6	24	0	
STOP	1942	1	15	24	0	
BREAK	1942	1	15	24	0	
CONTINUE	0	1	1	24	0	

The fields of this table are:

Field Name	Type	Size	Description
name	Text	N/A	Do not edit this field. It is there for your convenience to identify the fixed records. OASIS does not read this field.
Year	Number	Integer	The four-digit year number.
Month	Number	byte	The month number of the date(1-12), where January is always 1
Day	Number	byte	The day of the date (1-31).
Hour	Number	byte	The hour of the day (0-24)
Minute	Number	byte	The minute of the hour (0-59)
FLAG	Text	1	If the entry in the field is *B*, then the given date and time are interpreted as the beginning of the time step. The default is to interpret as the end of the time step. This field is only read for the first record, the start time. It is ignored for all other records.

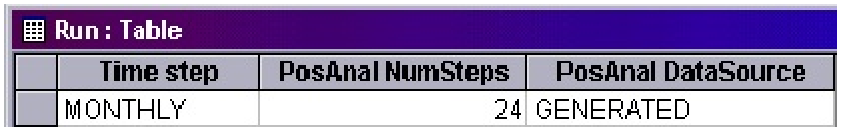
The fixed records of this table are:

START	The last day of the first simulation time step. See section 2.8.2.
STOP	The last day of the last simulation time step. See section 2.8.2.
BREAK	Do not edit this record. When OASIS shuts down prematurely, it records the time step when the run stopped. This information is used by the post-processors or by a continuation run.
CONTINUE	The time step when you wish for a continuation run to begin. This time must not come after the stop time or the break time. If the time precedes the start time, then OASIS will not run in continuation mode. In the example, the year zero clearly will prevent continuation mode. See section 2.8.3.

B. Table *Run*

Contains miscellaneous parameters for handling simulation time. There is only one record in this table.

Example



Time step	PosAnal NumSteps	PosAnal DataSource
MONTHLY	24	GENERATED

The fields of this table are:

Field Name	Type	Size	Description
Time step	Text	8	The type of simulation time step. Options are **DAILY**, **WEEKLY**, **MONTHLY**, **CYCLE**, or **DSS**. See section 2.8.1. The OASIS GUI links to this field through the *Type of time step* box on the *Time* tab (section 3.7.3 part B).
PosAnal NumSteps	Number	Integer	The number of time steps in each trace run of the position analysis. This field is only used if you are doing a position analysis (section 9.2.3). If you are not doing a position analysis, this field may be omitted. The OASIS GUI links to this field through the *Number of time steps per trace* box on the *Time* tab (section 3.7.3 part C).
PosAnal DataSource	Text	12	The technique for getting time-series data for a position analysis run (section 9.1.0). Choices are **GENERATED** or **HISTORICAL**. If you are not doing a position analysis, this field may be omitted. The OASIS GUI links to this field through the *Type of Position Analysis* box on the *Time* tab (section 3.7.3 part C).

C. Table *Year scheme*

Identifies the year scheme (section 2.8.5) to be used for the run. This is done by naming the month in which the year begins. The year always begins on the first of that month. The entry in this table is ignored if you are using the *Steps* table (section 4.5.2 part D) and the time steps are fixed to the year. There is only one record in this table.

The OASIS GUI links to this field through the *Beginning of Year* box on the *Time* tab (section 3.7.3 part B).

The fields of this table are:

Field Name	Type	Size	Description
Year scheme	Text	3	The 3-letter abbreviation for the month in which a year begins.

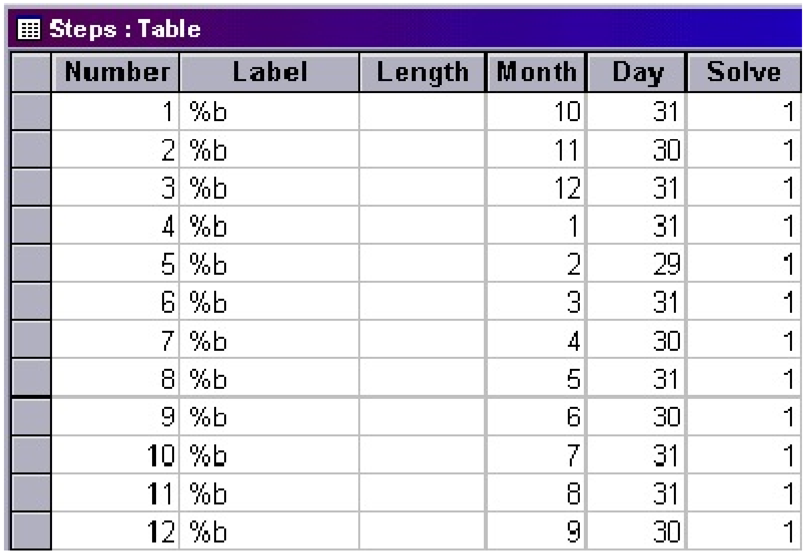
D. Table *Steps*

Contains a row for every time step within one time cycle of simulation. The table defines the cyclical time steps of simulation if the entry in the *Time step* field of the *Run* table is ***CYCLE***. In this case, it defines the order, length (or ending dates), labels, and MPO parameters. If the entry in the *Time step* field is ***DSS***, then this table defines only the labels and MPO parameters. If the entry in the *Time step* field is anything else then this table is not used and can be omitted. See section 2.8.1 for a discussion of the ways you can define time steps in OASIS, and 2.2.7 for a discussion of MPO. The OASIS GUI links to this table through the *Steps Table* control on the *Time* tab (section 3.7.3 part B).

In the *:STEP:* field, a Onevar input file may name a *Steps* table for defining special post-processor time steps (section 6.1.7 part I). The special table used by the post-processor has exactly the same format as the *Steps* table, but it does not have to have the name *Steps*, and it does not have to be in the time-parameters database file. The post-processors do not use the *Solve* field for these special steps..

When the *Time step* field says *CYCLE*, this table is used in one of two modes. The first mode defines the time steps on a cycle that is **not fixed to the year**. The steps are defined by their **length**, and you choose the appropriate total length of the cycle. This mode uses the *Length* field, but not the *Month* or *Day* fields. The second mode defines the time steps in a cycle that is **fixed to the year**. The steps are defined by their **ending dates**, and the cycle must be one year in length. The second mode uses the *Month* or *Day* fields, but not the *Length* field. Note that the first day of the year is the day following the end date of the last time step. You can define your cycle so that the year begins on any date.

Example: Monthly step


Steps : Table

Number	Label	Length	Month	Day	Solve
1	%b		10	31	1
2	%b		11	30	1
3	%b		12	31	1
4	%b		1	31	1
5	%b		2	29	1
6	%b		3	31	1
7	%b		4	30	1
8	%b		5	31	1
9	%b		6	30	1
10	%b		7	31	1
11	%b		8	31	1
12	%b		9	30	1

The example shows an entry that would have the same effect as entering *MONTHLY* into the *Time step* field of the *Run* table (section 4.5.2 part B) and *OCT* into the *Year scheme* table (section 4.5.2 part C). The example would not simulate any MPO. The one difference from the *MONTHLY* option is that this example would label each month with a three-letter abbreviation instead of the number format. For example, *Nov* instead of *11/31*.

More examples of the *Steps* table are given below.

The fields of this table are:

Field Name	Type	Size	Description
Number	Number	Integer	The number of the step in the cycle. The steps must be ordered 1, 2, 3, ... etc.
Label	Text	15	The label that is used to refer to this time step in output. In certain contexts, OASIS appends the year number to the end of the label. In other situations (such as the balance sheet output), it does not append the year number. You may apply special codes which OASIS can interpret for you. See notes below.
Length	Text	8	The length of the time step. Use this field if the cycle is *not* fixed to the year. If this field is used, then the *Month* and *Day* fields must be empty. See notes below.
Month	Number	Byte	The month number of the end date of the time step. Use this field if your cycle is fixed to the year. If this field is used, then the *Length* field must be empty.
Day	Number	Byte	The day of the month at the end of the time step. Use this field if your cycle is fixed to the year. If this field is used, then the *Length* field must be empty.
Solve	Number	Byte	The number of future periods, including the current period, to enter into the LP to solve. The value must be greater than or equal to zero. If the value is zero, then no LP is written for the time step. If you do not wish to do any MPO, then enter *1* for every step.

Notes:

***Label* field**
Text that you enter into this field is treated as the literal text for the label, except for special codes that are listed below. For reference, these codes are processed by the function *strftime* in the C run-time library. We present all of the codes below, so that you should not have to look up information on *strftime*. Note that the codes are case-sensitive.

Code	Description	Example
%a	Abbreviated weekday name (three letters)	Thu
%A	Full weekday name	Thursday
%b	Abbreviated month name (three letters)	Sep
%B	Full month name	September
%c	Date and time representation	09/30/20 24:00:00
%d	Day of month as decimal number (01 – 31)	30
%H	Hour in 24-hour format (00 – 23)	24
%I	Hour in 12-hour format (01 – 12)	12
%j	Day of year as decimal number (001 – 366)	366
%L	Abbreviated month name (one letter) (*J, F, M, A, M, J, J, A, S, O, N, D*)	S
%m	Month as decimal number (01 – 12)	09
%M	Minute as decimal number (00 – 59)	00
%n	The period number of the year. Equal to the OCL variable *period* (section 4.7.4).	2

Code	Description	Example
%N	The absolute period number. This is equal to 1 during the first time step and counts thereafter, never being reset. Equivalent to the OCL variable *abs_period* (section 4.7.4).	508
%p	A.M./P.M. indicator for 12-hour clock	PM
%S	Second as decimal number (00 – 59)	00
%U	Week of year as decimal number, with Sunday as first day of week (00 – 53)	52
%w	Weekday as decimal number (0 – 6; Sunday is 0)	4
%W	Week of year as decimal number, with Monday as first day of week (00 – 53)	52
%x	Date representation	09/30/20
%X	Time representation	24:00:00
%V	Abbreviated weekday name (one letter) (*S, M, T, W, T, F, S*)	T
%y	Year without century, as decimal number (00 – 99)	20
%Y	Year with century, as decimal number	1920
%%	Percent sign	%

By default, the routine adds leading zeros. You may add the symbol # to remove the leading zeros, like so:

%#d %#H %#I %#j %#m %#M %#S %#U %#w %#W %#y %#Y

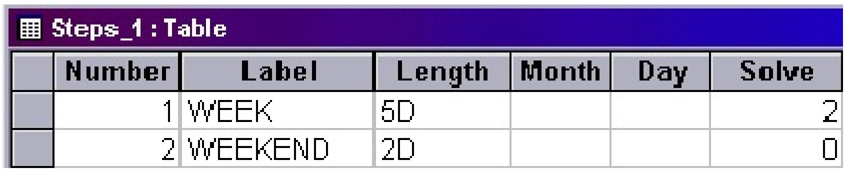
You may combine any number of codes with literal text. However maximum length of the label is 15 characters. We recommend that you do not try to include the year in your label, because OASIS automatically adds the year to the label when appropriate.

Length **field**

The text that you enter in this field must be an integer number followed by a code for one of three units of time: ***D*** for days, ***H*** for hours, or ***M*** for minutes. For example, if you enter *6D*, then the time step is 6 days long. An entry of *50H* specifies a step that is 50 hours long. The entry must use *only one* time unit. For example, if the time step is 89 minutes long, you should enter *89M*, **not** *1H29M*.

Here is an example of the table used for a cycle that is not fixed to the year.

Example: Twice-weekly step

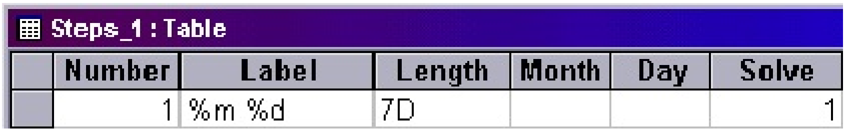

Steps_1 : Table

Number	Label	Length	Month	Day	Solve
1	WEEK	5D			2
2	WEEKEND	2D			0

This example creates a cycle that is seven days long. The first five days have the label *WEEK* and the last two days have the label *WEEKEND*. This example tells OASIS to do MPO. During the first step, OASIS will solve one LP for both time steps. During the second time step, no LP solves are done.

The next example is almost exactly the same as the pre-defined *WEEKLY* time step. The only difference is that the time step label defined below lacks a forward slash between the month and the day numbers.

Example: Weekly step



Steps_1 : Table

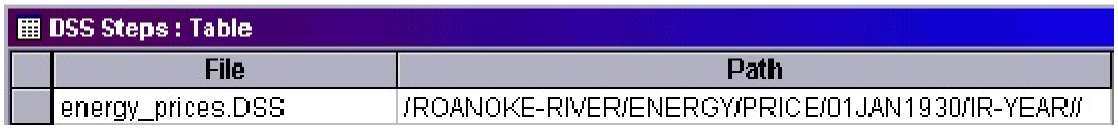
Number	Label	Length	Month	Day	Solve
1	%m %d	7D			1

E. Table *DSS Steps*

Identifies a DSS record upon which the simulation time steps are to be based. See section 2.8.1 for more information about simulation time steps. This table is only read if the entry in the *Time Step* field of the *Run* table is *DSS* (section 4.5.2 part B). Otherwise, this table can be omitted. There is only one record in this table.

The OASIS GUI links to this table through the *DSS File* and *DSS Record* controls on the *Time* tab (section 3.7.3 part B).

Example



DSS Steps : Table

File	Path
energy_prices.DSS	/ROANOKE-RIVER/ENERGY/PRICE/01JAN1930/IR-YEAR//

The fields of this table are:

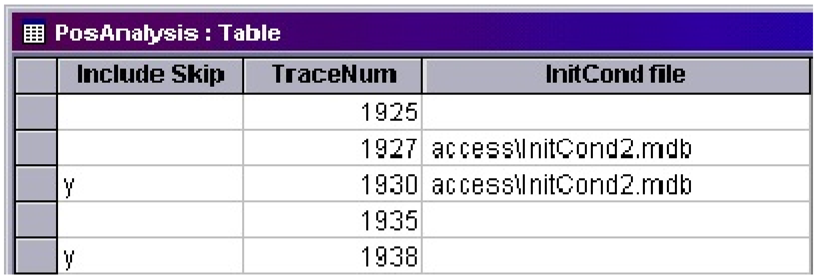
Field Name	Type	Size	Description
File	Text	128	The name of the file which contains the DSS record given in the *Path* field. The name can include path information, relative to the run directory, or absolute.
Path	Text	81	The DSS pathname of the record upon which the simulation time steps are to be based.

F. Table *PosAnalysis*

Identifies the component runs, or *traces*, of the position analysis. If you are not doing a position analysis (section 9.0.0), then this table can be omitted. Although you may enter one record for each trace of the position analysis, it is also possible to summarize runs with consecutive trace numbers by using the *Include Skip* field. You may specify a different initial-conditions file for each trace. The records in this table must be in time order.

The OASIS GUI links to this table through the *Position Analysis Traces* control on the *Time* tab (section 3.7.3 part C).

Example


PosAnalysis : Table

Include Skip	TraceNum	InitCond file
	1925	
	1927	access\InitCond2.mdb
y	1930	access\InitCond2.mdb
	1935	
y	1938	

The example tells the position analysis program to do runs with trace numbers 1925, 1927, 1928, 1929, 1930, 1935, 1936, 1937, and 1938. If we are doing the *historical* data source method, then the trace numbers are the year numbers of the start of each run. Traces number 1927 through 1930 use the initial-conditions file *InitCond2.mdb*. All other trace runs use whatever initial-conditions file is named in *model.cf*.

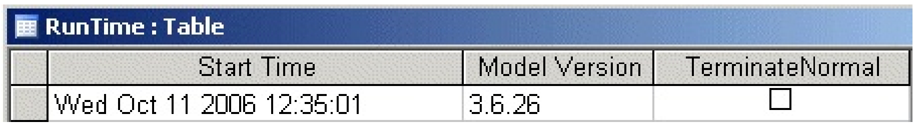
The fields of this table are:

Field Name	Type	Size	Description
Include Skip	Text	3	If this field is ***Y*** or ***YES***, then every trace number between that of the record and the previous record will be also be used as a trace number. These summarized traces use the same initial conditions file named in the current record.
TraceNum	Number	Integer	The trace number. The trace number is the text that is used for the F-path of designated input time-series records (section 9.1.0). If the data source method is *historical*, then the trace number is the year in which the trace begins.
InitCond file	Text	80	The initial conditions file (4.5.6) to use for the trace, with pathname absolute or relative to the run directory. If left blank, then the component run will use the file listed in *model.cf* (see section 4.4.0). If the *Include Skip* field is *YES*, then the name given must be identical to the name given in the previous record.

G. Table *Runtime*

Used by OASIS to store the real time at which the run was performed. At the beginning of a run, OASIS records the real time on the clock. This can be displayed in Onevar output (see section 6.1.9 part A). You should never edit the contents of this table.

Example


RunTime : Table

Start Time	Model Version	TerminateNormal
Wed Oct 11 2006 12:35:01	3.6.26	☐

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
Start time	Text	30	The time on the computer's clock when the run was executed. This is not related to the *time range*. OASIS writes to this field automatically. You should never edit the contents of this field.
Model Version	Text	15	The version number of *model.exe* that executed the run. OASIS writes to this field automatically. You should never edit the contents of this field.
TerminateNormal	Yes/No		This field indicates if the run ended successfully or with a fatal error. At the beginning of the run, *model.exe* writes *No* to the field. If the run terminates successfully (with no fatal errors), the program rewrites this field with *Yes*.

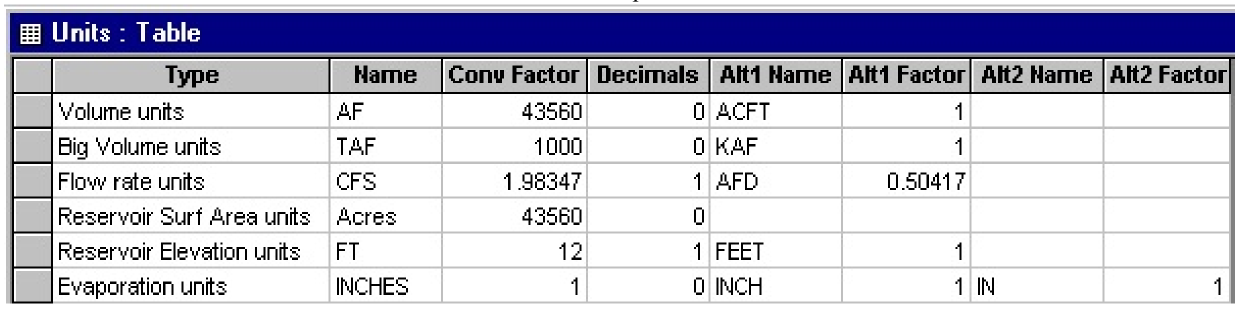
4.5.3 SYSTEM DATABASE FILE

A. Table *Units*

Defines all the units of measurement (section 2.9.0) that OASIS uses, except for water quality units, which are given in the table *Concentration* (section 4.5.3 part D). There are six records (rows) in this table, and their identities are fixed. This table may be omitted, in which case default units will be used. The example shows input that is equivalent to the default units.

Many users have been confused about the meanings of the different conversion factors in this table. Therefore, the GUI provides a special dialog box just for entering this information. It is highly recommended that you use this dialog box, called the *Units Wizard* (section 3.7.7), because it carefully illustrates the meaning of each entry.

Example



Units : Table

Type	Name	Conv Factor	Decimals	Alt1 Name	Alt1 Factor	Alt2 Name	Alt2 Factor
Volume units	AF	43560	0	ACFT	1		
Big Volume units	TAF	1000	0	KAF	1		
Flow rate units	CFS	1.98347	1	AFD	0.50417		
Reservoir Surf Area units	Acres	43560	0				
Reservoir Elevation units	FT	12	1	FEET	1		
Evaporation units	INCHES	1	0	INCH	1	IN	1

The fields of this table are:

Field Name	Type	Size	Description
Type	Text	N/A	Do not edit this field. It is there for your convenience to identify the fixed records. OASIS does not read this field.
Name	Text	9	This is the name of the primary unit for the dimension of measurement. The primary unit will be the default unit that OASIS uses to store values. It is also the default unit of OCL variables.
Conv Factor	Number	single	This is a factor for converting between dimensions, such as from length to volume. There is a specific meaning for the conversion factor of each row. Refer to the example above and the descriptions of the individual records below. *Please note that this conversion factor is for converting between dimensions; the subsequent factors for the alternates are for converting within a dimension.*
Decimals	Number	Byte	The number of digits after the decimal point that are displayed in a balance sheet for values measured in this unit. See section 5.2.0 for reference on the balance sheet output.
Alt*x* Name	Text	9	The alternate name or abbreviation, or the name of alternate units for the dimension of measurement. OASIS will recognize the alternate name and convert to the primary units for internal calculations. The field may be left blank.

Alt1*x* Factor	Number	single	The factor that you would multiply by a value measured in alternate units to get a value in primary units. In the example table above, most of the alternates are just alternate names for the same units. Suppose we had entered *YARDS* into the last record. The alternate factor would be 36.0. *Please note the distinction between this factor and the factor in the field labeled* Conv Factor. The field may be left blank.

The fixed records of this table are:

Volume units
Internally, all volumes are measured in the primary volume units, and all flow rates are measured in primary volume units per time step. Therefore, all flow and volume values in OCL expressions and output are by default measured in primary volume units.
Conversion factor: Multiply a value in volume units by the conversion factor to get a value in cubic elevation units.

Big Volume units
The big volume units are automatically treated as alternate units for volume units. The *database input* for reservoir storage values is assumed to be measured in the primary big volume units, if the units of the input are not labeled. The reference for each input table tells what the default units assumptions are.
Conversion factor: Multiply a value in big volume units by the conversion factor to get a value in volume units.

Flow rate units
The flow rate is a volume over a time step of constant size (a month does not have constant size). The *database input* for arc flows is assumed to be measured in the primary flow units, if the units of the input are not labeled. The reference for each input table tells what the default units assumptions are.
Conversion factor: Multiply a value in flow units by the conversion factor to get a value in volume units per day.

Reservoir Surf Area units
The surface area of a reservoir is measured in the primary area units. The *database input* for surface area in the *Reservoir S-A-E* table (section 4.5.3 part J) is assumed to be measured in the primary area units, if the units of the input are not labeled.
Conversion factor: Multiply a value in area units by this value to get a value in square elevation units.

Reservoir Elevation units
All reservoir elevations and evaporation rates are measured in the primary elevation units. The *database input* for elevation in the *Reservoir S-A-E* table (section 4.5.3 part J) is assumed to be measured in the primary elevation units, if the units of the input are not labeled.
Conversion factor: Multiply a value in elevation units by this value to get a value in evaporation units

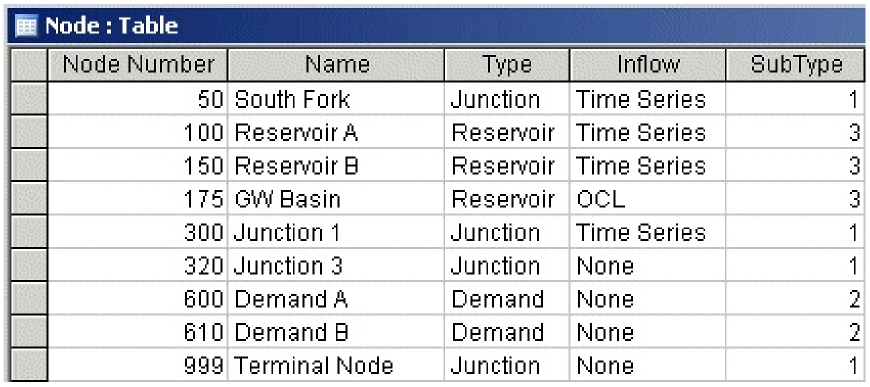
Evaporation units
The evaporation units are automatically treated as alternates for the elevation units. The *database input* for evaporation rate in the *Evaporation Pattern* (section 4.5.3 part L) table is assumed to be measured in the primary evaporation units, if the units of the input are not labeled.
Conversion factor: The entry in the *Conversion Factor* field for Evaporation units is moot. The recommended entry is “1". Effectively, the evaporation units are the starting point, from which the units for measuring all other dimensions are derived.

B. Table *Node*

This table contains a record for every node (section 2.1.1) in the system. The table is used to identify the node type, the source of inflow data, the boundary conditions for water quality computations, and the source of water quality data. The table also contains information about how the node is represented in the GUI's schematic.

The example does not show several fields that are required by the OASIS GUI. Those fields are described below.

Example



Node : Table

Node Number	Name	Type	Inflow	SubType
50	South Fork	Junction	Time Series	1
100	Reservoir A	Reservoir	Time Series	3
150	Reservoir B	Reservoir	Time Series	3
175	GW Basin	Reservoir	OCL	3
300	Junction 1	Junction	Time Series	1
320	Junction 3	Junction	None	1
600	Demand A	Demand	None	2
610	Demand B	Demand	None	2
999	Terminal Node	Junction	None	1

The following fields of the *Node* table are linked to the table in the OASIS GUI's *Node* tab (section 3.7.4):

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the node, between 1 and 999.
Name	Text	50	The name of the node. The name can be used to identify the node in the OASIS GUI, but this field is not read by *model.exe*. However, the GUI can write the node names as OCL substitutes (section 4.7.1 part I) for *model.exe* to read. This option can be configured in the GUI's *Preferences* dialog box (section 3.6.2 part C). If you intend to use the node names as OCL substitutes, then you should not use spaces in the node names.
Type	Text	12	The type of node. Choices are **JUNCTION**, **DEMAND**, or **RESERVOIR**.
Inflow	Text	15	If the node has no inflow from outside the system (unregulated inflow), enter **NONE**. If there is an unregulated inflow, enter the source of the inflow data. Choices are **TIME SERIES**, **OCL**, or **PATTERN**. See note below.
SubType	Number	Byte	The number of the node category for the node. Must be one of the codes in the *zzGUI_NodeType* table (section 4.5.9 part F). In the GUI interface, this field is reflected in the *Category* column. This field is not read by *model.exe*.

Notes:

***Inflow* field**
If **TIME SERIES**, then a record must be found in the **inflow** time-series database (section 4.6.4 part A). If **PATTERN**, then records must be entered into the *Inflow Pattern* table (section 4.5.5 part A). If **OCL**, then the *inflow* variable must be set with the OCL *set* command (section 2.5.1 part C).

The following fields of the *Node* table are not interfaced through the OASIS GUI. The model only reads these fields if OASIS is being used to simulate water quality (section 2.10.0). The *x* in the field names represent the number of the water quality constituent. There must be one of each of these fields for each water quality constituent in the model.

Field Name	**Type**	**Size**	**Description**
C*x*_type	Text	10	Field only used if water quality constituent *x* is being modeled. This field identifies the type of boundary condition used at the node. If there is no boundary condition at the node, then leave the field blank. The other choices are : ***Inflow*** the input data specifies the concentration in the unregulated inflow to the node. ***Node*** the input data specifies the exact concentration of the entire node. ***Treat*** the input data specifies the removal efficiency at the node. ***Add*** the input data specifies a value to add to the concentration at the node.
C*x*_input	Text	15	Field only used if water quality constituent *x* is being modeled. This field identifies the source of input data for the boundary condition used at the node. If there is no boundary condition at the node, then leave the field blank The other choices are **TIME SERIES**, **OCL**, or **PATTERN**. See note below.
C*x*_output	Text	4	Only used if water quality constituent *x* is being modeled. Enter **NO** to suppress water quality output from being written to the DSS database for this node. Otherwise, output will be written. Suppressing output is recommended wherever possible, due to the run time and disk space consumed by DSS.

Notes:

***C*x*_input* field**
If **TIME SERIES**, then a record must be found in the **inflow** time-series database (section 4.6.4 part B). If **PATTERN**, then records must be entered into the *C*x *Pattern* table (section 4.5.5 part B). If **OCL**, then the *conc_input* variable must be set with the OCL *set* command (section 2.5.1 part C).

The following fields of the *Node* table are read only by the OASIS GUI, but no interface for them appears on the *Node* tab. These fields are *not* read by *model.exe* or any of the post-processor programs. These fields should only be edited by the OASIS GUI. The fields read only by the OASIS GUI are:

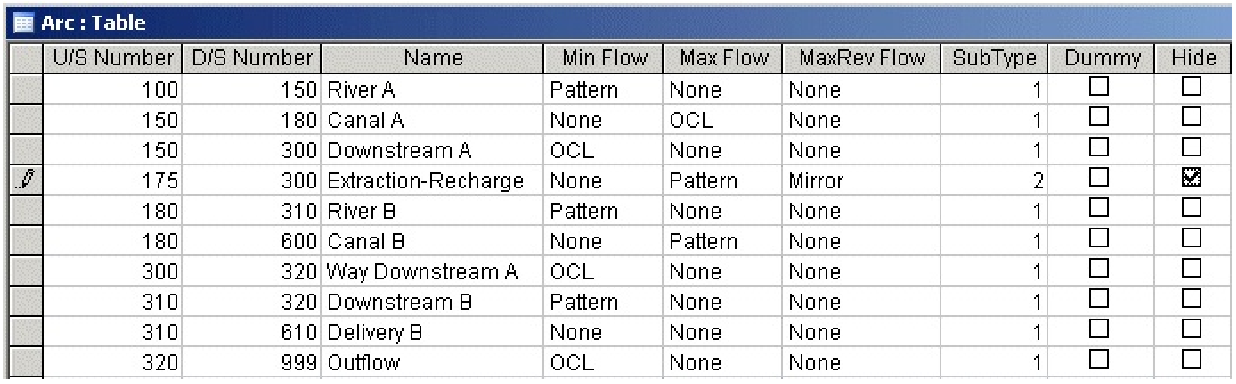
Field Name	**Type**	**Size**	**Description**
X **Y**	Number	Long Integer	The x- and y-coordinates of the center of the node on the schematic display, where X=0 is the left edge and Y=0 is the top edge.
NameX **NameY**	Number	Long Integer	(On the schematic display) the x- and y-coordinates of the center of the node-name label relative to the center of the node.
HideName	Yes/No		If *Yes*, then the GUI does not show a name label for the node on the schematic display. If *No*, then the name label is shown.
InflowX **InflowY**	Number	Long Integer	(On the schematic display) the x- and y-coordinates of the end of the arrow representing inflow to the node, relative to the center of the node.
InflowType	Number	Byte	The type of inflow shown on the schematic display. Must be one of the codes in the *zzGUI_InflowType* table (section 4.5.9 part H).
RotationAngle	Number	Double	The angle of rotation for the node-name label on the schematic display, in degrees counter-clockwise from horizontal.

C. Table *Arc*

This table contains a record for every arc in the system (section 2.1.2). The table is used to identify the nodes connected to each arc, the sources of data for: minimum (target) flow, maximum flow, and maximum reverse flow; the boundary conditions for water quality computations, and the source of water quality data. The table also contains information about how the arc is represented in the GUI's schematic.

The example does not show several fields that are required by the OASIS GUI. Those fields are described below.

Example



Arc : Table

U/S Number	D/S Number	Name	Min Flow	Max Flow	MaxRev Flow	SubType	Dummy	Hide
100	150	River A	Pattern	None	None	1	☐	☐
150	180	Canal A	None	OCL	None	1	☐	☐
150	300	Downstream A	OCL	None	None	1	☐	☐
175	300	Extraction-Recharge	None	Pattern	Mirror	2	☐	☑
180	310	River B	Pattern	None	None	1	☐	☐
180	600	Canal B	None	Pattern	None	1	☐	☐
300	320	Way Downstream A	OCL	None	None	1	☐	☐
310	320	Downstream B	Pattern	None	None	1	☐	☐
310	610	Delivery B	None	None	None	1	☐	☐
320	999	Outflow	OCL	None	None	1	☐	☐

The following fields of the *Node* table are linked to the table in the OASIS GUI's *Arc* tab (section 3.7.5):

Field Name	Type	Size	Description
U/S Number	Number	Integer	The node number at the upstream end of the arc.
D/S Number	Number	Integer	The node number at the downstream end of the arc.
Name	Text	50	The name of the arc. The name can be used to identify the arc in the OASIS GUI, but this field is not read by *model.exe*.
Min Flow	Text	15	The source of input data for the minimum (target) flow in the arc (section 2.4.0 part B). If there is no minimum flow, enter **NONE**. If there is a minimum flow, enter the source of the data. Choices are **TIME SERIES**, **OCL**, or **PATTERN**. See note below.
Max Flow	Text	15	The source of input data for the maximum (bound) flow in the arc (section 2.4.0 part A). If there is no maximum flow, enter **NONE**. If there is a maximum flow, enter the source of the data. Choices are **TIME SERIES**, **OCL**, or **PATTERN**. See note below.
MaxRev Flow	Text	15	The source of input data for the maximum reverse (bound) flow in the arc (section 2.4.0 part C). If there is no maximum reverse flow, enter **NONE**. If there is a maximum reverse flow, enter the source of the data. Choices are **MIRROR**, **TIME SERIES**, **OCL**, or **PATTERN**. See note below.
SubType	Number	Byte	The number of the arc category for the arc. Must be one of the codes in the *zzGUI_ArcType* table (section 4.5.9 part G). In the GUI interface, this field is reflected in the *Category* column.
Dummy	Yes/No		If **Yes**, then the arc is ignored. It cannot be used in any input that uses an arc number, such as *Minimum Flow* table or OCL *flow* variable. It is not entered into the LP router in any form.

Field Name	Type	Size	Description
Hide	Yes/No		If *No* then the arc is drawn normally on the schematic display. If *Yes*, then the arc is not drawn, although it is applied in the model.

Notes:

***Min flow*, *Max flow*, and *MaxRev flow* field**s
If **TIME SERIES**, then a record must be found in the **system** time-series database (section 4.6.2 part A, 4.6.2 part B, and 4.6.2 part C). If **PATTERN**, then records must be entered into the *Minimum flow*, *Maximum flow*, or *Maximum Reverse flow* table (section 4.5.3 part E, 4.5.3 part F, and 4.5.3 part G). If **OCL**, then the *min_flow*, *max_flow*, or *maxrev_flow* variable must be set with the OCL *set* command (section 2.5.1 part C). The option **MIRROR** is only available for maximum reverse flows. If used, then the maximum reverse flow will be the negative of the maximum flow. OASIS automatically handles this, so you do not need to enter any input for the maximum reverse flow value. If **MIRROR** is used, and there is no maximum flow, then the arc will be capable of unbounded negative flow.

The following field is not interfaced through the OASIS GUI:

Field Name	Type	Size	Description
Output	Text	4	(Optional). Enter **NO** to suppress arc flows from being written to the DSS database (section 5.6.0) for this arc. Otherwise, output will be written. Suppressing output is recommended wherever possible, due to resources consumed by DSS.

The following fields of the *Arc* table are not interfaced through the OASIS GUI. The model only reads these fields if OASIS is being used to simulate water quality (section 2.10.0). The *x* in the field names represent the number of the water quality constituent. There must be one of each of these fields for each water quality constituent in the model.

Field Name	Type	Size	Description
C*x*_type	Text	10	Field only used if water quality constituent *x* is being modeled. This field identifies the type of boundary condition used at the arc. If there is no boundary condition at the arc, then leave the field blank. The other choices are : ***Arc*** the input data specifies the exact concentration of the arc. ***Treat*** the input data specifies the removal efficiency at the arc. ***Add*** the input data specifies a value to add to the concentration at the arc.
C*x*_input	Text	15	Field only used if water quality constituent *x* is being modeled. This field identifies the source of input data for the boundary condition used at the arc. If there is no boundary condition at the arc, then leave the field blank The other choices are **TIME SERIES**, or **OCL**. See note below.

Notes:

***C*x*_input* field**
If **TIME SERIES**, then a record must be found in the **inflow** time-series database (section 4.6.4 part C). If **OCL**, then the *conc_input* variable must be set with the OCL *set* command (section 2.5.1 part C).

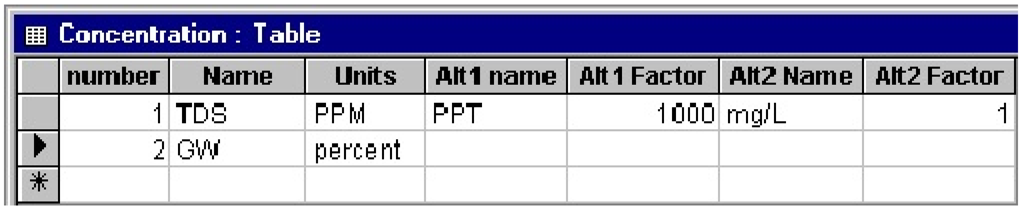
The following fields of the *Arc* table are read only by the OASIS GUI, but no interface for them appears on the *Arc* tab. These fields are *not* read by *model.exe* or any of the post-processor programs. These fields should only be edited by the OASIS GUI.

Field Name	**Type**	**Size**	**Description**
NameX **NameY**	Number	Long Integer	(On the schematic display) the x- and y-coordinates of the center of the node-name label relative to the center of the arc.
HideName	Yes/No		If *Yes*, then the GUI does not show a name label for the arc on the schematic display. If *No*, then the name label is shown.
NumBend	Number	Byte	The number of bend points in the arc as drawn on the schematic display.
b01 **b02** **b03** **b04** **b05** **b06**	Number	Byte	(On the schematic display) the x- and y-coordinates of each bend point drawn in the arc. The odd-numbered fields are the x-coordinates and the even-numbered fields are the y-coordinates. For each arc, the OASIS GUI only reads as many fields as it needs to fulfill the number of bend points indicated by the *NumBend* field. For example, if *NumBend* is 1, then only the *b01* and *b02* fields are read.
RotationAngle	Number	Double	The angle of rotation for the arc-name label on the schematic display, in degrees counter-clockwise from horizontal.

D. Table *Concentration*

This table contains a record for every water quality parameter in the run. If no water quality parameters are being simulated, then the table can be omitted entirely. For discussion of water quality, see 2.10.0. This table is not interfaced in the OASIS GUI.

Example



Concentration : Table

number	Name	Units	Alt1 name	Alt1 Factor	Alt2 Name	Alt2 Factor
1	TDS	PPM	PPT	1000	mg/L	1
2	GW	percent				

The fields of this table are:

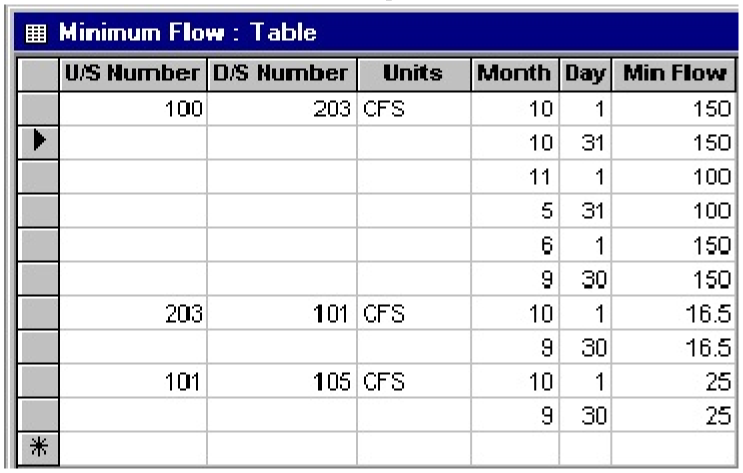
Field Name	Type	Size	Description
number	Number	byte	Assign each constituent with a number in the order it appears in this table, beginning with 1. The purpose is to reinforce the association of each constituent with its number (thereby the meaning of labels such as the *C1_type* field in the *Node* table).
Name	Text	12	The name of the constituent. This name will be used to label the concentration of the constituent in output and in OCL.
Units	Text	9	The name of the primary units of measurement for this constituent. All values will be stored in these units. All output will appear in these units. OCL variables will be measured in these units.
Alt*x* Name	Text	9	The alternate name or abbreviation, or the name of alternate units for the measurement of this constituent. OASIS will recognize the alternate name and convert to the primary units for internal calculations. The field may be left blank.
Alt1*x* Factor	Number	single	The factor that you would multiply by a value measured in alternate units to get a value in primary units. The field may be left blank.

E. Table *Minimum Flow*

This table contains a record for every arc with a pattern minimum (target) flow (section 2.4.0 part B), as identified in the *Arc* table (section 4.5.3 part C). If no arcs have pattern minimum flows, then the table can be omitted entirely. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Arc* tab (section 3.7.5). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Minimum Flow : Table

U/S Number	D/S Number	Units	Month	Day	Min Flow
100	203	CFS	10	1	150
			10	31	150
			11	1	100
			5	31	100
			6	1	150
			9	30	150
203	101	CFS	10	1	16.5
			9	30	16.5
101	105	CFS	10	1	25
			9	30	25

The fields of this table are:

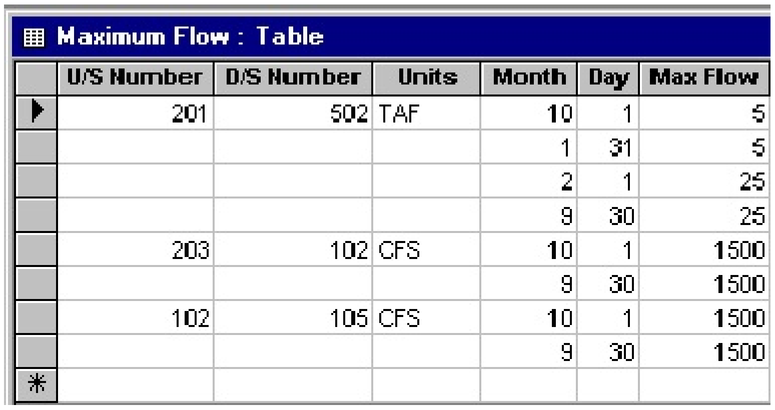
Field Name	Type	Size	Description
U/S Number	Number	Integer	The node number at the upstream end of the arc.
D/S Number	Number	Integer	The node number at the downstream end of the arc.
Units	Text	9	The units in which this flow is measured. Must be flow, volume, or big volume units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values will be assumed to be in **primary flow units** (section 2.9.0).
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Min Flow	Number	Single	The value of minimum (target) flow at the point in time. See section 4.5.1 for conventions on interpolation of the pattern.

F. Table *Maximum Flow*

This table contains a record for every arc with a pattern maximum (bound) flow (section 2.4.0 part A), as identified in the *Arc* table (section 4.5.3 part C). If no arcs have pattern maximum flows, then the table can be omitted entirely. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Arc* tab (section 3.7.5). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Maximum Flow : Table

U/S Number	D/S Number	Units	Month	Day	Max Flow
201	502	TAF	10	1	5
			1	31	5
			2	1	25
			9	30	25
203	102	CFS	10	1	1500
			9	30	1500
102	105	CFS	10	1	1500
			9	30	1500

The fields of this table are:

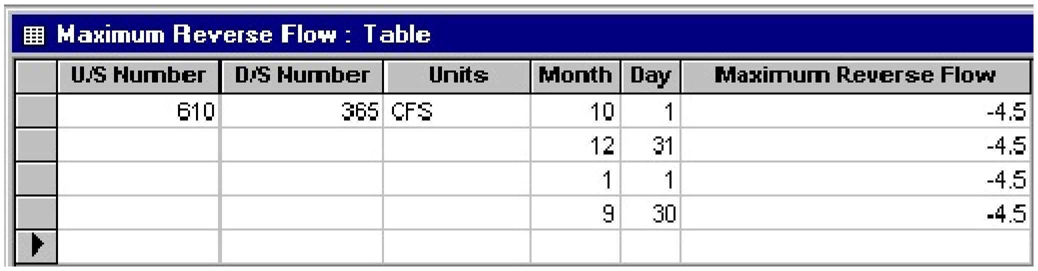
Field Name	Type	Size	Description
U/S Number	Number	Integer	The node number at the upstream end of the arc.
D/S Number	Number	Integer	The node number at the downstream end of the arc.
Units	Text	9	The units in which this flow is measured. Must be flow, volume, or big volume units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values will be assumed to be in **primary flow units** (section 2.9.0).
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Max Flow	Number	Single	The value of maximum flow at the point in time. See section 4.5.1 for conventions on interpolation of the pattern.

G. Table *Maximum Reverse Flow*

This table contains a record for every arc with a pattern maximum reverse (bound) flow (section 2.4.0 part C), as identified in the *Arc* table (section 4.5.3 part C). If no arcs have pattern maximum reverse flows, then the table can be omitted entirely. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Arc* tab (section 3.7.5). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Maximum Reverse Flow : Table

U/S Number	D/S Number	Units	Month	Day	Maximum Reverse Flow
610	365	CFS	10	1	-4.5
			12	31	-4.5
			1	1	-4.5
			9	30	-4.5

The fields of this table are:

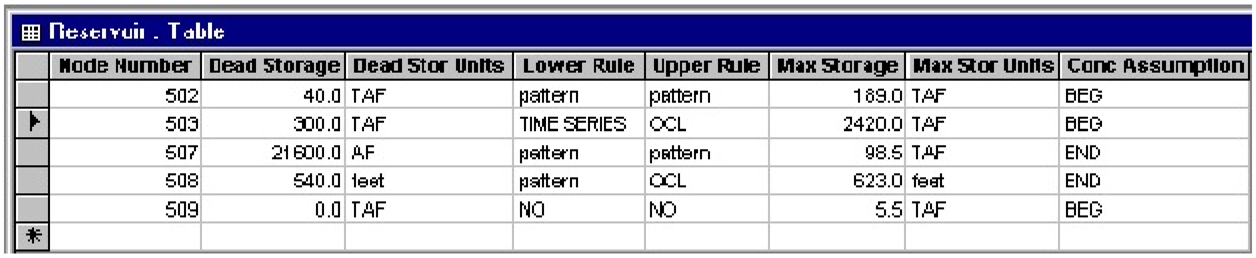
Field Name	Type	Size	Description
U/S Number	Number	Integer	The node number at the upstream end of the arc.
D/S Number	Number	Integer	The node number at the downstream end of the arc.
Units	Text	9	The units in which this flow is measured. Must be flow, volume, or big volume units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values will be assumed to be in **primary flow units** (section 2.9.0).
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Maximum Reverse Flow	Number	Single	The value of maximum reverse flow at the point in time. See section 4.5.1 for conventions on interpolation of the pattern. Remember that this is the lower bound on the flow in the arc, and a **negative** value must be used to allow flow in the reverse direction.

H. Table *Reservoir*

This table contains a record for every reservoir node in the system. If there are no reservoir nodes, then the table can be omitted entirely. The entry for the reservoir may indicate that it is a **single-zone** reservoir, or a **four-zone** reservoir. In the latter case, the value of the dead storage is given, and the sources for the lower and upper rule curves are identified. The value of the maximum storage is required for every reservoir, whether it has one or four zones. For discussion of reservoir storage zones, see section 2.4.0 part H. The type of assumption for water quality computations is needed only if water quality is being simulated. Thus, the *conc assumption* field may be omitted if there is no water quality. For a discussion of water quality computations, see section 2.10.0.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

Example



Node Number	Dead Storage	Dead Stor Units	Lower Rule	Upper Rule	Max Storage	Max Stor Units	Conc Assumption
502	40.0	TAF	pattern	pattern	189.0	TAF	BEG
503	300.0	TAF	TIME SERIES	OCL	2420.0	TAF	BEG
507	21600.0	AF	pattern	pattern	98.5	TAF	END
508	540.0	feet	pattern	OCL	623.0	feet	END
509	0.0	TAF	NO	NO	5.5	TAF	BEG

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node
Dead Storage	Number	Single	The dead storage, or top of the "A" zone (always a constant value) at the reservoir. This value is ignored for a single-zone reservoir.
Dead Stor Units	Text	9	The units in which in which the dead storage value is measured. Must be elevation, volume, or big volume units. If this field is omitted, then all values will be assumed to be in **primary big volume units** (section 2.9.0).
Lower Rule	Text	15	The source of the lower rule values. If **NONE** is entered, then the reservoir will be a single-zone reservoir. Choices are **TIME SERIES**, **PATTERN**, or **OCL**. See note below.
Upper Rule	Text	15	The source of the upper rule values. If **NONE** is entered, then the reservoir will be a single-zone reservoir. Choices are **TIME SERIES**, **PATTERN**, or **OCL**. See note below.
Max Storage	Number	Single	The capacity, or maximum storage (bound) of the reservoir.
Max Stor Units	Text	9	The units in which in which the maximum storage value is measured. Must be elevation, volume, or big volume units. If this field is omitted, then all values will be assumed to be in **primary big volume units** (section 2.9.0).

Field Name	Type	Size	Description
Conc Assumption	Text	3	The type of assumption to make when computing water quality. The same assumption will hold for all constituents. This field is not interfaced in the OASIS GUI. Choices for this field are: **BEG** assume that the outflow from the reservoir node has the same concentration as the beginning-of-period concentration at the reservoir.
			END assume that the outflow from the reservoir node has the same concentration as the end-of-period concentration at the reservoir.

Notes:

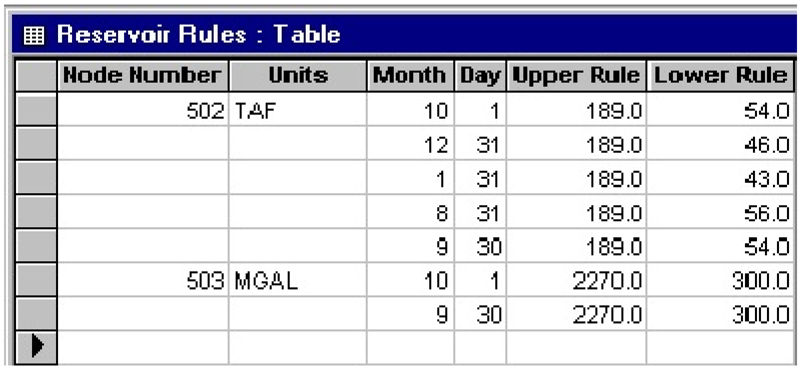
***Lower Rule* and *Upper Rule* field**s
If either of these two fields contains **NONE**, then the reservoir will have a single zone, and the contents of the other field is moot. If **TIME SERIES**, then a record must be found in the **system** time-series database (section 4.6.2 part E and 4.6.2 part F). If **PATTERN**, then records must be entered into the *Reservoir Rules* table (section 4.5.3 part I). If **OCL**, then the *upper_rule* or *lower_rule* variable must be set with the OCL *set* command (section 2.5.1 part C).

I. Table *Reservoir Rules*

This table contains a record for every reservoir node which has a pattern upper or lower rule curve (section 2.4.0 part H), as indicated in the *Reservoir* table (section 4.5.3 part H). If there are no reservoirs with pattern rule curves, then the table can be omitted entirely. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Reservoir Rules : Table

Node Number	Units	Month	Day	Upper Rule	Lower Rule
502	TAF	10	1	189.0	54.0
		12	31	189.0	46.0
		1	31	189.0	43.0
		8	31	189.0	56.0
		9	30	189.0	54.0
503	MGAL	10	1	2270.0	300.0
		9	30	2270.0	300.0

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node
Units	Text	9	The units in which the dead storage value is measured. Must be elevation, volume, or big volume units. If this field is omitted, then all values will be assumed to be in **primary big volume units** (section 2.9.0).
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Lower Rule	Number	Single	The value of the lower rule curve at the point in time. See section 4.5.1 for conventions on interpolation of the pattern. The value for the period is the value on the day at the **end of the period**.
Upper Rule	Number	Single	The value of the upper rule curve at the point in time. See section 4.5.1 for conventions on interpolation of the pattern. The value for the period is the value on the day at the **end of the period**.

Notes:

If only one of the lower or upper rule curves uses pattern values, then dummy values must be entered for the other. These values will be overwritten by the OCL or time-series values.

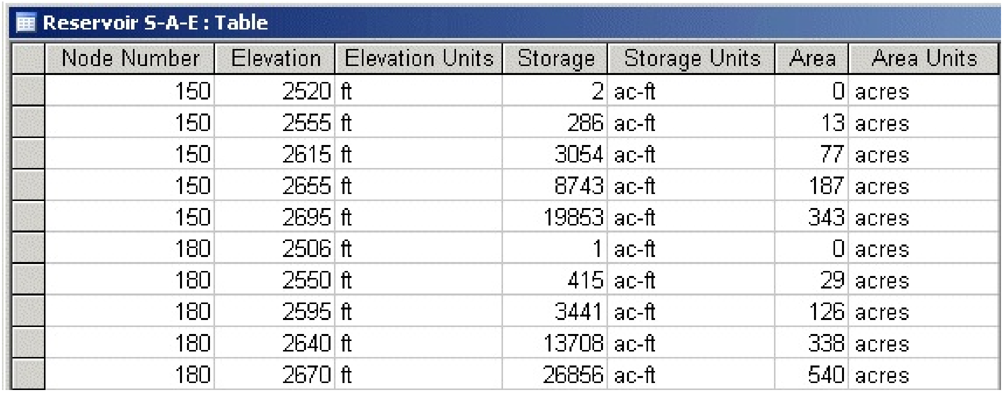
J. Table *Reservoir S-A-E*

Contains a look-up table which shows the relationship between storage, area, and elevation at reservoir nodes (section 2.4.0 part F). For each node, there should be a set of contiguous records, where each record gives a point on the storage-area-elevation "curve". OASIS will linearly interpolate between the given points. This table may contain an entry for every reservoir node in the system. If there are no reservoir nodes, then the table can be omitted entirely. If a reservoir node does not have an entry in this table, then OASIS will use a default for that reservoir, where area and elevation are always zero.

When OASIS needs to look up a value from the *Reservoir S-A-E* table, and the input elevation or storage exceeds the range of the table, OASIS uses the smallest or largest value in the table. In the example below, if OASIS computes a storage of 25000 ac-ft at node 150, then the storage exceeds the maximum storage value in the table. Therefore, OASIS assumes the elevation at node 150 is 2695 ft, because that is the largest elevation value in the table.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4). It is recommended that you use the *Reservoir Storage-Area-Elevation* dialog box (section 3.8.4) to edit the data in this table.

Example


Reservoir S-A-E : Table

Node Number	Elevation	Elevation Units	Storage	Storage Units	Area	Area Units
150	2520	ft	2	ac-ft	0	acres
150	2555	ft	286	ac-ft	13	acres
150	2615	ft	3054	ac-ft	77	acres
150	2655	ft	8743	ac-ft	187	acres
150	2695	ft	19853	ac-ft	343	acres
180	2506	ft	1	ac-ft	0	acres
180	2550	ft	415	ac-ft	29	acres
180	2595	ft	3441	ac-ft	126	acres
180	2640	ft	13708	ac-ft	338	acres
180	2670	ft	26856	ac-ft	540	acres

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node
Elevation	Number	Single	The elevation value for the point on the curve. If you enter -99, then OASIS will interpolate to get the elevation value at the point.
Elevation Units	Text	9	The units in which in which the elevation is measured. Must be elevation or evaporation units. If this field is omitted, then all values will be assumed to be in **primary elevation units** (section 2.9.0).
Storage	Number	Single	The storage value for the point on the curve. If you enter -99, then OASIS will interpolate to get the storage value at the point.
Storage Units	Text	9	The units in which in which the storage is measured. Must be volume or big volume units. If this field is omitted, then all values will be assumed to be in **primary big volume units** (section 2.9.0). See note below.
Area	Number	Single	The area value for the point on the curve. If you enter -99, then OASIS will interpolate to get the area value at the point.

Area Units	Text	9	The units in which in which the area is measured. Must be surface area units. If this field is omitted, then all values will be assumed to be in **primary surface area units** (section 2.9.0). See note below.

Notes:

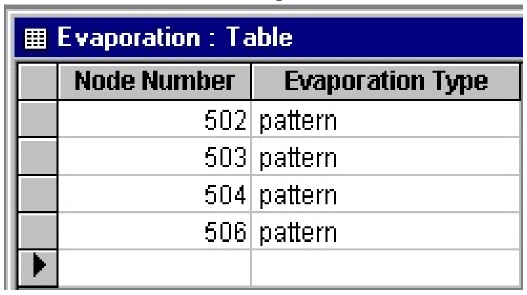
***Elevation Units*, *Storage Units*, and *Area Units* field**s
These fields are only read for the first record of each node, and the same units are applied to all values in the curve of that node.

K. Table *Evaporation*

Contains a record for each reservoir node at which evaporation should occur (section 2.4.0 part G). If you are not modeling evaporation at any reservoir nodes, then this table may be omitted entirely. If a reservoir node does not have an entry in this table, then OASIS will take zero evaporation from that reservoir.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

Example


Evaporation : Table

Node Number	Evaporation Type
502	pattern
503	pattern
504	pattern
506	pattern

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node
Evaporation Type	Text	9	The source of input data for the evaporation rate at the reservoir. If there is no evaporation at the reservoir, enter **NONE**. Other choices are **TIME SERIES**, **PATTERN**, or **OCL**. See note below.

Notes:

***Evaporation Type* field**
If **TIME SERIES**, then a record must be found in the **system** time-series database (section 4.6.2 part D). If **PATTERN**, then a set of records should be entered into the *Evaporation Pattern* table (section 4.5.3 part L). If **PATTERN**, and a set of records is not entered into the *Evaporation Pattern* table, then evaporation rate at this node is zero.

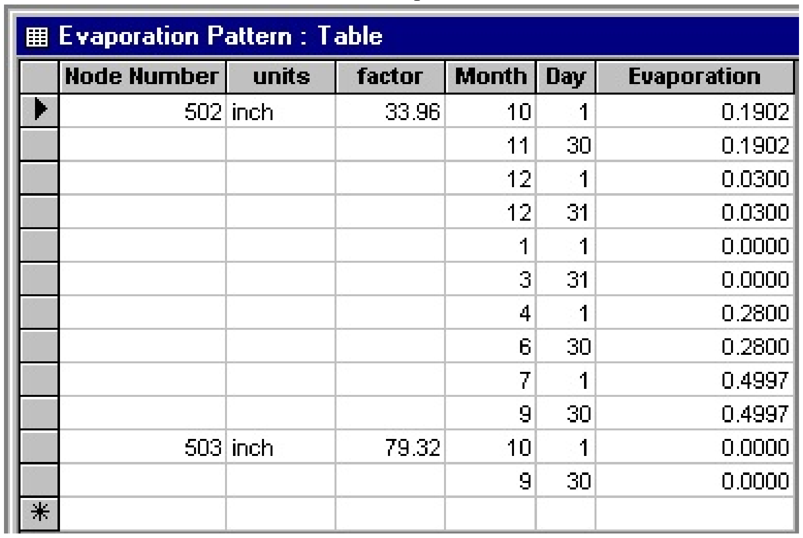
If **OCL**, then the *evap* variable must be set with the OCL *set* command (section 2.5.1 part C). If **OCL**, then the *evap_rate* variable can also be set with the OCL *set* command, but if *evap_rate* is not needed to compute *evap*, then *evap_rate* can be safely ignored.

L. Table *Evaporation Pattern*

This table contains a record for every reservoir node with a pattern evaporation rate, as identified in the *Evaporation* table (section 4.5.3 part K). If no arcs have pattern evaporation rate, then the table can be omitted entirely. For discussion of evaporation at reservoir nodes, see section 2.4.0 part G. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Node Number	units	factor	Month	Day	Evaporation
502	inch	33.96	10	1	0.1902
			11	30	0.1902
			12	1	0.0300
			12	31	0.0300
			1	1	0.0000
			3	31	0.0000
			4	1	0.2800
			6	30	0.2800
			7	1	0.4997
			9	30	0.4997
503	inch	79.32	10	1	0.0000
			9	30	0.0000

The fields of this table are:

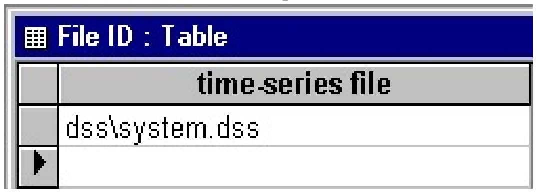
Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node.
Units	Text	9	The units in which the evaporation is measured. Must be elevation or evaporation units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values will be assumed to be in **primary evaporation units** (section 2.9.0).
factor	Number	Single	A factor that OASIS will multiply by every value in the pattern. OASIS only reads this field in the first record of each block.
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Evaporation	Number	Single	The value of evaporation at the point in time. See section 4.5.1 for conventions on interpolation of the pattern. OASIS processes this pattern in the same way as if it were entered in volume units, and were to be stored as a volume per period.

M. Table *File ID*

Contains the name of the time-series file (section 4.6.2) that supplements the system database. This table has only one record. The table is always required. If there are no system input variables to be retrieved from a time-series file, then the entry in this table is irrelevant. It is legal to name a file that is also named in the OCL file with the *:TIMEDB:* command, or named in one of the *File ID* tables of the other static databases.

The OASIS GUI provides an interface to this table when you click on *Time Series Data* in the *Edit* menu (section 3.6.2 part A).

Example


File ID : Table

time-series file
dss\system.dss

The fields of this table are:

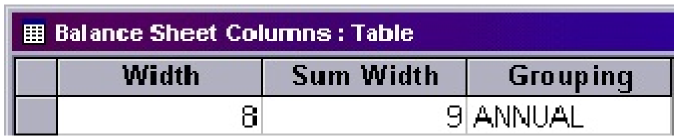
Field Name	Type	Size	Description
time-series file	text	64	The name of the time-series file. The name may include path information, absolute or relative to the run directory.

N. Table *Balance Sheet Columns*

Contains information on the arrangement and formatting of columns in the balance sheet output (section 5.2.0). This table has only one record. If this table is omitted, default formatting is used. The example shows input that is equivalent to the default formatting for a monthly time step.

The OASIS GUI links to this table through a control on the *Misc* tab (section 3.7.7).

Example



Balance Sheet Columns : Table

Width	Sum Width	Grouping
8	9	ANNUAL

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
Width	Number	Byte	The number of characters in each column of the balance sheet.
Sum Width	Number	Byte	The number of characters in the column labeled *total* at the end of each row. Making this column wider than the other columns separates it visually. Furthermore, it may be necessary to make it wider since it contains larger numbers than the other columns.
Grouping	Text	12	The system for determining how many columns are in each balance-sheet row, where each time step is represented by a column. Choices are ***DAILY***, ***WEEKLY***, ***MONTHLY***, ***QUARTERLY***, ***YEARLY***, or an integer number of time steps. See notes below.

Notes:

***Grouping* field**
This field allows you to choose how many columns are in each balance sheet, where each column represents a simulation time step. You should use this to break the simulation up into groups of time steps that are useful for analysis. For example, it is often useful to examine operating decisions one year at a time. You should also consider how readable the balance sheet will be. For example, a 50-column sheet is very difficult to view, since it probably does not fit on one computer screen or one sheet of paper.

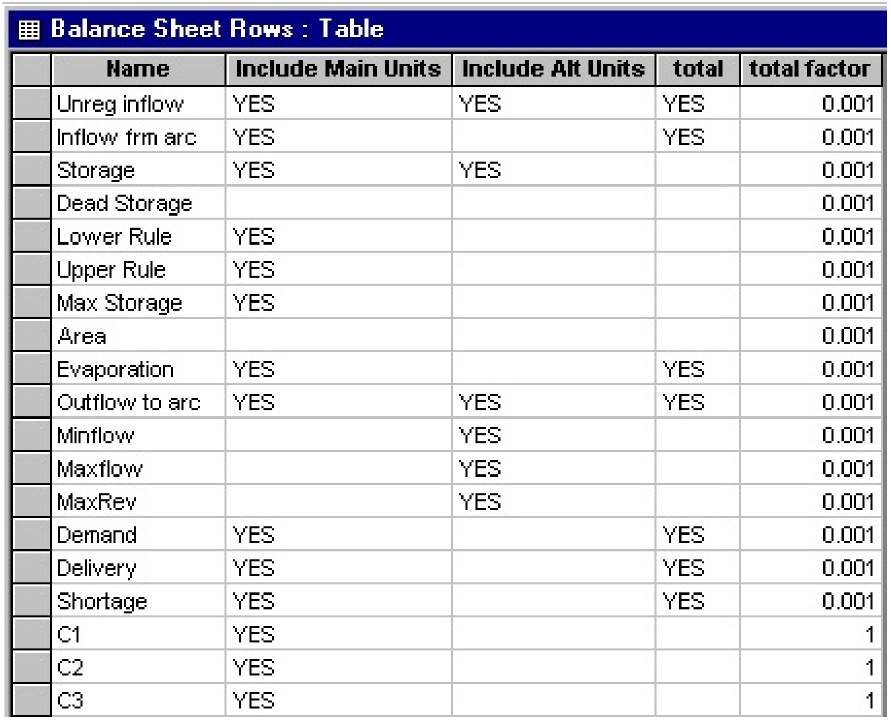
If you enter ***YEARLY***, ***QUARTERLY***, ***MONTHLY***, ***WEEKLY***, or ***DAILY***, then OASIS prints a balance sheet every time the simulation comes to the end of a year, quarter (a three-month interval), month, week, or day, respectively. If you enter an integer number in this field, OASIS writes a balance sheet every time that number of time steps have been simulated. OASIS will not print more than 75 columns in a balance sheet.

O. Table *Balance Sheet Rows*

Tells OASIS what types of variables to include in the balance sheet output (section 5.2.0). Including a variable means that rows for that variable type are printed wherever applicable. For example, including *shortage* means that shortage is printed for every demand node. Most variable types can be measured in two different ways, and this table allows you to tell OASIS to print one or both ways. There are 19 records (rows) in this table, and their identities are fixed. If this table is omitted, the balance sheet is written with default form. The example shows input that is equivalent to the default settings.

The OASIS GUI links to this table through a control on the *Misc* tab (section 3.7.7).

Example



Balance Sheet Rows : Table

Name	Include Main Units	Include Alt Units	total	total factor
Unreg inflow	YES	YES	YES	0.001
Inflow frm arc	YES		YES	0.001
Storage	YES	YES		0.001
Dead Storage				0.001
Lower Rule	YES			0.001
Upper Rule	YES			0.001
Max Storage	YES			0.001
Area				0.001
Evaporation	YES		YES	0.001
Outflow to arc	YES	YES	YES	0.001
Minflow		YES		0.001
Maxflow		YES		0.001
MaxRev		YES		0.001
Demand	YES		YES	0.001
Delivery	YES		YES	0.001
Shortage	YES		YES	0.001
C1	YES			1
C2	YES			1
C3	YES			1

The fields of this table are:

Field Name	Type	Size	Description
Name	Text	16	Do not edit this field. It identifies the fixed records for your convenience. OASIS does not read this field.
Include Main Units	Text	3	Tells OASIS whether to include the variable in the balance sheet measured in the main units. See the summary of the fixed records in this table (below) to find out what the main units are for each of the variables. Enter ***YES*** to include the variable. Enter ***NO*** or leave blank to omit the variable.
Include Alt Units	Text	3	Tells OASIS whether to include the variable in the balance sheet measured in the alternate units. See the summary of the fixed records to find out what the alternate units are for each of the variables. Enter ***YES*** to include the variable. Enter ***NO*** or leave blank to omit the variable.
total	Text	3	Tells OASIS whether to write a value in the *total* column at the end of the balance sheet row for the variable. See notes below.
total factor	Number	Single	The value in the *total* column is multiplied by this factor.

The fixed records of this table are:

Unreg inflow. The inflow to the node from outside the system. See section 2.4.0 part E.
Main units: primary volume units. **Alt units:** primary flow units.

Inflow frm arc. The flow from an arc into the node.
Main units: primary volume units. **Alt units:** primary flow units.

Storage. The storage at a reservoir node. See section 2.1.1 part B.
Main units: primary volume units. **Alt units:** primary elevation units.

Dead Storage. The dead storage level at a reservoir node. See section 2.4.0 part H.
Main units: primary volume units. **Alt units:** primary elevation units.

Lower Rule. The lower rule curve level at a reservoir node. See section 2.4.0 part H.
Main units: primary volume units. **Alt units:** primary elevation units.

Upper Rule. The upper rule curve level at a reservoir node. See section 2.4.0 part H.
Main units: primary volume units. **Alt units:** primary elevation units.

Max Storage. The max storage level at a reservoir node. See section 2.4.0 part H.
Main units: primary volume units. **Alt units:** primary elevation units.

Area. The surface area at a reservoir node. See section 2.4.0 part F.
Main units: primary area units. **Alt units:** none.

Evaporation. The evaporation at a reservoir node. See section 2.4.0 part G.
Main units: primary volume units. **Alt units:** primary flow units.

Outflow to Arc. The flow from the node into an arc.
Main units: primary volume units. **Alt units:** primary flow units.

Minflow. The minimum (target) flow from the node into an arc. See section 2.4.0 part B.
Main units: primary volume units. **Alt units:** primary flow units.

Maxflow. The maximum flow from the node into an arc. See section 2.4.0 part A.
Main units: primary volume units. **Alt units:** primary flow units.

MaxRev. The maximum reverse flow from the node into an arc. See section 2.4.0 part C.
Main units: primary volume units. **Alt units:** primary flow units.

Demand. The demand at a demand node. See section 2.4.0 part D.
Main units: primary volume units. **Alt units:** primary flow units.

Delivery. The delivery at a demand node. See section 2.4.0 part D.
Main units: primary volume units. **Alt units:** primary flow units.

Shortage. The shortage at a demand node. See section 2.4.0 part D.
Main units: primary volume units. **Alt units:** primary flow units.

C*x*. The concentration of water quality constituent number *x*. See section 2.10.0.
Main units: primary units for constituent number *x*. **Alt units:** none.

See section 2.9.0 for an explanation of units of measurement in OASIS.

Notes:

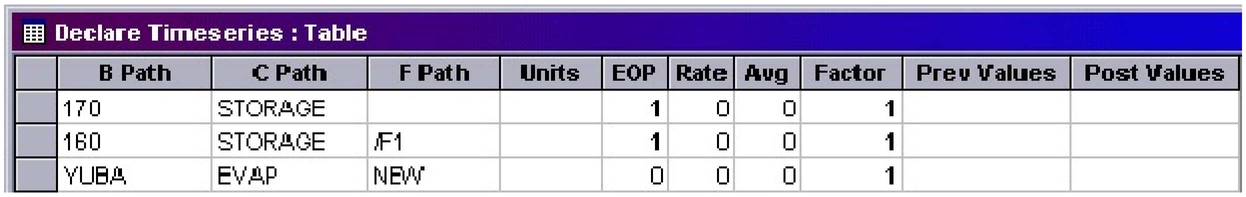
***Total* field**
The *total* column contains either the sum over all the columns of the balance sheet, or the average over all the columns. Rows where the variable is measured in primary volume units have a sum, while rows where the variable is measured in other units have an average. If ***YES*** is entered in this field, then the rows with both main units and alternate units will have a value in the *total* column. If ***NO***, then neither main-units or alternate-units rows will have a value in the *total* column.

P. Table *Declare Timeseries*

Contains information for special labeling and conversion for DSS time-series records (section 4.6.0). You do not need to enter records that do not need special treatment. If a record is not declared in this table, OASIS applies the standard assumptions to it. The table can be omitted entirely if no DSS records need special treatment.

The OASIS GUI links to this table through a control on the *Misc* tab (section 3.7.7).

Example


Declare Timeseries : Table

B Path	C Path	F Path	Units	EOP	Rate	Avg	Factor	Prev Values	Post Values
170	STORAGE			1	0	0	1		
160	STORAGE	/F1		1	0	0	1		
YUBA	EVAP	NEW		0	0	0	1		

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
B Path	Text	32	The B-part of the DSS pathname.
C Path	Text	32	The C-part of the DSS pathname.
F Path	Text	32	The F-part of the DSS pathname. If this field is left blank, then OASIS ignores the F-part of the DSS pathname when searching for the record. If this field contains the text */F1*, then OASIS applies the F-part from the command line option *F1* (section 4.1.0) to this record. Any other non-blank entry becomes the literal F-part of the pathname.
Units	Text	9	Leave this field blank. We have not finished this feature yet.
EOP	Number	Byte	Only applies to OCL *timesers* variables. Enter a ***1*** for the end-of-period method. Enter ***0*** to turn off the end-of-period method. See notes below.
Rate	Number	Byte	Only applies to OCL *timesers* variables. Enter a ***1*** if the data in the record is a flow rate that must be converted to volume per period. Otherwise, enter ***0***. See notes below.
Avg	Number	Byte	Only applies to OCL *timesers* variables. Enter a ***1*** if the data in the record should be averaged over the simulation time steps. Otherwise, enter ***0***. See notes below.

Field Name	Type	Size	Description
Factor	Number	Single	A factor that is multiplied by every data point in the record.
Prev Values	Text	10	Leave this field blank. We have not finished this feature yet.
Post Values	Text	10	Leave this field blank. We have not finished this feature yet.

Notes:

Flag fields: *EOP*, *Rate*, and *Avg*
These fields only apply to OCL *timesers* variables (section 4.7.4). For other types of variables, these fields are ignored. Only one of these three fields should have a value of *1* — the others should be zero. If more than one of the fields has a value of *1*, then the *EOP* field will override all others, and the *Rate* flag will override the *Avg* field. *If none of the fields have a value of 1*, then OASIS will assume that the values in the record have been integrated over each time span (see section 4.5.1).

***EOP* field**
If *1* is entered, the end-of-period method will be used. This means OASIS first interpolates between the input points, and then the value for each simulation period is computed as the value at the end of the period. See section 4.5.1 for more on time-pattern conventions.

***Rate* field**
If *1* is entered, OASIS will assume that the values are entered as flow rates, in units of *X* per day, and it will internally convert the pattern into volume per simulation period in units of *X*. See section 4.5.1 for more on time-pattern conventions.

***Avg* field**
If *1* is entered, OASIS will average the input data to derive the values for the simulation time steps.

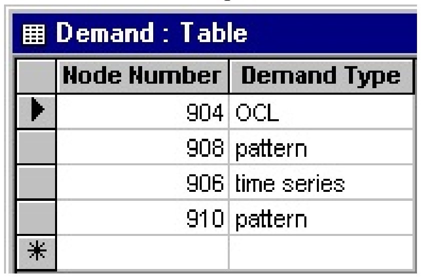
4.5.4 DEMAND DATABASE FILE

The demand file may be omitted entirely if there are no demand nodes.

A. Table *Demand*

Used to identify the sources of the demand input data for all of the demand nodes (section 2.4.0 part D). There must be a record in this table for every demand node in the system. If there are no demand nodes, then this table may be omitted entirely. The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

Example



Demand : Table

Node Number	Demand Type
904	OCL
908	pattern
906	time series
910	pattern
*	

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the demand node
Demand Type	Text	9	The source of input data for the demand at the demand node. Choices are **TIME SERIES**, **OCL**, or **PATTERN**. See note below.

Notes:

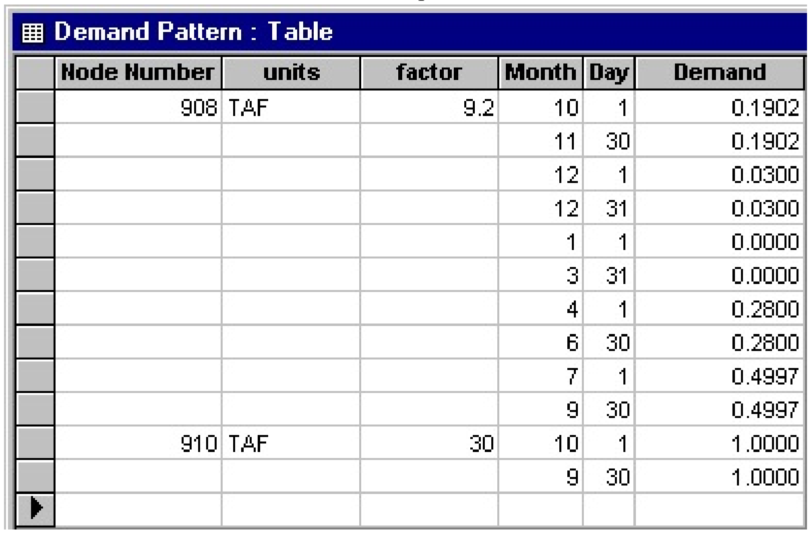
***Demand Type* field**
If **TIME SERIES**, then a record must be found in the **demand** time-series database (section 4.6.3 part A). If **PATTERN**, then a set of records should be entered into the *Demand Pattern* table (section 4.5.4 part B). If **PATTERN**, and a set of records is not entered into the *Demand Pattern* table, then demand at this node is zero. If **OCL**, then the *demand* variable must be set with the OCL *set* command (section 2.5.1 part C).

B. Table *Demand Pattern*

Provides pattern input for demand values (section 2.4.0 part D) at demand nodes. This table contains a set of records for every demand node with pattern demand input, as identified in the *Demand* table (section 4.5.4 part A). If no demand nodes have pattern demand input, then the table can be omitted entirely. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Demand Pattern : Table

Node Number	units	factor	Month	Day	Demand
908	TAF	9.2	10	1	0.1902
			11	30	0.1902
			12	1	0.0300
			12	31	0.0300
			1	1	0.0000
			3	31	0.0000
			4	1	0.2800
			6	30	0.2800
			7	1	0.4997
			9	30	0.4997
910	TAF	30	10	1	1.0000
			9	30	1.0000

The fields of this table are:

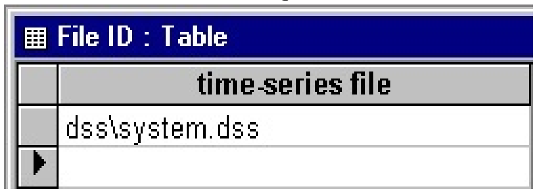
Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the demand node.
Units	Text	9	The units in which the demand is measured. Must be volume, big volume, or flow units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values will be assumed to be in **primary big volume units** (section 2.9.0).
factor	Number	Single	A factor that OASIS will multiply by every value in the pattern. OASIS only reads this field in the first record of each block.
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Demand	Number	Single	The value of demand at the point in time. See section 4.5.1 for conventions on interpolation of the pattern.

C. Table *File ID*

Contains the name of the time-series file (section 4.6.3) that supplements the demand database. This table has only one record. The table is always required. If there are no demand input variables to be retrieved from a time-series file, then the entry in this table is irrelevant. It is legal to name a file that is also named in the OCL file with the *:TIMEDB:* command, or named in one of the *File ID* tables of the other static databases.

The OASIS GUI provides an interface to this table when you click on *Time Series Data* in the *Edit* menu (section 3.6.2 part A).

Example


File ID : Table

time-series file
dss\system.dss

The fields of this table are:

Field Name	Type	Size	Description
time-series file	text	64	The name of the time-series file. The name may include path information, absolute or relative to the run directory.

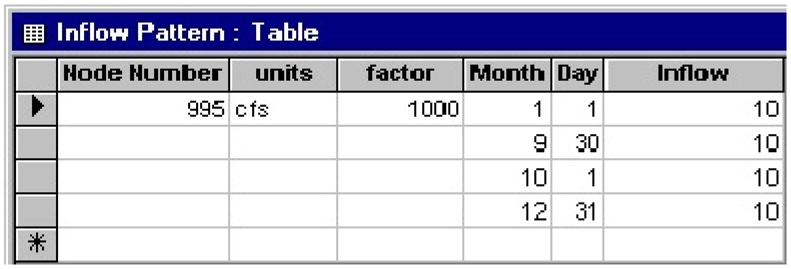
4.5.5 INFLOW DATABASE FILE

A. Table *Inflow Pattern*

Provides pattern input for inflow to nodes (section 2.4.0 part E). This table should contain a set of records for every node with pattern inflow input, as identified in the *Node* table (section 4.5.3 part B). If no nodes have pattern inflow input, then the table can be omitted entirely. If a node is flagged for pattern inflow input, but there is no entry for that node in this table, then the inflow to the node is zero. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Inflow Pattern : Table

Node Number	units	factor	Month	Day	Inflow
995	cfs	1000	1	1	10
			9	30	10
			10	1	10
			12	31	10

The fields of this table are:

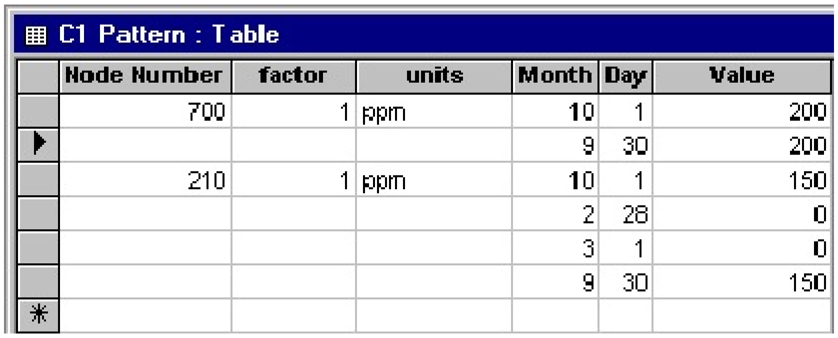
Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the node.
Units	Text	9	The units in which the inflow is measured. Must be volume, big volume, or flow units. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values are assumed to be in **primary flow units** (section 2.9.0).
factor	Number	Single	A factor that OASIS will multiply by every value in the pattern. OASIS only reads this field in the first record of each block.
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Inflow	Number	Single	The value of inflow at the point in time. See section 4.5.1 for conventions on interpolation of the pattern.

B. Tables *C1 Pattern*, *C2 Pattern*, etc.

Table *Cx Pattern* provides pattern input for water quality constituent *x* at nodes (There is no standard input for water quality pattern input at arcs). For discussion of water quality, see 2.10.0. This table should contain a set of records for every node with pattern input for water quality constituent *x*, as identified in the *Node* table (section 4.5.3 part B). If no nodes have pattern input for constituent *x*, then the table can be omitted entirely. If a node is flagged for pattern input for constituent *x*, but there is no entry for that node in this table, then the input for constituent *x* for the node is zero. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

This table is not interfaced through the OASIS GUI.

Example



Node Number	factor	units	Month	Day	Value
700	1	ppm	10	1	200
			9	30	200
210	1	ppm	10	1	150
			2	28	0
			3	1	0
			9	30	150

The fields of this table are:

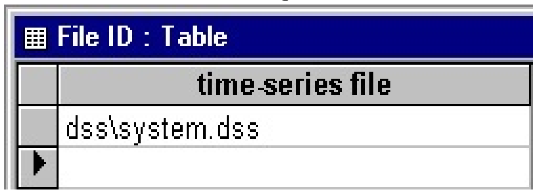
Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the node.
Units	Text	9	The units in which the input is measured. Must be units defined for this constituent in the *Concentration* table. If the type of boundary condition in the *Node* table is ***treat***, then the entry in this field is irrelevant. The units are the same for every value of the block, and OASIS only reads this field in the first record of each block. If this field is omitted, then all values are assumed to be in **primary units** (section 2.9.0) for this constituent.
factor	Number	Single	A factor that OASIS will multiply by every value in the pattern. OASIS only reads this field in the first record of each block.
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
Value	Number	Single	The value of the water quality input at the point in time. See section 4.5.1 for conventions on interpolation of the pattern. The value of the variable for a simulation period is the value **on the last day of the period**.

C. Table *File ID*

Contains the name of the time-series file (section 4.6.4) that supplements the inflow database. This table has only one record. The table is always required. If there are no inflow input variables to be retrieved from a time-series file, then the entry in this table is irrelevant. It is legal to name a file that is also named in the OCL file with the *:TIMEDB:* command, or named in one of the *File ID* tables of the other static databases.

The OASIS GUI provides an interface to this table when you click on *Time Series Data* in the *Edit* menu (section 3.6.2 part A).

Example


File ID : Table

time-series file
dss\system.dss

The fields of this table are:

Field Name	Type	Size	Description
time-series file	text	64	The name of the time-series file. The name may include path information, absolute or relative to the run directory.

4.5.6 INITIAL CONDITIONS DATABASE FILE

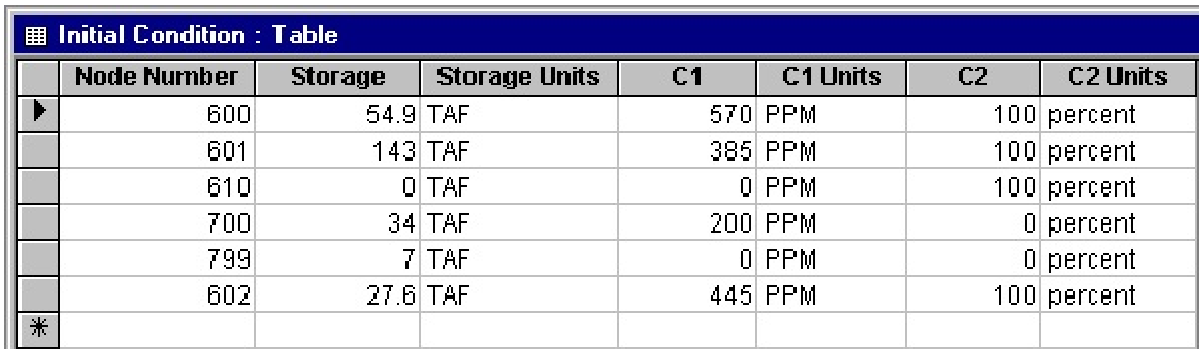
The initial condition file contains only one table. The file may be omitted entirely if there are no reservoir nodes.

A. Table *Initial Condition*

Provides initial values of storage and water quality at reservoir nodes. This table must contain a record for every reservoir node. If there are no reservoir nodes, then the table can be omitted entirely. The fields *C*x and *C*x *Units* are only used if water quality constituent *x* is entered in the *Concentration* table (section 4.5.3 part D), where *x* is the number assigned to the water quality constituent. The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

For discussion of reservoir nodes, see section 2.1.1 part B. For discussion of water quality, see section 2.10.0.

Example



Initial Condition : Table

Node Number	Storage	Storage Units	C1	C1 Units	C2	C2 Units
600	54.9	TAF	570	PPM	100	percent
601	143	TAF	385	PPM	100	percent
610	0	TAF	0	PPM	100	percent
700	34	TAF	200	PPM	0	percent
799	7	TAF	0	PPM	0	percent
602	27.6	TAF	445	PPM	100	percent

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node.
Storage	Number	Single	The storage at the node at the beginning of the first period of simulation.
Storage Units	Text	9	The units in which the initial storage value is measured. Must be volume or big volume units. If this field is omitted, then all values are assumed to be in **primary big volume units** (section 2.9.0).
C*x*	Number	Single	The initial concentration of water-quality constituent *x* at the node at the beginning of the first period of simulation. The field is only used if constituent *x* is being modeled.
C*x* Units	Text	9	The units in which the initial concentration of water-quality constituent *x* is measured. Must be units defined for constituent *x* in the table *Concentration* (section 4.5.3 part D). If this field is omitted, then all values are assumed to be in **primary units** for constituent *x*. The field is only used if constituent *x* is being modeled.

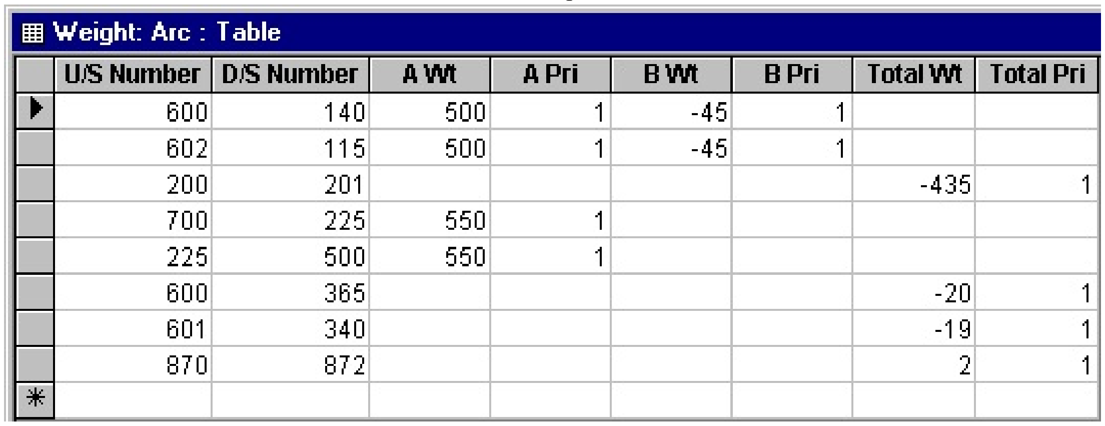
4.5.7 WEIGHTS DATABASE FILE

A. Table *Weight: Arc*

Provides weights (section 2.2.3) to apply to arc-flow decision variables. This table should have a record for every arc that you wish to weight. Arcs that you do not wish to weight do not need a record in this table. Any of the weight values can be positive, negative, or zero. The priority values must be between 1 and 6. You should always enter a weight on the A segment of flow that is larger than the weight on the B segment of flow.

The OASIS GUI links to this table through a control on the *Arc* tab (section 3.7.5).

Example


Weight: Arc : Table

U/S Number	D/S Number	A Wt	A Pri	B Wt	B Pri	Total Wt	Total Pri
600	140	500	1	-45	1		
602	115	500	1	-45	1		
200	201					-435	1
700	225	550	1				
225	500	550	1				
600	365					-20	1
601	340					-19	1
870	872					2	1

The fields of this table are:

Field Name	Type	Size	Description
U/S Number	Number	Integer	The node number at the upstream end of the arc.
D/S Number	Number	Integer	The node number at the downstream end of the arc.
A Wt	Number	Single	The weight to apply to segment A of the flow in this arc. This is the segment of the flow that is below the minimum flow (section 2.4.0 part B). If you do not wish to apply weight to segment A of this arc, this field may be left blank. OASIS ignores the value in this field if there is no minimum flow on this arc, as indicated in the *Arc* table (section 4.5.3 part C).
A Pri	Number	Integer	The priority level at which to enter the weight on segment A of the flow. If there is no weight on segment A, then this field may be left blank.
B Wt	Number	Single	The weight to apply to segment B of the flow in this arc. This is the segment of the flow that is above the minimum flow (section 2.4.0 part B). If you do not wish to apply weight to segment B of this arc, this field may be left blank. OASIS ignores the value in this field if there is no minimum flow on this arc, as indicated in the *Arc* table (section 4.5.3 part C).
B Pri	Number	Integer	The priority level at which to enter the weight on segment B of the flow. If there is no weight on segment B, then this field may be left blank.

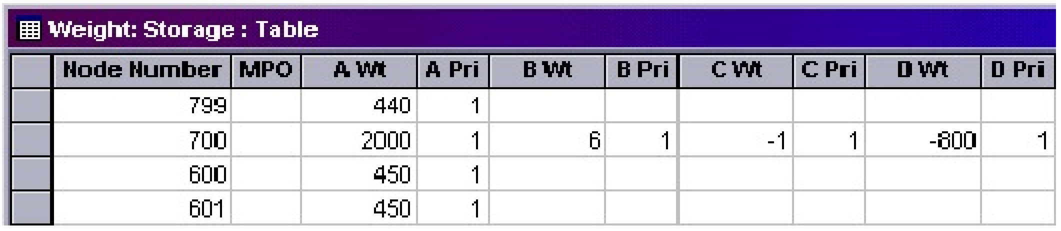
Field Name	Type	Size	Description
Total Wt	Number	Single	The weight to apply to the total flow in the arc. If you do not wish to apply weight to the total flow in this arc, this field may be left blank.
Total Pri	Number	Integer	The priority level at which to enter the weight. If there is no weight on total flow, then this field may be left blank.

B. Table *Weight: Storage*

Provides weights (section 2.2.3) to apply to reservoir-storage decision variables. This table should have a record for every reservoir that you wish to weight. Reservoirs that you do not wish to weight do not need a record in this table. Any of the weight values can be positive, negative, or zero. The priority values must be between 1 and 6. You should always enter a the weights so that the largest (most positive) is on zone A, then zone B, then zone C, and the smallest on zone D. See section 2.4.0 part H for a discussion of reservoir storage zones.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

Example



Weight: Storage : Table

Node Number	MPO	A Wt	A Pri	B Wt	B Pri	C Wt	C Pri	D Wt	D Pri
799		440	1						
700		2000	1	6	1	-1	1	-800	1
600		450	1						
601		450	1						

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node.
MPO	Text	3	Tells OASIS whether the weights will be applied to all MPO steps or only to the last MPO step. If **YES**, then the weights are applied to all MPO steps. If **NO** or blank, then the weight is only applied to the last MPO step. See section 2.2.7 for more about MPO. If you are not doing MPO, then the entry in this field is irrelevant.
A Wt	Number	Single	The weight to apply to zone A of the storage in this reservoir. If you do not wish to apply weight to zone A of this reservoir, this field may be left blank. If this is a single-zone reservoir, then the weight shown in this field is applied to the total storage in the reservoir.
A Pri	Number	Integer	The priority level at which to enter the weight on zone A of the reservoir. If there is no weight on zone A, then this field may be left blank.
B Wt	Number	Single	The weight to apply to zone B of the storage in this reservoir. If you do not wish to apply weight to zone B of this reservoir, this field may be left blank. If this is a single-zone reservoir, OASIS ignores the field.
B Pri	Number	Integer	The priority level at which to enter the weight on zone B of the reservoir. If there is no weight on zone B, then this field may be left blank.

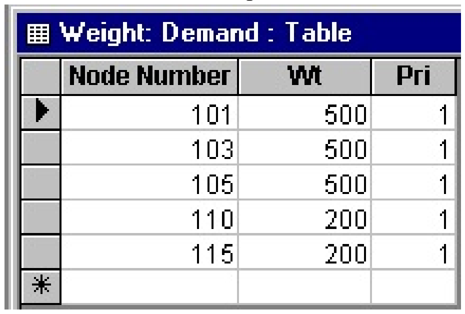
Field Name	Type	Size	Description
C Wt	Number	Single	The weight to apply to zone C of the storage in this reservoir. If you do not wish to apply weight to zone C of this reservoir, this field may be left blank. If this is a single-zone reservoir, OASIS ignores the field.
C Pri	Number	Integer	The priority level at which to enter the weight on zone C of the reservoir. If there is no weight on zone C, then this field may be left blank.
D Wt	Number	Single	The weight to apply to zone D of the storage in this reservoir. If you do not wish to apply weight to zone D of this reservoir, this field may be left blank. If this is a single-zone reservoir, OASIS ignores the field.
D Pri	Number	Integer	The priority level at which to enter the weight on zone D of the reservoir. If there is no weight on zone D, then this field may be left blank.

C. Table *Weight: Demand*

Provides weights (section 2.2.3) to apply to delivery decision variables at demand nodes (section 2.4.0 part D). This table should have a record for every demand node that you wish to weight. Demand nodes that you do not wish to weight do not need a record in this table. Any of the weight values can be positive, negative, or zero. The priority values must be between 1 and 6.

The OASIS GUI links to this table through a control on the *Node* tab (section 3.7.4).

Example



Weight: Demand : Table

Node Number	Wt	Pri
101	500	1
103	500	1
105	500	1
110	200	1
115	200	1

The fields of this table are:

Field Name	Type	Size	Description
Node Number	Number	Integer	The number of the reservoir node.
Wt	Number	Single	The weight to apply to the delivery at this demand node.
Pri	Number	Integer	The priority level at which to enter the weight on the delivery to the demand node. If there is no weight on the delivery, then this field may be left blank.

4.5.8 OCL STATIC DATABASE FILE

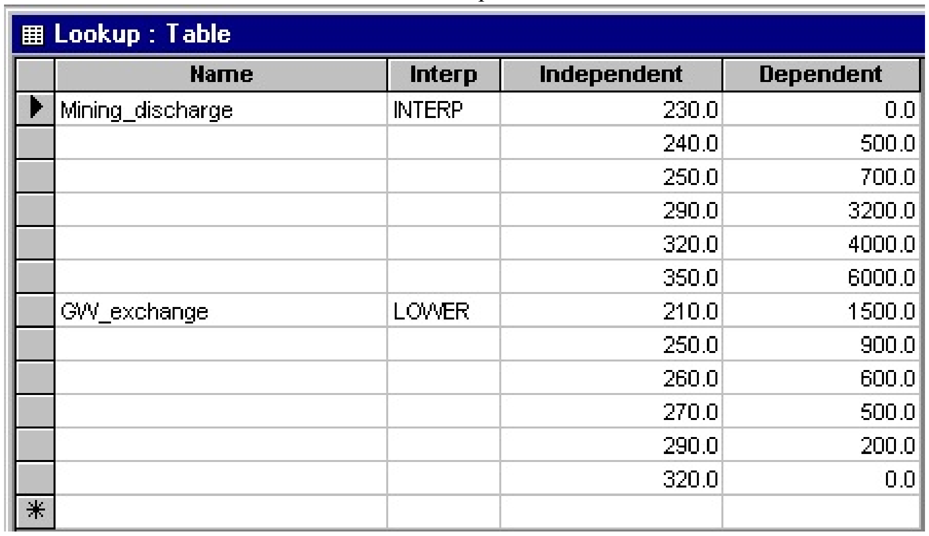
This static database stores supplemental input used by OCL. The name of the file is specified with the *:STATDB:* command (section 4.7.1 part E) in an OCL input file. When using the GUI, the file must be combined with all the other static databases in *statdata.mdb* (section 3.3.7).

A. Table *Lookup*

Provides "tables", "curves", or "functions" that can be referred to with the *Lookup* and *RevLookup* function in OCL. The table gives the value of a dependent variable as a function of an independent variable. Each function must be entered in a contiguous **block**. You may specify whether the function works by linear interpolation, or whether it rounds to the upper or lower breakpoint. See section 4.7.6 part M for more on the *Lookup* function and section 4.7.6 part Q for more on the *RevLookup* function.

The OASIS GUI links to this table through a control on the *OCL* tab (section 3.7.6). It is recommended that you use the *OCL Lookup* dialog box (section 3.8.5) to edit the data in this table.

Example


Lookup : Table

Name	Interp	Independent	Dependent
Mining_discharge	INTERP	230.0	0.0
		240.0	500.0
		250.0	700.0
		290.0	3200.0
		320.0	4000.0
		350.0	6000.0
GW_exchange	LOWER	210.0	1500.0
		250.0	900.0
		260.0	600.0
		270.0	500.0
		290.0	200.0
		320.0	0.0

The fields of this table are:

Field Name	Type	Size	Description
Name	Text	32	The name of the lookup table, which can be used in the OCL *Lookup* function. This record must be identical for every record in the block, or, if you are not using the GUI, it can be left blank in all but the first record. If you are using the GUI, then this field can never be blank.
Interp	Text	7	The method of getting a return value when the input value does not fall on one of the given breakpoints. This record will only be read from the first record of each block. The same method will be used between all breakpoints for a single function. Choices are ***INTERP***, ***UPPER***, or ***LOWER***, See notes below.
Independent	Number	Single	The value of the independent (input) variable at the breakpoint. The values must be ascending throughout the block.

Dependent	Number	Single	The value of the dependent (output) variable for the given value of the independent variable in the same row. If the function is used for the OCL *RevLookup* function, then the values must be either decreasing throughout the block or increasing throughout the block. If the function is not used for the OCL *RevLookup* function, then the dependent values do not have to follow any trend.

Notes:

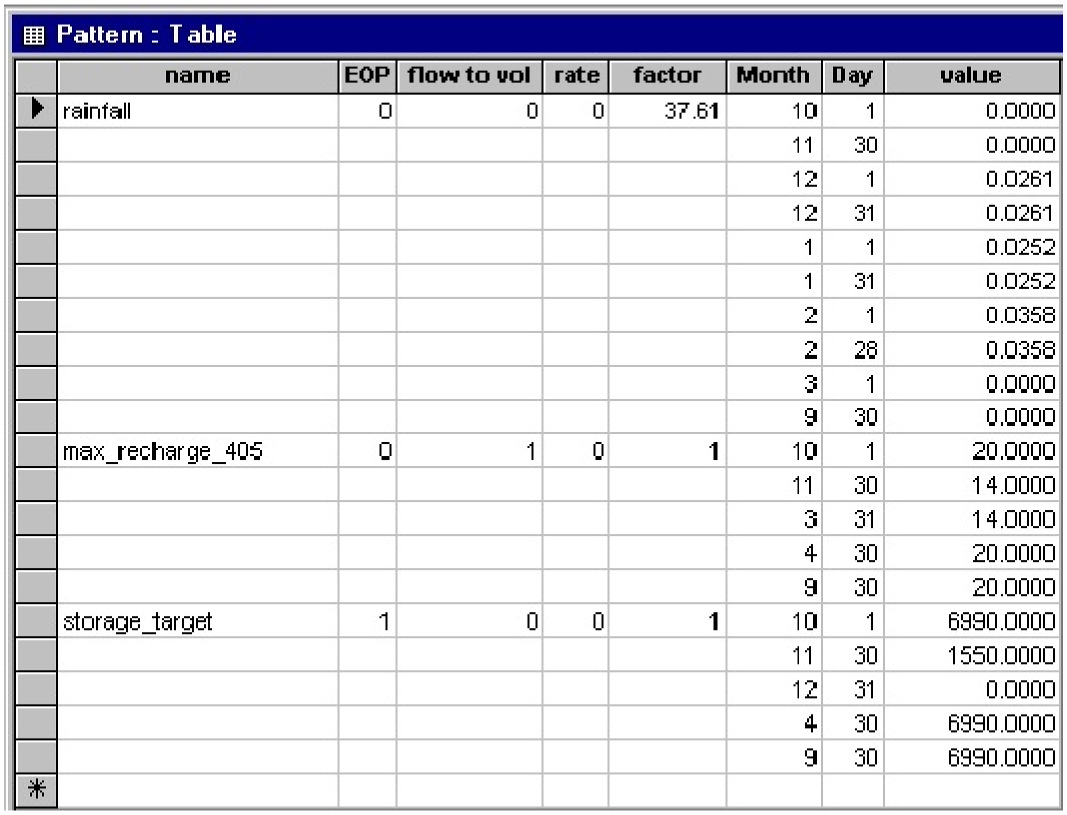
***Interp* field**
If the argument to the OCL *lookup* function is exactly equal to one of the values in the *Independent* field, then the corresponding value from the *Dependent* field will be returned, regardless of the interpolation method. If the argument does not equal one of the values in the *Independent* field, then the return value depends upon the interpolation method entered in the *Interp* field. If **UPPER**, the return value will be the dependent value corresponding to the next highest independent value. If **LOWER**, the return value will be the dependent value corresponding to the next lowest independent value. If **INTERP**, OASIS will linearly interpolate between the next highest and next lowest values to get the return value.

B. Table *Pattern*

Provides time-pattern input data that can be referred to with *pattern* variables in OCL. By setting the values in certain flag fields, you specify what method OASIS should use to derive the period values from the input points. See section 4.7.4 for more on the *pattern* variable. This table follows the conventions for pattern static input. See section 4.5.1 for a discussion of these conventions.

The OASIS GUI links to this table through a control on the *OCL* tab (section 3.7.6). It is recommended that you use the pattern dialog box (section 3.8.3) to edit the data in this table.

Example



Pattern : Table

name	EOP	flow to vol	rate	factor	Month	Day	value
rainfall	0	0	0	37.61	10	1	0.0000
					11	30	0.0000
					12	1	0.0261
					12	31	0.0261
					1	1	0.0252
					1	31	0.0252
					2	1	0.0358
					2	28	0.0358
					3	1	0.0000
					9	30	0.0000
max_recharge_405	0	1	0	1	10	1	20.0000
					11	30	14.0000
					3	31	14.0000
					4	30	20.0000
					9	30	20.0000
storage_target	1	0	0	1	10	1	6990.0000
					11	30	1550.0000
					12	31	0.0000
					4	30	6990.0000
					9	30	6990.0000

The fields of this table are:

Field Name	Type	Size	Description
Name	Text	32	The name of the pattern, which is used to identify the pattern when using the *pattern* variable.
EOP	Number	Byte	Enter a ***1*** for the end-of-period method. Enter ***0*** to turn off the end-of-period method. See notes below.
flow to vol	Number	Byte	Enter a ***1*** if the data in the *value* field is a flow rate that must be converted to volume per period, and it should be converted from primary flow units to primary volume units (section 2.9.0). Otherwise enter ***0***. See notes below.
rate	Number	Byte	Enter a ***1*** if the data in the *value* field is a flow rate that must be converted to volume per period, but no conversion factors should be assumed. Otherwise, enter ***0***. See notes below.
factor	Number	Single	A factor that OASIS will multiply by every value in the pattern.
Month	Number	byte	The month of the point in time. See section 4.5.1.
Day	Number	byte	The day of the month of the point in time. See section 4.5.1.
value	Number	Single	The value of the *pattern* variable at the point in time. See section 4.5.1 for conventions on interpolation of the pattern.

Notes:

Flag fields: *EOP*, *flow to vol*, and *rate*
Only one of these three fields should have a value of *1* — the others should be zero. If more than one of the fields has a value of *1*, then the *EOP* field will override all others, and the *flow to vol* flag will override the *rate* field. *If none of the fields have a value of 1*, then OASIS will assume that the values being entered have been integrated over each time span (see section 4.5.1).

***EOP* field**
If *1* is entered, the end-of-period method will be used. This means OASIS first interpolates between the input points, and then the value for each simulation period is computed as the value at the end of the period. See section 4.5.1 for more on time-pattern conventions.

***Flow to volume* field**
If *1* is entered, OASIS will assume that the values are entered in **primary flow units**, and it will internally convert the pattern into **primary volume units** per simulation period. See section 4.5.1 for more on time-pattern conventions.

***Rate* field**
If *1* is entered, OASIS will assume that the values are entered as flow rates, in units of *X* per day, and it will internally convert the pattern into volume per period in units of *X*. See section 4.5.1 for more on time-pattern conventions. The only difference between this flag and the previous *Flow to volume* flag is that with this flag, no automatic conversion factor is applied. You may apply any factor you like in the *factor* field.

4.5.9 STATIC DATABASE TABLES USED BY THE OASIS GUI

The OASIS GUI reads the single static database file *statdata.mdb* (section 3.3.7). The tables described below are necessary for the OASIS GUI but are not read by *model.exe* or the post-processors.

C. Table *Constants*

Contains substitute values that are automatically written to an OCL file by the GUI. The OASIS GUI links to this table through a control on the *OCL* tab (section 3.7.6). This table is not read by *model.exe* or the post-processor programs.

When a run is saved from the GUI, each record in this table is used to create a substitute value (section 4.7.1 part I). The substitutes are created in a file specified by the *GUI.ini* parameter *_OCLConst_fName* (section 3.3.5). If *_OCLConst_fName* is not entered into *GUI.ini*, then the substitutes are written to the file *constants_inc.ocl* in the subfolder *OCL* of the run folder. In order to take advantage of these substitutes, an *:INCLUDE:* statement (section 4.7.1 part H) for that OCL file must appear somewhere in the main OCL file. The OASIS GUI does not create any *:INCLUDE:* statements for this purpose.

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
Constant_Name	Text	50	The substitute name for the user-defined constant, without the square brackets at the beginning and end of the name.
Constant_Value	Number	Double	The value of the user-defined constant.
Constant_Description	Number	Single	A description of the constant, which is incorporated into an OCL comment (section 4.7.0 part D).

D. Table *zzGUI_Status*

Contains several flags indicating the status of the run.. This table is not read by *model.exe* or the post-processor programs.

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
Lock	Yes/No		If *Yes*, then the GUI prevents any change to model input. See section 3.4.9.
PostExe	Yes/No		The GUI sets this value to *Yes* when the model is executed. The GUI sets this value to *No* when a run is created.
OutputCurrent	Yes/No		The GUI sets this value to indicate whether the model output matches the model input. If *Yes*, then the output is consistent with the input. If *No*, then the output is not consistent with the input. See section 3.9.0.

E. Table *zzGUI_Page*

Contains the parameters defining the virtual page on which the GUI draws the model schematic (section 3.7.1). This table is not read by *model.exe* or the post-processor programs. Most of these parameters are controlled through the *Page Settings* dialog in the GUI interface (section 3.7.1 part A).

The fields of this table are:

Field Name	Type	Size	Description
PgColor	Number	Long Integer	Numeric code for the background color of the virtual page. You should rely on the GUI to select colors.
PgWid **PgHt**	Number	Integer	The width and height of the virtual page, where 1440 units is equivalent to one inch on the printed page.
MargColor	Number	Long Integer	Numeric code for the color of the margin lines that are drawn on the virtual page. You should rely on the GUI to select colors.
MargLf **MargTop** **MargRt** **MargBot**	Number	Integer	The distances of the left, top, right, and bottom margins from the edges of the virtual page, where 1440 units is equivalent to one inch on the printed page.
MargVis	Yes/No		If *Yes* then the margins are indicated by dotted lines on the virtual page. If *No*, then the margins are not shown.
CentX **CentY**	Number	Integer	Coordinates indicating the position of the virtual page in the schematic window. In the GUI interface, these values are determined by scrolling the schematic.
Zoom	Number	Integer	The magnification level of the schematic window.
kbZoom	Number	Integer	The magnification level of the schematic keybar.

F. Table *zzGUI_NodeType*

Contains a list of each node category that is displayed in the GUI schematic. This table is not read by *model.exe* or the post-processor programs. The GUI does not provide an interface for editing this data. The fields of this table are:

Field Name	Type	Size	Description
SubNum	Number	Byte	The number of the node category. These should simply be assigned in order, so that the first record is *1*, the second record is *2*, etc.
Type	Number	Byte	The node type that this category indicates. The values are: **1** Junction **2** Demand **3** Reservoir
Name	Text	30	The name of the node category.

G. Table *zzGUI_ArcType*

Contains a list of each arc category that is displayed in the GUI schematic. This table is not read by *model.exe* or the post-processor programs. The GUI does not provide an interface for editing this data.

The fields of this table are:

Field Name	Type	Size	Description
SubNum	Number	Byte	The number of the arc category. These should simply be assigned in order, so that the first record is *1*, the second record is *2*, etc.
Name	Text	30	The name of the arc category.

H. Table *zzGUI_InflowType*

Contains a list of each inflow category that is displayed in the GUI schematic. This table is not read by *model.exe* or the post-processor programs. The GUI does not provide an interface for editing this data.

The fields of this table are:

Field Name	Type	Size	Description
SubNum	Number	Byte	The number of the inflow category. These should simply be assigned in order, so that the first record is *1*, the second record is *2*, etc.
Name	Text	30	The name of the inflow category.

I. Table *zzGUI_Text*

Contains a description of each text type that is associated with nodes and arcs, and a list of all independent text boxes on the GUI schematic. This table is not read by *model.exe* or the post-processor programs. The descriptions of independent text boxes are edited through the GUI interface, but the text types that are associated with nodes and arcs can not be edited through the GUI interface.

The fields of this table are:

Field Name	Type	Size	Description
obID	Number	Long Integer	The object identification number. The value is not important except that it must be different than the value in all other records.
Category	Number	Byte	A code that indicates what type of text the record describes. **3** Independent text box. The *Index* field is ignored. **5** The text of the node number. The *Index* field is the number of the node category. **7** The text of the node name. The *Index* field is the number of the node category. **8** The text of the arc name. The *Index* field is the number of the arc category.
Index	Number	Integer	The meaning of this field depends on the entry in the *Category* field, as described above.
Text	Text	255	If the *Category* field is *3*, this is the text of the independent text box. Otherwise, this field is ignored.
FontName	Text	40	The font name. Font names are case-sensitive. We recommend that you only use the most common fonts to avoid compatibility issues when sharing files between computers.
Size	Number	Single	The font size.
Bold	Yes/No		If *Yes*, the text is in bold.
Italic	Yes/No		If *Yes*, the text is in Italic.
Under	Yes/No		If *Yes*, the text is underlined.
x **y**	Number	Long Integer	If the *Category* field is *3*, these are the coordinates of the independent text box. Otherwise, this is the distance of the text from the center of the node or arc.
Angle	Number	Single	If the *Category* field is *3* or *5*, this is the rotation angle of the text in degrees counterclockwise from horizontal. Otherwise, this field is ignored.
FontColor	Number	Long Integer	Numeric code for the color of the text

J. Table *zzGUI_Shape*

Contains a description of each shape that is associated with nodes and arcs, and a list of all independent shapes on the GUI schematic. This table is not read by *model.exe* or the post-processor programs. The descriptions of independent shapes are edited through the GUI interface, but the shapes that are associated with nodes and arcs can not be edited through the GUI interface.

The fields of this table are:

Field Name	Type	Size	Description
obID	Number	Long Integer	The object identification number. The value is not important except that it must be different than the value in all other records.
Category	Number	Byte	A code that indicates what type of text the record describes. **3** Independent shape. The *Index* field is ignored. **5** The shape of a node symbol. The *Index* field is the number of the node category. There can be more than one shape for any node symbol. If there is more than one shape for a symbol, the shape that appears first in the table is drawn first, and subsequent shapes are drawn on top of earlier shapes. **9** The shape of an inflow symbol (inflows are represented as arrows that are drawn from this shape to a node symbol). The *Index* field is the number of the inflow category. There can only be one shape per inflow symbol.
Index	Number	Integer	The meaning of this field depends on the entry in the *Category* field, as described above.
Shape	Number	Byte	Numeric code for the shape type: **2** **RECTANGLE** **4** **ELLIPSE** **8** **POLYLINE** **9** **POLYGON**
Ht **Wd**	Number	Integer	The height and width of the shape.
x **y**	Number	Long Integer	If the *Category* field is 3, the x and y position of the shape on the page. If the *Category* field is 5, the offset of the shape from the center of the symbol. Otherwise, this field is ignored.
LineColor	Number	Long Integer	Numeric code for the color of the shape's outline
LineWidth	Number	Single	The width of the shape's outline

LineStyle	Number	Byte	Numeric code for the line style of the shape's outline. **0** **Solid** **1** **Dash** **2** **Dot** **3** **Dash dot** **4** **Dash dot dot** **5** **None**
FillColor	Number	Long Integer	Numeric code for the color of that fills the shape
FillStyle	Number	Byte	Numeric code for the line style of the shape's outline. **0** **Solid** **1** **Transparent** **2** **Horizontal lines** **3** **Vertical lines** **4** **Forward diagonal lines** **5** **Backward diagonal lines** **6** **Crossed lines** **7** **Diagonal crossed lines**
BackColor	Number	Long Integer	The background color of the shape. Only applies if *FillStyle* field is 2-7 and the *BackStyle* field is 1.
BackStyle	Number	Byte	0 if the background is transparent, 1 if the background is opaque. Only applies if *FillStyle* field is 2-7.
numPar	Number	Byte	The number of the *p01...p16* fields to be read. This is the number of points in the polygon or polyline times two. The maximum value is 16. Only applies if the *Shape* field is 8 or 9.
p01 **p02** **...** **p15** **p16**	Number	Integer	The x and y coordinates of the points for a polygon or polyline, where (0,0) is the top left corner of the shape. Only applies if the *Shape* field is 8 or 9. If the value of the *numPar* field is *n*, then the first *n* of these fields are read, and the rest are ignored. The fields with odd-numbered names are the x coordinates, and the fields with even-numbered names are the y coordinates.

K. Table *zzGUI_Link*

Contains a description of each link (links are usually shown as arrows, but they can use other symbols besides arrowheads) that is associated with arcs and inflows. This table is not read by *model.exe* or the post-processor programs. No part of this table can be edited through the GUI interface.

The fields of this table are:

Field Name	Type	Size	Description
obID	Number	Long Integer	The object identification number. The value is not important except that it must be different than the value in all other records.
Category	Number	Byte	A code that indicates what type of symbol the link is used for: **6** The link definition is used for an arc category. The *Index* field is the number of the arc type. **9** The link definition is used for an inflow category. The *Index* field is the number of the inflow type.
Index	Number	Integer	The meaning of this field depends on the entry in the *Category* field, as described above.
LkSty_str **LkSty_end**	Number	Byte	Numeric code for the style of the start (*str*) or end of the link: **0** **None** **1** **Rectangle** **2** **Diamond** **3** **Octagon** **4** **Ellipse** **5** **Open Arrow** **6** **Stealth Arrow** **7** **Fill Arrow**
LkWid_str **LkWid_end**	Number	Single	Width of the symbol at the start (*str*) or end of the link.
LkLen_str **LkLen_end**	Number	Single	Length of the symbol at the start (*str*) or end of the link.
LineWid	Number	Single	The width of the line
LineSty	Number	Byte	Numeric code for the line style. **0** **Solid** **1** **Dash** **2** **Dot** **3** **Dash dot** **4** **Dash dot dot** **5** **None**
Color	Number	Long Integer	Numeric code for the color of the line and outline of the link

FillColor	Number	Long Integer	Numeric code for the color that fills the shape at the start and/or end of the link
LkFlags_str **LkFlags_end**	Number	Byte	These fields contain flags for setting optional features of the start (*str*) or end of the link. The value for this field is created by **adding** the following values. **Contact** — Add 2 if the link start or end should just touch the edge of the node symbol. Add 0 if the link start or end should overlap the node symbol. **Filled** — Add 4 if the link start or end should be filled. Add 0 if the symbol should not be filled. **Inverted** — Add 8 if the link start or end should have an inverted arrowhead. Add 0 for normal arrowhead.

L. Table *zzGUI_Image*

Contains a description of each image from an image file that appears on the schematic. This includes independent (floating) images, and no more than one background image. This table is not read by *model.exe* or the post-processor programs. The image information is edited through the GUI interface.

The fields of this table are:

Field Name	Type	Size	Description
obID	Number	Long Integer	The object identification number. The value is not important except that it must be different than the value in all other records.
Category	Number	Byte	A code that indicates what type of image the record describes. **3** Independent image. The *Index* field is ignored. **10** Background image. There can be only one background image. The *Index* field is ignored.
Index	Number	Integer	The meaning of this field depends on the entry in the *Category* field, as described above.
File	Text	200	The path and file name of image file. The path can be absolute or relative to either the home folder or the run folder, as determined by the *RelHome* and *RelRun* fields.
RelHome	Yes/No		*Yes* if the path of the image file is given in a form relative to the OASIS home folder.
RelRun	Yes/No		*Yes* if the path of the image file is given in a form relative to the OASIS run folder.
Ht **Wd**	Number	Integer	The height and width of the image on the schematic.
x **y**	Number	Long Integer	The x and y coordinates of the center of the image on the schematic.

M. Table *zzGUI_ZOrder*

Records the *Z-order* of every object on the schematic. The Z-Order is a complete list of which object appear in front of other objects. This table is not read by *model.exe* or the post-processor programs. This information is edited through the GUI interface by selecting *Move to Front* or *Move to Back* on specific objects. There should be no reason to edit this information outside the GUI.

The fields of this table are:

Field Name	Type	Size	Description
Category	Number	Byte	The value in this field is always 11 for objects on the schematic.
Index	Number	Integer	The value in this field is always 0 for objects on the schematic.
Order	Number	Integer	The Z-order of the object, where higher numbers are for objects that are in front of objects with lower numbers.
ObTyp	Number	Byte	A code that indicates what type of symbol the link is used for: **1** Node Symbol **2** Arc Symbol **3** Inflow Symbol **4** Node Name **5** Arc Name **6** Shape **7** Text **8** Image
obID	Number	Integer	The number that identifies this object from others of its type.
obID2	Number	Integer	The second number that identifies this object from others of its type.

4.6.0 TIME-SERIES DATABASES

The time-series database files are all in HEC-DSS format, also referred to simply as DSS. DSS is a database system that is specially designed to store time-series data, and it is a standard for many in the water-resources engineering field. DSS files can be viewed and edited using DSS-utility programs that are freely distributed by HEC, the U.S. Army Corps of Engineers Hydrologic Engineering Center. HydroLogics can supply copies of DSS utilities and their user manuals. The software can all be acquired from the HEC website: http://www.hec.usace.army.mil.

There are three classes of software for editing HEC-DSS data:

> **MS-DOS Utilities**
> These utilities have an outdated text-command interface. The functionality of the MS-DOS utilities for HEC-DSS are superseded by HecDssVue and the Excel plugin, although it is still convenient to use the MS-DOS utilities for specialized applications. The programs in the package that HydroLogics has found most useful are DSSUTL, DSSTS, and DSSITS. DSSTS and DSSITS can be used to transfer data from a command prompt or from an ASCII text file to DSS format. DSSTS is for regular-interval data and DSSITS is for irregular-interval data. DSSUTL can do many useful tasks, including viewing, editing, or deleting DSS data, copying it from one DSS file to another, or writing it to ASCII text. Refer to the HEC-DSS user manual for more information.
>
> **HecDssVue**
> HecDssVue is a graphical, Java-based utility program for HEC-DSS. HecDssVue proves very useful for viewing and organizing the time-series data. However, it lacks any way of importing data into HEC-DSS. For that, we recommend the Excel plugin. Refer to the HecDssVue user manual for more information about HecDssVue.
>
> **MS Excel Data Exchange Add-in**
> This utility is used to export regular-interval time-series data from an Excel File into a HEC-DSS file. The utility also makes it possible to import data from HEC-DSS to Excel, although for that purpose we find it easier just to copy the data from HecDssVue to the Windows clipboard, and paste it into Excel. Refer to the user manual of the Excel add-in for more info.

An OASIS run is associated with three time-series database files that are treated as supplements of the static database files (section 4.5.0). For example, the **demand** file contains a table called *File ID*, which contains the name of a time-series file. This time-series file can store time-series demand values. The **system** and **inflow** databases may also be supplemented by time-series files named in a *File ID* table. If you combine static databases which refer to time-series databases, then the supplemental time-series databases are automatically combined. For example, if you combine the system file and the inflow file, then the combined database only contains one *File ID* table. The time-series file that it names is the combined system- and inflow-time-series file.

When using the OASIS GUI, all three of the time-series databases that supplement the static data are combined into a single file. You can specify this file by clicking on *Time Series Data* in the *Edit* menu (section 3.6.2 part A).

OCL input may also be supplemented by time-series databases. You may name several time-series database files with the *:TIMEDB:* command (section 4.7.1 part F). It is legal to use the same file to supplement the static database information and to supplement OCL — just name the same time-series database file for both. See section 4.6.5 for more about OCL time-series databases. The OASIS GUI does not provide a direct interface for specifying these files – they must be edited in the OCL files themselves.

4.6.1 CONVENTIONS IN TIME-SERIES DATABASES

You should refer to the HEC-DSS user manual for a complete discussion of how DSS works. Here we discuss the conventions that OASIS uses when reading and writing DSS data.

> **Year scheme**
> Unlike OASIS, DSS will not label the year component of a date on any special year schemes. See section 2.8.5 for explanation of the year scheme. All DSS data is labeled on a January-December year. For example, suppose that

you are simulating with an October-September year scheme--the water year. In DSS, you will find October of water year 1922 under the label *October 1921*. OASIS knows how to read the DSS data and translate it into the year scheme that you are using.

Units of measurement
OASIS reads the *units* field in a DSS record, and it converts to the proper units if it can. The documentation of each of the time-series records below tell what units are recognized.

Time steps
OASIS no longer requires that the time-series input use the same time-step scheme as the simulation (versions previous to OASIS 3.0 did require this). Furthermore, OASIS can handle "irregular" DSS time steps. For example, if you are simulating at a monthly time step, it is perfectly legal to have OASIS read DSS data from a time series at a daily time step, and another time series at an irregular time step of once every three months. When OASIS reads these time-series records, it converts the data to the time step of simulation. The methods of redistributing the input data to the simulation time steps is the same as for pattern input data (see section 4.5.1 for conventions).

DSS pathnames
Every record in a DSS database has a ***pathname***. The pathname has six *parts*, labeled *A*, *B*, *C*, *D*, *E*, and *F*. Each pathname part contains a particular type of identifying information about the record.

When creating DSS data for OASIS, you must adhere to the naming rules that OASIS follows. The rules for each pathname part are:

A	OASIS ignores the A-part. You can use whatever is useful for you in the A-part.
B	Location information for the record. Usually the node or arc number, depending upon the data type. See sections 4.6.2 through 4.6.5 for details.
C	The type of data, such as *DEMAND* or *INFLOW*. See sections 4.6.2 through 4.6.5 for details.
D	The date. DSS programs automatically assign this part of the pathname and ignore your attempts to modify it.
E	The time-step length (*1MON* , *1WEEK*, or *1DAY*). HEC's DSS utility programs apply certain conventions to the time-step length (see the DSS manuals).
F	If you have entered a value in the *F Path* field of the *Declare Timeseries* table (section 4.5.3 part P) for a given record, then the F-part must match the entry in the table. If you did not enter a value into the *F Path* field, then OASIS ignores the F-part.

DSS automatically breaks a time-series up into **data blocks**, each covering a separate time interval. If you look at the catalog of a database with DSSUTL, you will generally see many records which have identical pathnames except for the D-part. For OASIS' purposes, *these all constitute one record*.

The D- and E-parts are dictated by DSS programs. OASIS always ignores the A-part. Thus, you are left B- and C-parts, and sometimes the F-part, to identify the record. When OASIS searches the DSS database for a particular record, it selects the first record in the catalog which exactly matches the B- and C-parts of the pathname. If an F-part has been specified, then the selected record must match the F-part as well. If there are multiple records which match OASIS' search criteria (for example, two records with identical pathnames except for the A-part) then OASIS selects the first one in the catalog. You cannot predict which one this will be, so *do not put multiple records into the database if they will both match the pathname parts that OASIS looks for.* If you must keep different copies of a record in a single database, give them different F-parts, and specify the F-part in the *Declare Timeseries* table (section 4.5.3 part P).

4.6.2 SYSTEM TIME-SERIES FILE

The name and path of the system time-series file is given in the *File ID* table of the system database (section 4.5.3 part M). This file may be the same file as the demand, inflow, or OCL time-series files. The following data may be found in the system time-series file:

Minimum flow (target) (C-part: *MIN_FLOW*)

Maximum flow (C-part: *MAX_FLOW*)

Maximum reverse flow (C-part: *MAXREV_FLOW*)

Reservoir evaporation rate (C-part: *EVAP*)

Reservoir upper rule curves (C-part: *UPPER_RULE*)

Reservoir lower rule curves (C-part: *LOWER_RULE*)

A. Time-series minimum flow

See section 4.6.1 for general conventions on time-series input.

B part	*`[bbb].[eee]`*
C part	**`MIN_FLOW`**
Description	The minimum flow target in the arc that goes from *[bbb]* to *[eee]*.
Conditions for use	Enter *TIME SERIES* in the *Min Flow* field in the *Arc* table (section 4.5.3 part C) for arc *[bbb].[eee]*.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/111.245/MIN_FLOW/01JAN1990/1WEEK//`

B. Time-series maximum flow

See section 4.6.1 for general conventions on time-series input.

B part	*`[bbb].[eee]`*
C part	**`MAX_FLOW`**
Description	The maximum flow in the arc that goes from *[bbb]* to *[eee]*.
Conditions for use	Enter *TIME SERIES* in the *Max Flow* field in the *Arc* table (section 4.5.3 part C) for arc *[bbb].[eee]*.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/196.005/MAX_FLOW/01JAN1990/1DAY//`

C. Time-series maximum reverse flow

See section 4.6.1 for general conventions on time-series input.

B part	`[bbb].[eee]`
C part	**`MAXREV_FLOW`**
Description	The maximum reverse flow in the arc that goes from *[bbb]* to *[eee]*.
Conditions for use	Enter *TIME SERIES* in the *MaxRev Flow* field in the *Arc* table (section 4.5.3 part C) for arc *[bbb].[eee]*.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/196.205/MAXREV_FLOW/01JAN1990/1MON//`

D. Time-series reservoir evaporation rate

See section 4.6.1 for general conventions on time-series input.

B part	`[nnn]`
C part	**`EVAP`**
Description	The evaporation rate at reservoir node *[nnn]*.
Conditions for use	Enter *TIME SERIES* in the *Evaporation Type* field in the *Evaporation* table (section 4.5.3 part K) for node *[nnn]*.
Units	OASIS converts into primary evaporation units per period. May be entered in **evaporation** or **elevation** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/746/EVAP/01JAN2010/1WEEK//`

E. Time-series reservoir upper-rule curve

See section 4.6.1 for general conventions on time-series input.

B part	`[nnn]`
C part	**`UPPER_RULE`**
Description	The upper rule at reservoir node *[nnn]*.
Conditions for use	Enter *TIME SERIES* in the *Upper Rule* field in the *Reservoir* table (section 4.5.3 part H) for node *[nnn]*.
Units	OASIS converts into primary volume units. May be entered in **volume**, **big volume**, **elevation**, or **evaporation** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/746/UPPER_RULE/01JAN2012/1DAY//`

F. Time-series reservoir lower-rule curve

See section 4.6.1 for general conventions on time-series input.

B part	*[nnn]*
C part	**LOWER_RULE**
Description	The lower rule at reservoir node *[nnn]*.
Conditions for use	Enter *TIME SERIES* in the *Lower Rule* field in the *Reservoir* table (section 4.5.3 part H) for node *[nnn]*.
Units	OASIS converts into primary volume units. May be entered in **volume**, **big volume**, **elevation**, or **evaporation** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	/A_PATH/746/LOWER_RULE/01JAN2010/1MON//

4.6.3 DEMAND TIME-SERIES FILE

The name and path of the demand time-series file is given in the *File ID* table of the demand database (section 4.5.4 part C). This file may be the same file as the system, inflow, or OCL time-series files. Only one type of data is found in the demand time-series file:

A. Time-series demand

See section 4.6.1 for general conventions on time-series input.

B part	*[nnn]*
C part	**DEMAND**
Description	The demand at demand node *[nnn]*.
Conditions for use	Enter *TIME SERIES* in the *Demand Type* field in the *Demand* table (section 4.5.4 part A) for node *[nnn]*.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	/A_PATH/830/DEMAND/01JAN1987/1DAY//

4.6.4 INFLOW TIME-SERIES FILE

The name and path of the system time-series file is given in the *File ID* table of the system database (section 4.5.5 part C). This file may be the same file as the system, demand, or OCL time-series files. The following data may be found in the inflow time-series file:

Inflow to a node (C-part: *INFLOW*)

Concentration input at a node (C-part: [name]_*INPUT*)

Concentration input at an arc (C-part: [name]_*INPUT*)

A. Time-series inflow

See section 4.6.1 for general conventions on time-series input.

B part	*[nnn]*
C part	**INFLOW**
Description	The inflow to node *[nnn]* from outside the system.
Conditions for use	Enter *TIME SERIES* in the *Inflow* field in the *Node* table (section 4.5.3 part B) for node *[nnn]*.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	/A_PATH/084/INFLOW/01JAN1990/1MON//

B. Time-series concentration input at a node

See section 4.6.1 for general conventions on time-series input.

B part	*[nnn]*
C part	*[name]*__INPUT__
Description	The concentration input at node *[nnn]* for the water quality constituent *[name]*.
Conditions for use	Water quality constituent *[name]* must be entered into the *Concentration* table (section 4.5.3 part D). Enter *TIME SERIES* in the *C*x*_input* field in the *Node* table for node *[nnn]* (section 4.5.3 part B), where *x* is the number of water quality constituent *[name]*.
Units	OASIS converts into primary units for water quality constituent *[name]*. May be entered in any recognized units for water quality constituent *[name]* (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	/A_PATH/084/TDS_INPUT/01JAN1995/1DAY//

C. Time-series concentration input at an arc

See section 4.6.1 for general conventions on time-series input.

B part	*[bbb]*.*[eee]*
C part	*[name]***_INPUT**
Description	The concentration input at the arc that goes from node *[bbb]* to node *[eee]* for the water quality constituent *[name]*.
Conditions for use	Water quality constituent *[name]* must be entered into the *Concentration* table (section 4.5.3 part D). Enter *TIME SERIES* in the *C*x*_input* field in the *Arc* table for arc *[bbb].[eee]* (section 4.5.3 part C), where *x* is the number of water quality constituent *[name]*.
Units	OASIS converts into primary units for water quality constituent *[name]*. May be entered in any recognized units for water quality constituent *[name]* (section 2.9.0). *Check that the label in the* Units *field is correct.*
Example Pathname	`/A_PATH/084.977/TDS_INPUT/01JAN1930/1WEEK//`

4.6.5 OCL TIME-SERIES FILE

The name and path of an OCL time-series file is given with the *:TIMEDB:* command in the OCL input file (section 4.7.1 part F). A single model run may use up to ten OCL time-series files. Any of the OCL time-series files may be the same file as the system, demand, or inflow time-series files. The only data that OASIS takes from the OCL time-series file are the OCL *timesers* variables (section 4.7.4). When OASIS reads the OCL time-series files, it searches for the *timesers* variables in each OCL time-series file in the order that the *:TIMEDB:* commands were entered. Once it finds a variable, it stops searching for that variable. Thus, if you enter variables with identical pathnames into different OCL time-series files, OASIS will use the first one it finds.

A. OCL time-series input

See section 4.6.1 for general conventions on time-series input.

B part	*[B part]*
C part	*[C part]*
Description	A time-series input variable referred to in OCL as **timesers(***[B part]/[C part]***)** (see section 4.7.4).
Conditions for use	None.
Units	OASIS converts into primary volume units per period. May be entered in **volume**, **big volume**, or **flow** units (section 2.9.0). *Check that the label in the* Units *field is correct.* For this variable, you may wish to enter *NONE* or a unit name that is not recognized, so that no conversion is performed. Elevation, surface area, and evaporation units are not recognized, so no conversion is performed on them. However, for values measured in any type of units, you may specify non-standard conversion methods using the *EOP*, *Rate*, and *Avg*, fields in the *Declare Timeseries* table (section 4.5.3 part P).

Example Pathnames	The variables with these pathnames
	`/A_PATH/830/TARGET_STORAGE/01JAN1987/1WEEK//`
	`/A_PATH//YEAR_TYPE/01JAN1987/1MON//`
	`/A_PATH/EAA/PUMP_DEMAND/01JAN1987/1DAY/RANDOM-F/`
	would be referred to in OCL with these names:
	timesers(830/TARGET_STORAGE)
	timesers(/YEAR_TYPE)
	timesers(EAA/PUMP_DEMAND)

4.7.0 OPERATIONS CONTROL LANGUAGE (OCL)

See section 2.5.0 for an introduction to OCL. The OCL input is entered into an ASCII text file, named in the control file (section 4.4.0). Although a *single* OCL file is named in the control file, this file may link to many more files through the OCL *:INCLUDE:* meta command (section 4.7.1 part H). OCL conventions are also used in the Onevar input file (section 6.1.3).

This section introduces five basic concepts of OCL:

A. General OCL syntax, including words and whitespace.
B. Quotation marks.
C. Square brackets and substitute names.
D. Comment markers.
E. Simulation commands.
F. Meta Commands.
G. Sections of the OCL file

A. General OCL syntax

Many OCL syntax forms are given in the following sections. In the syntax forms, text in **bold** must appear in the OCL input file exactly as shown. Italic text in *[brackets]* describes what you would place in that position. For example, the form:

:SUBSTITUTE: [*[name]***] =** *[replacement text]*

Is a generalized form for this example:

```
:SUBSTITUTE: [SHASTA] = 004
```

where *[replacement text]* = "004" and *[name]* = "Shasta".

OASIS reads the text of the OCL input as a series of **words**, which can be variable names, command names, numbers, mathematical symbols, or special keywords. In versions of OASIS previous to version 3.4.0, it was mandatory that every word had to be separated from other words by **whitespace**. That is no longer the case. You can use whitespace to separate words as you choose, but it is not mandatory.

Whitespace can take the form of **one or more** space characters, tab characters, or carriage-returns. There are some words, such as variable names, that may contain several pieces of modifying information, "suffixes", that cannot be separated by whitespace. In the following example of an OCL expression, notice how spaces, multiple spaces, and carriage-returns are all legally used as whitespace.

```
pattern(fish_minimum) +    flow320.180(-1) +flow320.180(-2)
   -   timesers(LAKE/FORCAST_INFLOW)
```

In the above example, we see two plus signs and a minus sign. Each is a distinct word in the expression. Then there are four OCL variables:

```
pattern(fish_minimum)
flow320.180(-1)
flow320.180(-2)
timesers(LAKE/FORCAST_INFLOW)
```

Each is a complete word that cannot be broken apart by whitespace. For example, in the first variable, the name *fish_minimum* is an identifier for the *pattern* variable. The syntax of the *pattern* variable specifies that the name of the pattern must be attached to the word *pattern*, within parentheses. If you had inserted whitespace, such as this:

```
pattern (fish_minimum)
```

then OASIS would not be able to read the name of the pattern, and it would report an error.

There are no requirements for aligning the input in columns or rows. OCL is *never* sensitive to **upper-case** or **lower-case**.

When **node numbers** are given in OCL, they must always be in **three-digit** form. For example, node 94 must be given as *094*.

B. Quotation marks

Quotation marks can be used to enter text absolutely literally. When text is in quotes, OASIS does not recognize comment markers (section 4.7.0 part D), substitute names (section 4.7.1 part I), or whitespace (section 4.7.0 part A). If a word begins with a quotation mark, then the next quotation mark OASIS finds is the end of the word (and the word cannot end any other way). If a word does not begin with a quotation mark, OASIS considers the word to have ended if it finds a quotation mark. Thus, there is no way that a word can be partly inside quotes and partly outside of quotes.

The quotation marks themselves are never stored as part of the word.

Quotation marks are primarily useful for entering a substitution text (section 4.7.1 part I) or a file path that contains whitespace. You can also use them to apply characters that would otherwise trigger an OCL-input error. For example, in the syntax for a *:FOR:* keyword, the list of replacement texts is separated by commas. If you want to define a replacement text that contains a comma, you will have to put quotes around that particular text.

C. Square brackets and substitute names

Substitute names (section 4.7.1 part I) are text codes that stand in for something else. OASIS internally converts a substitute name into a *replacement text* as it reads it. The convention of OCL is that square brackets are used to enclose a substitute name, so whenever OASIS finds square brackets, it must determine whether a substitution must be applied. Therefore, OASIS insists all square brackets appear in matching pairs, even if they are not part of a defined substitute name. OASIS generates an OCL error message if it cannot find a match for a square bracket. This rule is suspended inside quotation marks (section 4.7.0 part B) and in the Onevar title text (section 6.1.9 part A). Naturally, it is also ignored inside of comment markers (section 4.7.0 part D).

D. Comment markers

You can insert as much description as you desire through the use of comment markers. Comment markers can be inserted anywhere in the OCL input file, and they do not interfere with the flow of syntax outside the markers. OASIS ignores text that is marked as being in a comment, so that text does not have to follow any OCL syntax rules, including rules about the use of quotation marks or square brackets. A comment can be of any length and there is no limit to the number of times that comment markers can be used.

There are two types of comment markers:

Block comment markers: The characters **/*** mark the beginning of a block comment, and ***/** marks the end of the block comment. Once the program encounters the start-of-comment marker (/*), it ignores all text until it encounters an end-of-comment marker (*/) (except for new comment markers). Thus, every start-of-comment marker must be paired to one end-of-comment marker and vice-versa. The block comment may span multiple lines, or it may occupy only part of a line. Block comments can be nested inside of other block comments. A block comment can contain a line comment. However, *a block comment can not begin or end inside of a line comment.*

Line comment markers: The characters // mark the beginning of a line comment, and the comment includes all text until the end of the line. Thus, this kind of comment can not span multiple lines. A block comment can contain line comments. However, *a block comment can not begin or end inside of a line comment.*

For example, these lines will be completely ignored:

```
/* pattern(fish_minimum) + flow320.180(-1) +    flow320.180(-2)
   /*-   timesers(LAKE/FORCAST_INFLOW)*/
*/
```

OASIS will treat this line:

```
pattern(fish_minimum) /* + flow320.180(-1) */  + flow320.180(-2)
```

Or this set of lines:

```
     pattern(fish_minimum)
// + flow320.180(-1)
   + flow320.180(-2)
```

exactly the same as this line:

```
pattern(fish_minimum) + flow320.180(-2)
```

E. Simulation commands

Simulation commands are the heart of OCL. They are instructions that are directly incorporated into the simulation, and they include **OCL expressions** that are evaluated during simulation. Section 4.7.2 documents each of the simulation commands, and section 4.7.3 documents the syntax of OCL expressions. Two of the simulation commands appear in the **udef section** of the OCL file. They are:

> ***Udef***, (section 4.7.2 part B) for declaring a user-defined variable (a udef).
>
> ***Segment,*** (section 4.7.2 part C) declares several decision variables udefs which automatically act as segments of another decision variable.

The other simulation commands appear in the **command section** of the OCL file. They are:

> ***Set***, (section 4.7.2 part F) which assigns a value to a non-decision variable.
>
> ***Constraint,*** (section 4.7.2 part D) which enters a user-defined constraint into the LP.
>
> ***Target***, (section 4.7.2 part E) which enters a user-defined goal into the LP. The generalized goal is to make a target expression equal to a target value.
>
> ***Minimax***, (section 4.7.2 part H) which enters a user-defined goal into the LP. The generalized goal is to make two or more quantities equal to each other as closely as possible.
>
> ***Run_module*** (section 4.7.2 part G) tells OASIS to pass control to an external program and exchange data with the program. This allows OASIS to run in parallel with other models.
>
> ***Solve***, (section 4.7.2 part I) which tells OASIS to solve the LP routing problem.
>
> ***Cancel***, (section 4.7.2 part J) which tells OASIS to discard the LP results of a *solve* command.

During simulation, the commands of the command section are evaluated in the order that they are entered into the OCL file. Just before the LP routing problem is solved, the commands in the udef section are evaluated in the order they are entered into the OCL file. Thus, in general, the commands of the command section are evaluated before the commands in the udef section.

F. Meta commands

Meta commands are used for instructions that are *not* entered directly into the simulation. They *do not* contain expressions that are evaluated during simulation. Rather, they fill roles that the simulation commands cannot, including:

> demarcating sections of the file.
> declaring resources (databases and external modules) that will be used by OCL simulation commands.
> issuing directives to OASIS as it reads the OCL text.

See section 4.7.1 for the syntax and usage of each meta-command.

See section 4.7.0 part G for a description of the major sections of the OCL file. Meta commands for demarcating sections of the file:

> **:UDEF:**
> **:COMMANDS:**
> **:END:**
> **:ITERATE:**

Meta commands for declaring resources:

> **:STATDB:**
> **:TIMEDB:**
> **:MODULE:**

Meta commands for issuing directives to OASIS about how to read OCL:

> **:INCLUDE:**
> **:SUBSTITUTE:**
> **:FOR: :NEXT:**
> **:IF: :ELSEIF: :ELSE: :ENDIF:**

G. Sections of the OCL file

The OCL file has three major sections. Each section contains different kinds of input. The sections are:

> **External resources section.** The first section precedes the *:UDEF:* and *:COMMANDS:* keywords. It is used to declare external modules and supplemental databases, using the *:MODULE:*, *:STATDB:*, and *:TIMEDB:* meta-keywords. If there are no external resources to declare, then this section can be left empty.
>
> **Udef section.** The second section comes after the *:UDEF:* keyword. It is used to declare user-defined variables with the *udef* and *segment* commands (section 4.7.0 part E). If there are no user-defined variables to declare, then this section can be left empty. You may also omit it entirely by omitting the *:UDEF:* keyword.
>
> **Command section.** The third section follows the *:COMMANDS:* keyword. It contains simulation commands that will be evaluated during simulation. Section 4.7.0 part E contains a list of the simulation commands that can be used in this section. This section ends when the *:END:* keyword is found. You may leave this section empty, but the *:COMMANDS:* and *:END:* keywords are always required.

See section 4.7.1 for documentation of the meta-keywords that demarcate these sections.

4.7.1 SYNTAX OF OCL META COMMANDS

A. :UDEF:

Syntax form (see section 4.7.0 part A for conventions):

```
:UDEF:
```

Demarcates the beginning of the **udef section** of the OCL file, and the end of the section that preceded. It cannot appear before *:COMMANDS:*. It may be omitted if there are no udefs being declared. The udef section ends when *:COMMANDS:* is encountered. See section 4.7.0 part G for a discussion of the sections of the OCL file.

B. :COMMANDS:

Syntax form (see section 4.7.0 part A for conventions):

```
:COMMANDS:
```

Demarcates the beginning of the **command section** of the OCL file, and the end of the section that preceded. Must appear exactly once in every OCL input file. See section 4.7.0 part G for a discussion of the sections of the OCL file.

C. :END:

Syntax form (see section 4.7.0 part A for conventions):

```
:END:
```

Demarcates the end of the **command section** of the OCL file, and therefore the end of the file. Any text that follows the word *:END:* is ignored. Must appear exactly once in every OCL input file. See section 4.7.0 part G for a discussion of the sections of the OCL file.

D. :ITERATE:

Syntax form (see section 4.7.0 part A for conventions):

```
:ITERATE:
```

Marks the point where OASIS will begin re-evaluating simulation commands when it iterates from a ***solve*** command. Pairs of *:ITERATE:* markers and *solve* commands can be nested inside each other. See section 4.7.2 part I for information about the *solve* command. This keyword can only appear in the commands section of the OCL file (section 4.7.0 part G).

E. :STATDB:

Syntax form (see section 4.7.0 part A for conventions):

```
      :STATDB: [file name of database]
```
or
```
      :STATIC: [file name of database]
```

Used to declare a Microsoft Access database (section 4.5.8) containing time-pattern variables or lookup tables to be used by OCL. If *[file name of database]* is given with relative path, then Onevar locates the file relative to the run directory. This command can appear only once in the OCL file. It can only appear in the section of the OCL file for declaring external resources (section 4.7.0 part G). Although *:STATDB:* is preferred, it is possible to write *:STATIC:* for backward compatibility.

F. :TIMEDB:

Syntax form (see section 4.7.0 part A for conventions):

```
      :TIMEDB: [file name of database]
```
or
```
      :TIME: [file name of database]
```

Used to declare an HEC-DSS database file (section 4.6.5) containing time-series variables to be used by OCL. If *[file name of database]* is given with relative path, then Onevar locates the file relative to the run directory. This keyword can only appear in the section of the OCL file for declaring external resources (section 4.7.0 part G). Although *:TIMEDB:* is preferred, it is possible to write *:TIME:* for backward compatibility.

You may use this meta-command up to ten times in order to use data from ten different database files. Note that OASIS searches for time-series records in each of these databases *in the order you list them* with the *:TIMEDB:* meta-commands. Once it finds the records, it stops searching.

G. :MODULE:

Syntax form (see section 4.7.0 part A for conventions):

```
      :MODULE: [type] [module name] = [file name of module]
                  InitParam [Initialization Text]
```

Tells OASIS to initialize an **external module** contained in *[file name of module]*. See section 4.7.7 for more information about external modules. This module is identified in the *run_module* commands with the given *[module name]*. *[Module name]* is a unique string of your choice. The file name can be absolute or relative to the OASIS executable. OASIS does not initialize the module if there is no *run_module* command in the commands section which applies the module (see section 4.7.2 part G for more about the *run_module* command).

The parameter *[type]* tells OASIS what protocol type (section 4.7.7 part B) to use for communicating with the module. If *[type]* is ***DLL***, then the module is initialized as a dynamic link library (DLL). No other *[type]* is currently available.

The parameter *InitParam* is optional. *[Initialization Text]* can only appear after *InitParam*. *[Initialization Text]* is a string of text that is passed to the external module when it is initialized. The text is processed only by the module, and the meaning of the text is specific to the module. If *[Initialization Text]* contains whitespace, then it should be enclosed in quotes.

This keyword can only appear in the section of the OCL file for declaring external resources (section 4.7.0 part G).

H. :INCLUDE:

Syntax form (see section 4.7.0 part A for conventions):

```
      :INCLUDE: [file name]
```

When this keyword is encountered, OASIS behaves as if the complete text of the file given by *[file name]* was inserted at that point. *[File name]* must be given *relative to the run directory*. The included file must contain nothing but legal OCL input. Included files may include other files.

This command may appear in any section of the OCL file. It can not appear in the middle of another command. Furthermore, no file may end in the middle of a command, even if you try to continue the command in another file.

I. :SUBSTITUTE:

Syntax form (see section 4.7.0 part A for conventions):

```
    :SUBSTITUTE: [[name]] = [replacement text]
```

Defines a **substitute** that is used in subsequent OCL input. The **substitute name**, *[name]*, must be a continuous string (no whitespace) enclosed in square brackets. There must be an equal sign, followed by the *[replacement text]*. You may place quotes (section 4.7.0 part B) around *[replacement text]* in order to define a text that has whitespace. The quotes are not considered a part of *[replacement text]*. *[Replacement text]* cannot be more than 1000 characters in length.

This command may appear in any section of the OCL file. It can not appear in the middle of another command. Any substitute name can be re-defined with another instance of the *:substitute:* keyword.

Once the substitute has been defined, if OASIS encounters the *[name]*, in brackets, it replaces *[name]* and brackets with *[replacement text]* before it interprets the input. For example, if this substitute has been defined:

```
     :SUBSTITUTE: [Shasta] = "004"
```

and OASIS subsequently finds an occurrence of

```
    storage[shasta](-1)
```

it internally converts the word to

```
    storage004(-1)
```

before interpreting. Note that the internal conversion is reflected in error messages and other output.

Any substitute name can be reassigned to a new substitute text in a second instance of the *:SUBSTITUTE:* command.

Within OCL there are **pre-defined substitutes** that you can use without having given the *:SUBSTITUTE:* command. Although you can change these substitutes by using the *:SUBSTITUTE:* command, it is not recommended. The following substitutes are recognized by the OASIS model and the post-processors:

[Unit_Vol]	The name of the primary volume units, as given in the *Units* table (section 4.5.3 part A).
[Unit_Flow]	The name of the primary flow-rate units, as given in the *Units* table (section 4.5.3 part A).
[Unit_Elev]	The name of the primary elevation units, as given in the *Units* table (section 4.5.3 part A).
[RunDir]	The full absolute path of the run directory (section 2.3.1).
[HomeDir]	The full absolute path of the home directory (section 3.3.2).
[SameDir]	The full absolute path of the folder containing the file that the substitute appears in. This is intended for use in *:INCLUDE:* statements (section 4.7.1 part H), so that an OCL file can easily include a file that is in the same folder.

The following pre-defined substitutes are only recognized by the post-processors.

[RunPart]	The run directory, expressed as only the last folder name in the path (section 2.3.1).
[RunTime]	The time at which the model run was executed, which the model automatically recorded in the *Runtime* table (section 4.5.2 part G).
[RunDesc]	The one-line run description which can be entered in the control file (section 4.4.0).
[InFile]	The full absolute path of the Onevar input file (section 6.1.3). If you are running the plot program, then this refers to the Onevar input file identified in the *FileID* table of the plot-definition file (section 6.2.2).
[OutFile]	The full absolute path of the Onevar output file (section 6.1.4).
[OutTime]	The time at which the post-processor was executed.
[PlotFile]	The full absolute path of the plot-definition file (section 6.2.3).
[Version]	The version number of the OASIS executable, expressed in three parts delimited with dot characters (e.g. 3.3.06).
[VersionDash]	The version number of the OASIS EXECUTABLE, expressed in three parts delimited with dash characters (e.g. 3-3-06).

J. :FOR: :NEXT:

Syntax form (see section 4.7.0 part A for conventions):

```
        :FOR:
                    {   [[name1]] = {  [n1v1]  ,  [n1v2]  ,  ...  }
                        [[name2]] = {  [n2v1]  ,  [n2v2]  ,  ...  }
                                ...  }
                [OCL commands]
        :NEXT:
```

The *:FOR:-:NEXT:* pair of meta-keywords allows the same block of text to be read multiple times, or **iterations**. Everything between *:FOR:* and *:NEXT:* forms a **loop**. For every iteration of the loop, the block of **substitute names** that are associated with *:FOR:* will be redefined with new **replacement texts**. These substitutions follow the same conventions as with the *:SUBSTITUTE:* meta-command (section 4.7.1 part I).

:FOR: is followed by a pair of curly braces which enclose a list of substitutes whose scope is limited to this particular *:FOR:* loop. Each substitute name (*[name1]*, *[name2]*, ...) is enclosed in square brackets, just as with the *:SUBSTITUTE:* command. Each name is followed by an equal sign, then a pair of curly braces that enclose the list of replacement texts for that substitute (*[n1v1]*, *[n1v2]*, ...). Each replacement text is separated by a comma. You may put quotes (section 4.7.0 part B) around any of the replacement texts in order to include whitespace, commas, or curly braces in the text. Otherwise, OASIS interprets whitespace, commas, or curly braces to indicate the end of the replacement text.

The substitute names in a *:FOR:* loop may *not* match any names that have already been defined by the *:substitute:* command.

Each substitute must have the same number of replacement texts as the other substitutes. Each replacement text of that substitute is associated with an iteration of the loop.

When OASIS encounters *:NEXT:*, it redefines the substitutes and reads the loop again, starting at the end of the *:FOR:* statement. If there are no more iterations, the *:NEXT:* instead causes the substitutes to be purged from memory. Every *:FOR:* must have a matching *:NEXT:* and vice-versa.

This command may appear in any section of the OCL file. It can not appear in the middle of another command. You can put loops in included files, and you can put *:INCLUDE:* statements (section 4.7.1 part H) in loops. However OASIS will not allow you to place a *:FOR:* in a different file than its matching *:NEXT:*

Example:

```
        :FOR: {   [arc] =   { [reach1], [reach2], [reach3] }
                  [flow] = {    "32.4",    "56.8",      29.4 }
              }
              Set : max_flow[arc]    { value : [flow] }
        :NEXT:
```

is equivalent input to:

```
              Set : max_flow[reach1]    { value : 32.4 }
              Set : max_flow[reach2]    { value : 56.8 }
              Set : max_flow[reach3]    { value : 29.4 }
```

K. :IF: :ELSEIF: :ELSE: :ENDIF:

Syntax form (see section 4.7.0 part A for conventions):

```
       :IF: { [special expression] }
              [OCL commands]
       :ELSEIF: { [special expression] }
              [OCL commands]
       :ELSE:
              [OCL commands]
       :ENDIF:
```

This group of meta-commands defines *:IF:* **blocks** for conditional parsing. *:IF:* and *:ENDIF:* are always required in a block. *:ELSEIF:* is optional, and may appear any number of times. *:ELSE:* is optional and may only appear once. Unlike the other meta-commands, these may appear in the middle of another command.

If *[special expression]* is true, the *[OCL commands]* that immediately follow are read as input, and *[OCL commands]* that follow subsequent *:ELSEIF:* and *:ELSE:* statements are ignored until *:ENDIF:* is encountered. If the *[special expression]* is not true, then OASIS skips all *[OCL commands]* until the next *:IF:*, *:ELSEIF:*, *:ELSE:*, or *:ENDIF:*. The *[OCL commands]* following an *:ELSE:* are only read as input if none of the preceding special expressions were true. As OASIS skips over text, it still honors comment markers (section 4.7.0 part D), so be careful not to comment out the *:ELSE:* OR *:ENDIF:*.

The *[special expression]* must not be confused with the general OCL expressions used in the simulation commands (which are described in section 4.7.3). It expresses a true-or-false statement about the existence of an item in the model input, or about the identity of substitution text. Special expressions that test the existence of model items must fit the form:

```
       [item name] = [category name]
or     [item name] != [category name]
```

The equal sign creates a special expression that is true if the item does exist as a member of the category. The not-equal sign creates a special expression that is true if the item does not exist as a member of the category. There are certain categories of model components that can be checked for existence. Their category names are:

NODE	*[Item name]* is a three-digit node number. The expression is true if that node number is found in the *Node* table (section 4.5.3 part B).
JUNCTION	*[Item name]* is a three-digit node number. The expression is true if that node number is in the *Node* table (section 4.5.3 part B) as type *Junction*.
RESERVOIR	*[Item name]* is a three-digit node number. The expression is true if that node number is in the *Node* table (section 4.5.3 part B) as type *Reservoir*.
DEMAND	*[Item name]* is a three-digit node number. The expression is true if that node number is in the *Node* table (section 4.5.3 part B) as type *Demand*.
ARC	*[Item name]* is the beginning node number of an arc, followed by a period and the ending node number of an arc. The expression is true if that arc number is found in the *Arc* table (section 4.5.3 part C).
SUBSTITUTE	*[Item name]* is a substitute name, including the square brackets. The expression is true if the substitute name has been declared with the *:SUBSTITUTE:* meta-command (section 4.7.1 part I).
UDEF	*[Item name]* is a udef name. The expression is true if the udef name has been declared with the *UDEF* command (section 4.7.2 part B).
WQ	*[Item name]* is the name of a water quality constituent. The expression is true if the constituent name is found in the *Concentration* table (section 4.5.3 part D).

You may enter an expression that only consists of a single word. If you do this, OASIS checks whether the word is a substitute name, in which case the expression is true. You may also compare text strings with substitutes. The syntax of such an expression is

```
       [word 1] = [word 2]
or     [word 1] != [word 2]
```

In this case, OASIS replaces all substitutes in each of the two words, then checks whether the resulting text strings are equal.

Examples:

```
       :IF: { ARC = 230.120 }
          :IF:     { 230 = RESERVOIR }
             Udef : Stor_Wdrawl_230
          :ELSEIF: { 230 = DEMAND }
             Udef : Percent_deliv_230
          :ENDIF:
       :ENDIF:
```

If arc 230.120 does not exist, then no udef is defined by the above example. If it does, and node 230 is a reservoir, then the udef *Stor_Wdrawl_230* will be defined. If the arc exists, and node 230 is a demand node, then the udef *Percent_deliv_230* will be defined. If node 230 is neither reservoir nor demand, then the example does not define any udef.

```
:SUBSTITUTE: [xyz] = “CHATANOOGA”

:IF: { [xyz] }
      SET : demand333 { value : 2500 }
:ENDIF:

:IF: { [xyz] = KNOXVILLE }
      SET : demand333 { value : 0 }
:ELSE:
      SET : demand333 { value : demand333 * 2 }
:ENDIF:

:IF:     { [xyz] = CHATANOOGA }
      SET : demand398 { value : 220 }
:ElseIf: { [xyz] = CHATANOOGA }
      SET : demand398 { value : 990 }
:ElseIf: { [xyz] }
      SET : demand398 { value : 970 }
:Else:
      SET : demand398 { value : 950 }
:ENDIF:
```

The result of the above example is to set the value of *demand333* to 5000, and *demand398* to 220.

4.7.2 SYNTAX OF OCL SIMULATION COMMANDS

A. Conditions

Several of the OCL simulation commands can be *conditional*. That is, the command may include several **condition expressions**. OASIS evaluates the condition expressions as true or false, and certain parameters of the command depend upon which of its condition expressions is true. See section 4.7.3 for details about OCL expressions. The parameter fields which depend upon a condition expression form a **condition block**.

You do *not* need to formulate the conditions so that only one is true. OASIS simply evaluates the conditions in the order that they appear, and the first one that evaluates to true is chosen. The parameters in the chosen condition block are the ones that are applied for the time step. This process is repeated every time step of simulation.

You can write ***default*** for the condition expression. *Default* stands for a condition expression that is always true. You should put a default condition last in the series of condition blocks. Note that OASIS will continue to read conditions that follow a default condition, but those conditions would never be evaluated during simulation.

Most of the time, you write condition expressions that contain at least one **relational operator** (< = >), and possibly some **logical operators** (AND OR). However, OASIS never requires that the condition expression contain a relational operator. Any expression that evaluates to a **nonzero** value is “true”. Any expression that evaluates to **zero** is “false”.

The example below illustrates the condition blocks of a *set* command. There are three condition blocks in this example. Each condition block consists of the condition expression (following the word *condition*) and the value expression (following the word *value*) which will be assigned to the variable if the condition is true.

```
Set : QuantityX
{
   condition : month = 1
       value : 400
   condition : month = 2
       value : 800
   condition : default
       value : 1000
}
```

In this example, *QuantityX* will be set to 400 if the month equals 1 (January), to 800 if the month equals 2 (February), and 1000 otherwise.

You are not required to enter conditions for every command. If the command does not really need to be conditional, then you could make a single condition block whose condition expression is *default*. You achieve the same effect by omitting the condition field. For example:

```
Set : QuantityX
{  condition : default
       value : 999
}
```

is the same as:

```
Set : QuantityX
{   value : 999  }
```

The documentation of the specific simulation commands (in the rest of section 4.7.2) demonstrates both **conditional** and **unconditional** forms for the syntax of each command.

So that conditions can be better organized, OCL recognizes ***branched*** conditions. To create branched conditions, a condition expression must be followed by a pair of curly braces. Inside the braces is a complete set of conditions. Here is an example:

```
Set : QuantityX
{
   condition 1 : month = 1
    {
         condition 2 : inflow200 > 550
             value   : 200
         condition 3 : default
             value   : 400
    }
   condition 4 : month = 2  or  month = 3
    {
         condition 5 : inflow200 > 1000
             value   : 200
         condition 6 : default
             value   : 400
    }
   condition 7 : default
       value   : 1000
}
```

In this example, conditions 1 and 4 each have branches. OASIS deals with this by combining condition 1 into conditions 2 and 3, and condition 4 into conditions 5 and 6. Thus, internally, there will only be 5 conditions for this command. The exact same effect could be achieve without branched conditions, as in this example:

```
Set : QuantityX
{
   condition 2 : month = 1  and  inflow200 > 550
       value   : 200
   condition 3 : month = 1
       value   : 400
   condition 5 : month = 2  or  month = 3  and  inflow200 > 1000
       value   : 200
   condition 6 : month = 2  or  month = 3
       value   : 400
   condition 7 : default
       value   : 1000
}
```

Though both of the above examples are equivalent, you may find that branched conditions make your OCL more readable.

B. *Udef* Command

Syntax form (see section 4.7.0 part A for conventions):

Decision variable form:

```
     Udef : [udef name] NOSTORE STORE INIT{[val 1],[val 2],...,[val n]}
                        DECISION NoMultiple
         { [lower-bound expression] , [upper-bound expression] , INTEGER }
```

Non-decision variable form:

```
     Udef : [udef name]  NOSTORE STORE INIT{[val 1],[val 2],...,[val n]}
```

Tells OASIS to create a **user-defined variable** named *[udef name]*. Once the user-defined variable (or "**udef**" for short) has been created, it can be included in subsequent OCL expressions through the OCL file. This command can only appear in the **udef section** of the OCL file (section 4.7.0 part G). See section 2.5.1 part A for an introduction to this command.

[Udef name] can be any text within certain rules. The name cannot include any whitespace. The name must not begin with a number or include any parentheses. The name cannot be an exact match of an OCL keyword. OASIS will tell you if a name has violated any rules.

If you are entering a **decision variable** udef ***into an expression***, the letter *D* (or *d*) will be appended to the front of its name. However, do *not* put this *D* onto the front of *[udef name]* ***in the udef command***.

The presence of the word *DECISION* is a flag that *[udef name]* is a decision variable. If *DECISION* is present, then the command must follow the first syntax form, which includes the bound expressions within the curly braces. If *DECISION* is not present, then *[udef name]* is not a decision variable, and the command must follow the second syntax form, which does not include any bound expressions.

NOSTORE is an optional flag that tells OASIS not to keep a record of the variable in the **time-series output database** (section 5.6.0). This can save run time and disk space. However, it will prevent you from accessing values of *[udef name]* when post-processing. *STORE* is an optional flag that tells OASIS to write a record for *[udef name]* in the time-series output database, even if the flag in the control file (section 4.4.0) tells OASIS not to write time-series output. *STORE* has no practical effect when the time-series flag in the control file is on, because all udefs that are not flagged with *NOSTORE* are recorded in time-series output by default.

The keyword *INIT* and the curly braces containing **initial values**, *[val 1]...[val n]*, are optional. If used, *[val 1]...[val n]* will be assigned to memory as previous period values. The number of items *n* in this series can be from one to the number of periods in a year. Each value is separated from the others by commas. The values can only be numeric constants — expressions are *not* allowed. The values appear in order, so that *[val n]* is applied to the period just before the start of simulation.

The *[lower-bound expression]* and *[upper-bound expression]* are required for decision variable udefs. See section 4.7.3 for details about writing OCL expressions. These **bounds** will be entered into the LP during simulation. You may enter *unbounded* in place of either or both bound expressions. This will cause the variable to lack an upper bound, lower bound, or both, accordingly.

The word *integer* is an optional flag, to tell OASIS that *[udef name]* is restricted to integer values. If used, it must be entered after a comma following *[upper-bound expression]*. If not used, then *[upper-bound expression]* will be immediately followed by the closing curly brace — no comma. Remember that integer variables slow the solution time of the LP router.

The optional flag *NoMultiple* is only useful if you are doing MPO (section 2.2.7). This flag tells OASIS not to create a copy of the variable for each MPO step. Instead, there will be only one copy, associated with the first MPO step. Note that this flag only applies to decision variable udefs.

Examples:

```
UDEF : X_3
UDEF : X_4  init{3,4}
UDEF : ABCD     NOSTORE
```

Three non-decision variables, named *X_3, X_4,* and *ABCD* will be created. All except *ABCD* will be recorded in time-series output. *X_3* and *ABCD* will not have any initial values. For the period just before simulation begins, *X_4* will have a value of 4. For the period before that, *X_4* will have a value of 3.

```
UDEF : Z_6 DECISION init{5}  { 0 , X_3 - 22.3 }
UDEF : DEFG Decision NoStore  { 0 , 1 , integer }
```

Two decision variables will be created. The udef *Z_6* will not be an integer variable. It will have a value of 5 in the period just before simulation begins. Its lower bound is zero, and its upper bound is the value of *X_3* - 22.3. The udef *DEFG* will not be recorded in time-series output. It will be an integer variable with 0-1 bounds — that is, a binary variable.

```
UDEF : Bubba   DECISION  { 0 , unbounded }
UDEF : Charlie DECISION  { unbounded , unbounded }
```

Two decision variables will be created. *Bubba* will have a lower bound of zero, but no upper bound. *Charlie* will not have any upper or lower bounds. Both variables will be recorded in output, and neither will have initial values.

C. *Segment* Command

Syntax form (see section 4.7.0 part A for conventions):

```
Segment : [dvar name]   NOBINARY
{ { [bound 0 expr]   }
        [seg 1 name]  { [bound 1 expr] }
        [seg 2 name]  { [bound 2 expr] }
           [...]
        [seg n name]  { [bound n expr] }
}
```

Tells the program to create *n* decision-variable udefs, named *[seg 1 name]* through *[seg n name]*, which form segments of a decision variable *[dvar name]*. OASIS automatically ensures that the sum of *[seg 1 name]* through *[seg n name]* plus *[bound 0 expr]* is equal to *[dvar name]*. This command can only appear in the udef section of the OCL file (section 4.7.0 part G). See section 2.5.1 part B for an introduction to this command.

[Dvar name] can be a built-in decision variable, or a previously declared decision variable udef. Do not include the letter *d* (for *d*ecision) at the front of the name.

The optional flag *NOBINARY* suppresses binary variables that are automatically created for the *segment* command. By default, OASIS creates binary decision variables for each of the segment boundaries 1 through n-1. It then writes constraints so that each segment variable *[seg x name]* is nonzero until the variable *[seg x-1 name]* is equal to *[bound x-1 expr]*. The binary variables and their constraints are invisible to you unless you look in the file *LP.out*. Because binary variables may decrease solution times, you may wish to suppress them with the *NOBINARY* flag. You should only use *NOBINARY* if you are certain that the segments will come in order without the binaries.

Be aware that *[dvar name]* is effectively bounded by this command. Choose *[bound 0 expr]* and *[bound n expr]* to cover all possible values of *[dvar name]*.

The new udefs, *[seg 1 name]* through *[seg n name]*, are decision variables. However, you must not include the letter *d* (for *d*ecision) at the front of the names. Note OASIS does not save any of the new udefs to the time-series database, so they can not be referenced with the post-processor programs.

Each *[seg x name]* has a lower bound of zero, and an upper bound of *[bound x expr]* minus *[bound x-1 expr]*. The value of *[dvar name]* will be *[bound 0 expr]* when *[seg 1 name]* equals zero. The value of *[dvar name]* will be *[bound n expr]* when *[seg n name]* is at its upper bound. Each of the values of *[bound x expr]* is an OCL expression. See section 4.7.3 for details about writing OCL expression.

Example:

Suppose we wish to model leakage in a streambed. In the stream reach represented by arcs 100.150 and 150.200, water leaks into the ground according to the piecewise-linear function shown in figure 4.7.2 part C. Arc 150.800 represents the leakage. The first segment of the function from 0 CFS to 100 CFS, has a slope of 0.15. The second segment of the function from 100 CFS to 200 CFS, has a slope of 0.10 . The third segment of the function from 200 CFS to infinity, has a slope of 0.05. It has been determined that the flow into the reach will almost certainly never go above 4000 CFS.

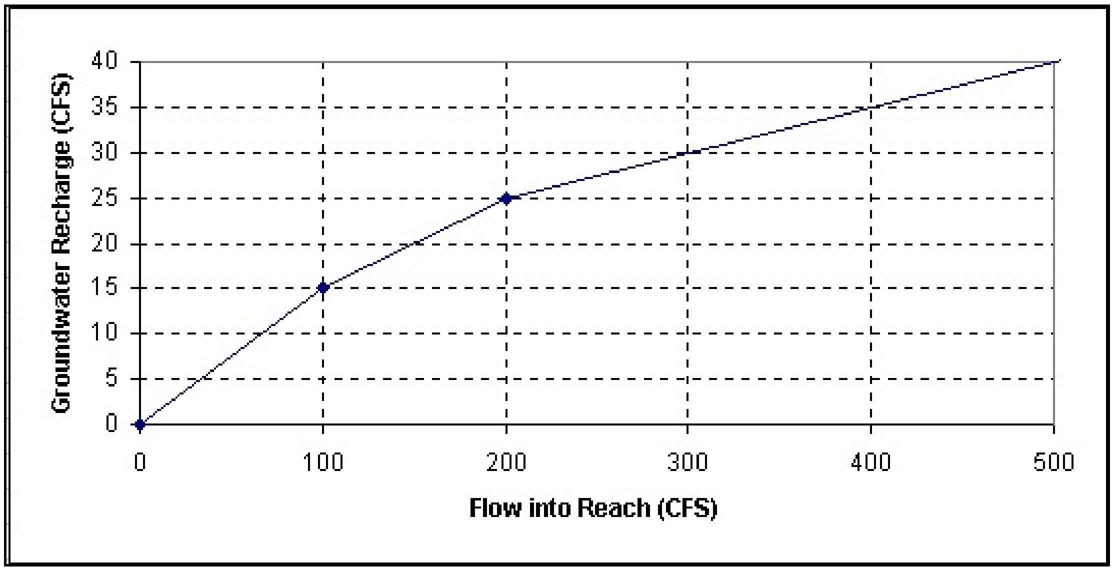


Figure 4.7.2 part C
Groundwater recharge from a stream

The following OCL input would be used to model the recharge described:

```
:UDEF:

Segment : Flow100.150
{ { 0 } FA100.150  { convert_units{  100 , CFS , AF } }
        FB100.150  { convert_units{  200 , CFS , AF } }
        FC100.150  { convert_units{ 4000 , CFS , AF } }
}

:COMMANDS:

CONSTRAINT recharge150 :
{  dFlow150.800 =   0.15 * dFA100.150
                  + 0.10 * dFB100.150
                  + 0.05 * dFC100.150
}

:END:
```

The *segment* command declares three udefs, *FA100.150*, *FB100.150*, and *FC100.150* as segments of *flow100.150*. The bound expressions in the *segment* command are the values of *flow100.150* where the slope of the recharge function changes. The value of *flow100.150* is effectively bounded between 0 and 4000 CFS. Since all the variables are measured in AF, our bounds must be converted from CFS to AF. The *NOBINARY* option has not been used in the *segment* command, though it could be added if it is determined that the router will not try to enter the segments out of order.

The *constraint* command shows how easy it is to use the variables created with the *segment* command. This command simply enforces the rule that the recharge, represented by *flow150.800*, is a linear function of *flow100.150*. Since it is a **piecewise** function, the recharge is actually a function of the three segments of *flow100.150*.

D. *Constraint* Command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:
```
     Constraint NoMultiple [constraint name] :
     {  [constraint expression]   }
```

Conditional form:
```
     Constraint NoMultiple [constraint name] :
     {   Condition :  [condition expression]
         Expression :  [constraint expression]    }
```

Gives OASIS a user-defined constraint to enter into the LP routing problem. See section 2.5.1 part D for an introduction to this command. See section 4.7.3 for details about writing OCL expressions.

The constraint may be conditional or unconditional. If unconditional, the constraint applies in every simulation time step. The input for unconditional constraints does not employ the keywords *condition* and *expression*. If conditional, the constraint is only entered into the LP routing problem if the condition expression evaluates to true for the time step. The conditional syntax form requires the keywords *condition* and *expression* to separate the *[condition expression]* from the *[constraint expression]*.

It is recommended that you give the constraint a name, although you can omit it. *[Constraint name]* cannot include any whitespace. Command names are not required to be unique. The purpose of *[constraint name]* is to serve as a convenient identifier in output messages.

The optional flag *NoMultiple* is only useful if you are doing MPO (section 2.2.7). This flag tells OASIS not to create a copy of the constraint for each MPO step. Instead, there will be only one copy, associated with the first MPO step.

[Condition expression] must follow the guidelines described in section 4.7.2 part A.

[Constraint expression] must be a linear expression of one or more **decision variables**. It must include exactly one comparison operator (=, <, <=, >=, *or* >) between the decision variable terms of the expression. Comparison operators within a coefficient are legal. You do not have to distribute the terms of the linear expression. OASIS will reject any non-linear expressions and issue an error message. Remember, decision variables are distinguished from non-decision variables because decision variables always start with an extra letter *d*.

Examples:

```
     Constraint Non-decreasing_flow :
     {   Condition : month >= 3 and month <= 8
         Expression : dFlow210.288 > flow210.288(-1) - 30   }
```

From March through August, *constraint* command *Non-decreasing_flow* will prevent the flow in the arc from being less than the previous period's flow, minus a tolerance of 30. This command has no effect in other months.

```
     Constraint export_limit :
     {   dExport  <  0.65 * ( dflow300.310 + dflow350.310 + inflow320 )
     }
```

Constraint *export_limit* is always written into the LP, since it is unconditional. Notice that the right-hand side of the constraint expression does not need to be distributed. It could just as easily have been written in a distributed form, with the same effect.

E. *Target* Command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:

```
Target NoMultiple [target name] : [target expression]
{
       Priority : [integer priority level]
       Penalty+ WARN : [penalty+ value]
       Penalty- WARN : [penalty- value]
       Value : [target value expression]
}
```

Conditional form:

```
Target NoMultiple [target name] : [target expression]
{
       Condition [condition name] : [condition expression]
       Priority : [integer priority level]
       Penalty+ WARN : [penalty+ value]
       Penalty- WARN : [penalty- value]
       Value : [target value expression]

       [...]

       Condition [condition name] : [condition expression]
       Priority : [integer priority level]
       Penalty+ WARN : [penalty value]
       Penalty- WARN : [penalty value]
       Value : [target value expression]
}
```

Gives OASIS a user-defined goal to enter into the LP routing problem. See section 2.5.1 part E for an introduction to this command. See section 4.7.3 for details about writing OCL expressions.

The target works by **penalizing** the router for letting *[target expression]* **deviate** from *[target value expression]*. Since the penalties can be positive or negative, there are different types of goals that can be created with the *target* command. Positive penalties will create a goal of making *[target expression]* equal to *[target value expression]*. However, negative penalties will create a goal of making *[target expression]* deviate from *[target value expression]* as much as possible. Penalty values of zero will leave the LP router indifferent to the deviation.

The *[target name]* is optional. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. Also, it can be used in the *target_val* variable (section 4.7.4).

The optional flag *NoMultiple* is only useful if you are doing MPO (section 2.2.7). This flag tells OASIS not to create a copy of the target for each MPO step. Instead, there will be only one copy, associated with the first MPO step.

The *[target expression]* must be a linear expression of one or more **decision variables**. It must not include any comparison operators (=, <, <=, >=, >) between the decision variable terms. Comparison operators within a coefficient are legal. You do not have to distribute the terms of the linear expression. OASIS rejects any non-linear expressions and issues an error message. Remember, decision variables are distinguished from non-decision variables because decision variables always start with an extra letter *d*.

The command can be entered in either conditional or unconditional form. There is little difference between the two. Internally, OASIS treats all targets as though they were conditional. It stores the unconditional target in memory by giving it the implicit condition *default*. The conditional form may have one or many conditions.

For the conditional form, each condition can be given an optional *[condition name]*. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. Each condition field is the head of a **condition block**. Each condition block must have complete *priority*, *penalty+*, *penalty-*, and *value* fields. Thus, the priority level, the penalties, and the target value may vary with each condition.

The *priority* field is the first item in each condition block. A different priority can be used for each condition. The *[integer priority level]* is the priority level at which the target will be applied in the LP routing problem. Enter it as a constant. See section 2.2.6 for more on priority levels.

The *penalty+* and *penalty-* fields are the second and third item in each condition block. Different penalty values can be used for each condition. *[Penalty+ value]* and *[penalty- value]* must be entered as constants. Either one can be positive, negative, or zero. When the *[target expression]* is greater than *[target value expression]*, the LP router loses *[penalty+ value]* points for every unit of deviation. When the *[target expression]* is less than *[target value expression]*, the LP router loses *[penalty- value]* points for every unit of deviation. See section 2.2.3 for an introduction to LP-router goals.

You may enter the keyword *bound* in place of *[penalty+ value]*, in order to constrain the *[target expression]* from being greater than the *[target value expression]*. You may also enter *bound* in place of *[penalty- value]* to constrain the *[target expression]* from being less than the *[target value expression]*. If you place *bound* in both penalty fields, or *bound* in one penalty field and zero in the other, then the *target* command is being used to define a constraint, not a goal. In this case, *[integer priority level]* is irrelevant. Some constraints you may wish to define with the *target* command, instead of the *constraint* command, because with the *target* command you can have many conditions with different target values.

The keyword *WARN* is optional, and you should only use it for special cases. It can be placed after either-or-both of the words *penalty+* and *penalty-*. Use of the *WARN* flag with *penalty+* tells OASIS to issue a warning message when the *[target expression]* is more than the *[target value expression]*. Use of the *WARN* flag with *penalty-* tells OASIS to issue a warning message when the *[target expression]* is less than the *[target value expression]*. These warnings are issued only if *WARN* is used for the chosen condition when the deviation occurred. The warning consists of a message in the file *debug.out* (section 5.1.0), telling which target had the deviation. Also, a note appears in the OASIS window telling you that there are warnings in *debug.out*.

The *value* field is the fourth and last field in each condition block. Different value expressions can be used for each condition. *[Target value expression]* can not include any decision variables.

Examples:

Consider a well field where we can pump water from the ground *or* inject it into the ground. The reversible arc 600.350 represents the well field. Flow in the positive direction is pumping; flow in the negative direction is injection. During the wet California winter, our policy is to inject, not pump. During the summer, we should pump but not inject. It will be a *goal* to follow this policy — if there is a huge surplus of water in summer, we would still like to inject it, and we would pump in winter if there was no other source.

```
TARGET pump/inject_penalties : dFlow600.350
{
   condition summer : month >= 5 and month <= 10
     priority :   1
     penalty+ :  15
     penalty- : 400
       value  :  0

   condition winter : default
     priority :   1
     penalty+ :  30
     penalty- :   0
       value  :  0
}
```

The target *pump/inject_penalties* has two conditions, one for summer (May-October) and one for winter (all other times). The target expression is the flow in our well-field arc, 600.350. Both conditions have a target value of zero. Flow greater than zero is pumping, so the *[penalty+ value]* is the penalty to the router per unit of pumping. Flow less than zero is injection, so the *[penalty- value]* is the penalty to the router per unit of injection. There are other weight and penalty values bearing on this decision, so we will not worry about the exact values of the penalties. However, notice that there is a higher penalty for pumping in the winter than in summer, and the penalty for injection is higher in summer than in winter.

```
TARGET total_stor_target : dStorage400 + dStorage401
{
  priority : 1
  penalty+ : 0
  penalty- : 130
    Value  : 200 + pattern(addnl_storage)
}
```

Target *total_stor_target* is unconditional. It expresses a goal of keeping at least 200 units, plus a seasonal pattern, in storage between two reservoirs, represented by nodes 400 and 401. The router loses 130 points for every unit that the combined storage falls short of the target value. Note that with this command alone, the LP router would have alternate optima when considering the difference in storage between reservoir nodes 400 and 401. Other commands that are not shown may thwart the alternate optima.

```
TARGET stor_046 : dstorage046
{
        condition : default
         priority : 2
         penalty+ : -18
         penalty- : bound
         value    : 0
}
```

The target *stor_046* is entered in a conditional form, but since this single condition is always true, we could just as easily use the unconditional form. This target is to encourage storage in reservoir node 46. The router *gains* 18 points for every unit of storage in node 46 over zero. It is a gain because the penalty has negative value. The *[penalty- value]* has been replaced by the keyword *bound*. This is because *dStorage046* is already bound from being less than zero. Therefore, it is a cleaner formulation to avoid assigning penalties to this range of impossibility (in fact, a *[penalty- value]* of *zero* could result in an unbounded variable in the LP).

F. *Set* Command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:

```
Set [command name] : [variable name]
{  Value : [value expression]  }
```

Conditional form:

```
Set [command name] : [variable name]
{
   Condition [condition name] : [condition expression]
   Value : [value expression]

   [...]

   Condition [condition name] : [condition expression]
   Value : [value expression]
}
```

Assigns the value given by *[value expression]* to a non-decision variable, *[variable name]*. See section 2.5.1 part C for an introduction to this command. See section 4.7.3 for details about writing OCL expressions.

[Variable name] can be any of the variable types from the following table. See section 4.7.4 for definitions of each variable type.

Variable name	Conditions for Use with *Set* Command
min_flow	Enter *OCL* into the *Min Flow* field in the *Arc* table (section 4.5.3 part C)
max_flow	Enter *OCL* into the *Max Flow* field in the *Arc* table (section 4.5.3 part C)
MaxRev_flow	Enter *OCL* into the *MaxRev Flow* field in the *Arc* table (section 4.5.3 part C)
inflow	Enter *OCL* into the *Inflow* field in the *Node* table (section 4.5.3 part B)
demand	Enter *OCL* into the *Demand Type* field in the *Demand* table (section 4.5.4 part A)
upper_rule	Enter *OCL* into the *Upper Rule* field in the *Reservoir* table (section 4.5.3 part H)
lower_rule	Enter *OCL* into the *Lower Rule* field in the *Reservoir* table (section 4.5.3 part H)
evap	Enter *OCL* into the *Evaporation Type* field in the *Evaporation* table (section 4.5.3 part K)
evap_rate	Enter *OCL* into the *Evaporation Type* field in the *Evaporation* table (section 4.5.3 part K)
conc_input at an arc	Enter *OCL* into the C*x_input* field in the *Arc* table (section 4.5.3 part C)
conc_input at a node	Enter *OCL* into the C*x_input* field in the *Node* table (section 4.5.3 part B)
[udef name]	Must defined as a non-decision-variable by a *udef* command (section 4.7.2 part B)

The *set* command always assigns the present period value of *[variable name]*. If you attach a time-lag indicator (section 4.7.4 part A) to *[variable name]*, it will be ignored.

It is legal to have more than one *set* command setting the same variable. If a *set* command is required for any variable, but is not found, then OASIS prints a warning message into the *debug.out* file (section 5.1.0). Generally, this is not a fatal error, because OASIS applies a default value to any variable that lacks a *set* command. However, it is possible to configure OASIS so that a missing *set* command triggers a fatal error. To do this, set the parameter *FatalMissingVarSet=1* in the *GUI.ini* file (section 3.3.5).

The *[command name]* is optional. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. With the *set* command, it is often most convenient to omit *[command name]*, because OASIS will assign a default name of *[variable name]* for the command name. However, it is still recommended that you use *[command name]* when there is more than one *set* command for *[variable name]*.

The command can be entered in either conditional or unconditional form. There is little difference between the two. Internally, OASIS treats all *set* commands as though they were conditional. It stores the unconditional *set* command in memory by giving it the implicit condition *default*. The conditional form may have one or many conditions.

For the conditional form, each condition can be given an optional *[condition name]*. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. Each condition field is the head of a **condition block**. Each condition block must have a *value* field. Thus, the value would vary with each condition.

Examples:

```
set : accum_flow100.200
{
   Condition : month = 10
   Value : flow100.200

   Condition : default
   Value : accum_flow100.200(-1) + flow100.200
}
```

This command sets the value of a non-decision variable udef, *accum_flow100.200*. The command follows the conditional form. The first condition is for October only. In October, *accum_flow100.200* is set equal to *flow100.200*. The second condition applies to all other months. It accumulates the value of the udef by setting its value equal to the previous month's value of *accum_flow100.200* plus the current value of *flow100.200*.

```
set accum100.200_step1 : accum_flow100.200
{
   Condition : month = 10
   Value : 0

   Condition : default
   Value : accum_flow100.200(-1)
}
set accum100.200_step2 : accum_flow100.200
{
   Value : accum_flow100.200(-1) + flow100.200
}
```

These two commands have the same effect as the single command in the first example. Our purpose here is to show that we can set the value of a specific variable more than once. In the previous example, we omitted the command name. Here, we use command names to distinguish the two commands. Also note that the second command in this example is unconditional.

G. *Run_module* Command

Syntax form (see section 4.7.0 part A for conventions):

```
Run_module  :  [module name]
{
   Thread : [thread type]
   Input : { [expression 1] , [expression 2] , [...] }
   Output : { [variable 1] , [variable 2] , [...] }
}
```

Tells OASIS to process an external procedure, known as an **external module**. The command includes parameter values to exchange with the module. See section 2.5.1 part I for an introduction to this command. See section 4.7.7 for more details about using external modules.

[Module name] must have been declared at the beginning of the OCL file with the *:MODULE:* meta-command (section 4.7.1 part G). It is possible for more than one *run_module* command to call *[module name]*.

If the command line parameter *PARENT* (section 4.1.0) was used, then it is possible to use the word *PARENT* for the *[module name]*. This allows OASIS to exchange data with the program that spawned it. Do *not* use the *:MODULE:* command to declare the module *PARENT*.

The field *thread* can be omitted, in which case the *[thread type]* is *NONE*. *[Thread type]* determines whether the module is processed in a new execution thread or not. If the module is to be processed in a new thread, then *[thread type]* indicates whether the *run_module* command is for the start or end of the new thread. *[Thread type]* can have the following values:

None This is the default case. The *run_module* command processes the external module in OASIS's original execution thread. The *run_module* command must contain both an *Input* field and an *Output* field

Start The *run_module* command causes a new thread to be started for the external module. After evaluating this *run_module* command, OASIS may be multitasking – allowing the external module to process at the same time as OASIS evaluates further OCL commands. The *run_module* command must contain an *Input* field but no *Output* field, because at this point OASIS sends data to the external module, but OASIS does not receive data until the module's thread is finished.

You may delay threading for the *run_module* command by attaching a time step number *n* to *Start* in parentheses. If you do this, then during the initial time steps OASIS processes the module in OASIS's original execution thread, just as if the *thread* field contained *None*. The first step on which threading is performed is step number *n*. For example, if the *thread* field contains *Start(3)*, then threading is not performed on steps 1 and 2, but on steps 3 and thereafter the *run_module* command is threaded. If no number is attached to *Start* in parentheses, then *n* implicitly equals 1.

End The *run_module* command causes OASIS to receive the results of an external module that was previously started in a new thread. OASIS does not proceed with the evaluation of further OCL commands until the thread is finished. The *run_module* command must contain an *Output* field but no *Input* field..

If *thread: start* is used, then it must be followed by another *run_module* command for *[module name]* with *thread: end*. Other OCL commands may occur between this pair of *run_module* commands. However, another *run_module* command for the same *[module name]* can not occur between this pair of *run_module* commands if it contains *thread: start* or *thread: none*. If *thread: end* is used, then it must be preceded by a matching *run_module* command with *thread: start*.

The *input* field contains a list of *[expression 1]*, *[expression 2]*, etc. The list is enclosed in curly braces, and each expression is separated from the others by commas. Each expression is evaluated, and the value is passed to the module. See section 4.7.3 for details about writing OCL expressions.

The *output* field contains a list of *[variable 1]*, *[variable 2]*, etc. The list is enclosed in curly braces, and each variable is separated from the others by commas. These are not expressions, but the names of individual variables. Each variable in the list must be one that can be legally set by OCL using the *set* command (see section 4.7.2 part F for a list of legal variable names). When the external module passes control back to OASIS, the values that the module passes back are assigned to *[variable 1]*, *[variable 2]*, etc., just as if they had been set with the *set* command.

OASIS does not check whether the number of items in the *Input* field and *Output* field are correct for the module. The module might or might do such an error check – it depends on how the module is coded. The input and output list may each contain up to 50 items.

Example:

```
:MODULE: DLL  compute_RMDO = modules\delt_out.exe

:COMMANDS:

RUN_MODULE : compute_RMDO
{
    input :  { abs_period , period , year ,
               storage046 , flow509.999(-1)  }
    output : { min_flow509.999 , x2_position }
}
:END:
```

This example shows how the module name must be declared with the *:MODULE:* command. Then, in the command section, the *run_module* command can be used to call the module. In the example, five parameters are passed to the module. The module passes back two parameters, the value of a built-in variable (*min_flow509.999*) and the value of a udef (*x2_position*). The *thread* field is omitted, so this *run_module* command does not execute in a new thread.

The following example shows how a *run_module* command can execute in a new thread:

```
RUN_MODULE : compute_RMDO
{   thread : START
    input :  { flow509.999(-1)  }
}

SOLVE : { priority : 1 }

RUN_MODULE : compute_RMDO
{   thread : END
    output : { x2_position }
}
:END:
```

In this example, the module is executed in a separate thread from the rest of OASIS. While the module is running, OASIS executes the *solve* command. This might save significant run time when running on a multiprocessor or multicore computer. However, note that the value of variable *x2_position* is not assigned until the second *run_module* command.

H. *Minimax* Command

Syntax form (see section 4.7.0 part A for conventions):

```
Minimax : [minimax variable]
{
      Priority : [integer priority level]
      Penalty : [penalty value]
      tolerance : [tolerance value]
}
```

Enters a user-defined goal into the LP which seeks to make two or more quantities equal to each other as closely as possible. See section 2.5.1 part F for an introduction to this command. This is a powerful, but complicated procedure, and it cannot be achieved with the *minimax* command alone. Effective use of the *minimax* command requires coordinated use of *constraint* commands, as will be explained.

The *[minimax variable]* is a decision variable udef that must be declared with the *udef* command (section 4.7.2 part B). The first step that OASIS does for the *minimax* command is to minimize *[minimax variable]*. It does this by entering *[minimax variable]* into the LP objective function at the priority level given by *[integer priority level]*, with a penalty of *[penalty value]*.

An effective *minimax* command must be applied in conjunction with two or more *constraint* commands that constrain the value of *[minimax variable]*. See section 4.7.2 part D for more on the *constraint* command. The constraint expressions of the *constraint* command must follow this form:

```
[minimax variable]  >  [quantity X to be equalized]
```

and repeated with similar *constraint* commands for every *[quantity X to be equalized]*. OASIS automatically detects any constraint that contains *[minimax variable]* and groups it with the *minimax* command.

As we said, the *minimax* command minimizes the *[minimax variable]*. It can be shown that the smallest value of *[minimax variable]* occurs when all *[quantity X to be equalized]* are equal. However, when other constraints force the value of one *[quantity X to be equalized]* to be greater than the others, the LP router is indifferent to the values of the others. Thus, OASIS automatically checks for such **binding** constraints. If it finds any, it temporarily removes the *[minimax variable]* from the binding constraint, and re-solves the LP routing problem. It then checks for more binding constraints, and continues the process until there are no more binding constraints.

If the greatest difference between the values of *[quantity X to be equalized]* is less than *[tolerance value]*, then OASIS will not do any more minimax iterations. Notice that if there are only two *[quantity X to be equalized]*, then there will be no additional minimax iterations, so *[tolerance value]* is irrelevant. *[Tolerance value]* is measured in the same units as *[minimax variable]*.

Example:

In the example, the quantities that we want to equalize are the percentages of shortages at several demand nodes. In other words, if there are shortages, we want each of these nodes to take an equal percent cut.

```
:UDEF:
udef : MM   DECISION  NOSTORE { 0 , unbounded }

:COMMANDS:

CONSTRAINT minimax_dem111 :
{   CONDITION  :  demand111 > 0
    Expression :    dMM  >   1 - dDelivery111 / demand111
}
CONSTRAINT minimax_dem115 :
{   CONDITION  :  demand115 > 0
    Expression :    dMM  >   1 - dDelivery115 / demand115
}
CONSTRAINT minimax_dem124 :
{   CONDITION  :  demand124 > 0
    Expression :    dMM  >   1 - dDelivery124 / demand124
}
CONSTRAINT minimax_dem150 :
{   CONDITION  :  demand150 > 0
    Expression :    dMM  >   1 - dDelivery150 / demand150
}

MINIMAX :   dMM
{
   Priority : 2
   penalty  : 80
   tolerance : .05
}

:END:
```

Our minimax variable is *MM*, declared with the *udef* command. The bounds on this variable are not critical, because various parts of the minimax will effectively bind it between 0 and 1. The *constraint* commands are used to constrain the minimax variable to be greater than the fractional shortage at four different demand nodes. The minimax command will penalizes the value of *MM* 80 points for each unit. Since the value of *MM* will always be between 0 (no shortage) and 1 (complete shortage), the router will lose between 0 and 80 points total. If, after solving the LP at priority 2, all four of the fractional shortages are within 0.05 of each other (the tolerance value), then OASIS will not bother to remove the binding constraints and do more iterations for this minimax. If the fractional shortages are not within the tolerance value, then OASIS may do up to two additional solves (there are four constraints for this minimax variable, and OASIS will stop iterating when there are only two constraints that have not been removed).

I. *Solve* Command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:
```
     Solve [command options list] :
     {
        [condition block]
     }
```

Conditional form:
```
     Solve [command options list] :
     {
        Condition [condition name] : [condition expression]
        [condition block]

        [...]

        Condition [condition name] : [condition expression]
        [condition block]
     }
```

where each *[condition block]* has one of the following forms:

Non-iterative form:
```
          Priority : [integer priority level]
          Options : [conditional options list]
```

Stopping-criteria expression form:
```
          Priority : [integer priority level]
          Options : [conditional options list]
          Criteria : [criteria expression]
          Itermax : [maximum number of iterations]
```

Stopping-on-convergence form:
```
          Priority : [integer priority level]
          Options : [conditional options list]
          Converge : [convergence expression]
          Tolerance : [tolerance expression]
          Itermax : [maximum number of iterations]
```

Tells OASIS to solve one or more priority levels of the LP routing problem. It can optionally tell OASIS to check whether user-specified criteria are met, and if not, to **iterate** the solve process. Thus, the *solve* command can be **iterative** or **non-iterative**.

See section 2.5.1 part G for an introduction to this command. See section 4.7.3 for details about writing OCL expressions.

It is possible to run OASIS without entering any *solve* commands. If you do not enter any, then OASIS automatically creates one as the last command, to solve all priority levels. If you do enter one, then it becomes your responsibility to issue enough *solve* commands so that *all* priority levels are solved. In this case, OASIS issues an error message if there are priority levels that lack *solve* commands.

If you are doing multiple-period optimization (MPO) (section 2.2.7), then OASIS evaluates all commands that precede the *solve* command *once for every MPO step* before it actually solves the LP. MPO cannot be combined with multiple priority levels in the same OASIS run. You should not combine iterative *solve* commands with MPO.

The *solve* command may be conditional or unconditional. If it is conditional, then each condition block may be individually defined as iterative or non-iterative, regardless of the types of the other blocks. The fields that are found in each condition block depend upon whether the block is iterative, and if so, how you wish to define the stopping criteria.

The *solve* command can be used with optional flags, entered either in *[command options list]* or *[conditional options list]*. Options entered in *[command options list]* will be applied to all conditions, while options entered in *[conditional options list]* will be applied only to the individual condition. Either of the options lists can be left blank. If there are not options for a condition block, then the *options* field can be omitted from that block entirely. Available options are:

Iterative. OASIS will check the stopping criteria and re-solve the LP if the criteria is not met. The default is a non-iterative solve.

NoWQ. OASIS will not solve for the water quality after solving the LP. The default is to solve for the water quality after every LP solution. Using this parameter can save run time, especially if you expect large numbers of iterations. Note that if the water quality has not been solved after all OCL commands are evaluated, OASIS will automatically solve water quality on its own.

Rewrite. Forces OASIS to rewrite the entire LP before solving. By default, OASIS only rewrites the entire LP before the first solve of each time step. Using this parameter can increase run time, but it will be necessary if you have changed the values of any built-in variables since the first solve of the time step.

For the conditional form, each condition can be given an optional *[condition name]*. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. Each condition field is the head of a **condition block**. Each condition block must have a *priority* field, but the other fields of the condition block may vary as shown in the syntax form.

When executing the *solve* command, OASIS will solve all priority levels that have not already been solved, up to and including *[integer priority level]*. It is legal to re-solve a priority level that has already been solved in the current time step. If priority levels greater than *[integer priority level]* have already been solved, then they will need to be re-solved before the time step is complete.

If the solve is iterative, it will evaluate the stopping criteria after it has solved *[integer priority level]*. The stopping criteria can be defined two ways:

Stopping criteria expression. This option is defined with the *criteria* field. The *[criteria expression]* will be evaluated after all priority levels are solved for this *solve* command. If *[criteria expression]* evaluates to true (or nonzero), then no more iterations will be done. If *[criteria expression]* evaluates to false (or zero), then OASIS will do another iteration.

Stopping on convergence. This option is defined with two fields: a *converge* field and a *tolerance* field. With this method, there will always be at least two iterations. After the second iteration and all subsequent iterations, OASIS takes the difference between the previous *[convergence expression]* and subtracts from the current *[convergence expression]*. If the absolute value of the difference is less than *[tolerance expression]*, then no more iterations will be done. Otherwise, OASIS will iterate again.

Both of the iterative syntax forms include an *itermax* field. You must enter an integer value for *[maximum number of iterations]*. If the maximum number of iterations have been performed, then OASIS stops iterating, regardless of the stopping criteria.

OASIS chooses the condition which is true before it solves the LP. If the *solve* command is iterative, OASIS will not re-evaluate the condition expression of the *solve* command with each iteration. Rather, it will keep using the chosen condition that was picked the first time.

If the *solve* command is iterative or is iterative under any conditions, then it must be matched with an *:ITERATE:* marker. Each *:ITERATE:* marker can be matched with only one *solve* command, and vice-versa. The *:ITERATE:* markers are matched with the *solve* commands in a nested fashion. That is, when OASIS reads an iterative *solve* command, it will be matched with the nearest previous *:ITERATE:* marker that has not already been matched. When OASIS iterates a *solve* command, it re-evaluates **all** OCL commands that follow the matching *:ITERATE:* marker.

Examples:

```
SOLVE :
{  condition : month = 5
    priority : 1
}
Constraint :
{  condition : month = 5  AND  storage680 < 40
   Expression : dflow700.120 < convert_units{ 15 , cfs , VOLUME }
}
SOLVE : { priority : 2 }
```

This example shows how we can write a rule that depends upon the results of an initial solve. The storage at node 680 is a decision variable, but assume that in this model its value does not change after the priority 1 solve. Therefore, we can constrain the flow in arc700.120, depending upon the storage in 680, after priority 1 has been solved by the first *solve* command. Notice that the conditions are such that the *constraint* command and the first *solve* command are only performed in month 5 (May). Thus, in all other months, OASIS solves both priority 1 and 2 when it evaluates the second *solve* command. Note that it is not necessary to use the *rewrite* option in the second *solve* command, because we have not changed any of the built-in variables.

```
SET initial_inflow200 : inflow200
{  value : timesers(200/base_inflow) - 30  }

:ITERATE:

SET revise_inflow200 : inflow200    {  value : inflow200 + 30  }

SOLVE ITERATIVE Rewrite :
{ condition : inflow250 > 5000
    priority : 1
    CRITERIA : flow201.202 > 1000
    itermax : 6

  condition : default
    priority : 1
    converge : flow201.202
    tolerance : .001
    itermax : 6
}
```

In this example, the first *set* command assigns a value to *inflow200*, and the second *set* command increments the value by 30 units. The *solve* command is iterative, so if the criteria are not met, then OASIS will re-evaluate all commands after the *:ITERATE:* marker. Thus, the second *set* command will increment the value of *inflow200* by 30 units every iteration. It is important that we use the *rewrite* option in the *solve* command, because we are changing the value of a built-in variable (*inflow*) after solving.

The two conditions of the *solve* command use different types of stopping criteria. The first condition uses a criteria expression, while the second uses the stopping-on-convergence method. When the first condition is true, iterations will stop when *flow201.202* exceeds 1000 units. When the second condition is true, iterations will stop when the difference between the values of *flow201.202* this iteration and last iteration is less than 0.001. Under both conditions, no more than 6 iterations will be performed.

J. *Cancel* Command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:
```
      Cancel :
      {   Priority : [integer priority level]   }
```

Conditional form:
```
      Cancel :
      {
          Condition [condition name] : [condition expression]
            Priority : [integer priority level]

         [...]

          Condition [condition name] : [condition expression]
            Priority : [integer priority level]
      }
```

Tells OASIS to cancel a single priority level, *[integer priority level]*, that has been previously solved with the *solve* command. See section 2.5.1 part H for an introduction to this command.

Normally, each priority level is constrained to the alternate optima of the priority levels that were solved before it (section 2.2.6). The effect of the *cancel* command is to remove the constraint so that the solution of future priority levels are *not* constrained to the alternate optima of *[integer priority level]*. OASIS cancels *[integer priority level]* regardless of the identity of the most recently solved priority level. If *[integer priority level]* has not yet been solved for the current time step, then the *cancel* command has no practical effect.

The *cancel* command does not affect the solved values of decision variables that are in memory – they remain the same after the *cancel* command as before the *cancel* command is evaluated. For example, if priority 1 is solved through use of the *solve* command, suppose that *flow100.200* is given the value 560.8 units. If the *cancel* command is then used to cancel priority 1, the value of *flow100.200* is still 560.8 units. The value of this variable does not change until another *solve* command is evaluated.

The *cancel* command may be conditional or unconditional. There is little difference between the two. Internally, OASIS treats all *cancel* commands as though they were conditional. It stores the unconditional *cancel* command in memory by giving it the implicit condition *default*. The conditional form may have one or many conditions.

For the conditional form, each condition can be given an optional *[condition name]*. The name cannot include any whitespace. The name is not required to be unique. It is for your convenience in OASIS output. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. Each condition field is the head of a **condition block**. Each condition block must have a *priority* field. Thus, the priority level would vary with each condition.

Example:

This example shows a greatly simplified version of a problem where the *cancel* command was actually used. It is so simplified that you could easily compute the values you need without the *cancel* command. We'll show an approach with the *cancel* command, and one without, and explain why the *cancel* command may be desirable.

Suppose there are two reservoirs, represented by nodes number 1 and 3. They are on separate forks of a river. There are in-stream flow requirements immediately below each reservoir. The inflow to each reservoir is uncontrolled, and there is no evaporation. Far downstream, below the confluence of the two forks, at the mouth of the river, there is an in-stream flow requirement. Usually, the flow requirement at the mouth is governing the operation. For some reason, it is important to know how much water would have to come out of storage if the flow requirement at the mouth did not exist.

Here's how you could compute the storage release *without the* cancel *command*. Not shown are weights on storage in each reservoir, and weights on the minimum flow targets in priority 1.

```
set compute_Min_Stor_release : Min_Stor_release
{
  value : min_flow001.101 + min_flow003.103 - ( inflow001 + inflow003 )
}
TARGET Final_outflow :   dFlow180.999
{  priority : 1
   penalty+ : 0
   penalty- : 100
     value  : 50
}

SOLVE :   { priority : 1 }
```

Here's how we could do it with the *cancel* command. Not shown are weights on storage in each reservoir, and weights on the minimum flow targets in priority 2.

```
TARGET Pri_1_stor :   dStorage001 + dStorage003
{  priority : 2
   penalty+ : -20
   penalty- : bound
     value  : 0
}
TARGET Pri_1_flow :   dFlow001.101
{  priority : 2
   penalty+ : 0
   penalty- : 80
     value  : min_flow001.101
}
TARGET Pri_1_flow :   dFlow003.103
{  priority : 2
   penalty+ : 0
   penalty- : 80
     value  : min_flow003.103
}

SOLVE :   { priority : 1 }

CANCEL :  { priority : 1 }

set compute_Min_Stor_release : Min_Stor_release
{
  value :   ( storage001(-1) + storage003(-1) )
          - ( storage001     + storage003     )
}
TARGET Final_outflow :   dFlow180.999
{  priority : 2
   penalty+ : 0
   penalty- : 100
     value  : 50
}

SOLVE :   { priority : 2 }
```

The first approach appears much simpler, so why would we ever want to use the *cancel* command? Suppose that instead of a single in-stream flow requirement, each of the two reservoirs was responsible for meeting several in-stream flow requirements, and there are numerous diversions, return flows, and local inflows along each fork of the river. Suppose we add more reservoirs and in-stream flow requirements upstream of reservoirs 1 and 3. The value expression in the *set* command *compute_Min_Stor_release* would become horribly complex! If you wanted to add a new flow requirement or a new diversion to the model, you would also have to modify the *set* command *compute_Min_Stor_release*. Figuring out how to modify this command would be like untying a difficult knot.

With a more complicated system, the second approach, using the *cancel* command, is much simpler. This is because the second approach takes advantage of OASIS' built-in continuity constraints. When OASIS solves priority 1, it is figuring out the solution to the formula that would have been so complicated using the first approach.

Whereas the first approach has only a priority 1, the second approach has two priority levels. The second priority level reflects the actual operating rules. The first priority level is used only to compute *Min_Stor_release*. The priority-1 *target* commands *pri_1_flow* and *pri_1_stor* are duplicating operating goals that exist in priority 2 (in the database weights tables – not shown). In fact priority 1 must contain separate versions of all operating goals that affect *Min_Stor_release*. It definitely does not contain target *Final_outflow*. If you add new operating goals to priority 2, and those goals should affect the value of *Min_Stor_release*, then those goals will need to be duplicated in priority 1. That is extra work, but it is simpler than the first approach, because you do not have to interpret the complicated formula. Also remember that you do not have to compute new values for demand or minimum flow for the extra priority level. Those values can be computed once, and applied to both priority levels.

Note that the *cancel* command tells OASIS that priority 2 is not constrained to the alternate optima of priority 1. However, even after the *cancel* command is issued, the results of the *solve* command for priority 1 remain in the variables *storage001* and *storage003*. These variables do not change until priority 2 is solved.

4.7.3 SYNTAX OF OCL EXPRESSIONS

The OCL **expression** is a key element of OCL syntax. When OASIS evaluates OCL commands each time step, the expressions are evaluated to their constant values. Expressions consist of the following types of symbols:

constants

non-decision variables

decision variables

mathematical operators

parentheses

functions

Constants are always stored as floating-point numbers. You may write them in regular decimal form or scientific notation. For example, you could write *345100000* or *3.451e8* to enter the same constant. Non-decision variables are described in section 4.7.4. Decision variables are described in section 4.7.5. Functions are documented in section 4.7.6.

OCL expressions may include the following operators, listed in the order that they will be evaluated.

`^`	Power
`*   /`	Arithmetic multiplication and division
`+   -`	Arithmetic addition and subtraction
`<  >  <=  >=  =  !=`	Comparison or relational operators: less-than, greater-than, less-than-or-equal-to, greater-than-or-equal-to, equal-to, and not-equal-to
`and  or`	Logical operators

Parentheses will always override the order of operations.

Normally, comparison operators and logical operators will be reserved for condition expressions, and condition expression will have at least one comparison operator. However, there is no strict requirement for conditions expressions to include a comparison operator, and comparison operators can always be used in other types of expressions. When a comparison or logical expression is evaluated, if the expression is true, the result is one. If the expression is false, the result is zero. For example:

```
( 2 + 2 = 4 )
```

evaluates to one, while

```
( 2 + 2 = 5 )
```

evaluates to zero. Therefore,

```
( 2 + 2 = 4 ) * 8
```

evaluates to eight, while

```
( 2 + 2 = 5 ) * 8
```

is zero. How, then, does the OCL expression evaluator know when a condition expression is true? Any condition expression which evaluates to a non-zero value (any positive or negative number) is true. Any condition expression which evaluates to zero is false.

4.7.4 SYNTAX OF OCL NON-DECISION VARIABLES

Decision variables are the unknown variables that are solved by the LP router (section 2.2.0). **Non-decision variables** are evaluated to their constant values before being incorporated into the LP problem. See section 4.7.5 for discussion of decision variables. Once the LP has been solved, the values of decision variables are stored as non-decision variables. In OCL, the non-decision variable forms of the decision variables have the same names, except that the decision variables have an extra letter *d* (for *decision*) at the front of their name.

This section will cover the time lags and time indices that can be applied to non-decision variables, and give the details of the syntax of every non-decision variable recognized in OCL. Decision variables are covered in section 4.7.5.

Many variable names must include identifying information, such as node numbers, arc numbers, or the name of the pattern for the *pattern* variable. This identifying information is attached to the variable — do not try to separate it with whitespace. Remember that node numbers must always be given in three-digit form. For example, node 94 must be given as *094*.

A. Time lags and time indices on non-decision variables

The **time lag** on a variable indicates which time step it belongs to *relative to the current step*. Every non-decision variable has a *default* time lag, which is the lag of the most current known value of the variable. You can override the default lag by entering a time lag or index in parentheses at the end of the variable, *not separated by whitespace*. For example:

`inflow950`	The current time-step inflow at node 950 (default).
`inflow950(0)`	The current time-step inflow at node 950.
`inflow950(-1)`	The inflow at node 950 one time step ago.
`inflow950(-2)`	The inflow at node 950 two time steps ago.
`inflow950(+1)`	The inflow in the next time step. (The "+" sign is mandatory).

In place of the lag, you can also enter **absolute time-step indexing**. A dollar sign (*$*) indicates that the absolute index is a period number of the year. The dollar sign should precede period numbers (1-[number of periods per year]). For simulations using a monthly time step, you can use an *M* or *m* preceding month numbers (1-12). You may also use *C* or *c* with a number to indicate a step of the time-step cycle (section 2.8.1).

The absolute time index must specify *which* period, past or present, to use. For example, if an OCL expression is being evaluated in March, and the expression includes December inflow, should the model use inflow next December or last December? Thus, the *$*, *M*, or *C* must be preceded by one of the following characters:

+	Use the future or current value.
-	Use the past value.
=	Use the value from the current year, regardless of whether it is present or past.

Examples:

`inflow950(+$3)`	The inflow at node 950 during the next period 3, or the current period if it is period 3.
`inflow950(+m3)`	The inflow at node 950 during the next March, or the current month if it is March.
`inflow950(-m3)`	The inflow at node 950 last March. If the current month is March, then use the inflow one year ago.
`inflow950(=m6)`	The inflow at node 950 during June of the current year (the current water year if on a water-year basis).
`evap220(=c3)`	The evaporation at node 220 during the third step of the current time-step cycle.
`evap220(-c3)`	The evaporation at node 220 during the third step of the previous time-step cycle.

If you are simulating at a monthly time step, note that month number 3 (*=m3*) is always March. However, period number 3 (*=$3*) and cycle-step number 3 (=c3) are December if the simulation is on a water-year basis.

B. *Abs_period* variable

Syntax form (see section 4.7.0 part A for conventions):
        abs_period

The absolute period of the simulation. This is a counter which starts at 1 in the first time step and increments by one for every time step thereafter, without being ever reset. A primary use of this variable is for identifying the initial time step (e.g. *Condition : abs_period = 1*). Lags and time indices will not work on this variable.

C. *Ann_demand* variable

Syntax form (see section 4.7.0 part A for conventions):
        ann_demand*[nnn]*

(Obsolete). Annual demand at the node number *[nnn]*, in primary volume units (section 2.9.0) per year. This is simply the value that was entered into the *Demand* table in the defunct *Annual limit* field, multiplied by the value from the defunct *Factor* field. Because it is a constant, lags and time indices will not work on this variable.

D. *Concentration* variable

Syntax form (see section 4.7.0 part A for conventions):
        concentration*[nnn]***(***[constituent name]***)**

The concentration of water quality constituent *[constituent name]* at node *[nnn]*, measured in the primary units of *[constituent name]* (section 2.9.0). For a reservoir, it is the beginning-of-period concentration, and the default is the current time step (0). For other node types, it is the end-of-period concentration, and the default is the previous time step (-1). See section 2.10.0.

Example: `concentration350(TDS)`

E. *Conc_input* variable at a node

Syntax form (see section 4.7.0 part A for conventions):
        conc_input*[nnn]***(***[constituent name]***)**

The water quality input for *[constituent name]* at node *[nnn]*. This represents either the concentration of the inflow, the concentration imposed on the entire node, the fraction removed at the node, or the value added to the node; depending on the entry in the *Node* table (section 4.5.3 part B). The value is either a fraction, or measured in the primary units for *[constituent name]*. Default is the current time step (0). See section 2.10.0.

Example: `conc_input068(TDS)`

F. *Conc_input* variable at an arc

Syntax form (see section 4.7.0 part A for conventions):
        conc_input*[bbb]***.***[eee]***(***[constituent name]***)**

The water quality input for *[constituent name]* at the arc that goes from node *[bbb]* to node *[eee]*. This represents either the exact concentration imposed on the arc, the fraction removed at the arc, or the value added to the arc, depending on the entry in the *Arc* table (section 4.5.3 part C). The value is either a fraction, or measured in the primary units for *[constituent name]*. Default is the current time step (0). See section 2.10.0.

Example: `conc_input530.022(THM)(-2)`

G. *Cycle_step* variable

Syntax form (see section 4.7.0 part A for conventions):
        cycle_step

The number (1 - number of steps in the cycle) of the step within the time-step cycle. Default is the current time step (0). See section 2.8.1.

H. *Day* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        day
```

The calendar day number (1-31) of the end of the time step. Default is the current time step (0). See section 2.8.1.

I. *Dead_stor* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        dead_stor[nnn]
```

The dead storage, in primary volume units (section 2.9.0), at reservoir node *[nnn]*. Because it is a constant, lags and time indices have no meaning for this variable. See section 2.4.0 part H.

J. *Demand* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        demand[nnn]
```

The period's demand at demand node *[nnn]*, in primary volume units (section 2.9.0) per time step. Default is the current time step (0). See section 2.4.0 part D.

K. *Delivery* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        delivery[nnn]
```

The period's delivery at demand node *[nnn]*, in primary volume units (section 2.9.0) per time step. Default is the previous time step (-1). (In Onevar the default is the current time step (0).) This variable is the result of solving the *dDelivery* decision variable (section 4.7.5), which is the current-time-step delivery at the node. See section 2.4.0 part D.

L. *Elevation* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        elevation[nnn]
```

The beginning-of-period water-surface elevation, in primary elevation units (section 2.9.0), at reservoir node *[nnn]*. Default is the current time step (0). After a *solve* command, the default is the *beginning-of-period* elevation of the *next* time step, which is the same as the end-of-period elevation of the current time step. See section 2.4.0 part F.

M. *Evap* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        evap[nnn]
```

The beginning-of-period evaporation, in primary volume units (section 2.9.0), at reservoir node *[nnn]*. Default is the current time step (0). After a *solve* command, the default is the *beginning-of-period* evaporation of the *next* time step, which is the same as the end-of-period evaporation of the current time step. See section 2.4.0 part G.

N. *Evap_rate* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        evap_rate[nnn]
```

The evaporation rate, in primary elevation units (section 2.9.0), used to compute beginning-of-period evaporation at reservoir node *[nnn]*. Default is the current time step (0). See section 2.4.0 part G.

O. *Flow* variable

Syntax form (see section 4.7.0 part A for conventions):
    `flow`*`[bbb]`***`.`***`[eee]`*

The flow through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. Default is the previous time step (-1). (In Onevar the default is the current time step (0).) This variable is the result of solving the *dFlow* decision variable (section 4.7.5), which is the current-time-step flow in the arc.

Example: `flow530.022(=$3)`

P. *Inflow* variable

Syntax form (see section 4.7.0 part A for conventions):
    `inflow`*`[nnn]`*

The flow from outside the system to node *[nnn]*, in primary volume units (section 2.9.0) per time step. Default is the current time step (0). See section 2.4.0 part E.

Q. *Julian* variable

Syntax form (see section 4.7.0 part A for conventions):
    `julian`

The day number (1-366) of the year at the end of the time step. Default is the current time step (0). The last day of the year is always 366, and the number for leap day is skipped during non-leap years. For example, in the standard January-December year, leap day is julian day 60. Thus, during non-leap years, the sequence goes directly from 59 to 61. See section 2.8.1.

R. *Length* variable

Syntax form (see section 4.7.0 part A for conventions):
    `length`

The length of the time step, measured in days. Default is the current time step (0). This may be a non-integer value. See section 2.8.1

S. *Lower_rule* variable

Syntax form (see section 4.7.0 part A for conventions):
    `lower_rule`*`[nnn]`*

The storage value of the lower rule curve, in primary volume units (section 2.9.0), at reservoir node *[nnn]*. Default is the current time step (0). See section 2.4.0 part H.

T. *Max_flow* variable

Syntax form (see section 4.7.0 part A for conventions):
    `max_flow`*`[bbb]`***`.`***`[eee]`*

The maximum flow through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. Default is the current time step (0). See section 2.4.0 part A.

U. *Max_stor* variable

Syntax form (see section 4.7.0 part A for conventions):
    `max_stor`*`[nnn]`*

The maximum storage (capacity), in primary volume units (section 2.9.0), of reservoir node *[nnn]*. Because it is a constant, lags and time indices have no meaning for this variable. See section 2.4.0 part H.

V. *MaxRev_flow* variable

Syntax form (see section 4.7.0 part A for conventions):
`MaxRev_flow`*`[bbb]`***`.`***`[eee]`*

The maximum reverse flow (bound) through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. Default is the current time step (0). See section 2.4.0 part C.

W. *Min_flow* variable

Syntax form (see section 4.7.0 part A for conventions):
`min_flow`*`[bbb]`***`.`***`[eee]`*

The minimum (target) flow through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. Default is the current time step (0). See section 2.4.0 part B.

X. *Minute* variable

Syntax form (see section 4.7.0 part A for conventions):
`minute`

The minute (1-1440) of the day at the end of the time step. Default is the current time step (0). See section 2.8.1.

Y. *Month* variable

Syntax form (see section 4.7.0 part A for conventions):
`month`

The calendar month number (1-12) of the end of the time step. Default is the current time step (0). See section 2.8.1.

Z. *MPO_step* variable

Syntax form (see section 4.7.0 part A for conventions):
`MPO_step`

The MPO step (1-number of MPO steps) currently being evaluated. Lags and time indices will not work on this variable. See section 2.2.7.

AA. *Num_MPO_steps* variable

Syntax form (see section 4.7.0 part A for conventions):
`Num_MPO_steps`

The total number of MPO steps that are solved during the current time step. See section 2.2.7. Lags and time indices will not work on this variable.

BB. *Pattern* variable

Syntax form (see section 4.7.0 part A for conventions):
`pattern(`*`[name]`***`)`**

A time-pattern variable read from the OCL static database. See section 4.5.8 part B. If a *pattern* variable is used, then a static file must be identified with the *:STATDB:* meta-keyword (section 4.7.1 part E) at the beginning of the input file. The name of the variable (as it appears in the static file) must be given in parentheses at the end of the variable name. Default is the current time step (0).

Example: `pattern(Keswick_flow_target)`

CC. *Period* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        period
```

The period number (1 - number of periods per year) of the time step. Default is the current time step (0). Lags and time indices will not work on this variable.

If you are using a daily-time-step model, you should note the behavior of this variable during leap year. Suppose you are using a regular calendar year (i.e. not water year). The *period* value on February 1 is always 32. However, the *period* value of March 1 would depend on whether it is leap year. In a non-leap year, March 1 would have a *period* value of 60, while in leap year, it would be 61.

DD. *Prep* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        prep([var name])
```

The variable from the pre-processor database that was identified with name *[var name]* in the *:PREPDB:* field (section 6.1.7 part U). This variable can be used only in the Onevar input file (section 6.1.3). Default is the current time step (0).

EE. *Shortage* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        shortage[nnn]
```

The shortage at demand node *[nnn]*, in primary volume units (section 2.9.0) per time step. Default is the previous time step (-1). See section 2.4.0 part D.

FF. *Storage* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        storage[nnn]
```

The end-of-period storage, in primary volume units (section 2.9.0), at reservoir node *[nnn]*. Default is the previous time step (-1). In other words, the default is the beginning-of-period storage for the current step. (In Onevar the default is the current time step (0).) This variable is the result of solving the *dStorage* decision variable (section 4.7.5), which is the *current-time-step* end-of-period storage at the node. After a *solve* command, the default lag for the *Storage* non-decision variable is the current time step (0).

GG. *Table* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        table([table name])
```

The value of a Onevar table (section 6.1.9 part C), assumed to be current time step (0). This variable can be used only in the Onevar input file (section 6.1.3).

By using this variable, you can create some of the effects of a spreadsheet within Onevar. However, there are restrictions on use of the *table* variable. The table named by this variable must precede the table in which the variable is used. Also, the time lag on this variable must refer to the present or a previous period, not a future period.

HH. *Target_val* variable

Syntax form (see section 4.7.0 part A for conventions):
```
        target_val([target name])
```

The evaluated target value of the *target* command with *[target name]* (section 4.7.2 part E). Because OASIS does not prohibit redundant names for the *target* command, it is possible for you to create more than one *target* command with *[target name]*. The *target_val* variable always refers to the first *target* command with *[target name]*. If *[target name]* does not precede the use of the *target_val* variable, then OASIS is unaware of the existence of *[target name]* when it reads the variable, and it issues an error. Lags and time indices will not work on this variable.

Example:

```
Set : stor_targ
{    Condition : month = 3  and  indicator > 4.5
         Value :   670
     Condition : month = 3  and  indicator > 2.5
         Value :   700
     Condition : month = 3
         Value :   740
     Condition : default
         Value :   680
}
Target stor500-502 :  dStorage500 + dStorage502
{    Condition : month = 3  and  indicator > 4.5
        Priority : 1   Penalty+ : 0   Penalty- : 50    value : stor_targ
     Condition : month = 3  and  indicator > 2.5
        Priority : 1   Penalty+ : 0   Penalty- : 70    value : stor_targ
     Condition : month = 3
        Priority : 1   Penalty+ : 10  Penalty- : 70    value : stor_targ
     Condition : default
        Priority : 1   Penalty+ : 0   Penalty- : 50    value : stor_targ
}
```

In the example above, you must apply extra care to make sure that the condition statements are identical between the target command and the *set* command. If a change was made to one of the commands, there is a danger that you would forget to make the identical change to the other command. This problem can be relieved by, firstly, removing the *set* command. Secondly, add the *set* command shown below *after* the *target* command.

```
Set : stor_targ
{     Value :  targ_val(stor500-502)    }
```

II. *Timesers* variable

Syntax form (see section 4.7.0 part A for conventions):

```
timesers([b-path]/[c-path])
```

A variable read from the DSS time-series database. See section 4.6.5. If a *timesers* variable is used, then a DSS file must be identified with the *:TIMEDB:* meta-keyword (section 4.7.1 part F) at the beginning of the input file. The b-path and c-path of the DSS pathname must be given in parentheses at the end of the variable name. Default is the current time step (0).

Example:
```
timesers(Kern/FORECAST_INFLOW)
timesers(SanJoaquin/FORECAST_INFLOW)(-3)
```

JJ. *Upper_rule* variable

Syntax form (see section 4.7.0 part A for conventions):

```
Upper_rule[nnn]
```

The storage value of the upper rule curve, in primary volume units (section 2.9.0), at reservoir node *[nnn]*. Default is the current time step (0). See section 2.4.0 part H.

KK. *Year* variable

Syntax form (see section 4.7.0 part A for conventions):

```
year
```

The year number at the end of the time step.

LL. Udef variable

Syntax form (see section 4.7.0 part A for conventions):

```
[udef name]
```

A user-defined variable that was created through OCL's *udef* command (section 4.7.2 part B). If the udef is created as a non-decision variable, it is assumed to be current time-step value (0). If the udef is created as a decision variable, it is assumed to be previous-time-step value (-1). (If the udef is created as a decision variable, Onevar assumes that it is a current-time-step value (-1).) The current-time-step value of decision variables is an unknown and can only be applied as *d[udef name]* (see section 4.7.5). OASIS does not intrinsically attach any units of measurement to the value of the *udef* variable. The units of measurement for a *udef* variable depend on how it is used in the model.

4.7.5 SYNTAX OF OCL DECISION VARIABLES

Decision variables are the unknown variables that are solved by the LP router (section 2.2.0). **Non-decision variables** are evaluated to their constant values before being incorporated into the LP problem. See section 4.7.4 for discussion of non-decision variables. Once the LP has been solved, the values of decision variables are stored as non-decision variables. In OCL, the non-decision variable forms of the decision variables have the same names, except that the decision variables have an extra letter *d* (for *decision*) at the front of their name.

This section will provide the syntax of every decision variable recognized in OCL. Non-decision variables are covered in section 4.7.4.

There are many more restrictions on the use of decision variables than on non-decision variables. The only expressions that may contain decision variables are the *[constraint expression]* of the *constraint* command, and the *[target expression]* of the *target* command (These expressions must be **linear combinations** of the decision variables). Furthermore, decision variables cannot appear in expressions that are arguments to functions. See section 4.7.3 for more details about OCL expressions.

Many variable names must include identifying information, such as node numbers, or arc numbers. This identifying information is attached to the variable — do not try to separate it with whitespace. Remember that node numbers must always be given in three-digit form. For example, node 94 must be given as *094*.

A. Time lags on decision variables

Every decision variable has a default time lag of zero, meaning the current time step. Explicit time lags on a decision variable are legal only when doing MPO (section 2.2.7). The explicit lags indicate the value of the decision variable at MPO steps other than the one currently being evaluated. If you are doing MPO, you can enter an explicit lag in parentheses at the end of the variable, *not separated by whitespace*. For example:

`dDelivery910`	The delivery at node 910 for the current MPO step (default).
`dDelivery910(0)`	The delivery at node 910 for the current MPO step.
`dDelivery910(+2)`	The delivery at node 910 two MPO steps ahead of the current MPO step.
`dDelivery910(-1)`	The delivery at node 910 one step before the current MPO step.

These time lags have similar syntax to the *relative* time lags on non-decision variables (section 4.7.4 part A). There is no decision-variable equivalent to the absolute time indices of the non-decision variables.

In place of the lag, you may enter a special code into the parentheses indicating that the decision variable is to be *accumulated* (that is, *summed*) over the MPO steps. The following codes are recognized:

ACC	The instances of the variable are summed for all MPO steps.
+ACC	The instances of the variable are summed for all MPO steps that follow the step currently being evaluated. This *does not* include the step currently being evaluated.
-ACC	The instances of the variable are summed for all MPO steps that precede the step currently being evaluated. This *does not* include the step currently being evaluated.

An important advantage of using the accumulation codes is that OASIS automatically adjusts the number of terms in the expression when the number of MPO steps changes.

As an example, suppose there are four MPO steps to be solved this step. If this OCL command is used:

```
Constraint NoMultiple Short : {  dFlow300.555(ACC) < pattern(Max300.555)  }
```

it is the same as using this command:

```
Constraint NoMultiple Long-4 :
{  dFlow300.555 + dFlow300.555(+1) + dFlow300.555(+2) + dFlow300.555(+3)
          <  pattern(Max300.555)  }
```

However, if in the following time step there are only three MPO steps to be solved, the example with the *ACC* code is equivalent to this command.

```
Constraint NoMultiple Long-3 :
{  dFlow300.555 + dFlow300.555(+1) + dFlow300.555(+2) < pattern(Max300.555)  }
```

With the *ACC* code, OASIS automatically adjusts the number of terms. Without the *ACC* code, this task is more difficult to write and to read, because we would have to write out both long versions of this constraint and add condition statements.

B. *dDelivery* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        dDelivery[nnn]
```

The delivery at demand node *[nnn]*, in primary volume units (section 2.9.0). The solved values of this variable become the *delivery* non-decision variable (section 4.7.4).

Example: `dDelivery165`

C. *dFlow* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        dFlow[bbb].[eee]
```

The flow through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. The solved values of this variable become the *flow* non-decision variable (section 4.7.4).

Example: `dFLOW450.032`

D. Flow-split variables

Syntax form (see section 4.7.0 part A for conventions):

```
        dFlowA[bbb].[eee]
        dFlowB[bbb].[eee]
```

The segments of the flow through the arc that goes from node *[bbb]* to node *[eee]*, in primary volume units (section 2.9.0) per time step. These segments are divided by the minimum (target) flow value of the arc (section 2.4.0 part B). The A-segment is below the minimum flow, and the B-segment is above minimum flow. The solved values of these variables are not directly accessible through OCL expressions.

Example: `dFlowA450.032`

E. *dStorage* variable

Syntax form (see section 4.7.0 part A for conventions):

```
        dStorage[nnn]
```

The storage at reservoir node *[nnn]*, in primary volume units (section 2.9.0). The solved values of this variable become the *storage* non-decision variable (section 4.7.4).

Example: `dStorage652`

F. Storage zone variables

Syntax form (see section 4.7.0 part A for conventions):

```
        dStorA[nnn]
        dStorB[nnn]
        dStorC[nnn]
        dStorD[nnn]
```

These are the individual segments of storage at reservoir node *[nnn]*, in primary volume units (section 2.9.0). See section 2.4.0 part H for a discussion of reservoir zones. The solved values of these variables are not directly accessible through OCL expressions.

Example: `dStorage165`

G. Udef decision variables

Syntax form (see section 4.7.0 part A for conventions):

```
        d[udef name]
```

The current-time-step value of a user-defined decision variable. The solved values of this variable become the non-decision variable *[udef name]* (section 4.7.4). *[Udef name]* must have been defined with the *udef* command (section 4.7.2 part B). OASIS does not intrinsically attach any units of measurement to the value of the *udef* variable. The units of measurement for a *udef* variable depend on how it is used in the model.

Example:

Suppose we have a decision variable udef named *Oscar*...

```
        ( dOscar - Oscar ) / Oscar
```

The above linear expression is equal to the percent change in *Oscar*. The variable *dOscar* is the decision variable – the value of *Oscar* for the current time step. Without the *d* at the beginning, the variable *Oscar* is the most current known value of Oscar.

4.7.6 SYNTAX OF OCL FUNCTIONS

OCL has many built-in functions that can be included in your OCL expressions (section 4.7.3). Most function arguments are OCL expressions, although some functions take specialized arguments. Decision variables can never be part of expressions that are arguments to functions. The arguments to the function are always enclosed in curly braces, and separated from each other by commas.

A. *Abs_val* function

Syntax form (see section 4.7.0 part A for conventions):

```
        abs_val{ [argument expression] }
```

Returns the absolute value of *[argument expression]*.

B. *Accumulate* function

Syntax form (see section 4.7.0 part A for conventions):

```
        accumulate{ [variable] , [first time index] , [last time index] }
```

Returns the sum of the values of *[variable]* over several time steps. The *Accum* function is provided for backward compatibility, but it is superseded by the more flexible *TimeAccum* function (section 4.7.6 part U). In both of these functions, the principle of accumulating a value across several time steps is the same. However, with the *Accum* function, the time steps can only be specified in a small number of ways. With the *TimeAccum* function, the time steps can be specified more directly and clearly

[Variable] can be almost any non-decision variable, but it is not an expression. If you attach a time index to the end of *[variable]* in parentheses, it will be ignored. *[First time index]* is the code for the beginning of the accumulation, and *[last time index]* is the code for the end of the accumulation. Neither of the last two arguments are expressions. To construct these time index codes, follow the rules for the codes that are attached to variables (see section 4.7.4 part A). You can use any combination of absolute and relative time indices. If *[first time index]* comes after *[last time index]*, the function returns zero.

Almost any non-decision variable can be entered for *[variable]*. The only exceptions are those variables, such as *abs_period*, on which lags and time indices do not work (see section 4.7.4).

For example, suppose our simulation uses a regular calendar year (January-December) and a monthly time step. The values of the inflow at node 101 for each of the twelve months (starting in January) are:

{10, 25, 30, 55, 10, 60, 5, 8, 20, 100, 10, 31}

`accumulate{ inflow101 , =m2 , =m5 }`	would return 120.
`accumulate{ inflow101 , 0 , =m5 }`	would return 130 in January, 120 in February, 65 in April, 10 in May, and zero in all months after May.
`accumulate{ inflow101 , -1 , =m5 }`	would be 120 in March, 65 in May, 10 in June, and zero in all months after June.
`accumulate{ inflow101 , -1 , +2 }`	would be 120 in March and 161 in October.
`accumulate{ inflow101 , -$2 , +2 }`	would be 120 in March, 190 in April, and 195 in May.

C. *Convert_units* function

Syntax form (see section 4.7.0 part A for conventions):

```
        convert_units{ [value expression] , [input unit name] ,
                       [output unit name] , [lag expression] }
```

Converts the *[value expression]* from a value measured in *[input unit name]* to a value measured in *[output unit name]*. *[Input unit name]* and *[output unit name]* are text strings — not expressions. These two arguments must match names of units given in the *Units* table (section 4.5.3 part A). *[Lag expression]* is optional. If *[lag expression] = x,* that tells the function that the conversion should be performed assuming the number of days *x* time steps ago. It is only needed when the conversion differs by time step, such as the conversion from flow to volume when using a monthly time step.

For example, suppose that in our monthly model, the inflow to 101 is 500 million gallons (MGAL) this month. Our primary flow units are million gallons per day (MGD). The following example

```
        Convert_units{ inflow101 + 50 , MGAL , MGD }
```

would return 18.33 in June (30-day month), and 17.74 in July (31-day month). However,

```
        Convert_units{ inflow101 + 50 , MGAL , MGD , -1 }
```

would return 17.74 in June (May is a 31-day month), and 18.33 in July (June is 30-day month).

D. *Date_to_Jul* function

Syntax form (see section 4.7.0 part A for conventions):

```
        date_to_jul{ [month] , [day] }
```

Returns a julian day number (the day number of the year from 1-366) corresponding to the date given by *[month]* and *[day]*. Both arguments can be provided as expressions. *[Month]* must be a number 1-12, and *[day]* must be a number 1-31. The input values and the return value do not have to correspond to any model time step.

The last day of the year is always julian day number 366, and the number for leap day is skipped during non-leap years. For example, in the standard January-December year, leap day is julian day 60. Thus, during non-leap years, the julian sequence goes directly from 59 to 61. See section 2.8.1.

E. *Elev_to_stor* function

Syntax form (see section 4.7.0 part A for conventions):

```
        elev_to_stor{ [node_number] , [elevation value expression] }
```

Returns the storage, measured in primary volume units (section 2.9.0), at reservoir *[node number]*, given the *[elevation value expression]*. *[Node number]* cannot be an expression. *[Elevation value expression]* is assumed to be in primary elevation units. This function performs a look-up using the values entered into the *Reservoir S-A-E* table (section 4.5.3 part J). This function performs the inverse operation of the *Stor_to_elev* function.

F. *Exp* function

Syntax form (see section 4.7.0 part A for conventions):

```
        exp{ [argument expression] }
```

Returns the base of the natural logarithm raised to the power of *[argument expression]*.

G. *Floor* function

Syntax form (see section 4.7.0 part A for conventions):

```
        floor{ [value expression] }
```

Returns *[value expression]* rounded down to the nearest whole number.

H. *Is_Leap_Year* function

Syntax form (see section 4.7.0 part A for conventions):

```
        is_leap_year{ [year expression] }
```

Returns 1 if *[year expression]* is the year number of a leap year, and otherwise returns 0. The model's year scheme offset is taken into account when determining if the year is a leap year. See section 2.8.0 for more discussion of time measurement in OASIS.

I. *Jul_to_Day* function

Syntax form (see section 4.7.0 part A for conventions):

```
        jul_to_day{ [julian expression] }
```

Returns the day number of the month of the date corresponding to *[julian expresssion]*, where *[julian expression]* is a julian day number (the day number of the year from 1-366).

J. *Jul_to_Month* function

Syntax form (see section 4.7.0 part A for conventions):

```
        jul_to_month{ [julian expression] }
```

Returns the month number (1-12) of the date corresponding to *[julian expresssion]*, where *[julian expression]* is a julian day number (the day number of the year from 1-366).

K. *Log10* function

Syntax form (see section 4.7.0 part A for conventions):

```
        log10{ [argument expression] }
```

Returns the base-10 logarithm of *[argument expression]*.

L. *LogN* function

Syntax form (see section 4.7.0 part A for conventions):

```
        logN{ [argument expression] }
```

Returns the natural logarithm of *[argument expression]*.

M. *Lookup* function

Syntax form (see section 4.7.0 part A for conventions):

```
        lookup{ [table name] , [lookup value expression] }
```

This function looks up the value of the independent variable, given by *[lookup value expression]*, in the table named *[table name]*, and returns the corresponding value of the dependent variable. *[Table name]* is a text string — not an expression. If this function is used, there must be a static database identified with the *:STATDB:* keyword (section 4.7.1 part E) at the beginning of the file. The lookup table with *[table name]* must be entered into the table called *Lookup* in the OCL-database file (section 4.5.8 part A). In the *Lookup* table, you specify whether the table rounds up, rounds down, or interpolates between values.

N. *Max* function

Syntax form (see section 4.7.0 part A for conventions):

```
        max{ [value 1 expression] , [...] , [value n expression] }
```

Returns the maximum of the values of *[value 1 expression]...[value* n *expression]*. The number of arguments, *n*, must be at least two, but no more than six.

O. *Min* function

Syntax form (see section 4.7.0 part A for conventions):

```
        min{ [value 1 expression] , [...] , [value n expression] }
```

Returns the minimum of the values of *[value 1 expression]...[value* n *expression]*. The number of arguments, *n*, must be at least two, but no more than six.

P. *Remainder* function

Syntax form (see section 4.7.0 part A for conventions):

```
        remainder{ [argument 1 expression], [argument 2 expression] }
```

Returns the remainder when *[argument 1 expression]* is divided by *[argument 2 expression]*. Both arguments are rounded down to the nearest whole number before dividing.

Q. *RevLookup* function

Syntax form (see section 4.7.0 part A for conventions):

```
        RevLookup{ [table name] , [lookup value expression] }
```

This function looks up the value of the dependent variable, given by *[lookup value expression]*, in the table named *[table name]*, and returns the corresponding value of the independent variable. *[Table name]* is a text string — not an expression. If this function is used, there must be a static database identified with the *:STATDB:* keyword (section 4.7.1 part E) at the beginning of the file. The lookup table with *[table name]* must be entered into the table called *Lookup* in the OCL-database file (section 4.5.8 part A). In the *Lookup* table, you specify whether the table rounds up, rounds down, or interpolates between values.

The *RevLookup* function switches the roles of the dependent and independent variables in the OCL *Lookup* function (4.7.6 part M). The *RevLookup* is intended for use when a functional relationship between two variables needs to be looked up with either variable as input. If the functional relationship only calls for one variable to be the input and one the output, then the *Lookup* function should be used, not the *RevLookup* function.

R. *Round* function

Syntax form (see section 4.7.0 part A for conventions):

```
        round{ [value expression] , [increment expression] }
```

Returns the value of *[value expression]* rounded to the nearest multiple of *[increment expression]*. For example:

```
        ROUND{ 14 , 3 }
        ROUND{ 3.14159 , .001 }
        ROUND{ 87.99 , 10 }
```

Would return 15, 3.142, and 90, respectively. Note that the rounding algorithm is based on rounding to the nearest multiple of one. Internally , the value of *[value expression]* is divided by the value of *[increment expression]* rounded to the nearest integer, and then multiplied by *[increment expression]*. When rounding to the nearest integer, the algorithm rounds decimals of 0.5 toward the nearest even integer, to avoid bias.

S. *Stor_to_area* function

Syntax form (see section 4.7.0 part A for conventions):

```
        stor_to_area{ [node_number] , [storage value expression] }
```

Returns the surface area, measured in primary area units (section 2.9.0), at reservoir *[node number]*, given the *[storage value expression]*. *[Node number]* cannot be an expression. *[Storage value expression]* is assumed to be in primary volume units. This function performs a look-up using the values entered into the *Reservoir S-A-E* table (section 4.5.3 part J).

T. *Stor_to_elev* function

Syntax form (see section 4.7.0 part A for conventions):

```
        stor_to_elev{ [node_number] , [storage value expression] }
```

Returns the elevation, measured in primary elevation units (section 2.9.0), at reservoir *[node number]*, given the *[storage value expression]*. *[Node number]* cannot be an expression. *[Storage value expression]* is assumed to be in primary volume units. This function performs a look-up using the values entered into the *Reservoir S-A-E* table (section 4.5.3 part J). This function performs the inverse operation of the *Elev_to_stor* function.

U. *TimeAccum* function

Syntax form (see section 4.7.0 part A for conventions):

```
        TimeAccum{ [variable] , [first step code] , [first step parameters],
                              [last step code] , [last step parameters], }
```

Returns the sum of the values of *[variable]* over several time steps. The *TimeAccum* function supersedes the less flexible *Accum* (section 4.7.6 part B) function. In both of these functions, the principle of accumulating a value across several time steps is the same. However, with the *Accum* function, the time steps can only be specified in a small number of ways. With the *TimeAccum* function, the time steps can be specified more directly and clearly.

Almost any non-decision variable can be entered for *[variable]*. The only exceptions are those variables, such as *abs_period*, on which lags and time indices do not work (see section 4.7.4 part A). *[Variable]* can not be an expression. If you attach a time index to the end of *[variable]* in parentheses, it will be ignored.

The time step when the accumulation calculation is started is described by *[first step code]* and *[first step parameters]* and the time step of the end of accumulation is described by *[last step code]* and *[last step parameters]*. *[First step code]* and *[last step code]* can not be entered as expressions, but each must match one of the codes given in the table below. *[First step parameters]* and *[last step parameters]* each represent between one and three function arguments, and each of these arguments can be an OCL expression. *[First step parameters]* must correspond to *[first step code]*, and *[last step* *parameters]* must correspond to *[last step code]* as shown in the table:

Step code	**description**	**Step parameters (can be entered as expressions)**
lag	count of time steps relative to the current time step.	*[number of time steps]*
$	given time step number of the year and given year	*[time step number of the year], [year number]*
=$	given time step number of current year	*[time step number of the year]*
+$	next occurrence of given time step number of the year. If current time step is the given time step, then the current time step is used.	*[time step number of the year]*
-$	previous occurrence of the given time step number of the year	*[time step number of the year]*
date	given year, month, and day	*[month number], [day number of month], [year number]*
=date	given month and day of current year	*[month number], [day number of month]*
+date	next occurrence of given month and day. If current time step match the given month and day, then the current time step is used.	*[month number], [day number of month]*
-date	previous occurrence of given month and day.	*[month number], [day number of month]*
jul	given year and day number of the year (1-366)	*[day number of year], [year number]*
=jul	given day number of the current year	*[day number of year]*
+jul	next occurrence of given day number of the year. If current time step matches given day number of the year, then current time step is used.	*[day number of year]*
-jul	previous occurrence of given day number of the year.	*[day number of year]*
m	given month and given year (legal only if simulation time step is monthly)	*[month number], [year number]*
=m	given month of current year (legal only if simulation time step is monthly)	*[month number]*
+m	next occurrence of given month (if current month is the given month, then the current time step is used) (legal only if simulation time step is monthly)	*[month number]*
-m	previous occurrence of the given month (the current time step is never used) (legal only if simulation time step is monthly)	*[month number]*
=c	given cycle step number of current cycle	*[cycle step number]*
+c	next occurrence of given cycle step number. If current time step matches the given cycle step number, then current time step is used.	*[cycle step number]*
-c	previous occurrence of given cycle step number	*[cycle step number]*

The first time step and last time step can be described by any pair of the codes described above, and the same code may be used for both. However, the first time step is assumed to precede the last time step. If OASIS evaluates the function and determines that the last time step precedes the first time step, then the function returns zero.

The methods of offsetting time steps are related to the time lags and time indices described in section 4.7.4 part A. See section 2.8.0 for more discussion of time measurement in OASIS.

Suppose our simulation uses a regular calendar year and a daily time step. Using OASIS's *day* variable for *[variable]*, the results of the *TimeAccum* function would be as shown in the table of examples below.

Function	Value on Jan 1	Value on Jan 31
`TimeAccum{day, lag, 0, lag, 2}`	6	34
`TimeAccum{day, $, 2,year, =$, 3}`	5	5
`TimeAccum{day, =jul, 1, +jul, 3}`	6	67167
`TimeAccum{day, =date, 3,1, +date, 3,3}`	6	6
`TimeAccum{day, date, month,day,year, lag, 2}`	6	34

V. *TimeOffset* function

Syntax form (see section 4.7.0 part A for conventions):

`TimeOffset{` *`[variable]`* `,` *`[step code]`* `,` *`[step parameters]`* **`}`**

Returns the value of *[variable]* at the time step given by *[step code]* and *[step parameters]*. Generally this is used to apply the value of a variable from something other than the current time step. Some of the effects of this function can be achieved more concisely by applying a lag or time index to the variable, as described in see section 4.7.4 part A. However, the lag or time index can only be specified as a constant value, while the *TimeOffset* function can specify a time step using an OCL expression.

Almost any non-decision variable can be entered for *[variable]*. The only exceptions are those variables, such as *abs_period*, on which lags and time indices do not work (see section 4.7.4 part A). *[Variable]* can not be an expression. If you attach a time index to the end of *[variable]* in parentheses, it will be ignored.

[Step code] can not be entered as an expression, but must match one of the codes given in the table below. *[Step parameters]* represents between one and three function arguments, and each of these arguments can be an OCL expression. *[Step parameters]* must correspond to *[step code]* as shown in the table:

Step code	**description**	**Step parameters (can be entered as expressions)**
lag	count of time steps relative to the current time step.	*[number of time steps]*
$	given time step number of the year and given year	*[time step number of the year], [year number]*
=$	given time step number of current year	*[time step number of the year]*
+$	next occurrence of given time step number of the year. If current time step is the given time step, then the current time step is used.	*[time step number of the year]*
-$	previous occurrence of the given time step number of the year	*[time step number of the year]*
date	given year, month, and day	*[month number], [day number of month], [year number]*
=date	given month and day of current year	*[month number], [day number of month]*

Step code	**description**	**Step parameters (can be entered as expressions)**
+date	next occurrence of given month and day. If current time step match the given month and day, then the current time step is used.	*[month number], [day number of month]*
-date	previous occurrence of given month and day.	*[month number], [day number of month]*
jul	given year and day number of the year (1-366)	*[day number of year], [year number]*
=jul	given day number of the current year	*[day number of year]*
+jul	next occurrence of given day number of the year. If current time step matches given day number of the year, then current time step is used.	*[day number of year]*
-jul	previous occurrence of given day number of the year.	*[day number of year]*
m	given month and given year (legal only if simulation time step is monthly)	*[month number], [year number]*
=m	given month of current year (legal only if simulation time step is monthly)	*[month number]*
+m	next occurrence of given month (if current month is the given month, then the current time step is used) (legal only if simulation time step is monthly)	*[month number]*
-m	previous occurrence of the given month (the current time step is never used) (legal only if simulation time step is monthly)	*[month number]*
=c	given cycle step number of current cycle	*[cycle step number]*
+c	next occurrence of given cycle step number. If current time step matches the given cycle step number, then current time step is used.	*[cycle step number]*
-c	previous occurrence of given cycle step number	*[cycle step number]*

For example, if *[step code]* is *date*, then it must be followed by three function arguments. If *[step code]* is *+$*, then it must be followed by one function argument.

The methods of offsetting time steps are related to the time lags and time indices described in section 4.7.4 part A. See section 2.8.0 for more discussion of time measurement in OASIS.

Suppose our simulation uses a regular calendar year and a daily time step. Results of the *TimeOffset* function would be as shown in the table of examples below:

Function	**Value on Jan 1, 1990**	**Value on Jan 31, 1990**
`TimeOffset{day, lag, 0}`	1	31
`TimeOffset{day, lag, 2}`	3	2
`TimeOffset{day, $, 2, year-2 }`	2	2
`TimeOffset{day, =jul, julian+2}`	3	2
`TimeOffset{year, =jul, 3}`	1990	1990
`TimeOffset{year, +jul, 3}`	1990	1991
`TimeOffset{day, =date, 3, 17}`	17	17

W. *Weekday* function

Syntax form (see section 4.7.0 part A for conventions):

```
       weekday{ [year] , [month] , [day] }
```

Returns a number code for the day of the week of *[year]*/*[month]*/*[day]*. The codes are 1 through 7 representing Sunday through Saturday. All three of the arguments can be provided as expressions. *[Year]* must be given in 4-digit form. *[Month]* must be a number 1-12, and *[day]* must be a number 1-31.

4.7.7 EXTERNAL MODULES

External modules are programs external to OASIS which it initializes and calls during a simulation run. A module can be created with any computer language, so the program is created to follow the protocol for running with OASIS. There are at least two ways to think of external modules:

> As separate modeling programs that run in **parallel** and communicate with OASIS. You may think of OASIS as the model of water operation, while the external module might be a model of irrigated crops, biology, flood damage, etc.
>
> As user-designed routines or functions that **plug in** to OASIS to expand its computational ability.

Technically, there is no difference between these two approaches – they are only a matter of scale.

Computer programs are sets of very precise instructions for the computer. If there is a situation that the program was not written to handle, the results can be unpleasant. When you want two programs to exchange information, they must agree on exactly how to do so, to avoid situations that weren't written into the programs. Therefore, we say that we have a **protocol** for OASIS to communicate with external modules. The module must be designed according to the protocol if it and OASIS are to function smoothly together.

At the heart of the protocol, you tell OASIS to **call** a module by applying the *run_module* command (section 4.7.2 part G) in OCL. When this command is evaluated, OASIS passes a list of argument values to the module. If the module is threaded, then OASIS processes the module in a thread, and continues evaluating OCL commands in its own thread. If the module is not threaded, then OASIS waits for the module to complete its procedures. With a threaded module, OASIS does not wait until it evaluates a second *run_module* command that receives output. When it is finished, the module passes argument values back to OASIS. The module is then inactive until OASIS calls it again.

A single OASIS run can employ many different modules. The OCL *:MODULE:* meta-command (section 4.7.1 part G) must be used once in the declarations-section of the OCL file for module that is used. However, OASIS will skip the initialization if that module is never called by a *run_module* command in the commands section (see section 4.7.0 part G for a discussion of the sections of the OCL file). The *:MODULE:* meta-command tells OASIS the user-defined name of the instance of the module.

Modules may be newly written programs, or they may be adaptations of old programs. Adapting an old program to run as an OASIS module is generally not difficult. The adaptation usually consists of adding a few lines of code to handle the module protocol. Difficulties may arise if the existing program works with assumptions (particularly time-step assumptions) that are incompatible with OASIS.

HydroLogics staff have experience developing external modules. If you are creating an external module, you will probably find it easier to copy examples that HydroLogics can provide.

A. General steps of the external module protocol

Although we may think of the module as a program that runs in **parallel** with OASIS, computer programs generally must execute steps in a **series**. We can say our process has parallel nature because OASIS and its modules may exchange information every time step of simulation, even if they take turns executing within the time step.

The default case is that OASIS and the external module take turns executing within each time step. It is important to understand that the module is inactive until OASIS tells it to execute. When OASIS lets the module execute, then OASIS is inactive until the module returns control. The steps of the protocol describe what happens when OASIS passes control to the module.

However, it is possible for the external module to process in its own execution thread. In this case, OASIS and the module are truly multitasking. Note that this is only effective when running on a multiprocessor or multicore computer. It is probably better to view this case as computing each time step with calculations in series, but having a selected part of the calculations being done in parallel. It is only during time steps (evaluation of the *run_module* command) that this multitasking occurs. The multitasking is not available for initialization or shutdown.

The *thread* field of the *run_module* command (section 4.7.2 part G) determines whether the module is processed in its own thread – nothing within the module can control this. However, when multithreading is done, it may be important to ensure that the procedures of the module are "thread safe".

The general steps of the protocol are:

> **Initialization.** When OASIS runs, it goes through initializing steps – reading input, opening output files, and setting up variables. OASIS's initialization also includes initializing the module so that the module can perform the same types of tasks. There must be a specific subroutine in the module for OASIS to call at this time. This routine is only called once (per instance of the module) per run.

Step. This is the part of the module OASIS calls when the OCL *run_module* command (section 4.7.2 part G) is evaluated. This occurs one or more times per OASIS time period. There must be one specific routine in the module for OASIS to call for this step, and it calls the same routine every time it evaluates the *run_module* command.

First, OASIS passes a list of argument values to the module. Then, OASIS passes all control to the module and waits while the module executes its procedures. The module's procedures might include computations and reading or writing to files. When the module is finished with its procedures, it passes argument values back to OASIS. The module then waits until OASIS calls it again.

Shutdown. When OASIS closes, it calls upon the module to close itself. The module should then go through its shutdown stage, which might include writing summary output and closing files. There must be a specific subroutine in the module for OASIS to call for shutdown. This subroutine could be invoked for a normal completion of a run, or when there is an error.

These steps are described as though OASIS is the director of the process. While this is in some sense true, you could also view the external module as the director of the process, for once it has control, it decides when to return control to OASIS. The only difference is that it is OASIS that was executed first, so it makes the first call to the module.

B. Dynamic Link Library (DLL)

An external module is contained in a dynamic-link library with the *DLL* extension (it might also have an *EXE* extension), and it contains functions that OASIS calls. Information is passed in the arguments of the function calls. In earlier versions of OASIS there were other protocol types for external modules. Now however, all external modules follow a DLL protocol.

A standard executable contains functions that it calls as it executes. A **dynamic-link library** is a program file that contains functions for *other* programs to call as they execute. This system is very easy to understand and use. It is written just as if it were a stand-alone program with functions for the three steps of the general protocol. However it simply lacks the main function that connects the parts by looping from one time step to the next – instead, you let OASIS handle the role of the main function.

The external module DLL is **dynamically loaded** into OASIS. This is so OASIS can be built without knowing how many external module DLLs there will be in any run, or what their names are. Dynamic loading allows OASIS to determine this information as it runs. OASIS calls the Windows function *LoadLibrary*, which allows it to map the addresses of the DLL functions as it runs. The functions effectively become a part of OASIS, and you can do step-through debugging on them.

You do not need extensive experience with DLL programming, since you can copy examples that HydroLogics has already developed.

The general steps of the external module protocol (section 4.7.7 part A) are applied as follows:

Initialization. There must be a function called *MODULE_INITIALIZE* that OASIS can call. The arguments to this function are the character string for the name of the run directory, the string length of the run directory name, and an array of OASIS functions that the module can call and OASIS variables that the module can set. This function returns a 2-byte integer, whose value should be 1 if the function finished satisfactorily, 0 if there was an error.

Step. There must be a function called *MODULE_STEP* that OASIS can call. The first argument to this function is an array of 4-byte floating point numbers. When OASIS calls the module, this array contains the values of the input arguments of the *run_module* command. When the function returns, this array contains the values of the output arguments of the *run_module* command. This function returns a 2-byte integer, whose value should be 1 if the function finished satisfactorily, 0 if there was an error.

The second argument to *MODULE_STEP* is a 2-byte integer containing the number of input arguments. The third argument is a 2-byte integer containing the number of output arguments. OASIS does nothing to check whether the number of arguments in the input and output lists of the *run_module* command match some expectation built into the module. However, it is possible to program the the module to check the number of arguments.

It is possible for there to be more than one *run_module* command for the same module. You may wish to program the function *MODULE_STEP* so that it executes different procedures to handle the different *run_module* commands.

Shutdown. There must be a function called *MODULE_SHUTDOWN* that OASIS can call. The function has no arguments. The function does not return a value, since OASIS is shutting down whether the *MODULE_SHUTDOWN* function had an error or not.

For more detail on each of these parts, refer to an example program.

Remember that the functions of the DLL become functions of OASIS when OASIS calls them. Thus, if you stop the program (or there is an error) within one of the DLL functions, OASIS will terminate. There are two options for avoiding an unfriendly shutdown:

Return from *MODULE_STEP* with a value of zero. This causes OASIS to issue a generic message for a fatal error. You can program the module to write a more descriptive error message of its own.

Call the function *module_error_shutdown* in OASIS. The address of this function is passed in the third argument to *MODULE_INITIALIZE*. The function is written in C++, and it is declared like so in OASIS:

```
extern "C" __declspec( dllexport )
       void  module_error_shutdown(char error_text[])
```

The single argument, *error_text*, is a C character string (null-delimited). Write a description of the error into this string, and OASIS will print it in a pop-up window on the screen.

HydroLogics has not developed the ability to use more than one instance of the same DLL. This ability can be developed if there is sufficient interest. One way to work around this is to make a second copy of the DLL file, giving it a different name.

C. Parent module

It is theoretically possible for an external module to be the controlling program which calls dynamically-linked functions in OASIS. However, this capability has never been completed. This capability can be developed if there is sufficient interest.

CHAPTER 5
REFERENCE: MODEL OUTPUT

5.0.0 INTRODUCTION

OASIS generates many kinds of output, and most of it is user-definable in some way. However, you are probably better off relying on **post-processors** (Chapter 6) than looking directly at these output files. Post-processor programs read the input and output files, and present exactly the data you want, in exactly the format that you want. Direct viewing of the OASIS output files should be reserved for those times when you need to debug your operating rules or scrutinize a routing decision.

See section 2.6.0 for a general overview of the output files that OASIS writes. The sections of this chapter describe each of the OASIS output files, which are

Debug output (5.1.0)

Balance sheet output (5.2.0)

OCL output (5.3.0)

Weight output (5.4.0)

LP output (5.5.0)

Time-series output (5.6.0)

You can quickly open the ASCII-text output files from the *Output* menu of the OASIS GUI (section 3.6.4). However, the time-series output file is in HEC-DSS format, and the GUI does not provide any way to edit this file directly.

5.1.0 DEBUG OUTPUT

The debug output file is reserved for special messages, usually when there is a problem. Whenever a warning or a fatal error occurs, an explanation is written to this file. Most of these explanatory messages are also written to a pop-up window that appears when OASIS stops on the error. However, if you have an error, it is often worth checking the debug output to see if there is additional information. When warning messages are written to this file, a brief message appears in the OASIS application window, telling you to check the debug output.

You can have special warning messages written to this file when selected OCL targets experience a deviation. To use this option, enter the *WARN* flag in the *target* command (section 4.7.2 part E).

The file is always named *debug.out* and it always appears in the run directory. There is no way for you to change the file name or path. Except for the *WARN* flag in the *target* command, there is nothing you can do to define what is written to this file.

5.2.0 BALANCE SHEET OUTPUT

The balance sheet output contains a report of every flow in and out, for every node in the system, for every time step of simulation. It also reports basic information such as minimum flows, maximum flows, deliveries, shortages, evaporation, elevation, and water quality. This provides a convenient way to track routing decisions across time and space. The balance sheet does *not* write information that is specific to OCL.

As a security measure, OASIS is programmed to report any **imbalance** to this file, even though the continuity-of-flow constraints (section 2.2.4) guarantee that there will be no imbalance. The only time you would see imbalance being reported is when OASIS has stopped with an infeasible LP.

The file is always named *balance.out* and it always appears in the run directory. There is no way for you to change the file name or path. The balance sheet output can be either on or off, depending on a flag in the control file (section 4.4.0). You can also customize the output, as we will explain. OASIS writes information to this file at the end of every simulation year.

You should look at an example balance sheet file to help understand the format (Run OASIS to generate an example). The balance sheet output consists of several **balance sheets**, printed one after another, down the page. Each balance sheet consists of a balance summary for each node in the system (except terminal nodes). Each variable that pertains to the routing in and out of that node is listed in a row, and each time step is in a column. Each balance sheet only covers a portion of the total simulation time range. The method of deciding how many time steps, or columns, are in a balance sheet is called the **grouping**. For example, at a daily time step, you could have a balance sheet for every week or every month. You define the grouping in the *Grouping* field of the *Balance Sheet Columns* table (section 4.5.3 part N). The last column in every balance sheet is a total (which can also be an average) over all the time steps in the balance sheet. If you do not use the *Balance Sheet Columns* table, OASIS automatically chooses a grouping.

You can select which variables are printed as the rows of the balance sheet output in the *Balance Sheet Rows* table (section 4.5.3 part O). Most of the variables can be presented in two different ways. Any variables that are a type of flow can be displayed in volume units per time step, or in flow units. Reservoir storage variables can also be displayed as elevations. In this table, you can also specify whether a **total** will be reported for the variable. For flow units, reservoir storages or elevations, and water quality, the total will actually be an average.

You tell OASIS how many decimal places to display with each value in the balance sheet through the *Decimals* field in the *Units* table (section 4.5.3 part A).

Tips for searching the balance sheet file:
The balance sheet file can be huge, so when you want to see a particular time or a particular node, you should search for your data using the capabilities of the software that you use to view the file. There are two tricks that can make your searching more efficient:

To find a date. Each balance sheet begins with this text:

`BALANCE SHEET for` *`[date]`*

You will want to skip directly to the balance sheet that contains the date you are looking for. You can easily let your software search for it once you know that the word *for* only appears in this line at the top of each balance sheet. Suppose your balance sheets have an annual grouping method. If you wanted to go directly to the year 1966, you would tell your software to search for the string:

```
for 1966
```

To find a node. The balance summary for each node begins with a row that says:

`Node` *`[number]`*

You will want to skip directly to the node that you are looking for. You can easily let your software search for it once you know that the word *Node* only appears at the top of each node's balance summary. There are two spaces between the word *Node* and the node number. Thus, to find node 567, you would tell your software to search for the string:

```
Node  567
```

Note that the node numbers are aligned to the right-hand side, so if it is less than three digits, you will need more spaces between the word and the node number.

5.3.0 OCL OUTPUT

The OCL output shows the detailed results of your OCL commands. This is an important resource for determining whether your OCL commands are properly modeling the rules that you want.

The file is always named *OCL.out* and it always appears in the run directory. There is no way for you to change the file name or path. There are several categories of OCL output, and you choose which types of output you want to see by editing a flag in the control file (section 4.4.0). The OCL output file can be very large, so it is a good idea not to generate OCL output that you don't need. The categories of OCL output are listed in the following sections. OASIS writes information to this file every time step.

5.3.1 SUMMARY OF OCL INPUT

The summary of OCL input is always the first section of information written to *OCL.out*. There is no way for you to prevent OASIS from writing this information. This summary is written only before the first time step of the run.

The summary of OCL input includes the following sections:

SUMMARY OF UDEFS. This is a list of every udef that you have created either with the *udef* command (section 4.7.2 part B) or the *segment* command (section 4.7.2 part C). Each udef is preceded by a number. You may need to know this number if you are looking at the LP output (section 5.5.0). If a udef is a decision variable, the word *DECISION* appears to the right of the udef name. If the udef is a minimax variable, the word *MINIMAX* also appears to the right of the udef name. If the udef is not a decision variable, and there was no *SET* command or other command that assigned it a value, then the message *(Not Assigned a value)* displays to the right of the udef name. If there was no OCL simulation command that made reference to the variable (other than assigning its value), then the message *(Never Referenced)* appears to the right of the udef name.

SUMMARY OF CONSTRAINTS. This is a list of every constraint that you have created with the *constraint* command (section 4.7.2 part D). Each constraint is preceded by a number. You may need to know this number if you are looking at the LP output (section 5.5.0). If the constraint is part of a minimax, the word *MINIMAX* also appears to the right of the constraint name, along with the name of the minimax variable that it is associated with.

SUMMARY OF TARGETS. This is a list of every target that you have created with the *target* command (section 4.7.2 part E). Each target is preceded by a number. You may need to know this number if you are looking at the LP output (section 5.5.0). Each condition of each target gets a row in this list. The targets are listed according to their priority levels — all of the priority 1 targets are listed first, then all of the priority 2 targets, and so on. Since the priority level of any target can be different under different conditions, a target could appear in different sections of the list. For each target condition, this table shows the penalties and the priority level.

SUMMARY OF MINIMAX. This is a list of every minimax that you have created with the *minimax* command (section 4.7.2 part H). Each minimax is preceded by a number. You may need to know this number if you are looking at the LP output (section 5.5.0). For each minimax, this table shows the penalty and the priority level.

5.3.2 OCL EXPRESSION RESULTS

The section reporting OCL expression results is written to *OCL.out* each time step. It includes a summary of the results of the evaluation of many of the OCL expressions. It is generally the *first* section to be written to *OCL.out* for each time step. OASIS writes this information if the flag in the control file is 1, 3, or 4 (section 4.4.0).

The OCL-expression-results section includes information about the following OCL commands:

***Set* command** (section 4.7.2 part F). When OASIS evaluates a *set* command, it writes a row in the output file. This row starts with the name of the command, followed by the name of the command's condition that was found to be true, and then the value that was computed for the variable. For example, this line:

```
SET:Max_Flow150.180         cond:Normal           val=0.813652
```

Indicates that OASIS evaluated the *set* command named *max_flow150.180*, the condition named *Normal* was found to be true, and thus the value of 0.813652 was assigned to the variable. If no condition was found to be true, then the output would look like this:

```
SET:Max_Flow150.180         cond: -- none --
```

***Target* command** (section 4.7.2 part E). When OASIS evaluates a *target* command, it writes a row in the output file. This row starts with the name of the command, followed by the name of the command's condition that was found to be true, and then the value that was computed for the target value. For example, this line:

```
TARG:Transfer        cond:Jun           val=56.8
```

Indicates that OASIS evaluated the *target* command named *Transfer*, the condition named *Jun* was found to be true, and thus the value of 56.8 was assigned to the target value. If no condition was found to be true, then the output would look like this:

```
TARG:Transfer        cond: -- none --
```

For further detail about the results of the *target* command, you can look at the target-results section of the OCL output file (section 5.3.3) or at the LP output file (section 5.5.0).

***Run_module* command** (section 4.7.2 part G). When OASIS evaluates a *run_module* command, it writes three rows in the output file. The first row shows the name of the module, the second row contains a list of the values of the input arguments that OASIS sends to the module, and the third row contains a list of the values of the output arguments set by the module. For example:

```
RUN_MODULE : "W2-Scho"
    INPUT  :  53, 1, 8, 4, 21
   OUTPUT  :  4.7
```

***Constraint* command** (section 4.7.2 part D). When OASIS evaluates a *constraint* command, it writes a row in the output file. This row starts with the name of the command, followed by an indication of whether the command's condition was found to be true. For example, this line:

```
CONSTR: WJWW_demand            cond  stsfd:0
```

Indicates that OASIS evaluated the *constraint* command named *WJWW_demand*, and the condition was found false. If the condition was found true, a nonzero value would have been displayed after *stsfd*. For more detail about the results of the *constraint* command, you can look at the LP output file (section 5.5.0).

***Minimax* command** (section 4.7.2 part H). No output is written. For further detail about the results of the *minimax* command, you can look at the LP results section of the OCL output file (section 5.3.3) or at the LP output file (section 5.5.0).

***Solve* command** (section 4.7.2 part I). When OASIS evaluates a *solve* command, it writes at least one row in the output file. The first row contains the number of the solve command and the name of the first condition. Each condition that is evaluated is written on a separate row, until a condition is found to be true. On the line with the condition name, OASIS prints *stsfd* (an abbreviation for *satisfied*), followed by a value. Zero means the condition was found to be false, nonzero means the condition was found to be true. If the command was iterative, a final row is printed that tells what iteration number was solved and why more iterations will or will not be solved. Due to iteration, the same solve command may be repeated many times per time step. An example of output for the *solve* command:

```
SOLVE # 2 :  cond: mode1              stsfd: 0
             cond: mode2              stsfd: 1
   SOLVED ITERATION #0001   STOPPING CRITERIA NOT MET
```

For further detail about the results of the *solve* command, you can look at the LP output file (section 5.5.0).

***Cancel* command** (section 4.7.2 part J). OASIS writes a row for each condition that was evaluated, and tells whether it evaluated to true (nonzero). If a condition was not true, then you will see the text:

```
stsfd: 0
```

stsfd is an abbreviation for *satisfied*. If the condition was true, then you will see a nonzero value.

***Udef* command** (section 4.7.2 part B). No output is written. For detail about the results of the *udef* command, you can look at the LP output file (section 5.5.0).

***Segment* command** (section 4.7.2 part C). When OASIS evaluates a *segment* command, it writes one row into the output file. Note that all of the segment commands are evaluated just before the first solve command of each time step. The row starts with the name of the variable that is segmented. This is followed by a pair of curly braces that contains a list of each segment boundary, with the name of the corresponding segment variable inserted between each pair of boundary values. For example, the output:

```
SEG:  flow160.179       { 0.00 , seg01 , 1983.00 , seg02 , 3966.00 }
```

Shows that variable *flow160.179* is split into two segments called *seg01*, between 0 and 1983, and *seg02*, between 1983 and 3966. For more detail about the results of the *segment* command, you can look at the LP output file (section 5.5.0).

5.3.3 REPORT OF TARGET AND MINIMAX RESULTS

The OCL-target-and-minimax-results section is written to *OCL.out* each time step. It includes a summary of the results of the *target* and *minimax* variables after the LP has been solved. It generally appears after the expression results section (section 5.3.2) within each time step. OASIS writes this information if the flag in the control file is 2, 3, or 4 (section 4.4.0).

This section of *OCL.out* includes information about the following OCL commands:

***Minimax* command.** (section 4.7.2 part H) A minimax includes several quantities that are to be equalized. For each of these quantities, there is a constraint that forces the minimax variable to be greater than the quantity. Thus, OASIS reports the value of the minimax variable (in parentheses in the column labeled *MINIMAX VARIABLE*), and it reports the difference between the variable and each of the quantities to be equalized (the column labeled *DIFF*). If the constraint for any quantity was found to be binding, there is an *X* in the column labeled *BINDING*.

If OASIS does additional iterations for the *minimax* command, then the report of the minimax results is written once for each iteration. Since evaluations of OCL simulation commands may be done after the minimax, this section may interrupt the expression-results section (section 5.3.2).

***Target* command.** (section 4.7.2 part E) OASIS reports the target results in separate subsections for each priority level. All of the priority 1 targets are listed first, then all of the priority 2 targets, and so forth. This report is written once at the end of every time step. It does not show results from a priority level that was canceled by the *cancel* command (section 4.7.2 part J).

Each target gets two rows in the table. The first row, with the target name, shows the deviation of the target expression from the target command (*slack* and *surplus*). The second row shows the weight on each deviation, and in the last column of the second row, labeled *OBJ*, you can see the total points earned for this target command. This table lists *weights*, meaning that a penalty will be shown as a negative weight.

5.4.0 WEIGHT OUTPUT

The weight output shows a complete list of all weights that go into the LP router. Although weights are entered in diverse places in OASIS input, this file enables you to compare weight values in one place.

The weight values are sorted by priority level. Within the list for each priority level there may be up to five weight categories: arcs, reservoirs, demands, OCL targets, and OCL minimax. The lists printed for the two OCL categories of weights are identical to the summary of targets and summary of minimax that appear in OCL output (section 5.3.1). It is to your benefit to assign recognizable names to the targets and conditions so that they are easily identified in these lists.

The file is always named *weight.out* and it always appears in the run directory. There is no way for you to change the file name or path. There is nothing you can do to define what is written to this file.

5.5.0 LP OUTPUT

LP output shows exactly what is in the LP that OASIS passes to XA, the LP-solving software. It can also show the exact results for each decision variable. This file is generated by XA itself, so it is not friendly to those who are unfamiliar with LP concepts. Users of OASIS should not need to use the LP output very often. See section 2.2.0 for an introduction to LP concepts for OASIS users. Chapter 7 contains a detailed explanation of how the LP is written.

The file is always named *LP.out* and it always appears in the run directory. There is no way for you to change the file name or path. The LP output can be turned off, or it can be turned on at one of two levels. You specify what level by editing a flag in the control file (section 4.4.0). The LP output file can be *extremely* large and time-consuming to generate, so it is a very good idea not to generate it if you don't need it. LP output is written every time an LP is solved.

The built-in variables in the LP are measured in primary volume units (section 2.9.0). The units of each OCL udef depend on how you use the udef.

Depending on what level the LP output is turned on at, *LP.out* will include a statement of the LP, or a statement of the LP and an LP solution report.

5.5.1 STATEMENT OF THE LP

The statement of the LP is generated if the flag in the control file is either 1 or 2 (section 4.4.0). This is the *algebraic form* of the LP as XA received it from OASIS. All of the LP goals and constraints are represented in the LP. One statement of the LP appears every time an LP is solved, which is one or more times per time step. See chapter 7 for a detailed explanation of the LP conventions. The algebraic form includes the following parts (in the order they appear):

Heading. OASIS stamps a heading before each statement of the LP, so you can identify which LP solve it is associated with. The heading identifies the time step, the priority level, and the iteration number of the *solve* command. If the *solve* command is not iterative, it still says *ITER 01*. This is an example of the heading:

```
-----------------------------------------------------
       Time step:01/31 1931    Period #    1
-------PRIORITY 1-----ITER 01------------------------
```

If additional iterations are being done for the *minimax* command, the heading also indicates the minimax iteration number with the label *MINIMAX ITER*.

Objective function. The objective function is labeled ***OBJ:***. It is always equal to the priority objective variable that represents the priority level identified in the heading.

Constraints. The LP constraints are entered in the following order:

POBJ:	Priority objectives.
CON:	Continuity-of-flow constraints.
FSP:	Flow-splitting constraints.
SSP:	Storage-splitting constraints.
SEG:	*Segment*-command definition.
BU:, BL:	*Segment*-command binary constraints for segment ordering.
TARG:	*Target*-command constraints.
CSTR:	*Constraint*-command constraints.

See section 7.3.0 for a complete description of each constraint.

Decision-variable bounds. Section 7.2.0 describes all of the decision variables and their names, and tells how the bounds on each variable are determined from user input. The list of decision variable bounds looks something like this:

```
QT165870 <= 33.1 | QT170870 <= 0.4 | QT175870 <= 7.1 | DEL101 <= 393.9 |
DEL748 <= 44 | DEL750 <= 269.9 | DEL755 <= 343.3 | DEL760 <= 287.2 |
DEL795 <= 66.3 | DEL797 <= 160.8 | DEL810 <= 33.8798 | DEL820 <= 8469.95 |
STO600 <= 1e+006 | STO601 <= 1e+006 | STO602 <= 1e+006 | STO610 <= 100000
STO611 <= 100000 | STO640 <= 50000 | STO700 <= 1e+006 | STA700 = 0 |
STB700 <= 25000 | STC700 <= 15000 | STD700 <= 960000 | STO799 <= 1e+006 |
UDEF010 <= 8.9995e+006 | UDEF011 <= 500 | UDEF012 <= 8.9995e+006 |
```

If a variable has default bounds, then XA will not display it in this list. The defaults are a lower bound of zero and no upper bound. All variables that do not have default bounds *are* displayed in this list. If the variable is in the list, but one of the two bounds is not shown, then the default is being used for that bound. For example, no lower bound is stated for, *QT165870*, the first variable in the list above. That is because its lower bound is zero.

Statistics. XA reports some statistics on the size of the LP, such as the number of variables and constraints.

Solution message. If XA finds a feasible solution, it writes a message like this:

```
O P T I M A L   L P   S O L U T I O N ---> OBJECTIVE 111707.7834
```

The *objective* is the value of the objective function — the total number of points that the LP router gets for the overall routing decision. If there are integer decision variables, the above message is followed by one that looks like this:

```
I N T E G E R   S O L U T I O N ---> OBJECTIVE 111706.7514/1
```

This is because when there are integer variables, XA has to solve the LP in two stages. First, it solves the LP without restricting the integer variables to integer values. Then, it solves again, this time forcing the integer variables to have integer value.

If there was no feasible solution, XA writes a message like this:

```
N O   F E A S I B L E   S O L U T I O N ---> INFEASIBILTY 1677.75439
```

and it may print suggestions about how to make the LP feasible, such as:

```
Change row CSTR017 by 3048.000000
Change row CSTR020's upper bound by 3048.000000
```

These suggestions are important clues as to what is wrong with the LP. *They are not necessarily the changes that you should mak*e. XA is merely a computer algorithm, it can not tell what *you* were trying to do. You will have to carefully consider why XA suggests those particular changes and figure out what other changes might also solve the problem.

5.5.2 LP SOLUTION REPORT

The LP solution report is generated if the flag in the control file (section 4.4.0) is 2. This is a summary of the LP solution for *every variable* and *every constraint*. One LP solution report appears for every time an LP is solved, which is one or more times per time step. In this section of the LP output, you can see the value of each variable and the value of the left-hand-side of each constraint, which are easily understood. There are other types of information in this section that require some knowledge of LP concepts.

There are two tables in the solution report. The first lists all of the decision variables (called *columns* in the matrix that represents the LP). See section 7.2.0 for a description of each variable type. The second table lists all of the constraints (called *rows* in the matrix that represents the LP). See section 7.3.0 for a description of each constraint type.

In the table of decision variables, some of the columns are

COLUMNS. This gives the name of the variable.

AT. There are several codes describing the state of the variable:

LL	The variable is at its lower bound.
UL	The variable is at its upper bound.
EQ	The upper bound equals the lower bound.
BS	The variable is ***in the basis***. That is, it is between upper and lower bounds.
**	The variable is outside of its bounds. If this occurs, the LP is infeasible.

ACTIVITY. The value of the variable.

LOWER LIMIT. The lower bound, same as in the statement of the LP (section 5.5.1).

UPPER LIMIT. The upper bound, same as in the statement of the LP (section 5.5.1).

REDUCED COST. If a variable is at one of its bounds, then presumably the LP router would "like" to change the value of the variable, but the bound is preventing it. The reduced cost is the amount of change that would occur in the objective function per unit change in the value of the bound.

In the table of constraints, some of the columns are

ROW. This gives the name of the constraint.

AT. There are several codes describing the state of the constraint:

LL	The constraint is at its lower bound.
UL	The constraint is at its upper bound.
EQ	The upper bound equals the lower bound.
BS	The constraint is ***in the basis***. That is, it is between upper and lower bounds.
**	The constraint is outside of its bounds. If this occurs, the LP is infeasible.

ACTIVITY. The value of the left-hand-side of the constraint.

5.6.0 TIME-SERIES OUTPUT

By default, OASIS records the value of every decision variable and every variable computed by OCL into the time-series-output database, which is in HEC-DSS format. The file is meant to be read for post-processing. Therefore, OASIS only stores output for those variables that cannot be directly retrieved from input (time-series and pattern input can be directly retrieved). This database can be accessed with DSS utility programs or by other software that uses HECLIB library routines. We recommend that you rely upon OASIS's post-processing programs (Chapter 6) rather than dealing directly with the time-series output database.

The name of this file is given in the control file (section 4.4.0). Generally, the file belongs in the run directory. However, because the name can be given with absolute or relative path information, you can locate the file in any directory you like. A flag in the control file allows you to turn the time-series output on or off. The time-series output is meant to be the primary record of the OASIS run, so you would only turn it off under very special circumstances where you need to save time and only minimal output is needed. Even when the time-series output is nominally off, OCL udefs with the *STORE* flag (section 4.7.2 part B) are still written to the time-series output file.

A special text record is written to the time-series output file with B-part *EXECUTION* and a blank C-part. OASIS writes the time of execution and the version number of *model.exe* that executed the run into this record. This information is redundant with the information stored in the *RunTime* table (section 4.5.2 part G). However, it may be useful when you need to confirm that the right files are being used.

The following table shows each of the variables that OASIS writes to the time-series output. All of the variables are measured in primary volume units; except the OCL udefs, which are in unknown units; and the water quality variables, which are in the primary units of the water quality constituent. See section 2.9.0 for more information about units of measurement in OASIS. Note that the F part of the DSS pathnames are always blank.

B part	C part	Description
USER-DEFINED	*[udef name]*	OCL udef with *[udef name]*. Can be suppressed by entering the flag *NOSTORE* in the *udef* command (4.7.2 part B).
STORAGE	*[nnn]*	The storage at reservoir node *[nnn]*.
LOWER RULE	*[nnn]*	The lower rule at reservoir node *[nnn]*. Only written if computed by OCL.
UPPER RULE	*[nnn]*	The upper rule at reservoir node *[nnn]*. Only written if computed by OCL.
EVAP	*[nnn]*	The evaporation at reservoir node *[nnn]*.
EVAP_RATE	*[nnn]*	The evaporation rate at reservoir node *[nnn]*. Only written if computed by OCL.
FLOW	*[bbb]*.*[eee]*	The flow through arc *[bbb].[eee]*. Can be suppressed by entering *NO* in the *Output* field of the *Arc* table (section 4.5.3 part C).
MIN_FLOW	*[bbb]*.*[eee]*	The minimum (target) flow through arc *[bbb].[eee]*. Only written if computed by OCL.
MAX_FLOW	*[bbb]*.*[eee]*	The maximum flow through arc *[bbb].[eee]*. Only written if computed by OCL.
MAXREV_FLOW	*[bbb]*.*[eee]*	The minimum reverse flow through arc *[bbb].[eee]*. Only written if computed by OCL.
DELIVERY	*[nnn]*	The delivery at demand node *[nnn]*.
DEMAND	*[nnn]*	The demand at demand node *[nnn]*. Only written if computed by OCL.
INFLOW	*[nnn]*	The inflow to node *[nnn]*. Only written if computed by OCL.
[name]	*[nnn]*	The concentration of water quality constituent with *[name]* at node *[nnn]*. Can be suppressed by entering *NO* in the *C*x*_Output* field of the *Node* table (section 4.5.3 part B), where *x* is the number of the constituent with *[name]*.
*[name]***_INPUT**	*[nnn]*	The concentration input for water quality constituent with *[name]* at node *[nnn]*. Only written if computed by OCL.
*[name]***_INPUT**	*[bbb]*.*[eee]*	The concentration input for water quality constituent with *[name]* at arc *[bbb].[eee]*. Only written if computed by OCL.

CHAPTER 6
REFERENCE: POST-PROCESSOR PROGRAMS

6.0.0 INTRODUCTION

You run the post-processor programs after OASIS model runs are completed. The post-processors read OASIS's input and output data, and present it in a user-defined form. You create input files for the post-processors that specify what data to present, and how to format it.

There are two post-processor programs: **Onevar** and **Plot**. Both programs perform essentially the same procedures to retrieve data from OASIS's input and output. The difference is that Onevar presents data by creating an ASCII text file of numeric tables, while Plot plots the same data on x-y axes.

Both Onevar and Plot read a **Onevar input file**. This file provides formulas for the data to be presented. Onevar also gathers information from this file for formatting the text data it presents. Plot reads an additional file, the **plot-definition file**, which provides parameters for formatting the graphical plot.

Both programs can present data in either time-series order or in probability-of-exceedence order. Both are capable of presenting data by simulation period, or redistributing the data over time steps of your choice. These options are controlled through fields in the header of the Onevar input file (section 6.1.7).

6.1.0 ONEVAR PROGRAM

Onevar is the OASIS post-processor that presents data in tables in a text file. The unit of output for Onevar is the **table**. A single Onevar output file can contain up to 200 tables. Each table contains the values of a formula, or simple text values. There are several general **format** options which reinterpret the tables as columns or cells in a report (see section 6.1.4). Onevar can also save the data to a HEC-DSS file (section 6.1.5).

The program is contained in the file *Onevar.exe.* This file must be found in the same directory as *model.exe*. You may execute the program with command line parameters (section 4.1.0). Onevar needs to be able to read the following files when it runs:

The **model pointer file** (section 4.3.0), unless the command line argument *DIR* is used (section 4.1.0). The model pointer file must be in the same directory as *Onevar.exe*.

The **Onevar pointer file** (section 6.1.2), unless the command line argument *IN* is used (section 4.1.0). The Onevar pointer file must be in the same directory as *Onevar.exe*.

The **control file** (section 4.4.0) in the directory named by the model pointer file. The file *model.cf* is opened unless another file name is specified with the command line argument *CF* (section 4.1.0).

All of the **model input files** named in the control file, including the static databases (section 4.5.0), time-series database (section 4.6.0), and the OCL file (section 4.7.0)

The **model time-series output database** named in the control file (section 4.4.0).

The **Onevar input file** (section 6.1.3) named in the Onevar pointer file or the command line (section 4.1.0).

Onevar does not initialize any external modules, or have access to input that is specific to a module.

When the command-line option *NoRunInput* (section 4.1.0) is applied, Onevar can run without reading a control file, model input files, and the model time-series output database. See section 6.1.6 for more information about this special use of Onevar.

Onevar is run by the OASIS GUI when you click on *TABLES* (section 3.6.4 part A). If the GUI is configured properly, you do not need to worry about the pointer files, because the GUI manages them for you.

6.1.1 ONEVAR COMPUTATIONS

Every Onevar run prepares output from the input and output of an OASIS model run. The Onevar input file (section 6.1.3) tells Onevar what data to present, and what processing must be done on the data. In the most basic form, Onevar simply creates a set of time series output. Each *table* command (section 6.1.9 part C) in the Onevar input file creates one output time series. Many useful Onevar input files contain nothing more than simple *table* commands.

There are many optional processes that can be applied to the data before it is written to output. Because there are several of these processes, it is important to understand in what sequence the processes occur. The computations are always done in a certain sequence. Your entries in the Onevar input file determine whether optional processes are invoked or not. The sequence of the most common processes is:

> First, Onevar computes the values of all ***table* commands** (section 6.1.9 part C). Every Onevar input file defines at least one *table* command. Every *table* command has at least one *value* expression that is evaluated. A *table* command can have multiple *condition* expressions that determine what *value* expression is evaluated. Onevar computes the value of every table for every time step in the time range.
>
> Next, Onevar **redistributes** the values of all *table* commands to the **post-processor time step size**. This is done only if there is a *:STEP:* field in the Onevar input file header (section 6.1.7 part I) and the time step size it identifies is different than the simulation time step. For each *table* command, a different method of time step conversion can be done. That is, one table might use averaging, and another table might use the minimum value. This is specified in the *step* fields of the *table* command (section 6.1.9 part C).
>
> Next, Onevar filters out the unwanted time steps according to a ***StepFilter* command**. This is done only if the Onevar input file contains a *StepFilter* command (section 6.1.9 part E). If the *StepFilter* command is false for a given time step, then that time step is rejected for all *table* commands. A rejected time step is not included in subsequent processes, and it is not shown in the output file.
>
> Next, Onevar **sorts** each column of information for **probability-of-exceedence** tables or plots. This is done only if the Onevar input file contains *PROBABILITY* in the header of the *:SORT:* field of the Onevar input file (section 6.1.7 part G).
>
> Finally, Onevar **writes the output file**, and it computes **summary-row** information as it creates the file. If the *:FILEDSS:* field appears in the Onevar input file header, then output is written to a HEC-DSS file. If the *:FILE:* field appears in the Onevar input file header, then output is written to a text file. If *:FILEIHB:* appears in the Onevar input file header, then output is written to an IHA hydro data file (a very specialized option). Every Onevar input file must use at least one of these three options, and it can do more than one. However, summary information is only created for the text output file. See section 6.1.7 for details about these fields of the Onevar input file header.
>
> The summary-row information may include the sum, average, minimum, and maximum (among other things, listed in the *Options* field of the *table* command (section 6.1.9 part D)) for each column of data. The text output takes on one of four different formats: *TABLES, COLUMNS, SEQUENTIAL,* or *REPORT* (section 6.1.4). For *COLUMNS* and *SEQUENTIAL* format, the summary information is being computed once for each *table* command. For *TABLES* format, the summary information, such as sum and maximum, is being computed for each column in each table. There is no summary information computed for *REPORT* format.

The above list excludes some of the more advanced options. The following outline gives a more complete look at the Onevar computations. Note that computations are always done in the following sequence. Your entries in the Onevar input file determine whether optional processes are invoked or not.

```
1.    Begin
2.    Read model input files (chapter 4)
3.    Read Onevar input file (section 6.1.3)
4.    Read pre-processor database (section 6.1.6)

5.    If a trace filter is applied (position analysis only) (section 6.1.10)
      6.    For each position analysis trace
            7.    Read time series data
            8.    Compute values of the trace filter table for all time steps
            9.    Find the WHOLERUN value of the trace filter table for the current trace
      10.   Return to 6 for the next position analysis trace
      11.   Sort the traces according to the WHOLERUN values of the trace filter table
      12.   Select the traces that match the TraceNum field
```

13. For each position analysis trace (for simulation mode means this means only one time)
    14. Read time series data
    15. For all *table* commands (section 6.1.9 part C) that precede the *:TIMESHIFT:* marker (section 6.1.8), compute all table values for all time steps
    16. Redistribute table values to the post-processor time-step size if *:STEP:* field is applied (section 6.1.7 part I)
    17. For all *table* commands (section 6.1.9 part C) that follow the *:TIMESHIFT:* marker (section 6.1.8), compute all table values for all time steps
18. Return to 13 for next position analysis trace

19. Shift the time labels according to the *:DateChangeStart:* field (section 6.1.7 part T)
20. Sort the table values if *:SORT: PROBABILITY* is applied (section 6.1.7 part G)
21. Write HEC-DSS output
22. Store virtual HEC-DSS output for any table that invokes the *VirtualDSS* option in the *Options* field
23. Write IHA hydro data file
24. Write text output, computing summary-row information (section 6.1.9 part D) as the file is written.
25. If the Onevar input file contained :NEWFILE: (section 6.1.8), return to 1 for the next section

6.1.2 ONEVAR POINTER FILE

The Onevar pointer file is an ASCII text file that must be found in the same directory as *Onevar.exe*. The name of the pointer file is *Onevar.cf*. The sole purpose of this file is to tell Onevar the name and path of the Onevar input file.

If the command line argument *IN* is used (section 4.1.0), then the name of the Onevar input file comes from the command line, and Onevar does not read the pointer file.

The pointer file must include a pipe character "|", followed by the file name, including the path. The path can be absolute or relative to the pointer file. The use of the pipe character allows you to put comments in the pointer file, because all text preceding the pipe and all text following the file name are ignored. An example text from the Onevar pointer file is:

```
| Onevar\outflow.inp
```

6.1.3 ONEVAR INPUT FILE

The Onevar input file provides formulas for the data that Onevar or Plot are to present. This file also tells Onevar how to format the output. Plot reads this file in almost exactly the same way as Onevar, so most of the following discussion applies to Plot as well as Onevar. The major difference is that Plot ignores any information in the Onevar input file that tells how to format the text data. See section 6.2.2 for a discussion of how Plot reads the Onevar file. Plot gets its formatting information from a plot definition file, described in section 6.2.3.

You will want to create a library of Onevar input files, with which you can quickly analyze your simulation results. You tell Onevar which Onevar input file to use by editing the Onevar pointer file, *Onevar.cf* (section 6.1.2) or with the command line option *IN* (section 4.1.0).

The Onevar input file is an ASCII text file. The information is divided into two major sections: the **header section** and the **table-definitions section**. The header section contains some information that applies to the entire Onevar run. The table-definitions section contains information defining the individual tables and title lines. A third section, the **trace-filter** section, is optional and is only available for position analysis (PA). In the trace-filter section, you can define a criteria for sorting the traces of the PA and selecting particular traces to display from the sorted list.

When Onevar reads the Onevar input file, it uses the same OCL-parsing routines that the model relies upon when reading the OCL input file. This means that the formulas for table values are entered as OCL expressions (see section 4.7.3 for reference on OCL expression syntax). The Onevar input file generally follows the conventions of OCL (see section 4.7.0). Onevar has its own set of meta commands for demarcating the Onevar input file (section 6.1.8). It also uses meta commands for entering parameters in the header section (section 6.1.7). In place of the OCL simulation commands, Onevar uses the commands *table* and *title* to define the elements of the Onevar output file (section 6.1.9).

Use of OCL conventions in the Onevar input file gives you many advantages:

You write the formulas for table values using OCL expressions (section 4.7.3). Thus, the formulas may include any non-decision variables (section 4.7.4), operations, or functions (section 4.7.6) that are available in OCL.

OCL comment markers (section 4.7.0 part D) can be applied anywhere in the Onevar input file.

OCL substitute names (section 4.7.1 part I) defined in the OCL input file are recognized in the Onevar input file.

The OCL meta-commands for directing the compiler (section 4.7.1) can all be used in the Onevar input file. Thus, you can use loops, conditionals, and substitutes, and include other files in the Onevar input file.

You can use any data from the OCL supplemental databases (sections 4.5.8 and 4.6.5). You may even include data in the supplemental databases that are not used by the model -- only by Onevar.

6.1.4 FORMATS OF THE ONEVAR OUTPUT FILE

There are several different format types in which Onevar output can be generated. The format type is specified in the *:FORMAT:* field in the header of the Onevar input file (section 6.1.7 part F). If the *:FORMAT:* field is omitted, then the format type will be *TABLE*.

A. *TABLE* format type

The *TABLE* format puts each series of values into a table which has

> data that reads across a row of fixed length. By default, the row represents one year, but you may specify a different length for the row in the *:GROUPING:* field of the header (section 6.1.7 part K).
>
> one column for each period of the rows
>
> optional **total** column at the end of each row, determined by the *options* field in each table definition (section 6.1.9 part C).
>
> optional summary rows such as **avg**, **min**, and **max** at the bottom of each column, determined by the *options* field in each table definition (section 6.1.9 part C).

Optional title lines, entered as part of the table definition, may appear before each table. Tables appear one after the other, down the page. Independent title lines may appear between tables.

Here is an example input file for the *TABLE* format:

```
  :FILE:   deliv.prn    /* name of the output file */
  :FORMAT: TABLE
  :TIME: 10/31/1927 , 9/30/1934

 :TABLES:

 Table Pump_Indep
 { title :   Independent Municipal Pumping (TAF)
   value : (  max_flow602.115
            + max_flow601.150 + max_flow601.155 + max_flow600.145 + max_flow600.140
            + max_flow601.135
            + demand148 + demand118  )   /   1000
   format : 6.2
       options : avg min max blank total
 }
 TITLE : ****THIS IS AN INDEPENDENT TITLE LINE****
 Table Demand_total
 { title :   Total Demand
   title :   (Acre-feet)
   format : 6
   value :  demand101 + demand103 + demand105 + demand110 + demand115 + demand120
          + demand123 + demand125 + demand130 + demand133 + demand135 + demand140
          + demand145 + demand150 + demand155 + demand160 + demand170 + demand175
          + demand165 + demand118 + demand148
   options : total
 }

 Table
 { format : 7.0
   title : Total Demand minus Independent Municipal Pumping (AF)
   options : avg min blank
   value :  table(Demand_total) - Table(Pump_Indep)
 }
 :END:
```

Here is the output, *deliv.prn* that Onevar would generate from the example input for the *TABLE* format type.

```
  Independent Municipal Pumping (TAF)

  YEAR 10/31 11/30 12/31 01/31 02/28 03/31 04/30 05/31 06/30 07/31 08/31 09/30   TOTAL
  1927  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44
  1928  0.57  0.25  0.20  0.21  0.39  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.46
  1929  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44
  1930  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44
  1931  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44
  1932  0.57  0.25  0.20  0.21  0.39  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.46
  1933  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44
  1934  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.44

   AVG  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    8.45
   MIN  0.57  0.25  0.20  0.21  0.38  0.22  0.30  0.85  1.33  1.60  1.45  1.09    0.20
   MAX  0.57  0.25  0.20  0.21  0.39  0.22  0.30  0.85  1.33  1.60  1.45  1.09    1.60
****THIS IS AN INDEPENDENT TITLE LINE****

  Total Demand
  (Acre-feet)

  YEAR 10/31 11/30 12/31 01/31 02/28 03/31 04/30 05/31 06/30 07/31 08/31 09/30   TOTAL
  1927  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1928  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1929  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1930  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1931  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1932  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1933  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662
  1934  5358  3254  2457  2304  2328  2655  3562  5179  6729  8305  8549  6981   57662

Total Demand minus Independent Municipal Pumping (AF)

  YEAR  10/31  11/30  12/31  01/31  02/28  03/31  04/30  05/31  06/30  07/31  08/31  09/30
  1927   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1928   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1929   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1930   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1931   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1932   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1933   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
  1934   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980

   AVG   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
   MIN   5357   3254   2457   2304   2327   2655   3562   5178   6728   8304   8548   6980
```

B. *COLUMN* format type

The *COLUMN* format has

one row per simulation period

one column for each data series (still called a “table”).

optional summary rows such as **avg**, **min**, **max** and **total** at the bottom of each column, determined by the *options* field in each table definition (section 6.1.9 part C). The summary rows can also be shown a some user-defined frequency, such as once per year, as defined by the *:SUMMARY:* field (section 6.1.7 part L).

Optional title lines, entered as part of the table definition, may appear at the top of each column. Onevar truncates these title lines to the column width. If independent titles are entered before the first “table”, Onevar prints them at the top of the file. Those entered after the last “table” get printed at the bottom of the file. Independent titles do not get truncated. Independent titles entered between “tables” are ignored, because it would not fit the format to print them between columns.

The *SEQUENTIAL* format appears similar to the *COLUMN* format, except that in *SEQUENTIAL* format, single columns appear one after another, down the page. In *COLUMN* format, the columns appear side-by-side, across the page.

Here is an example input file for the *COLUMN* format:

```
 :FILE:   pump_treat.prn
 :FORMAT: column
 :TIME:         10/31/1923 , 4/30/1925

:TABLES:

title: [RunTime]
title:
title:    These titles are printed because they are before the first table.
title:

Table
{        /* Notice how the titles have been aligned so they
            will fit into the 7-character column              */
  title : GW Stor
  title :     TAF
  format : 7.1    /* <------- the width of the column will be seven characters */
  options :  MIN MAX blank
  value : ( storage600 + storage601 + storage602 ) / 1000
}

Table
{ title :   Hopyard    This part of the title will be truncated
  title :       CFS
  format : 9.1         /* <--------  the width of the column will be nine characters */
  value : convert_units{ flow[W_Hopyard] , AF , CFS }     options : blank MIN TOTAL
}
TITLE : ########## THIS TITLE WILL NOT BE PRINTED BECAUSE IT OCCURS BETWEEN "TABLES" ####

Table
{       value :   convert_units{ flow850.300 , AF , CFS }
        title :    TREAT
        title :      CFS
}
TITLE : THIS IS THE SECOND-TO-THE LAST LINE
TITLE : THIS IS THE LAST LINE

 :END:
```

Here is the output file, *pump_treat.prn*, that would be generated by the example input for the *COLUMN* format type.

```
Thu Oct 22 1998 13:26

   These titles are printed because they are before the first table.

          GW Stor  Hopyard   TREAT
   DATE       TAF      CFS     CFS

 10/31/1923  223.6      2.1      34
 11/30/1923  226.1      0.0      32
 12/31/1923  231.1      0.0      25
 01/31/1923  234.7      0.0      23
 02/28/1923  238.0      0.0      23
 03/31/1923  240.8      0.0      27
 04/30/1923  242.5      0.0      36
 05/31/1923  241.5      2.1      30
 06/30/1923  237.7      2.1      37
 07/31/1923  234.7      2.1      37
 08/31/1923  232.5      2.1      37
 09/30/1923  230.9      2.1      37
 10/31/1924  229.8      2.1      34
 11/30/1924  232.3      0.0      32
 12/31/1924  234.8      0.0      25
 01/31/1924  235.7      0.0      17
 02/29/1924  236.0      0.0      17
 03/31/1924  236.5      0.0      22
 04/30/1924  237.1      0.0      30
 05/31/1924  234.7      2.1      30
 06/30/1924  231.1      2.1      37
 07/31/1924  227.4      2.1      37
 08/31/1924  223.9      2.1      37
 09/30/1924  218.7      3.6      15
 10/31/1925  214.8      3.6       0
 11/30/1925  213.4      3.6       0
 12/31/1925  212.6      3.6       0
 01/31/1925  214.2      0.0      17
 02/28/1925  216.7      0.0      17
 03/31/1925  218.6      0.0      22
 04/30/1925  219.4      0.0      30

    MIN      223.6      0.0
    MAX      242.5
  TOTAL              14.4

THIS IS THE SECOND-TO-THE LAST LINE
THIS IS THE LAST LINE
```

C. *SEQUENTIAL* format type

The *SEQUENTIAL* format puts each data series into a table which has

one row per simulation period

only one column

optional summary rows such as **avg**, **min**, **max** and **total** at the bottom of the column, determined by the *options* field in each table definition (section 6.1.9 part C). The summary rows can also be shown a some user-defined frequency, such as once per year, as defined by the *:SUMMARY:* field (section 6.1.7 part L).

Optional title lines, entered as part of the table definition, may appear at the top of each table. Tables appear one after the other, down the page. Independent title lines may appear between tables.

The *SEQUENTIAL* format appears similar to the *COLUMN* format, except that in *SEQUENTIAL* format, single columns appear one after another, down the page. In *COLUMN* format, the columns appear side-by-side, across the page.

Here is an example input file for the *SEQUENTIAL* format:

```
  :FILE:   seq.prn
  :FORMAT:   SEQUENTIAL
  :TIME:         10/31/1923 , 4/30/1924

 :TABLES:

 title: [RunTime]
 title:

 Table
 { title : Sum of the storage in 3 groundwater sub-basins (TAF)
   format : 7.1    /* <------- the width of the column will be seven characters */
   options :  MIN MAX blank
   value : ( storage600 + storage601 + storage602 ) / 1000
 }
 TITLE :                 #### THIS TITLE GETS PRINTED ####

 Table
 { title : Pumping at the Hopyard wells
   title : (CFS)
   title :
   format : 12.1         /* <--------  the width of the column will be twelve characters */
   value :  af_to_cfs{ flow[W_Hopyard] }          options :  MIN  TOTAL
 }
 TITLE : THIS IS THE LAST LINE

 :END:
```

Here is the output file, *seq.prn*, that would be generated by the example input for the *SEQUENTIAL* format type.

```
Thu Oct 22 1998 13:26

Sum of the storage in 3 groundwater sub-basins (TAF)
   DATE      VALUE

 10/31/1923  223.6
 11/30/1923  226.1
 12/31/1923  231.1
 01/31/1923  234.7
 02/28/1923  238.0
 03/31/1923  240.8
 04/30/1923  242.5
 05/31/1923  241.5
 06/30/1923  237.7
 07/31/1923  234.7
 08/31/1923  232.5
 09/30/1923  230.9
 10/31/1924  229.8
 11/30/1924  232.3
 12/31/1924  234.8
 01/31/1924  235.7
 02/29/1924  236.0
 03/31/1924  236.5
 04/30/1924  237.1

    MIN      223.6
    MAX      242.5

                #### THIS TITLE GETS PRINTED ####
Pumping at the Hopyard wells
(CFS)

   DATE           VALUE

 10/31/1923         2.1
 11/30/1923         0.0
 12/31/1923         0.0
 01/31/1923         0.0
 02/28/1923         0.0
 03/31/1923         0.0
 04/30/1923         0.0
 05/31/1923         2.1
 06/30/1923         2.1
 07/31/1923         2.1
 08/31/1923         2.1
 09/30/1923         2.1
 10/31/1924         2.1
 11/30/1924         0.0
 12/31/1924         0.0
 01/31/1924         0.0
 02/29/1924         0.0
 03/31/1924         0.0
 04/30/1924         0.0
    MIN             0.0
  TOTAL            14.4

THIS IS THE LAST LINE
```

D. *REPORT* format type

The *REPORT* format prints a special table, called a ***report block***, for each simulation period. Each report block contains a list of the values of different formulas. One or more columns must be defined for the report block, using the *:COLUMN:* marker (section 6.1.8). Each value that appears in the report block is defined as a “table”. Onevar prints each “table” value into the row below the preceding “table” value. When it encounters a new *:COLUMN:* marker, it puts the next “table” into the first row of a new column.

Each *:COLUMN:* marker contains the input fields *pad*, *title*, and *value*.

> The ***pad*** field gives the width of blank space that appears in the front of each title. This is to separate the column from the previous column.
>
> The ***title*** field gives the width of the title of each “table”.
>
> The ***value*** field gives the width of the value of each “table”.

The total width of the column is the sum of the entries in the *pad*, *title*, and *value* fields.

Each Onevar input file can define only one report block. The beginning of the report block is marked with the *:BLOCK:* keyword (section 6.1.8). Independent titles that appear before the *:BLOCK:* marker are not repeated with the report block. Independent titles that appear after the *:BLOCK:* keyword but before the first *:COLUMN:* marker are repeated with each report block, but appear at the top of the block, outside of any columns. You may optionally define the end of the report block with a final *:BLOCK:* marker. Independent titles that appear after this marker are not repeated with each report block, but do appear at the end of the file.

Independent titles that are entered in a report block, after a *:COLUMN:* marker, will be printed in the column. They will be truncated to the total width of the column. Padding defined in the *pad* field of the *:COLUMN:* marker will not be applied to the independent title.

You can enter a blank spot in the report block with the keyword *BLANK*. This has a similar effect to entering a blank independent title line, with one difference. If you are using a delimiter (defined in the *:DELIMITER:* field in the heading), then a blank spot created with *BLANK* will have a delimiter to separate the title part from the value part. A blank spot created with *title* will not have this delimiter.

Here is an example input file for the *REPORT* format:

```
  :FILE:   REPORT.prn
  :FORMAT: REPORT
  :time:  4/30/1932 , 6/30/1932

  :delimiter: |

 :TABLES:

 title: [RunDir]
 title: [RunDesc]
 title: [RunTime]

 :BLOCK:

 title :    All flows are measured in acre-feet per year.
 title :    All ratios are calculated as the annual average of the monthly ratios.

 :COLUMN: { pad : 1  title : 8   value : 8 }

 BLANK
 Table
 { title : Q300101
   format : 5    value :  flow300.101
 }
 Table
 { title : Q305103
   format : 24    value :  flow305.103
 }
 title : ABCDEFGHIJKLMNOPQRSTUVWXYZ

 :COLUMN: { pad : 1  title : 9   value : 6 }

 Table
 { title :  STOR799
   format : 6.2      value :  storage799 / 1000
 }
 Table
 { title :  STOR799
   format : 6.2      value :  storage799 / 1000
 }
 BLANK
 Table
 { title :  STOR799
   format : 6.2      value :  storage799 / 1000
 }

 title : ABCDEFGHIJKLMNOPQRSTUVWXYZ
 Table
 { title :  STOR799
   format : 6.2      value :  storage799 / 1000
 }

 :BLOCK:

 blank
 title : This title does not get repeated because it is after the :BLOCK:


 :END:
```

Here is the output file, *REPORT.prn*, that would be generated by the example input for the *REPORT* format type.

```
D:\OASIS\runs\R12-B3\
A fictitious run used for examples in the manual.
Thu Oct 22 1998 13:26

 04/30/1932

   All flows are measured in acre-feet per year.
   All ratios are calculated as the annual average of the monthly ratios.
         |        |  STOR799 | 42.21
 Q300101 |     290|  STOR799 | 42.21
 Q305103 |     264|          |
ABCDEFGHIJKLMNOPQR|  STOR799 | 42.21
         |        |ABCDEFGHIJKLMNOPQ
         |        |  STOR799 | 42.21

 05/31/1932

   All flows are measured in acre-feet per year.
   All ratios are calculated as the annual average of the monthly ratios.
         |        |  STOR799 | 36.35
 Q300101 |     398|  STOR799 | 36.35
 Q305103 |     315|          |
ABCDEFGHIJKLMNOPQR|  STOR799 | 36.35
         |        |ABCDEFGHIJKLMNOPQ
         |        |  STOR799 | 36.35

 06/30/1932

   All flows are measured in acre-feet per year.
   All ratios are calculated as the annual average of the monthly ratios.
         |        |  STOR799 | 30.06
 Q300101 |     469|  STOR799 | 30.06
 Q305103 |     349|          |
ABCDEFGHIJKLMNOPQR|  STOR799 | 30.06
         |        |ABCDEFGHIJKLMNOPQ
         |        |  STOR799 | 30.06

This title does not get repeated because it is after the :BLOCK:
```

6.1.5 HEC-DSS OUTPUT FROM ONEVAR

The format types described in section 6.1.4 apply to Onevar's output to text files. It is possible to instead save the data calculated by Onevar in a HEC-DSS file. The Onevar input file can be configured so that a single execution of Onevar saves data only in a text file, only in a HEC-DSS file, or in both a text file and a HEC-DSS file. See section 4.6.0 for more information about HEC-DSS.

To make Onevar save data in a HEC-DSS file, enter a *:FILEDSS:* field in the header section of the Onevar input file (section 6.1.7 part B). This field tells the name of the file in which Onevar saves the data it calculates.

When the *:FILEDSS:* field appears in the header section, every Onevar table definition (section 6.1.9 part C) must contain the fields *DSSRecord*, and *DSSUnits* (and optionally *DSSVarType*). The *DSSRecord* field tells Onevar the name of the record that the data is to be written to. You can enter *NONE* into this field in order to prevent a particular table from being saved to the HEC-DSS file.

The records that are identified in Onevar table definitions are overwritten for the time range that Onevar processes. Other records in the HEC-DSS file are not changed, and the records that are identified in Onevar table definitions are not changed outside of the time range that Onevar processes.

6.1.6 USING ONEVAR AS A PRE-PROCESSOR

Onevar was originally designed to post-process model input and output data. Whereas it says in section 6.1.0 that model input and output are required to run Onevar, it is possible to run Onevar in the special *pre-processor* mode, in which no model input or output files are required. To run in this mode, use the command-line option *NoRunInput* (section 4.1.0).

When the command-line option *NoRunInput* is used, Onevar reads the following files:

The **model pointer file** (section 4.3.0), unless the command line argument *DIR* is used (section 4.1.0). The model pointer file must be in the same directory as *Onevar.exe*.

The **Onevar pointer file** (section 6.1.2), unless the command line argument *IN* is used (section 4.1.0). The Onevar pointer file must be in the same directory as *Onevar.exe*.

The **Onevar input file** (section 6.1.3) named in the Onevar pointer file or the command line (section 4.1.0).

Optionally, a static database file containing a ***Steps* table** named in the Onevar input file with the *:STEP:* keyword (section 6.1.7 part I).

Optionally, any **OCL static database files** or **OCL time-series database files** named in the Onevar input file using the *:STATDB:* (section 6.1.7 part D) or *:TIMEDB:* (section 6.1.7 part E) keywords.

Optionally, the **pre-processor database file** named in the Onevar input file with the *:PREPDB:* keyword (section 6.1.7 part U).

In pre-processor mode, Onevar uses either the model pointer file or the command line to determine the run directory. Any input or output files specified by the Onevar input file are assumed to be in the run directory (unless they have absolute path names). However, Onevar does not actually read the model control file, nor does it automatically read any other files in the run directory. Thus, you may specify a run directory that does not contain *model.cf* or other input files.

Ordinarily, Onevar reads the model's time-parameters database (section 4.5.2) to determine the time steps of the model. In pre-processor mode, this does not happen. Therefore, the time steps at which Onevar processes must be defined in one of two ways:

If a **pre-processor database file** named in the Onevar input file with the *:PREPDB:* keyword (section 6.1.7 part U), then the time steps defined by the table in the pre-processor database become the time steps at which Onevar does calculations. If the Onevar input file contains a *:STEP:* field (section 6.1.7 part I), then Onevar redistributes the Onevar table values to steps defined by the *:STEP:* field, similar to how it behaves in its regular mode. The start and end times for Onevar processing are decided by the first and last records in the table in the pre-processor database.

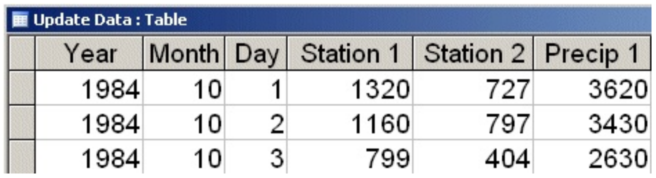
If a **pre-processor database file** is *not* named in the Onevar input file with the *:PREPDB:* keyword (section 6.1.7 part U), then the Onevar input file must contain a *:STEP:* field (section 6.1.7 part I). Whatever time steps are defined by the *:STEP:* field become the time steps at which Onevar does calculations. The Onevar input file can only contain one *:STEP:* field, so this leaves no way for Onevar to redistribute the Onevar table values to any other time steps. The start and end times for Onevar processing are decided by the *:TIME:* keyword in the Onevar input file (section 6.1.7 part J).

In pre-processor mode, most OCL variables, such as *storage* and *flow* can not be used. Note also that OCL functions such as *elev_to_stor* and *convert_units* can not be used. In fact, Onevar can not do any conversion of units of measurement because it does not read a *Units* table. Thus, you will need to explicitly write out any formulas for unit conversion.

When a pre-processor database file is declared with the *:PREPDB:* keyword, you can refer to the values in this table using OCL *prep* variables (section 4.7.4).

The *:PREPDB:* keyword names an MS Access file and a table within that file. The file can contain other tables, but for the purpose of reading the pre-processor database, they are ignored. The table can have any name. Each record in the table is associated with a time step. The size of the time steps in the table must be one of four regular types: daily, weekly, monthly, or yearly.

Example


Update Data : Table

Year	Month	Day	Station 1	Station 2	Precip 1
1984	10	1	1320	727	3620
1984	10	2	1160	797	3430
1984	10	3	799	404	2630

The fields of this table are:

Field Name	**Type**	**Size**	**Description**
Year	Number	Integer	The year of the date at the end of the time step
Month	Number	Integer	The month of the date at the end of the time step
Day	Number	Integer	The day of the month at the end of the time step
Data Field	Number	Single	The data fields can have any name, and spaces are permitted within the field name. Onevar will read a maximum of 60 data fields.

6.1.7 FIELDS OF THE ONEVAR INPUT-FILE HEADER SECTION

After the *:TABLES:* marker in the Onevar input file, you can define individual tables and independent titles. The **header** section comes before the *:TABLES:* marker. In the header section, you may enter many different general input parameters, which apply to the entire Onevar run. Each parameter is in a field identified by a meta-keyword. Most of these fields are optional, since Onevar has default settings. These fields do not have to be in any particular order.

A. *:FILE:* field

Syntax form (see section 4.7.0 part A for conventions):

```
:FILE: [file name]
```

Specifies *[file name],* the name of a file to which Onevar writes text output. *[File name]* may include complete path information. If the path information is relative, Onevar locates the file relative to the run directory. If this field is not found, then Onevar does not write a text file. Every Onevar input file must contain this field or the *:FILEDSS:* field. It is permitted to have both *:FILE:* and *:FILEDSS:* fields, in which case Onevar will write both text output and HEC-DSS output.

If a file with the name *[file name]* already exists when Onevar runs, then the file is overwritten. There are two exceptions:

> If the Onevar input file contains *:NEWFILE:*, then the file named *[file name]* is overwritten the first time it is identified within that Onevar run. Subsequent passes will append to the end of the file.
>
> If the *:FileAppend:* command is given in the Onevar input file header, then the output is appended to the end of *[file name]*, instead of overwriting.

B. *:FILEDSS:* field

Syntax form (see section 4.7.0 part A for conventions):

```
:FILEDSS: [file name]
```

Specifies *[file name],* the name of a file to which Onevar writes data in HEC-DSS format. *[File name]* may include complete path information. If the path information is relative, Onevar locates the file relative to the run directory. If this field is not found, then Onevar does not write data to HEC-DSS format. Every Onevar input file must contain this field or the *:FILE:* field. It is permitted to have both *:FILEDSS:* and *:FILE:* fields, in which case Onevar will write both text output and HEC-DSS output. If this field is used, then every Onevar table definition (section 6.1.9 part C) must contain a *DSSRecord* field. See section 6.1.5 for more information about writing HEC-DSS data with Onevar.

If a file named *[file name]* already exists when Onevar is run, then Onevar adds its output into *[file name]*–overwriting if those records already exist–but does not overwrite or destroy any other data in the file.

C. *:FILEIHB:* field

Syntax form (see section 4.7.0 part A for conventions):

```
:FILEIHB: [file name]
```

Specifies *[file name],* the name of a file to which Onevar writes binary data that The Nature Conservancy's IHA software can read as a *hydro data file*. This is a very specialized option that would probably only be used in conjunction with IHA software. The OASIS GUI uses this feature of Onevar to send data to IHA as described in section 3.6.4 part C.

[File name] may include complete path information. If the path information is relative, Onevar locates the file relative to the run directory. *[File name]* should include the filename extension *.IHB*. Onevar actually writes two files when creating a hydro data file. The second file has the exact same name and path as *[file name]*, but Onevar automatically exchanges the *.IHB* extension for an *.INI* filename extension. Thus, the Onevar input file does not specify the name of this second file anywhere – Onevar automatically determines it from the name of the first file. If either the *.IHB* or the *.INI* file exists when Onevar is run, then the file is overwritten.

If this field is not found, then Onevar does not write an IHA hydro data file. If this field is applied, then it is not necessary to have a *:FILE:* or *:FILEDSS:* field. It is permitted to use this field at the same time as either or both of the *:FILEDSS:* or *:FILE:* fields. Onevar can write output to all three formats in one run if so chosen.

D. *:STATDB:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :STATDB: [file name]
```

Specifies *[file name],* the name of a MS Access file that contains the tables *Pattern* and/or *Lookup* (section 4.5.8). If *[file name]* is given with relative path, then Onevar locates the file relative to the run directory. This keyword can not be used if *:STATDB:* appears in the OCL input file (section 4.7.1 part E). If Onevar is run in pre-processor mode (section 6.1.6), then of course Onevar does not read any OCL file and so there is such no conflict.

E. *:TIMEDB:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :TIMEDB: [file name]
```

Specifies *[file name],* the name of a HEC-DSS input file that contains time-series variables to use in Onevar expressions. If *[file name]* is given with relative path, then Onevar locates the file relative to the run directory. This keyword can appear up to five times, but the total number of instances that can appear between the Onevar input file and the OCL input file (section 4.7.1 part F) is five. If Onevar is run in pre-processor mode (section 6.1.6), then of course Onevar does not read any OCL file and so there is such no conflict.

Note that Onevar searches for time-series records in each of these databases *in the order you list them* with the *:TIMEDB:* meta-commands. Once it finds the records, it stops searching.

F. *:FORMAT:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :FORMAT: [format code]
```

Specifies the general format type for Onevar output (section 6.1.4). *[Format code]* may be ***TABLE***, ***COLUMN***, ***SEQUENTIAL***, or ***REPORT***. If this field is omitted, then the format type is *TABLE*.

G. *:SORT:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :SORT: [sort code]
```

Tells Onevar whether to sort each series as time series or probability-of-exceedence series. *[Sort code]* should be ***TIME*** for time series, or ***PROB*** for probability of exceedence. If this field is omitted, then the sort type will be time series. Note that the probability type cannot be used with *REPORT* format.

H. *:DELIMITER:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :DELIMITER: [delimiter character]
```

Tells Onevar to separate each unit of information on a line with *[delimiter character]*. The delimiter allows a spreadsheet or other program to easily parse the Onevar output file. *[Delimiter character]* can be any ASCII character that does not function as whitespace. If you wish to use the tab character as a delimiter, use the code ***TAB*** for *[delimiter character]*. If this field is omitted, no delimiters will be applied.

I. *:STEP:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :STEP: [time step code]
```

Tells Onevar to redistribute the table values into the time steps indicated by *[time step code]*. When this field is given, Onevar *first* computes the table values at the time step of simulation. After all table values have been computed for every time step, it *then* redistributes them over the time step indicated by *[time step code]*. If this field is omitted, then the values are presented at the time step of simulation.

[Time step code] may refer to an Access table which defines a time-step cycle, using this format:

```
        :STEP: [File name]:[Table name]
```

for example

```
        :STEP:  Onevar\step_defs.mdb:Steps_Hourly
```

This table has the exact same format as the *Steps* table in the OASIS time-parameters database (section 4.5.2 part D). *[File name]* may include absolute or relative (from the run directory) path information. *[Table name]* may or may not be in the time-parameters database or any other static database file (section 4.5.0). Of course, the number of MPO steps is irrelevant to Onevar.

Alternatively, the *[time step code]* may be a code for one of several pre-defined time step types. The available codes are:

WEEKLY	**ANNUAL**
DAILY	**YEARLY**
MONTHLY	**WHOLERUN**

ANNUAL and ***YEARLY*** have identical meaning. The code ***WHOLERUN*** tells Onevar that the entire run is to be treated as one time step. The other codes should be self-explanatory.

When redistributing from the simulation time step to the Onevar time step, the post-processor must be told what redistribution method to use. Therefore, if the *:STEP:* field is used, **each table** must contain a *step* field (section 6.1.9 part C).

If the *:STEP:* field points to a *Steps* table in a database, and that steps table contains a cycle that is fixed to the year (section 2.8.1), then the post-processor steps will use whatever year scheme (section 2.8.5) is implied in the table. Otherwise, the year scheme for the post-processor steps is the same as for the simulation steps.

If the command line option *NoRunInput* is applied (see section 6.1.6), then *[time step code]* actually defines the time steps that are used to calculate table values. It is thus possible to apply a second time-step code in the *:STEP:* field. In this case, the syntax form would be (see section 4.7.0 part A for conventions):

```
        :STEP: [time step code], [time step code 2]
```

The output is thus converted from *[time step code]* to *[time step code 2]*. *[Time step code 2]* can not appear in the *:STEP:* field if *NoRunInput* is not applied in the command line, or if *:PREPDB:* appears in the Onevar input file header.

J. *:TIME:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :TIME: [start date] , [end date]
```

or

```
        :TIME:  default
```

Tells Onevar to limit the output to the time range from *[start date]* to *[end date]*. Onevar always applies the start or end date of the OASIS run if those dates define a range more limited than that given in the *:TIME:* field. If *default* is entered, or if this field is omitted, then the start and end of the OASIS run are used.

The format of *[Start date]* and *[end date]* is *M/D/YYYY*, where *M* is the month number, *D* is the day, and *YYYY* is the four-digit year. Do not put whitespace anywhere in the *M/D/YYYY* sequence. Note that *[start date]* must be separated from *[end date]* by a comma.

K. *:GROUPING:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :GROUPING: [grouping code]
```

Tells Onevar how many columns to print in the *TABLE* format (section 6.1.4). This field is ignored for all formats other than *TABLE*.

[Grouping code] may be one of the following:

ANNUAL	**WHOLERUN**
YEARLY	**MONTHLY**

ANNUAL and *YEARLY* have identical meaning. If the code is *ANNUAL*, then each row in the table will contain the values that end in one year. The column headings will be the dates at the end of the periods. Note that not every value in the column will correspond to that exact date if the time steps are not fixed to the year (as with a *WEEKLY* time step). If the code is *MONTHLY*, then each row in the table will contain the values that end in one month. The column headings will be the period numbers within the month. If the code is *WHOLERUN,* then all values of the table will be presented in a single row.

Instead of one of the above codes, *[grouping code]* may be an integer number. If *[grouping code]* is a number, then the table will contain that number of columns. The first period of the table is always presented in the first row and first column of the table. The column headings will be the numbers 1-*[grouping code]*.

If this field is omitted, then the default grouping is *ANNUAL*.

L. *:SUMMARY:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :SUMMARY: [summary code]
```

Tells Onevar how many time steps are printed between summary rows in the *COLUMN* and *SEQUENTIAL* format (section 6.1.4). This field is ignored for *TABLE* and *REPORT* formats. The summary rows may include *TOTAL*, *MIN*, *MAX*, *AVG*, etc., as defined in the *options* field of the Onevar table definitions (section 6.1.9 part D). When this field is omitted from the Onevar input file, the summary rows are printed only at the end of the file (*i.e.* the default *[summary code]* is *WHOLERUN*). However, you may use this field to print summary rows at some other frequency. For example, if the *MAX* row is printed in the output file, then in the default case the maximum of all time steps is reported. However, if a *[summary code]* of *ANNUAL* is applied, then the output file will display the maximum for each year.

[Summary code] may be one of the following:

ANNUAL	**WHOLERUN**	**WEEKLY**
YEARLY	**MONTHLY**	**DAILY**

ANNUAL and *YEARLY* have identical meaning. Instead of one of the above codes, *[summary code]* may be an integer number. If *[summary code]* is a number, then that number of rows appear between summary rows.

M. *:PAGELENGTH:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :PAGELENGTH: [pagelength code]
```

Tells Onevar to repeat the column labels after an interval described by *[pagelength code]*. *[Pagelength code]* may be an integer number, or it may be one of the following codes:

ANNUAL	**WEEKLY**	
YEARLY	**MONTHLY**	**DAILY**

ANNUAL and *YEARLY* have identical meaning. If the code is *ANNUAL*, Onevar reprints the headers after one year's worth of values have been printed. If the code is *MONTHLY,* Onevar reprints the headers after one month's worth of values have been printed, and so forth. If *[pagelength code]* is a number, then Onevar reprints the headers after that number of rows of values have been printed. The total number of rows of data does not have to be an integer multiple of *[pagelength code]*.

For *COLUMN* and *SEQUENTIAL* format, all title lines of the "table" are repeated. For *TABLE* format, only the date labels are repeated. This field is ignored for *REPORT* format. If *[pagelength code]* is zero, or this field is omitted, then the column labels are not repeated.

N. *:FileAppend:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :FileAppend:
```

Tells Onevar to append output to the end of the file identified by the *:FILE:* field in the Onevar input-file header, instead of overwriting that file. Of course, this makes no difference if the output file does not already exist.

O. *:NOLABELS:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :NOLABELS: [Label category]
```

Tells Onevar not to print the default row or heading labels, or both. User-defined titles are *not* affected by this option. If this flag is omitted, then the default row and heading labels are printed. If *[label category]* is *HEAD* then the default heading labels are suppressed. If *[label category]* is *ROW* then the row labels are suppressed. If *[label category]* is *ALL* then both heading labels and row labels are suppressed.

P. *:NOBLANK:* field

Syntax form (see section 4.7.0 part A for conventions):

```
    :NOBLANK:
```

Tells Onevar not to print default blank rows. By default, blank rows separate tables and separate column headers from the values. This flag does not have any effect on the blank line that separates the period values from the summary values, which is controlled by the *BLANK* flag in the *options* field of a table definition. If this flag is omitted, then the default blank rows will be printed.

Q. *:NOYEAR:* field

Syntax form (see section 4.7.0 part A for conventions):

```
    :NOYEAR:
```

Tells Onevar to omit the year component when printing date labels.

R. *:DATESLASH:* field

Syntax form (see section 4.7.0 part A for conventions):

```
            :DATESLASH:
```

Tells Onevar to print a slash character before the year component of the date. By default, there is not a slash but a space character before the year component. These examples show what the dates would look like with and without this option:

code	**without *:DATESLASH:***	**with *:DATESLASH:***
%b	Sep 1993	Sep/1993
%m/%d	09/30 1993	34241

S. *:DATETITLE:* field

Syntax form (see section 4.7.0 part A for conventions):

```
            :DATETITLE: [title text]
```

Defines *[title text]*, a string of text that is used in place of the default label in the header at the top of the row of dates or frequency values. You can repeat this field up to three times in order to create a custom, multi-row title for the first column. If necessary, Onevar will increase the width of the first column in order to make *[title text]* fit. Therefore, be aware of all whitespace that you use in this field.

The way that Onevar reads *[title text]* is the same as for the *title* command (section 6.1.9 part A). After the keyword *:DATETITLE:*, there is one space character. All text between this first space character and the end of the line is treated as the *[title text]*, including spaces and tabs. A title definition can never include more than one line. If you include substitute names (in brackets) (section 4.7.1 part I) in *[title text]*, they will be substituted in output. Comment markers (section 4.7.0 part D) are not honored within *[title text]*. The title will always be truncated after 125 characters.

T. *:DateChangeStart:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :DateChangeStart: [new start date]
```

Tells Onevar that the output should be shifted in time, such that *[new start date]* becomes the end date of the first time step of the output.

If the *:DateChangeStart:* field is applied, then the effect is merely changing the time-step labels on the output. Firstly, this means that the table values are computed just as they would be without the *:DateChangeStart:*. All variables, including variables that reflect time parameters such as *julian*, *month*, and *year*, are determined according to the original time range.

Secondly, this means that Onevar does not consider whether the new time steps are of the same size as the old time step. One situation where this might be important is if the output time steps are monthly. For example, if values that come from November are shifted to December, the use of the *:DateChangeStart:* field does not cause Onevar to recalculate the value in any way to compensate for the change from a 30-day month to a 31-day month.

U. *:PREPDB:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :PREPDB:
        {
           File : [file name]
           Table : [table name]
           Prep([var name 1]) = [field name 1]
           Prep([var name 2]) = [field name 2]
              ...
           Prep([var name N]) = [field name N]
        }
```

Tells Onevar to read the pre-processor table *[table name]* in MS Access file *[file name]*. If *[file name]* is given with relative path, then Onevar locates the file relative to the run directory. For each *prep* variable (section 4.7.4) that is to be used in Onevar expressions, there must be a *Prep* field associating the variable with a field in the table. The number of *Prep* fields, *N*, can be from 1 to 60. The variable names can not contain spaces, although the field names can. If the field name contains spaces, be sure to put quotation marks around *[Field name X]*.

The *:PREPDB:* keyword can only appear if the *NoRunInput* command-line option is used (section 4.1.0). See section 6.1.6 for more information about pre-processor mode with Onevar.

V. *:TimeEndOfStep:* field

Syntax form (see section 4.7.0 part A for conventions):

```
        :TimeEndOfStep:
```

Tells Onevar to assume that the starting date given in the *:TIME:* field of the Onevar input-file header (section 6.1.7 part J) identifies the end of the time step. If this field is omitted, then Onevar assumes that the starting date identifies the beginning of the time step. This field is ignored unless Onevar is called with the *NoRunInput* command-line option (see section 6.1.6).

6.1.8 META-KEYWORDS FOR DEMARCATING THE ONEVAR FILE

A. *:TABLES:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
:TABLES:
```

Marks the start of the table-definitions section, and the end of the header section.

B. *:END:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
:END:
```

This keyword marks the end of the table-definitions section, and the end of the file. Onevar ignores anything that appears after this keyword.

C. *:NEWFILE:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
:NEWFILE:
```

This keyword marks the end of the table-definitions section, similar to the *:END:* keyword. However, instead of signaling the end of the file, this keyword signals the start of a whole new header section. The keyword tells Onevar that it should virtually restart, reading everything after *:NEWFILE:* as if it were reading a whole new input file. If this keyword is read by Plot, Plot treats it the same as the *:END:* keyword.

When Onevar encounters *:NEWFILE:* it closes the Onevar input file, evaluates the tables, and writes the output defined before the *:NEWFILE:* marker. Then it reopens the input file and begins reading after the *:NEWFILE:* marker, and it evalutes the tables and writes the output defined after the marker. A single Onevar input file can contain any number of *:NEWFILE:* markers. If Onevar encounters an error before the first part is completed, it will not evaluate or even read the parts after *:NEWFILE:*. Thus, a principal reason for using *:NEWFILE:* is that you have a process that should not be evaluated unless another process or processes are successfully completed.

The output file declared after *:NEWFILE:* can be different than the output(either text or HEC-DSS) file declared before *:NEWFILE:*. Furthermore, the output files can be the same. If the output files are the same, then the tables evaluted after *:NEWFILE:* are appended to the end of the output file.

D. *:TRACEFILTER:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
:TRACEFILTER:
```

This keyword marks the beginning of the trace-filter section, and the end of the header section. If this keyword is used, then it must appear *before* the *:TABLES:* keyword. This keyword is optional, and it can only be used in position-analysis mode. See section 6.1.10 for documentation of the trace-filter section.

E. *:BLOCK:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
      :BLOCK:
```

Defines the start and end of the information that should be repeated in the **report block**, when using the *REPORT* format type (see section 6.1.4). This marker should not appear when using any other format type. This keyword is optional, needed only if there are some titles that you wish to repeat in the block, and some that you do not wish to repeat. If it is used, *:BLOCK:* must appear before the first *:COLUMN:* marker.

F. *:COLUMN:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
      :COLUMN: {     pad : [pad width]
                   title : [title width]
                   value : [value width]    }
```

Marks the beginning of a new column in the *REPORT* format (see section 6.1.4). It cannot be used with other formats. There must be at least one *:COLUMN:* marker if the *REPORT* format is being used.

This command defines the width of each part of the column. This same width is applied to all "tables" of the column. *[Pad width]* is the width of blank space at the beginning of the column. *[Title width]* is the width of the titles, or labels, of the column. *[Value width]* is the width of the space allocated for the values in the column.

G. *:TIMESHIFT:* meta-command

Syntax form (see section 4.7.0 part A for conventions):

```
      :TIMESHIFT:
```

Marks the beginning of a series of tables that are evaluated *after* other tables have been converted to post-processor time steps. The tables that appear after the *:TIMESHIFT:* marker are the ***post-shift*** tables. Usage of the post-shift tables is subject to certain restrictions. The *:TIMESHIFT:* marker can only appear after the *:TABLES:* marker, and it can only be applied once. It cannot be used for position analysis. The *:TIMESHIFT:* marker should be used with the *:STEP:* field in the Onevar header (section 6.1.7 part I).

The documentation of the *:STEP:* field (section 6.1.7 part I) describes how the table values are computed for simulation time steps, then redistributed to post-processor time steps. The values of the post-shift tables are not computed until after the other tables have been redistributed. After the transition to post-processor time (the "time shift"), the values of the post-shift tables are computed at post-processor steps. However, it is important to realize that most variables are not redistributed to the new time steps – only the Onevar tables. For that reason, the value expression of a post-shift table cannot contain most variables. The legal variables include *table*, and time-parameter values such as *day* and *abs_period* (see section 4.7.4).

6.1.9 ONEVAR OUTPUT COMMANDS

The output commands are to Onevar what the simulation commands are to OCL in OASIS. These commands define specific pieces of information to be evaluated and displayed. These commands always appear after the *:TABLES:* marker in the Onevar input file.

A. *Title* definition

Syntax form (see section 4.7.0 part A for conventions):

```
    title : [title text]
```

or

```
    title([location code]) : [title text]
```

Defines a string of text to be displayed in the Onevar output file. Note that the *title* definition can be an independent command, or it can be a field of the *table* definition (section 6.1.9 part C). In both cases, it follows the same syntax.

After the colon, there is one space character. All text between this first space character and the end of the line is treated as the *[title text]*, including spaces and tabs. A title definition can never include more than one line. If you include substitute names (in brackets) (section 4.7.1 part I) in *[title text]*, they will be substituted in output. Comment markers (section 4.7.0 part D) are not honored within *[title text]*. The title will always be truncated after 150 characters.

Here are some examples:

```
    title : Flow deficit at Hat Creek (MGD)
    title : This is more title text
    title :   This title text includes two spaces in front.
```

It is possible to attach a *[location code]* value, in parentheses, to the keyword *title*. The value of *[location code]* indicates a special location for the title. The possible values of *[location code]* are:

title(*[location code]***)**	**Location where title is written in output file**
title(BeforeHead)	Immediately before the column header rows (the column titles).
title(AfterHead)	Immediately after the column header rows (the column titles).
title(BeforeSumm)	Immediately before the summary rows.
title(AfterSumm)	Immediately after the summary rows.

The location codes can only be used for titles that are independent commands. If the title is part of a table, then the location code can not be used.

If one of the above location codes is applied to a title definition, then that title will not be displayed in the same order as independent titles in the Onevar output file. Note that the location indicated by *[location code]* might occur multiple times in the output file. For example, if the *:SUMMARY:* keyword (section 6.1.7 part L) appears in the Onevar header section, the summary rows might appear at the end of every year's worth of data. Any titles with the location code *BeforeSumm* would be printed before each set of summary rows. There can be more than one title using any value of *[location code]*.

There is a second syntax form for the title definition, which is now obsolete, though Onevar still honors it for backwards compatibility. The syntax form is:

```
    title([code])
```

The second syntax form allows you to print information that Onevar automatically generates. In this syntax form, there is no colon or *[title text]*. Instead, you attach parentheses to the word *title*, containing a *[code]*, which may be one of these options:

title(*[code]*)	**Onevar prints to output**	**Superseded by**
title(description)	The exact text of the *run description* (the second line of the control file -- see section 4.4.0).	**title : [RunDesc]**
title(directory)	The full, absolute path name of the run directory	**title : [RunDir]**
title(time)	The date and time that the OASIS run began. This information is stored in the *Runtime* table (section 4.5.2 part G) of the time parameters database	**title : [RunTime]**

Each of the options in the second syntax form can be created using pre-defined substitute names (section 4.7.1 part I) with the first syntax form of the title definition. The table above notes which substitute names supersede which options of the second syntax form. It is preferable to use the pre-defined substitutes, since they are more general in form, more flexible, and include more options.

By default, each title gets printed with a new-line character at the end. Either syntax form can include an ampersand, attached to the word *title*, in order to suppress the new line. In this way, you can put information from more than one *title* definition onto the same line. For example, this input:

```
title& : Run executed:
title&(time)
title :  by Jim Smith
Title : Engulf & Devour, Inc.
title :
title :   Study description :  [RunDesc]
```

would produce this output:

```
Run executed: Tue Oct 06 1998 16:20 by Jim Smith
Engulf & Devour, Inc.

  Study description :  X32-X40.mumbo-jumbo
```

B. *Blank* definition

Syntax form (see section 4.7.0 part A for conventions):

```
Blank
```

Tells Onevar to fill this space in the report block with a blank. This is only useful for the *REPORT* format type (section 6.1.4). This command has a similar effect to entering a *title* definition with blank text, but there is a difference. If you are using a delimiter (defined in the *:DELIMITER:* field in the heading), then a blank spot created with *BLANK* will have a delimiter to separate the title part from the value part. A blank spot created with *title* will not have this delimiter.

C. *Table* definition

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:

```
Table [name]
{
   Title : [title text]
   Legend : [legend text]
   InitCol : [initial column text]
   Format : [width].[number of decimals]
   Step : [step method]
   Value : [value expression]
   Text : [output text]
   Options :  [options list]
   DSSRecord :  [DSS record name]
   DSSUnits :  [DSS unit name]
   DSSVarType :  [DSS variable type]
}
```

The conditional form, which is slightly more complex, is described after all the fields of the unconditional form are described.

This command gives the formula for the output series in *[value expression]*, and provides formatting information for presenting the output series. Every Onevar file may have up to 400 *table* definitions. The way Onevar prints the output series in relationship to the other series depends upon the general format type (section 6.1.4).

[Name] is optional. If *[name]* is left blank, then Onevar will automatically assign the table's name as the number in the order. For example, the first table would be named "1", the second "2", etc. The name field may be used to refer to the value of the table with the *table* variable (see section 4.7.4).

Of the fields within the curly braces, all except *value* are optional (if *:FILEDSS:* appears in the Onevar header section, then the *DSSRecord* field is required). The fields do not have to be entered in any particular order. However, the titles will be printed in the order that they appear in the *title* fields.

The ***title*** fields are optional. You may enter between zero and six *title* fields per table. The *title* fields in the *table* definition follow the same syntax rules as the independent *title* command (section 6.1.9 part A).

The output appearance of the titles in a *table* definition varies by format type (see section 6.1.4 for a description of format types).

> ***TABLE* and *SEQUENTIAL* format**. The titles are all printed at the top of the table. There is a blank line between the last title and the column labels, unless suppressed with the *:NOBLANK:* flag.
>
> ***COLUMN* format**. The titles are all used as column labels. Each is be truncated to the width defined in the *format* field of the *table* definition. The number of rows for column labels is the greatest number of *title* fields in any of the *table* definitions. If any "table" has a lesser number of labels, blanks are used in the bottom part of the label for that column. There is a blank line between the last title line and the data values, unless suppressed with the *:NOBLANK:* flag.
>
> ***REPORT* format**. The first title defines a label for the data. Subsequent titles are ignored. The title is truncated at the width given in the *title* field of the *:COLUMN:* command.

The ***legend*** field is only used if the Onevar file is being used by the Plot program. The Plot program does not require the *legend* field -- it is optional. *[Legend text]* is used as a label for the data in the legend of the plot. *[Legend text]* is parsed by the same rules as for *[title text]* in the *title* field (see section 6.1.9 part A for details). If the Onevar file is being used by Onevar, then the *legend* field is ignored.

The ***DSSRecord*** field must appear if the *:FILEDSS:* field appears in the Onevar header section. If the *:FILEDSS:* keyword does not appear, then the *DSSRecord* field is ignored. If ***NONE*** is entered into the *DSSRecord* field, then this table is not saved to the HEC-DSS file. If the table should be saved to the HEC-DSS file, then there are two ways to enter *[DSS record name]*. In neither form should there be any spaces in the entry.

> *[B part]/[C part]*
>
> When the record name is entered this way, the A part and F part will be blank. The D part and E part are automatically determined according to the output time step. Only the B and C parts are entered, and the only slash character in the entry should be between the B and C parts.
>
> */[A part]/[B part]/[C part]/[D part]/[E part]/[F part]/*
>
> In this form, the A, B, C, and F parts are all specified. The D part and E part are automatically determined according to the output time step. Whatever is entered for the D and E parts in the *DSSRecord* field is ignored. Slash characters must appear at the beginning and end and between each part of the record name.

The ***DSSUnits*** field must appear if the *:FILEDSS:* field appears in the Onevar header section. However, if ***NONE*** is entered into the *DSSRecord* field, then the *DSSUnits* field is not required. If the *:FILEDSS:* keyword does not appear, then the *DSSUnits* field is ignored. *[DSS unit name]* is written to the unit field of the HEC-DSS record. The ***DssVarType*** field is never required. If the *:FILEDSS:* keyword does not appear, then the *DSSVarType* field is ignored. The value in *[DSS Variable Type]* is written into the *Type* field of the HEC-DSS record. If the *DSSVarType* field is not present, then the default value of *INST-VAL* is written to the *Type* field. Possible values of *[DSS Variable Type]* are *PER-AVER*, *PER-CUM*, *INST-VAL*, *INST-CUM*. OASIS software is not sensitive to the *Type* field of HEC-DSS records, but other software might be.

See section 6.1.5 for more information about writing to HEC-DSS with Onevar.

The ***InitCol*** field allows you to define special text that will appear at the beginning of every row of the table (*before* the standard row label of date or frequency). If the *InitCol* field is omitted, then no special text is printed at the beginning of every row. *[Initial column text]* is parsed by the same rules as *[title text]* in the *title* field. Note that any space characters at the end of *[initial column text]* will be reproduced in the output. The width of the initial column is determined by the length of *[initial column text]*. When the format is *COLUMNS*, the initial column is based on the first table definition only. If the format is *SEQUENTIAL* or *TABLES*, each table is printed with its own initial column. The *InitCol* field is ignored for *REPORT* format.

The ***format*** field defines the width (in ASCII characters) of the column or columns, and the number of digits to appear after the decimal point. For the *REPORT* format type, *[number of decimals]* is used, but the *[width]* information is ignored. *[Width].[number of decimals]* is a single OCL "word" (it contains no whitespace). The period and the *[number of decimals]* may be omitted, which has the same effect as entering a zero for *[number of decimals]*. If the *format* field is omitted, then the default format is "8.0".

If *[width]* is zero, then the table or column is not printed. Onevar still computes the values of such a table -- it just does not print the results. You can refer to such a table using the *table* variable (section 4.7.4), even though it is not visible..

The ***step*** field is required if the *:STEP:* field is applied in the heading (section 6.1.7 part I). Otherwise, this field is ignored. *[Step method]* is a code telling the post-processor what method to use when redistributing the values from the simulation time step to the time step indicated in the *:STEP:* field. The following codes can be used:

sum	The sum of all values from the simulation time steps which fall within the new time step.
avg	The mean of all values from the simulation time steps which fall within the new time step. This option computes the mean as the sum of the values divided by the number of steps.
wt_avg	The mean of all values from the simulation time steps which fall within the new time step. This option computes the mean as the sum of the values, *weighted by the length of each step*, divided by the total length of the new step.
$*[per number]*	The value of simulation step *[per number]* that falls within the new time step. For example, if the new step is *ANNUAL, $2* indicates the second period of the year.
m*[month number]*	The value of month *[month number]* of the year. This option is only acceptable if the time-step size of simulation is monthly and the new time step is *ANNUAL*.

EOP	The value at the end of the new time step.
max	The maximum of all values from the simulation time steps which fall within the new time step.
min	The minimum of all values from the simulation time steps which fall within the new time step.
max(*[n]*)	The *[n]*th largest value from the simulation time steps which fall within the new time step, where *[n]* is a positive integer.
min(*[n]*)	The *[n]*th smallest value from the simulation time steps which fall within the new time step, where *[n]* is a positive integer.

One ***value*** field or *text* field is always required. The table can not have both a *value* and *text* field, unless it uses the conditional syntax form described below. For each simulation time step of the Onevar run, *[value expression]* is evaluated to generate the data series that will be printed in the Onevar output file. *[Value expression]* follows the same syntax rules as other OCL expressions (see section 4.7.3 for syntax rules). However, decision variables such as *flow* and *delivery* are assumed to have a lag of 0 instead of -1. Thus, *delivery325* would be *current-time step* delivery at node 325.

One *value* field or ***text*** field is always required. The table can not have both a *value* and *text* field, unless it uses the conditional syntax form described below. *[Output text]* is displayed in the table output in lieu of a numeric value. After the word *text*, there is a colon, then one space character. All text between this first space character and the end of the line is treated as the *[output text]*, including spaces and tabs. *[Output text]* can never include more than one line. If you include substitute names (in brackets) (section 4.7.1 part I) in *[Output text]*, they will be substituted in output. Comment markers (section 4.7.0 part D) are not honored within *[title text]*. When *[output text]* is displayed in the output file, it is truncated, if necessary, to the length described by *[width]***.***[number of decimals]*.

The *text* field can not be applied if the *:SORT:* field contains *PROBABILITY* (section 6.1.7 part G), if there is a *:FILEDSS:* field (section 6.1.7 part B), or if the Onevar input file is used for Plot. When table values are redistributed to post-processor time steps via the *:STEP:* field (section 6.1.7 part I), any instances of text in the table are treated as zero. It is suggested that you should not use the *text* field in a table when the *:STEP:* field is applied in the Onevar input-file header, unless the table comes after the *:TIMESHIFT:* marker .(section 6.1.8)

The ***options*** field is, fittingly, optional. *[Options list]* consists of zero or more words. It is recommended that you separate the words with whitespace, although Onevar does not require it. The following flags can be entered into the options list:

page_break	For *TABLE*, *SEQUENTIAL*, or *REPORT* format, a page-break character will be printed at the end of the table. This option is ignored for *COLUMN* format.
descending	A probability-of-exceedence sorted series will be sorted in descending order. By default, such series are sorted in ascending order. This option is ignored for time-series sort type.
ascending	A probability-of-exceedence sorted series will be sorted in ascending order. By default, such series are sorted in ascending order. This option is ignored for time-series sort type.
NoPlot	Plot program will not use this table definition to create a line. Plot selects the first *x* tables that *do not* have the *NoPlot* option, where *x* is the number of lines to be plotted. This option is ignored by Onevar.
NoInterp	When converting from simulation time steps to post-processor time steps, *do not* interpolate to get values of data between the endpoints of simulation time steps Instead, the post-processor derives the value of the data point by using the value of the time step in which that data point falls.
VirtualDSS	This is a very advanced option that is only used in conjunction with the *:NEWFILE:* marker. This option tells Onevar to save the table output into a *virtual HEC-DSS file*. This virtual file only exists in RAM which Onevar allocates. A subsequent run of Onevar following the *:NEWFILE:* marker attempts to read from this virtual file. The virtual file is destroyed when Onevar comes to the *:END:* marker. In specialized situations, this option can save run time because the results of intermediate calculations do not need to be saved to disk.

Summary options:

total avg min max stdvp stdev cov ACC([k]) skewp skew
AdjAvg med avp([n]) LPrs([p]) PR([p]) blank

These options determine *summary rows* (and in one case, a summary column) that can be displayed at the bottom of every column in the text output file. Each of these options is discussed in detail in section 6.1.9 part D.

Syntax form (see section 4.7.0 part A for conventions):

Conditional form:

```
Table [name]
{
   Condition : [condition expression]
   Value : [value expression]

   Condition : [condition expression]
   Text : [output text]

   Condition : [condition expression]
   Value : [value expression]

   [...]

   Condition : [condition expression]
   Value : [value expression]
}
```

The conditional form includes all of the same fields (such as *Title* and *Format*) that are used in the unconditional form, but for brevity the syntax form above shows only the *Condition*, *Value*, and *Text* fields. The difference in the conditional form is that there can be one of more *condition* fields, each defining a condition block. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. However, branched conditions are not possible in the Onevar table definition.

Each condition block includes exactly one *value* field or *text* field. A condition block can not contain both types of field. Other types of fields can not come between the *condition* field and the *value* or *text* field. It is possible for one condition block to designate text, while another designates a value.

As with other OCL commands, for each time step, the condition expressions are evaluated in the order they are entered. The first condition expression that evaluates as true is selected for the time step. The *[value expression]* in that condition block is then evaluated and displayed in output, or else the *[output text]* is displayed.

D. Summary options with the *Table* definition

The ***options*** field of the ***table*** command contains a list of features that can be turned on by including the respective code in the list, or turned off by leaving the respective code out of the list. A large number of the options are for summary information that can be displayed in a table. All of these summary options are ignored for *REPORT* format (section 6.1.4). Most types of summary information appear in special rows at the bottom of the table. However, one summary option is different:

total For *TABLE* format, a column labeled *TOTAL* appears at the end of each row, containing the sum of all values in the row. In the *stdev*, *avg*, *aavg*, and *avp* rows, Onevar prints the standard deviation and average of the total column. In the *min* and *max* rows, Onevar prints the minimum and maximum over the entire table.

For *COLUMN* or *SEQUENTIAL* format, a row containing the sum over all periods appears at the bottom of the column. Thus, for *COLUMN* or *SEQUENTIAL* format, this option functions much like the other summary options.

The remainder of the summary options are for special rows that appear at the bottom of the table. Each such row summarizes the values that appear in each column. The summary row works in a very similar way for *TABLE*, *COLUMN* or *SEQUENTIAL* format (section 6.1.4). The principal distinction is that with *TABLE* format, each table command is output as many columns, and the summary row contains a value for each column. With *COLUMN* and *SEQUENTIAL* format, the entire table becomes a single column, so the summary row only contains a single value for each table command.

See section 6.1.7 part L for details about the *:SUMMARY:* field in the Onevar input file header. This field can be combined with *COLUMN* or *SEQUENTIAL* format to report summary information over part of the time range. For example, the summary rows can printed for each year.

The options for summary rows are:

avg A row labeled *AVG* appears at the bottom with the average (arithmetic mean) for each column, which is calculated as:

$$M_x = \frac{1}{N}\sum_{n=1}^{N} x_n$$

min A row labeled *MIN* appears at the bottom with the minimum for each column.

max A row labeled *MAX* appears at the bottom with the maximum for each column.

stdvp A row labeled *STDVP* appears at the bottom with the standard deviation (standard deviation of the sample) for each column. The standard deviation of the sample is considered to be a “biased” estimate of the population standard deviation, and is best applied when the sample of points represents the complete population. This is equivalent to the worksheet function *STDEVP* in MS Excel. The formula for computing the standard deviation of the sample is:

$$STDVP_x = \sqrt{\frac{1}{N}\sum_{n=1}^{N} (x_n - M_x)^2}$$

stdev A row labeled *STDEV* appears at the bottom with the sample standard deviation for each column. The sample standard deviation is considered to be an “unbiased” estimate of the population standard deviation, and is used when the sample of points does not represent the complete population. This is equivalent to the worksheet function *STDEV* in MS Excel. The formula for computing the sample standard deviation is:

$$STDEV_x = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N} (x_n - M_x)^2}$$

cov A row labeled *COV* appears at the bottom with the coefficient of variation for each column. This is calculated as:

$$COV_x = \frac{STDVP_x}{M_x}$$

ACC(*[k]*) A row labeled *ACCkk*–where *kk* is the two-digit value of *[k]*–appears at the bottom with the lag-*[k]* autocorrelation coefficient for the column. The lag *[k]* must be a numeric constant between 1 and 99. You can not enter an expression for *[k]*. The *options* field of any table can contain more than one instance of the *ACC* option, each one containing a different value of *[k]*. The autocorrelation coefficient is calculated:

$$r_{x,k} = \left(\frac{1}{STDVP_x \cdot STDVP_y}\right)\left(\frac{1}{N-k}\right)\sum_{n=k}^{N}(x_n - M_x)(y_n - M_y)$$

$$y_n = x_{n-k}$$

When calculating the autocorrelation, Onevar strictly defines x_{n-k} as the value *k* time steps ago, as opposed to the value that merely appears to be offset by *k* places in the output table. If a value for either x_n or x_{n-k} is not available, then that sample point is not included in the calculation. A point may be excluded from the calculation due to a stepfilter (section 6.1.9 part E), a *text* output in the table instead of *value*, or the point being outside the range of the *:TIME:* field (section 6.1.7 part J). For example, if a row is not shown in *COLUMNS* format due to a stepfilter, then x_n for that row and x_{n-k} for the row *k* steps ahead are considered to be unknown, and neither is included in the summation used to compute $r_{x,k}$–not even in the calculation of *STDVP* or *M*.

If the sample size *N* is large, then generally this means that the sample sets of *x* and *y* are mostly overlapping. However, there are always some points that are not contained in both sets, so the mean and standard deviation of the unlagged values, M_n and $STDVP_x$, is generally not precisely the same as the mean and standard deviation of the lagged values, M_y and $STDVP_y$

skewp A row labeled *SKEWP* appears at the bottom with the coefficient of skewness of the sample for each column. This is considered a "biased" estimate of the coefficient of skewness, and it is best applied when the points in the column represent the complete population. The coefficient of skewness of the sample is calculated as:

$$SKEWP_x = \frac{1}{STDVP^3}\frac{1}{N}\sum_{n=1}^{N}(x_n - M_x)^3$$

skew A row labeled *SKEW* appears at the bottom with the sample coefficient of skewness for each column. This is considered an "unbiased" estimate of the coefficient of skewness, and it is best applied when the points in the column do not represent the complete population. The sample coefficient of skewness is calculated as:

$$SKEW_x = \frac{N}{(N-1)(N-2)}\frac{1}{STDEV^3}\sum_{n=1}^{N}(x_n - M_x)^3$$

AdjAvg A row labeled *AAVG* appears at the bottom with the adjusted average for each column. This is computed as:

$$AdjAvg = \left(\frac{1}{N+1}\right)\sum_{n=1}^{N} x_n$$

med A row labeled *MED* appears at the bottom with the median for each column. This same value can be reported using the option *PR(0.5)* described below.

avp(*[n]*) A row labeled *AVP* appears at the bottom with the product of the average (mean) and *[n]* for each column. The multiplier *[n]* must be a numeric constant. You can not enter an expression for *[n]*.

You may only include the *avp* option once for each table, but you may use a different value of *[n]* for each table.

LPrs(*[p]*)	A row labeled *LPrs*[p] appears at the bottom with the value with a *[p]* chance of non-exceedence, as computed by a log-Pearson III distribution fitted to the values in the column. The multiplier *[p]* must be a numeric constant between 0 and 1 (non-inclusive). You can not enter an expression for *[p]*. The *options* field of any table can contain more than one instance of the *LPrs* option, each one containing a different value of *[p]*. The log-Pearson distribution is developed using the unbiased sample standard deviation and sample skewness as shown with the *STDEV* and *SKEW* options above, in imitation of the USGS software SWSTAT. Furthermore, Onevar follows the example of SWSTAT by basing the distribution only on the nonzero values in the column. The distribution is then adjusted according to the number of zeros in the column. The *LPrs* option is similar to the *PR* option listed below. However, *LPrs* is used to get quantile values from a standard distribution function, whereas *PR* is used to get quantile values directly from the distribution of the sample. A log-Pearson III distribution is recommended by the US Water Resources Council as a method for flood flow frequency studies. It is considered a suitable estimator for the probability of extremely low-flow or high-flow events.
PR(*[p]*)	A row labeled *PR*[p] appears at the bottom with the value with a *[p]* chance of non-exceedence, as computed directly from the cumulative distribution of the sample. The multiplier *[p]* must be a numeric constant between 0 and 1 (non-inclusive). You can not enter an expression for *[p]*. The *options* field of any table can contain more than one instance of the *PR* option, each one containing a different value of *[p]*. The *PR* option is similar to the *LPrs* option listed below. However, *LPrs* is used to get quantile values from a standard distribution function, whereas *PR* is used to get quantile values directly from the distribution of the sample. Onevar internally sorts all values in the column, and assigns each value a probability *p*, where *p=n/(N+1)*, where *n*=the rank of the value and *N*=the number of values. As needed, Onevar uses linear interpolation to get the value that corresponds to *[p]*. This may be described as finding the "percentile" value. For example, *PR(0.75)* tells Onevar to report the 75 percentile value. The option *PR(0.5)* would return the median, also available with the *MED* option described above.
blank	A blank line separates the summary lines at the bottom (*min*, *max*, *avg*, etc.) from the other lines.

E. *StepFilter* command

Syntax form (see section 4.7.0 part A for conventions):

Unconditional form:

```
StepFilter
{  Value : [value expression]  }
```

Conditional form:

```
StepFilter
{
   Condition : [condition expression]
   Value : [value expression]

   [...]

   Condition : [condition expression]
   Value : [value expression]
}
```

Provides a basis for rejecting ("filtering out") some time steps from the output display. If a *StepFilter* command is applied in the Onevar output file, then only those time steps when *[value expression]* evaluates as true or as a nonzero value are shown in the output. Any time steps when *[value expression]* evaluates as false or zero are not shown in the output, and they are not included in the calculations for the summary rows of the tables, such as *MIN*, *MAX*, and *AVG* (section 6.1.9 part C).

The *StepFilter* command can appear anywhere in the *:TABLES:* section of the Onevar input file – before, after, or in between table definitions. However, the *StepFilter* command must be positioned in relation to the *:TIMESHIFT:* marker, as described below. There can be no more than one instance of this command in a Onevar input file. If a *StepFilter* command is not applied in a Onevar input file, then no time steps are filtered out of the output.

If table values are being redistributed to new time steps via the *:STEP:* field (section 6.1.7 part I), then the *StepFilter* command can only appear after the *:TIMESHIFT:* marker (section 6.1.8). If the *:STEP:* field is not applied, then the *StepFilter* command can not appear after the *:TIMESHIFT:* marker. When redistribution to new time steps is performed, the filter rule is determined based on the post-processor time steps, not the model time steps.

The *StepFilter* command can be entered in either conditional or unconditional form. The conditional form may have one or many conditions. The *[condition expression]* must follow the guidelines described in section 4.7.2 part A. However, branched conditions are not possible with this command. Each condition field is the head of a **condition block**. Each condition block must have a *value* field.

As with other OCL commands, for each time step, the condition expressions are evaluated in the order they are entered. The first condition expression that evaluates as true is selected for the time step. The *[value expression]* in that condition block is then evaluated. It is the *[value expression]* that ultimately determines whether a time step is rejected via the *StepFilter* command. If no condition evaluated as true during a time step, then that time step is rejected.

When step-filtering occurs, the effect on the output tables varies by format type (see section 6.1.4 for a description of format types).

***COLUMN* and *SEQUENTIAL* format**. If a time step is filtered out, then the corresponding row in the output file is skipped, and no blank space is shown to represent the time step.

***TABLE* format**. If an entire column of the table is composed of time steps that are filtered out, then that column is entirely omitted from the output display. If a time step is filtered out, but its column contains other time steps that are not filtered out, then a blank space is shown for that time step. If an entire row of the table is composed of time steps that are filtered out, then blank space is shown for the entire row.

***REPORT* format**. If a time step is filtered out, then the corresponding report block in the output file is skipped, and no blank space is shown to represent the time step.

Examples:

```
StepFilter
{
   Condition : month = 10
   Value : 1

   Condition : default
   Value : 0
}
```

In the above example, the output would only include values from the month of October, because in any other month, the value expression would be zero. The exact same effect can be achieved more concisely like so:

```
StepFilter{  Value : month=10 }
```

The value expression would be true in October, and false in all other months. Thus, values for all months except October are filtered out.

```
StepFilter{  Value : flow233.567 > 10 }
```

In the above example, the filter is based on a simulated flow. All time steps when the flow in arc 233.567 is less than or equal to 10 will be filtered out of the output display. Time steps when the flow is greater than 10 are displayed.

6.1.10 TRACE-FILTER SECTION IN THE ONEVAR INPUT FILE

The trace-filter section of the Onevar file is only used with position-analysis (PA) output. See Chapter 9 for more about PA. The trace-filter section is optional, only for use when you want to:

sort the display of PA traces by some criteria other than the values of the output being displayed

and/or

display some of the PA traces but exclude others.

Syntax form (see section 4.7.0 part A for conventions):

```
:TRACEFILTER:
[table definition]
TraceNum{ [Trace-number list]  }
```

The trace-filter section comes after the header section, before the table-definitions section. It begins with the keyword *:TRACEFILTER:* after the end of the header section. The keyword *:TABLES:* marks the end of the trace-filter section and the beginning of the table-definitions section (section 6.1.8).

The trace-filter section must contain a *TraceNum* field. *[Trace-number list]* identifies the particular traces from the sorted order which you want to display in the output. The list is delimited by commas and dashes. A comma means *and,* and a dash means *through*. For example, this *TraceNum* field:

```
TraceNum{ 7-10 , 12 , 16-20 }
```

calls for traces 7 through 10, trace 12, and traces 16 through 20. It is equivalent to this:

```
TraceNum{7,8,9,10,12,16,17,18,19,20}
```

Traces that are not in the list will not be displayed. In the above examples, traces 1-6, 11, 13-15, and all higher than 20 will not be displayed. The keyword *ALL* can be used in place of *[trace-number list]* to indicate that none of traces will be left out of the display.

The *TraceNum* field can be replaced with a *TracePct* field with the form:

```
        TracePct{ [Trace-percentile list]  }
```

The trace-filter section can not contain both *TraceNum* and *TracePct*. The *[Trace-percentile list]* has almost exactly the same syntax as the *[Trace-number list]*. However, this list identifies the traces by their percentile rank (using numbers 0-100) instead of the trace number. In order for the trace to have a percentile rank, it is implicit that the traces must be sorted according to a *[table definition]* as described below. Suppose the position analysis consists of nine traces. If the *TracePct* field looks like this:

```
        TracePct{ 20, 70-90 }
```

Then the display will include only trace numbers 2, 7, 8, and 9, where the traces have been sorted by according to the variable in *[table definition]*, with trace 1 (percentile 10) corresponding to the lowest value of the variable. If the values entered into the *TracePct* field do not precisely correspond to percentile rank values from the position analysis, then the post-processor program rounds to the nearest percentile rank values.

The trace-filter section can contain a single table definition (never more than one!). *[Table definition]* should be excluded if you do not wish to select your traces from a sorted list. If *[table definition]* is applied, it must come *before* the *TraceNum* field. *[Table definition]* has identical syntax to the table definition in the table-definitions section (section 6.1.9 part C). Onevar's evaluation of this table is distinct from the evaluation of the tables in the table-definitions section.

> The trace-filter table is always evaluated as though the *:SORT:* field contained *PROBABILITY* and the *:STEP:* field contained *WHOLERUN*. This does not affect the evaluation of the tables in the tables-definition section; they are still evaluated according to your *:SORT:* (section 6.1.7 part G) and *:STEP:* (section 6.1.7 part I) entries in the header section..
>
> The trace-filter table is evaluated for all PA traces, while the tables in the table-definitions section are evaluated only for those traces identified in the *TraceNum* field.
>
> The trace-filter table is not displayed in output. This means that the *title* and *format* fields are irrelevant. If you wish, you may put a table identical to the trace-filter table in the table-definitions section, so that you can see what its values are. However, remember that this output will be filtered according to the *TraceNum* field.

Having identified all of its components, we can now explain how the trace-filter section is evaluated:

> The trace-filter section is evaluated before the table-definitions section.
>
> Firstly, the trace-filter table is evaluated for all PA traces.
>
> Next, the trace-filter table is aggregated for a *WHOLERUN* step type, and it is sorted by its values. This results in a sorted series with one value representing each trace.
>
> Next, the traces are selected according to the *TraceNum* field. Suppose the *TraceNum* field contained *1-5*. Thus, Onevar would select the five traces at the top of the sorted list. If no *[table definition]* was given, then no sorting would be done. Onevar would simply select the first five traces.
>
> Finally, the tables of the table-definitions section are evaluated and displayed *only for the selected traces*.

Here is an example of a Onevar input file using a trace filter.

```
:FILE:   stages_1-10.txt
:DELIMITER: ,

:TRACEFILTER:

    Table 1
    {   value  :  elevation120
        step   :  MIN
    }
    TraceNum{1-10}

:TABLES:

Table 1
{ title  :  OUTFLOW
  value  : flow340.150
  format :  8.2
}

:END:
```

This example tells Onevar to print 10 traces. The selected traces are the 10 with the lowest low points in elevation at reservoir node number 120. The output is a time-series of flow in arc 340.150 for those 10 traces. If we wanted to present the 10 traces with the highest low points in reservoir elevation, we could add the field:

> *options : descending*

to the trace-filter table.

6.2.0 PLOT PROGRAM

Plot is the OASIS post-processor that presents data in graphical plots. The unit of output for Plot is the **line**. A single plot can contain many lines. Each line represents the values of a formula.

Plot runs much like Onevar (section 6.1.0). It reads formula information from a Onevar input file (section 6.1.3), and gets information about formatting the plot from the plot-definition file (section 6.2.3). When it has finished running, it creates a window, in which your plot is displayed. You can **modify** and **print** the plot through a graphical interface (section 6.2.4). The plot window remains open until you choose to close it.

While Onevar can only process data for one run at a time, Plot can process data from one run or from **multiple runs**.

> When it is using only one run, Plot can present many different variables from that one run on a single plot.
>
> When it is using multiple runs, Plot presents the results for *one* variable from up to six different runs. It does not present multiple variables from multiple runs.

Plot can present **multiple plots** with one execution. Each of these plots has its own format and data. The multiple plots are presented as multiple documents (each with its own window) inside one instance of the plot program. Each document window can be expanded, shrunk, hidden, closed, moved around with the mouse, or maximized to take up the entire display. Any subset of the plots can be visible in the display at one time.

When you do multiple plots, each plot contains data from the same set of model runs. If you want to see plots that contain a different set of model runs, you must change your plot pointer file (section 6.2.1) and run Plot again.

The program is contained in the file *Plot.exe*. This file must be found in the same directory as *model.exe*. Plot will need to be able to read the following files when it runs:

The **model pointer file** (section 4.3.0), unless the command line argument *DIR* is used (section 4.1.0), or unless run directories are named in the Plot pointer file (section 6.2.1). The model pointer file must be in the same directory as *Plot.exe*.

The **Plot pointer file** (section 6.2.1). The Plot pointer file must be in the same directory as *Plot.exe*.

The **control file** in the directory named by the model pointer file (section 4.4.0). The file *model.cf* is opened unless another file name is specified with the command line argument *CF* (section 4.1.0).

The Plot pointer file (section 6.2.1) can name more than one run directory. If it does, Plot will need to be able to read the control file for each.

All of the **model input files** named in the control file(s), including the static databases (section 4.5.0) and the OCL file (section 4.7.0).

The **model time-series output databases** (section 5.6.0) named in the control file(s).

The **plot-definition file** (section 6.2.3), named by the Plot pointer file.

The **Onevar input file** (section 6.1.3) named by the plot-definition file's *File ID* table (section 6.2.3 part A).

Plot does not initialize any external modules, or have access to input that is specific to a module.

When the command-line option *NoRunInput* (section 4.1.0) is applied, Plot can run without reading a control file, model input files, and the model time-series output database. This is called *pre-processor* mode. The behavior of Plot in pre-processor mode is the same as Onevar. See section 6.1.6 for more information about this special use of Plot.

Plot is run by the OASIS GUI when you click on *PLOTS* (section 3.6.4 part B). If the GUI is configured properly, you do not need to worry about the pointer files, because the GUI manages them for you.

6.2.1 PLOT POINTER FILE

The Plot pointer file is an ASCII text file. By default, the pointer file is named *plot.cf*, and it must be found in the same directory as *Plot.exe*. This default name and path can be overridden with the command-line parameter *PLOTPF* (section 4.1.0). The purpose of this file is to tell Plot the name and path of the plot-definition file or files. It may also contain the names of run directories to use in the plot. It *must* contain the names of run directories if you are plotting multiple runs on one plot.

When you use the **OASIS GUI**, the plot pointer file is automatically handled for you, so you do not need to view or edit it.

The pointer file contains the following information, in order:

The number of graphs to plot, preceded by a pipe character (|).

The names of the plot-definition files which define each graph. The number of plot definition files must match the number of graphs indicated above. Each file name is preceded by a pipe. The file path can be absolute or relative to *Plot.exe*.

The number of runs to be plotted, preceded by a pipe. Each graph will plot information from each of the runs. If you enter zero, one run is plotted, and the Plot program uses *directry.nam* (section 4.3.0) or the command line (section 4.1.0) to get the name of the run.

The pathnames of the run directories which contain each run. The number of run directories must match the number of runs indicated above. Each pathname is preceded by a pipe. The path can be absolute or relative to *Plot.exe*.

Here is an example text from a Plot pointer file. This file directs Plot to create three plots with data from two run directories.

Example of a Plot pointer file

```
| 3                           // number of graphs to plot
|   plotdefs\delivery_1.mdb   // name of plot definition file
|   plotdefs\storage.mdb      // name of plot definition file
|   plotdefs\Jeffs_plot.mdb   // name of plot definition file

| 2                           // number of runs to plot
|   runs\base_run             // run directory of the first run
|   runs\run22                // run directory of the second run
```

6.2.2 ONEVAR INPUT FILE

Plot reads a Onevar input file to get the ***formulas*** of the plot lines, while the ***formatting*** information is given in the plot definition file. Thus, writing a formula for a line on the plot is just like writing a formula for a Onevar table. Furthermore, you can use the same Onevar file as input to both Plot and Onevar, so that you can see the same data in a plot form and a table form. The general details of the Onevar input file are given in sections 6.1.3 - 6.1.9, while this section discusses the specific way the Plot treats the Onevar input file.

Plot gets the name of the Onevar input file to use from the *File ID* table (section 6.2.3 part A)

Plot ignores any information in the Onevar input file that tells how to format a text table. For example, the *:FORMAT:* field in the header section, and the *format* and *title* fields in the table definition are meaningless to Plot. You *do **not** have to remove this information* in order for Plot to read the file. This information may be useful if you are going to run Onevar using the same file.

Rather than explain which parts of the Onevar input file are ignored by Plot, we will point out those that it actually uses. Plot uses the following fields from the **header section** (section 6.1.7):

***:SORT:* field**	Can specify a probability-of-exceedence or a time-series plot.
***:STEP:* field**	Can plot the data at different time steps than the simulation time steps.
***:TIME:* field**	Can specify limits of the time range. This is only used for a probability plot. It is ignored for a time-series plot. Change the x-axis range (section 6.2.3 part D) to restrict the time interval that is displayed for a time-series plot.
***:STATDB:* field**	Can include data from an OCL static database if this was not done from the OCL file.
***:TIMEDB:* field**	Can include data from an OCL time-series database.
***:PREPDB:* field**	Can include data from a pre-processor database.

Plot heeds the following fields from the ***table* definition** (section 6.1.9 part C):

***value* field**	Always required, because it gives the formula of the line.
***legend* field**	Gives a string of text to be displayed in the legend box of the plot. The entry in this field overrides the entry in the *legend text* field of the *Lines* table (section 6.2.3 part B). If you omit this field, Plot uses the information from the *Lines* table.
***step* field**	Required if the *:STEP:* field was applied in the header.

***ascending* or *descending* options in the *options* field**

Can specify the sort order if sorting the data for a probability-of-exceedence plot. Other options in the *options* field are ignored.

***NoPlot* option in the *options* field**

Means that Plot will not use the table to create a line on the plot.

Plot reads the ***StepFilter*** command (section 6.1.9 part E) and filters out time steps accordingly.

Each table definition in the Onevar input file is used to define a line for Plot, not counting those tables which use the *NoPlot* option. If there are more tables than the number of lines defined in the *Lines* table (section 6.2.3 part B), then the extra tables will be ignored. If there are fewer tables in the Onevar input file than the number of lines defined in the *Lines* table, then the number of tables in the Onevar input file is the number of lines plotted. If multiple runs are being plotted, then only the very first table definition is used, and all others are ignored.

Plot can also be given a Onevar input file that contains a trace-filter section (section 6.1.10). This allows you to plot individual traces of a position analysis (PA), and select only particular traces to plot. Using a trace-filter section is the *only* way to produce time-series plots of a PA. Note that you cannot display multiple runs on a trace-filtered plot. On a single trace-filter plot, only one variable can be displayed at a time, so only the first table in the table-definitions section is applied – subsequent tables are ignored. Furthermore, since the number of traces to plot can be very large, Plot does not require that you make a record in the *Lines* table (section 6.2.3 part B) for every trace. If the number of traces selected exceeds the records in the *Lines* table, then Plot automatically reuses the records from the table as often as necessary.

6.2.3 PLOT-DEFINITION FILE

The plot-definition file contains formatting information for the appearance of the plot, just as the Onevar input file contains formatting information for the appearance of Onevar tables. Because of the large amount of information, the plot-definition file is an MS-Access database. Refer to section 4.5.0 for some general information about MS-Access databases.

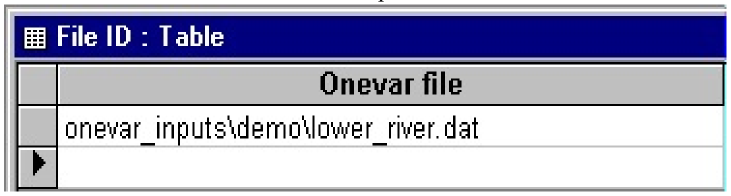
Unlike the Onevar input file, the plot-definition file contains no information about how to generate the data. For that, the plot-definition file refers to a Onevar input file (section 6.2.2). The name of the Onevar file is given in the *File ID* table of the database (section 6.2.3 part A).

Note that it is possible to make most changes through the plot program's **graphical user interface** and then save them to file (section 6.2.4). Therefore, **most users will not need to edit the plot-definition file through the MS Access interface**.

A. Table *File ID*

This table contains the name of the Onevar input file that contains formulas for the lines on the plot. This table contains only one record.

Example



File ID : Table

Onevar file
onevar_inputs\demo\lower_river.dat

The fields of this table are:

Field Name	Type	Size	Description
Onevar file	Text	64	The name and path of the Onevar input file from which Plot is to retrieve the formulas for the lines. The path can be absolute or relative to *Plot.exe*.

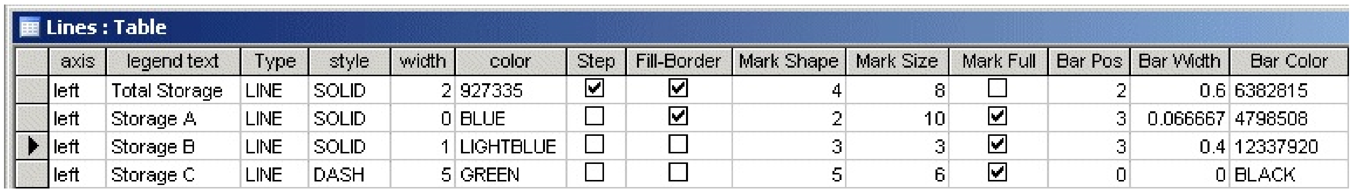
For information about the Onevar input file, see 6.2.2.

B. Table *Lines*

This table describes the appearance of the lines on the plot. There is a record for each line. If the plot comes from a single model run, then Plot determines the number of lines to plot as the lesser of the number of records in this table or the number of Onevar tables. If the plot comes from multiple model runs, then Plot determines the number of lines to plot as the lesser of the number of records in this table or the number of runs to plot.

The fields of this table are:

Example



Lines : Table

	axis	legend text	Type	style	width	color	Step	Fill-Border	Mark Shape	Mark Size	Mark Full	Bar Pos	Bar Width	Bar Color
	left	Total Storage	LINE	SOLID	2	927335	☑	☑	4	8	☐	2	0.6	6382815
	left	Storage A	LINE	SOLID	0	BLUE	☐	☑	2	10	☑	3	0.066667	4798508
▶	left	Storage B	LINE	SOLID	1	LIGHTBLUE	☐	☐	3	3	☑	3	0.4	12337920
	left	Storage C	LINE	DASH	5	GREEN	☐	☐	5	6	☑	0	0	BLACK

The fields of this table are:

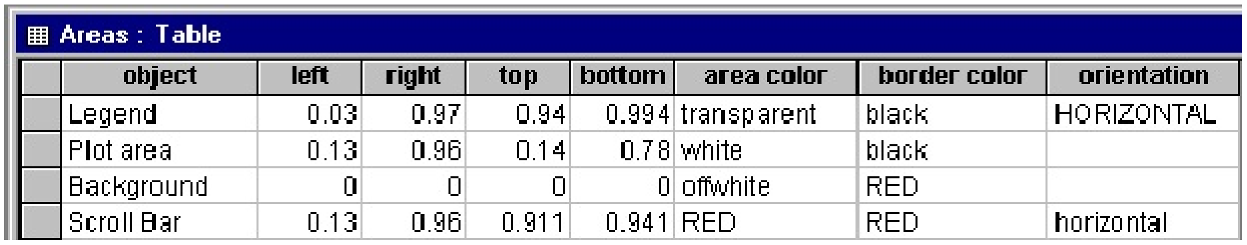
Field Name	Type	Size	Description
axis	Text	5	Tells Plot which axis this line is associated with. Choices are ***LEFT*** or ***RIGHT***. Plot will not draw an axis unless at least one line is associated with the axis. If there are multiple runs being plotted, then all lines are associated with the same axis as the first line.
legend text	Text	50	This text will be used to label the line in the legend. If the *legend* field is used in the Onevar file (see section 6.1.9 part C), then the entry in this field is overridden.
Type	Text	18	Tells Plot how whether to use an ordinary line or other graphing convention. Choices are: **LINE** — A line connects each data point **LINE+MARK** — A line connects each data point and a marker appears at each data point. **MARK** — A marker appears at each data point, but there is no line connecting data points. **2DBAR** — Each data point is represented by a vertical bar from zero to the y-value. **3DBAR** — Each data point is represented by a vertical bar from zero to the y-value. The vertical bar has a 3-D appearance.
style	Text	20	Tells Plot the style of the line. See section 6.2.3 part H for choices. This field is ignored if the *Type* field is not *LINE* or *LINE+MARK*.
width	Number	byte	The number of pixels of the width of the line (1 or more). This field is ignored if the *Type* field is not *LINE* or *LINE+MARK*.
color	Text	20	If the *Type* field is *LINE*, *LINE+MARK*, or *MARK*, then this field tells the color of the line and/or markers. If the *Type* field is *2DBAR* or *3DBAR* then this field tells the color of borders that are drawn around the bar. See section 6.2.3 part G for color choices.

Step	Yes/No		This field is ignored unless the *Type* field is *LINE* or *LINE+MARK*. If this field is checked, then the line is drawn in stair-step fashion: flat between data points. If the field is not checked, then the line is drawn directly between data points.
Fill-Border	Yes/No		If the *Type* field is *LINE* then an entry of *YES* means that the area between the line and the x-axis is filled in. If the *Type* field is *LINE+MARK* or *MARK* then an entry of *YES* means that a drop line is drawn between the marker and the x-axis. If the *Type* field is *2DBAR* or *3DBAR* then an entry of *YES* means that a border line is drawn around the vertical bars. An entry of *NO* means that these respective features are not drawn on the plot.
Mark Shape	Number	byte	This field is ignored unless the *Type* field is *MARK* or *LINE+MARK*. Tells Plot the type of marker to use, according to these numeric codes: **1** X **6** ASTERISK **2** UP TRIANGLE **7** DIAMOND **3** DOWN TRIANGLE **8** CIRCLE **4** BOX **9** DOT **5** PLUS
Mark Size	Number	byte	This field is ignored unless the *Type* field is *MARK* or *LINE+MARK*. Tells Plot the size of the marker.
Mark Full	Yes/No		This field is ignored unless the *Type* field is *MARK* or *LINE+MARK*. If *YES* then the marker is drawn with its center filled. If *NO* then the marker is drawn with its center empty.
Bar Pos	Number	byte	This field is ignored unless the *Type* field is *2DBAR* or *3DBAR*. Tells Plot how to offset the vertical bar in relation to the x-value. If more than one series is being plotted, using different offsets can enhance the visibility of the bars. The entry can be one of the following numeric codes: **1** Left **2** Right **3** Middle
Bar Width	Number	single	This field is ignored unless the *Type* field is *2DBAR* or *3DBAR*. Tells Plot the width of the vertical bar in units of the x-axis.
Bar Color	Text	20	This field is ignored unless the *Type* field is *2DBAR* or *3DBAR*. Tells Plot the color of the vertical bar. See section 6.2.3 part G for color choices.

C. Table *Areas*

Describes the format of four rectangular "area" objects on the plot: the legend, plot frame, background, and scroll bar. The identities of the records (rows) are fixed. There are four records, one for each of the areas.

Example



Areas : Table

object	left	right	top	bottom	area color	border color	orientation
Legend	0.03	0.97	0.94	0.994	transparent	black	HORIZONTAL
Plot area	0.13	0.96	0.14	0.78	white	black	
Background	0	0	0	0	offwhite	RED	
Scroll Bar	0.13	0.96	0.911	0.941	RED	RED	horizontal

The fields of this table are:

Field Name	Type	Size	Description
Object	Text	20	Do not edit this field. It is there for your convenience to identify the fixed records. Plot does not read this field.
left	Number	Single	See notes below.
right	Number	Single	See notes below.
top	Number	Single	See notes below.
bottom	Number	Single	See notes below.
color	Text	20	The color of that fills the area. See section 6.2.3 part G for choices.
border color	Text	20	The color of the border of the area. See section 6.2.3 part G for choices.
orientation	Text	12	For the legend area, choices are ***vertical*** or ***horizontal***. For the scroll bar, enter ***NONE*** to suppress the scroll bar. For all other records, this field is ignored.

The fixed records of this table are:

Legend	This is a box containing a list of labels for each line on the plot. The list can be *vertical* (listing down) or *horizontal* (listing across), as indicated in the *orientation* field.
Plot Area	This is the area bounded by the plot axes. The *orientation* field is ignored for this record.
Background	This is the background of the entire image. The *left, right, top, bottom,* and *orientation* fields are ignored for this record.
Scroll Bar	This is a bar with a *slider*. When the plot is displayed, you can move the slider with the mouse, scrolling the visible range of the x-axis. To make a plot without a scroll bar, enter *NONE* in the *orientation* field. The *color* and *border color* fields do not have any effect for the scroll bar.

Notes:

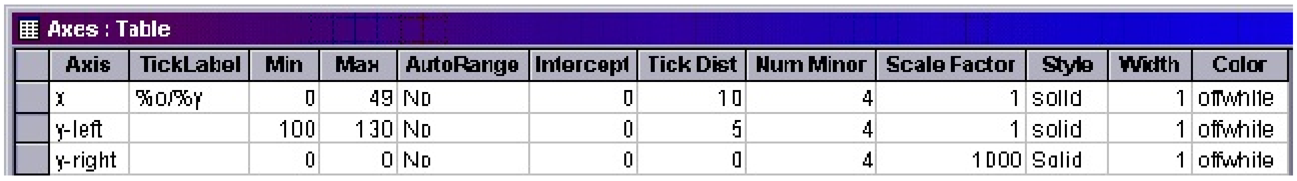
***left, right, top,* and *bottom* fields**

These are the coordinates of the left, right, top, and bottom corners of the area, as a fraction (0-1) of the total area in the window. For example, 0.5 is the exact center of the window. The coordinates (0,0) are the left, top corner of the window. All four of these fields are ignored for the *background* record.

D. Table *Axes*

This table describes the format of the axis lines on the plot. The identities of the records (rows) are fixed.

Example



Axes : Table

Axis	TickLabel	Min	Max	AutoRange	Intercept	Tick Dist	Num Minor	Scale Factor	Style	Width	Color
x	%o/%y	0	49	No	0	10	4	1	solid	1	offwhite
y-left		100	130	No	0	5	4	1	solid	1	offwhite
y-right		0	0	No	0	0	4	1000	Solid	1	offwhite

The fields of this table are:

Field Name	Type	Size	Description
AXIS	Text	10	Do not edit this field. It is there for your convenience to identify the fixed records. Plot does not read this field.
TickLabel	Text	15	Specifies how the x-axis will be labeled. This field is ignored for the y-axes. If you enter ***DECIMAL***, then the x-axis is measured in years and increments smaller than one year are expressed as a decimal fraction of a year. If you enter anything else, then the x-axis is measured in simulation or post-processor time steps, and the entry is used as a formula for creating the tick labels. See notes below.
Min	Number	Single	The minimum of the axis. Enter this number *unscaled*. Plot divides it by the scale factor. The value is ignored if ***YES*** is entered in the *AutoRange* field.
Max	Number	Single	The maximum of the axis. Enter this number *unscaled*. Plot divides it by the scale factor. The value is ignored if ***YES*** is entered in the *AutoRange* field.
AutoRange	Text	4	Tells Plot whether to choose a minimum and maximum for axis. If ***NO***, then Plot applies the values you enter in the *Min* and *Max* fields. If ***YES***, then Plot automatically chooses a minimum and maximum for the axis that fits all of the data.
Intercept	Number	Single	The point on this axis where the x-axis crosses. This field is ignored for the x-axis. Enter this number *unscaled*. Plot will divide it by the scale factor.
tick dist	Number	Single	The distance between major tick marks on this axis. Enter this number *unscaled*. Plot will divide it by the scale factor.
num minor	Number	Byte	The number of minor tick marks between each major tick mark on the axis.

Scale Factor	Number	Single	All values on this axis will be divided by the scale factor. This field is ignored for the x-axis.
style	Text	20	Tells Plot the style of the axis line. See section 6.2.3 part H for choices.
width	Number	Byte	The number of pixels of the width of the axis line (1 or more).
color	Text	20	The color of the axis line. See section 6.2.3 part G for choices.

The fixed records of this table are:

X	The x-axis is always the date or the probability of exceedence. Therefore, Plot does not read a scale factor for this record. It also does not read an entry in the *Intercept* field.
Y-left	The y-left axis is only used if there is at least one line associated with the y-left axis by the *axis* field of the *Lines* table (section 6.2.3 part B). This axis appears on the left side of the plot, and it can have completely different scaling than the y-right axis.
Y-right	The y-right axis is only used if there is at least one line associated with the y-right axis by the *axis* field of the *Lines* table (section 6.2.3 part B). This axis appears on the right side of the plot, and it can have completely different scaling than the y-left axis.

Notes:

***TickLabel* field**

If the entry in this field is anything other than ***DECIMAL***, then Plot will use absolute period numbers for the x-axis values, and the entry is used as a format specification for the tick labels.

Absolute period numbers are assigned to the time steps by starting at 1 for the first step and incrementing by one for every time step thereafter, without ever resetting. Plot reports the x-values as the post-processor time steps, specified by the *:STEP:* field (section 6.1.7 part I). If no special post-processor steps were specified by the *:STEP:* field, then the post-processor time steps are equal to the simulation time steps.

The format specifications are the same as those used in the *Label* field in the *Steps* table. See section 4.5.2 part D for a thorough description of the codes used to create a label. Remember that the codes *are* case sensitive. One additional code is available for Plot that is not available in the *Steps* table.

Code	Description
%o	The time step label used by OASIS or the post processor, without an appended year number.

The *%o* code calls for the very same labels as you see in a Onevar output. On the plot, you will probably want to see the year in the tick labels, so *%o/%y* is a good choice for the *TickLabel* field.

When choosing between the decimal-year-based x-axis and the time-step-based x-axis, consider the following facts.

We usually associate a date with a month and day number, so decimal fractions of a year may be difficult to interpret.

When measuring the x-axis in time steps, major tick marks cannot fall between time steps.

By measuring the x-axis in years, the minimum, maximum, and tick distance of the axis are independent of the time steps. This enables you to overlap two runs on the same plot that used different time-step sizes or time steps that were offset from each other. However, remember that the x-values on the plot are *absolute period numbers*, not *date coordinates*. The x-axis labels which Plot displays come from the first of the multiple runs, so if subsequent runs have non-overlapping time steps then the x-axis labels might not be appropriate. If you pass the command line argument *WarnXAxis* to Plot, it will display a warning message if there is any potential for mislabeling (see section 4.1.0).

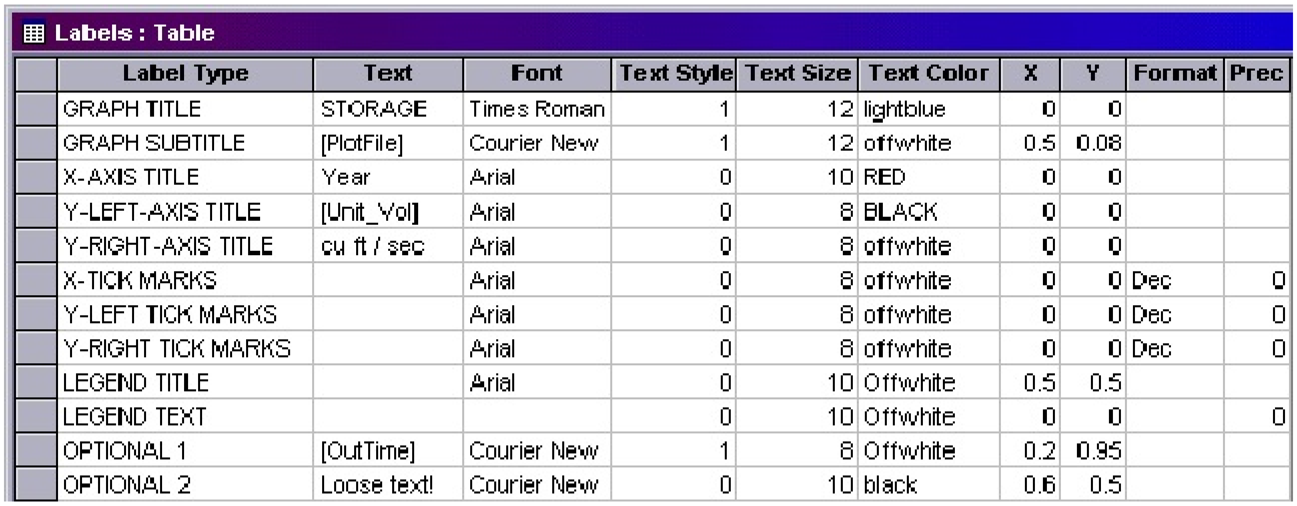
By measuring the x-axis in time steps, the minimum and maximum of the axis do not have to change when the simulation time range changes. Thus, time-step-based x-values are a good choice for position analysis (Chapter 9)

When the x-axis is measured in time steps, every time step is represented by an equal distance on the axis. This might be considered misleading if the time steps have varying sizes. When the x-axis is measured in years, distances on the axis are always proportional to the length of time.

E. Table *Labels*

Provides information for most of the text information that appears in the plot window, including the title, axes titles, and format of the axis tick labels (However, the labels for individual lines in the legend area are given in the *Lines* table [section 6.2.3 part B]). The identities of the records (rows) are fixed.

Example


Labels : Table

Label Type	Text	Font	Text Style	Text Size	Text Color	X	Y	Format	Prec
GRAPH TITLE	STORAGE	Times Roman	1	12	lightblue	0	0		
GRAPH SUBTITLE	[PlotFile]	Courier New	1	12	offwhite	0.5	0.08		
X-AXIS TITLE	Year	Arial	0	10	RED	0	0		
Y-LEFT-AXIS TITLE	[Unit_Vol]	Arial	0	8	BLACK	0	0		
Y-RIGHT-AXIS TITLE	cu ft / sec	Arial	0	8	offwhite	0	0		
X-TICK MARKS		Arial	0	8	offwhite	0	0	Dec	0
Y-LEFT TICK MARKS		Arial	0	8	offwhite	0	0	Dec	0
Y-RIGHT TICK MARKS		Arial	0	8	offwhite	0	0	Dec	0
LEGEND TITLE		Arial	0	10	Offwhite	0.5	0.5		
LEGEND TEXT			0	10	Offwhite	0	0		0
OPTIONAL 1	[OutTime]	Courier New	1	8	Offwhite	0.2	0.95		
OPTIONAL 2	Loose text!	Courier New	0	10	black	0.6	0.5		

The fields of this table are:

Field Name	Type	Size	Description
Label type	Text	20	Do not edit this field. It is there for your convenience to identify the fixed records. Plot does not read this field.

Text	Text	80	The text that Plot will display in the image. You may choose not to use a label by leaving this field blank. Plot recognizes and replaces OCL substitute names in this field (section 4.7.1 part I). This field is ignored for the *x-tick marks*, *y-left tick marks*, *y-right tick marks*, and *legend text* records.
font	Text	50	The font of the label. See section 6.2.3 part I for choices.
text style	Number	Byte	The text style for the label. See section 6.2.3 part J for choices.
text size	Number	Byte	The size of the label text.
text color	Text	20	The color of the label text. See section 6.2.3 part G for choices.
x	Number	Single	See notes below.
y	Number	Single	See notes below.
format	Text	3	Numeric format type used only for the *x-tick marks*, *y-left tick marks*, and *y-right tick marks* records. For all other records, it is ignored. The choices are: ***DEC*** Regular decimal notation; i.e. 5678.34 ***SCI*** Scientific notation; i.e. 5.67834x10^3 ***ENG*** Engineering notation; i.e. 5.67334K
prec	Number	Byte	The number of digits after the decimal point. This field is used only for the *x-tick marks*, *y-left tick marks*, and *y-right tick marks* records. For all other records, it is ignored. If you enter a negative number, Plot will automatically choose a precision level.

The fixed records of this table are:

Graph Title	This is the title that appears at the top of the graph.
Graph Subtitle	This is an optional label that usually appears below the graph title. However, you can locate it wherever you like. The *x* and *y* fields must be used for this record.
X-axis Title	This is a label for the x-axis. It is printed below the x-axis.
Y-left-axis Title	This is a label for the y-left-axis. It is printed to the left of the y-left-axis, rotated 90 counterclockwise.
Y-right-axis Title	This is a label for the y-right-axis. It is printed to the right of the y-right-axis, rotated 90 clockwise.
X-tick Marks	These are the numbers that label the tick marks on the x-axis. The *text* field is ignored for this record — you only provide formatting information for the tick marks. The ticks appear below the axis.
Y-left Tick Marks	These are the numbers that label the tick marks on the y-left-axis. The *text* field is

	ignored for this record — you only provide formatting information for the tick marks. The ticks appear to the left of the axis.
Y-right Tick Marks	These are the numbers that label the tick marks on the y-right-axis. The *text* field is ignored for this record — you only provide formatting information for the tick marks. The ticks appear to the right of the axis.
Legend Title	This is an optional title that usually appears at the top of the legend box. However, you can locate it wherever you like. The *x* and *y* fields must be used for this record.
Legend Text	This is the formatting for the labels that appear in the legend. The *text* field is ignored for this record — you only provide formatting information for the legend labels. Furthermore, the *text color* field is ignored, since each legend label is automatically the same color as the corresponding plot line.
Optional *[x]*	You may have up to nine extra labels. You can locate them wherever you like, so the *x* and *y* fields must be used for these records. These last nine records of the table are completely optional; you may omit any or all of them if they are unneeded.

Notes:

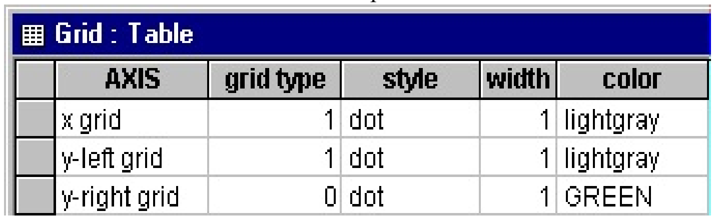
***x* and *y* fields**

These fields provide the x and y coordinates of the *center* of the label, as a fraction (0-1) of the total area in the window. For example, 0.5 is right in the center of the window. The coordinates (0,0) are the left, top corner of the window. These two fields are used only for the legend title, the graph subtitle, and the optional labels. All other labels have a position that is determined automatically, so the entry in this field is ignored.

F. Table *Grid*

Describes the format of grid lines that may cross the plot area. You may use this table to suppress grid lines. The identities of the records (rows) are fixed. There are three records, one for each of the axes.

Example



Grid : Table

AXIS	grid type	style	width	color
x grid	1	dot	1	lightgray
y-left grid	1	dot	1	lightgray
y-right grid	0	dot	1	GREEN

The fields of this table are:

Field Name	Type	Size	Description
AXIS	Text	20	Do not edit this field. It is there for your convenience to identify the fixed records. Plot does not read this field.

grid type	Number	Byte	A code telling Plot the type of grid lines to display. **0** No grid lines **1** Grid lines on major tick marks. **2** Grid lines on minor tick marks. **3** Grid lines on both major and minor ticks.
style	Text	20	Tells Plot the style of the grid lines. See section 6.2.3 part H for choices.
width	Number	byte	The number of pixels of the width of the grid lines (1 or more).
color	Text	20	The color of the grid lines. See section 6.2.3 part G for choices.

The fixed records of this table are:

x-grid	Grid lines that cross the x-axis.
y-left-grid	Grid lines that cross the y-axes, associated with the tick marks on the y-left-axis. Even if you are using both y-axes, you probably only want grid lines to be linked to one of the y-axes.
y-right-grid	Grid lines that cross the y-axes, associated with the tick marks on the y-right-axis. Even if you are using both y-axes, you probably only want grid lines to be linked to one of the y-axes.

G. Quinn-Curtis color choices

Wherever color input is needed in the plot-definition file, you can enter any of the following named colors:

BLACK	***MAGENTA***	***LIGHTGREEN***	***WHITE***
BLUE	***BROWN***	***LIGHTCYAN***	***PALEGREEN***
GREEN	***LIGHTGRAY***	***LIGHTRED***	***MEDGRAY***
CYAN	***GRAY***	***LIGHTMAGENTA***	***OFFWHITE.***
RED	***LIGHTBLUE***	***YELLOW***	

You can also enter ***TRANSPARENT*** for some fields.

Another option is to enter a number between 0-16777215 to use any color on the full RGB palette. This option is not available for text. Note that such numbers are entered as text. Due to the difficulty of interpreting the numerical color codes, we suggest you rely on the plot program's graphical user interface to select such colors.

H. Line-style choices

Wherever line-style input is needed in the plot-definition file, you can enter any of the following:

SOLID	***DASHDOT***	***NONE***
DASH	***DASHDOTDOT***	***INSIDEFRAME***
DOT		

I. Font choices

The font choices will depend upon what fonts are installed on your computer. We recommend that you only use the most common fonts to ensure that the files are portable from computer to computer. Three mainstay fonts are ***Arial***, ***Times New Roman***, and ***Courier New***. To see the other choices, run Plot and double-click on any text. The dialog box that appears has a button labeled *Text Parameters*. Click it, and another dialog box appears. You can see the other font choices in the pull-down menu labeled *Font*.

Note that the capitalization is important when entering a font name (unlike for almost all other input). The initial letters should be capitalized, and the others should be un-capitalized. Problems with capitalization of the font name are avoided if you work exclusively through the dialog boxes in the Plot interface.

J. Text-style choices

The text style can be plain, bold, italic, underlined, or a combination. You enter the text style as a number code. In order to compute the number code, add together the codes for the styles that you want:

Style	Number code
Plain	0
bold	1
italic	2
underline	4

For example, if you want the text bold and underlined, enter 5.

6.2.4 PLOT-WINDOW INTERFACE

After you have run Plot, the window remains open until you close it. As long as it is open, you can modify the display and save changes if you wish. All plot features can be edited by selecting menu options. Most plot features can also be edited by double-clicking the item.

When data is saved, it is stored in a plot-definition file (section 6.2.3). Because almost all features of the plot can be modified through the interface, most users should not need to edit the plot-definition file using MS Access.

To save changes to the plot layout:

Click: *File* > *Save* (To save changes in the same file)

File > *Save As* (To save changes in a new or different file)

To save an image file of the plot:

Click: *File* > *Save Metafile Image*

Or: *File* > *Save Bitmap Image*

To copy an image of the plot to the Windows clipboard for pasting into a word processor, slideshow, or other software**:**
Click: File > Copy to Clipboard

To select the plot window you want to see from among all the plots open in the current instance of the program**:** Click: *Window* and then select the plot you want by the name of the plot-definition (**.mdb*) file. Alternatively, press *CTRL-TAB* to toggle through each plot window.

To arrange the plot windows in standard patterns: Click: *Window* and then select *Tile Horizontally*, *Tile Vertically*, or *Cascade*.

To see which model run or runs were used to generate the plot: Click: *Info* > *List Model Runs*. A popup dialog box appears showing the complete path of the run folder of each model run that was used to generate the plot.

To modify the appearance of a data series on the plot: Click: *Edit* and then select the data series (listed by run name or legend text) from the list at the bottom of the menu. A dialog box appears showing the editable characteristics of the appearance of the data series. Alternatively, you can call this dialog box by double-clicking on the line, markers, or vertical bars for the data series right in the plot. However, it is sometimes difficult to click the mouse pointer on the exact spot, so it may be more reliable to use the menu. To modify the legend text for a data series, see instructions below for modifying the legend.

To modify the x- or y-axes:

Click: *Edit* > *X Axis*

Edit > *Y Axis Left*

or: *Edit* > *Y Axis Right*

and then choose whether to edit the axis, the axis tick labels, or the axis title. Alternatively, you can double click on the axis (the line itself) to edit the axis range and appearance of the line, on the tick labels to edit the appearance of the tick labels, or on the axis title to edit the appearance of the axis title.

To identify a data series with a different y-axis (either left or right): you must use MS Access to edit the *Axis* field of the *Lines* table of the plot-definition file, and then re-run the plot program. This feature can not be modified through the Plot interface.

To modify the grid lines:

Click: *Edit* > *X Axis* (For vertical grid lines)

Edit > *Y Axis Left* (For horizontal grid lines)

or: *Edit* > *Y Axis Right* (For horizontal grid lines)

Then, in the dialog box, click the *Style* button in the *Grids* box.

To modify the background colors: Click: *Edit* > *Graph*.

To modify the size and placement of the plot frame within the window: Click: *Edit* > *Graph*. The locations of the boundaries of the plot frame are given as percentages of the size of the plot window, with the left top corner as (0,0).

To modify the text or appearance of the plot title, plot subtitle, or legend title: Click: *Edit* and select either *Title*, *Subtitle*, or *Legend Title*. Alternatively, you can double-click on the text object itself.

To add an optional (user-defined) text box: Click: *Edit* > *Add Text* and fill out the dialog box. Note that the coordinates of the new text box are presented as fractions of the size of the plot window, with the left top corner as (0,0).

To modify the text, location, or appearance an optional (user-defined) text box: Double-click on the text itself and fill out the dialog box. Note that the coordinates of the text box are presented as fractions of the size of the plot window, with the left top corner as (0,0).

To delete an optional (user-defined) text box: Click on the text itself and then press the *Delete* key.

To modify the legend: Click: *Edit* > *Legend*. The locations of the four boundaries of the legend are given as percentages of the size of the plot window, with the left top corner as (0,0).

To modify the scroll bar or to add or remove the scroll bar: Click: *Edit* > *Scroll Bar*. The locations of the four boundaries of the scroll bar are given as percentages of the size of the plot window, with the left top corner as (0,0).

To associate the plot with a different Onevar-input file: Click: *Edit* > *Onevar File*. We recommend that the Onevar file be identified with a path relative to the home folder, although you can also enter an absolute path.

To select a color in any of the dialog boxes: Note that the currently selected color is shown in a small rectangle next to the selection box labeled *Color*. You may select any of the **named colors** in the selection box labeled *Color*. To select any of the **unnamed colors**, click on ***Custom Color*** in the list. Note that *Custom Color* is not available for all plot features (for example, it is available for plot lines but not for any text objects). If *Custom Color* is available, it is the first item in the selection box labeled *Color*. When you click on *Custom Color*, another dialog box opens which allows you to select any color from the full RGB spectrum. If *Custom Color* is already selected in the selection box, then you can click on *Custom Color* again to select a different custom color. See 6.2.3 part G for a list of colors available to Plot.

CHAPTER 7
REFERENCE: LINEAR PROGRAM

7.0.0 INTRODUCTION

This chapter is a reference for those who need a better understanding of how OASIS uses linear programming (LP). It will be especially useful if you have to debug LP problems. However, it is not expected that every OASIS user needs to know the material presented in this chapter.

The linear program (LP) is the ultimate expression of the rules for routing water in an OASIS model. Generally, at least one LP is created and solved in each time step of simulation (it is possible to solve *no* LP if you are doing MPO, see section 2.2.7). Solving the LP determines the values of the **decision variables**. See section 2.2.0 for an introduction to concepts in OASIS routing.

To solve the LP, OASIS uses the software package XA, by Sunset Software. XA is proprietary, so when HydroLogics provides a client with a copy of OASIS, a license to use XA is included in the deal. XA runs from a dynamic-link library (DLL) that is called by OASIS. When OASIS runs, you can see the XA window appear on the screen, containing copyright notices and contact information for Sunset Software.

OASIS actually takes advantage of XA's ability to solve *mixed-integer* linear programs (MILPs), though we always refer to it simply as LP (Not every OASIS model needs to use integers). MILP means that you can have *integer variables* that can only have integer value. For example, 2 and 3 might be legal values, but not 2.21. In order to solve the MILP, XA actually solves the problem in two distinct steps. First, it solves the problem without restricting any variables to integer value. Secondly, it modifies the result by forcing the integer variables to take on integer values. Knowing this may help you understand errors reported in the LP output (section 5.5.0). You can create integer variables with the *udef* command (section 2.5.1 part A).

7.1.0 DEFINITIONS

The following terms will be useful to the OASIS user who needs to understand the OASIS LP.

Decision variables. The unknown variables whose values are determined by the LP solution.

Constraints. An equality or inequality expression that the LP solution can not violate. For LP, the constraints must be linear expressions of the decision variables.

Bounds. Every decision variable can have an upper bound and a lower bound. These are the maximum and minimum values that the LP solution can assign to the variable. For the OASIS user, bounds have the same practical effect as constraints, so they are referred to as a type of constraint throughout this manual.

Unbounded. An *unbounded* decision variable has no bound value. An *unbounded* constraint has no equality or inequality operator linking the right-hand side to the left-hand side. Thus, the constraint is completely moot. This occurs in the OASIS LP because the constraint is holding a place, and it may become bounded at a later step.

Feasible solution. An LP solution where all of the constraints and bounds are obeyed.

Infeasible LP. An LP where not all of the constraints and bounds can be simultaneously obeyed. A simple example would be:

```
A > 5
A = B
B < 0
```

Objective function. A linear combination of decision variables that the LP solution optimizes. For OASIS, the LP solution **maximizes** the objective function. Every operating goal is represented by a term in the objective function.

Optimal solution. The feasible solution with the highest possible value of the objective function.

7.2.0 DECISION VARIABLES

Every decision variable name follows a coding system, so that you can identify the variable. The syntax of the decision variable names is distinct from the syntax of OCL variables. For example, the udef named *NetDeepPercolation* in OCL may be represented by the variable *UDEF023* in the LP. The LP variable names are compact for efficiency, while OCL variable names are intended to be highly readable. However, most of the decision variables *can* be referenced in OCL.

In the generalized forms below, text in **bold** is literally as it appears in the LP. Italic text in *[brackets]* describes what you would place in that position.

A. *QT* variable

Code	**QT** *[bbb] [eee]*
Definition	The flow in the arc that flows from node *[bbb]* to node *[eee]*. The *T* is for total, to distinguish this variable from the *QA* and *QB* variables.
Example	**QT100203** – The flow in the arc that goes from node 100 to node 203.
Upper bound	Maximum flow (section 2.4.0 part B) if any. Otherwise unbounded.
Lower bound	Maximum reverse flow (section 2.4.0 part C) if any. Otherwise zero.
Obj. Weight	*Weight: Arc* table (section 4.5.7 part A)
OCL variable	**dFlow** (section 4.7.4)

B. *QA* variable

Code	`QA` *[bbb] [eee]*
Definition	The first segment of flow in the arc that flows from node *[bbb]* to node *[eee]*. This segment is below the lower bound and the minimum (target) flow (section 2.4.0 part B). This variable is only included if the arc has been assigned a minimum (target) flow.
Example	`QA100203` – The first segment of the flow in the arc that goes from node 100 to node 203.
Upper bound	Minimum (target) flow (section 2.4.0 part B).
Lower bound	Unbounded.
Obj. Weight	*Weight: Arc* table (section 4.5.7 part A)
OCL variable	None

C. *QB* variable

Code	`QB` *[bbb] [eee]*
Definition	The second segment of flow in the arc that flows from node *[bbb]* to node *[eee]*. This segment is above the minimum (target) flow (section 2.4.0 part B). This variable is only included if the arc has been assigned a minimum (target) flow.
Example	`QB100203` – The second segment of the flow in the arc that goes from node 100 to node 203.
Upper bound	unbounded
Lower bound	Zero
Obj. Weight	*Weight: Arc* table (section 4.5.7 part A)
OCL variable	None

D. *STO* variable

Code	`STO`*[nnn]*
Definition	The storage in reservoir node *[nnn]*. This is the *total* storage.
Example	`STO203` – The storage in reservoir node 203.
Upper bound	Maximum storage at node *[nnn]* (section 2.4.0 part H).
Lower bound	Zero
Obj. Weight	*Weight: Storage* table (section 4.5.7 part B)
OCL variable	**dStorage** (section 4.7.4)

E. *STA* variable

Code	`STA`*[nnn]*
Definition	The storage in zone A of reservoir node *[nnn]*. This variable is not included for single-zone reservoir nodes. See section 2.4.0 part H.
Example	`STA455` – The storage in zone A reservoir node 455.
Upper bound	Dead storage at node *[nnn]* (section 2.4.0 part H).
Lower bound	Zero.
Obj. Weight	*Weight: Storage* table (section 4.5.7 part B)
OCL variable	**dStorA** (section 4.7.4)

F. *STB* variable

Code	`STB`*[nnn]*
Definition	The storage in zone B of reservoir node *[nnn]*. This variable is not included for single-zone reservoir nodes. See section 2.4.0 part H.
Example	`STB455` – The storage in zone B reservoir node 455.
Upper bound	Lower rule minus dead storage at node *[nnn]* (section 2.4.0 part H).
Lower bound	Zero.
Obj. Weight	*Weight: Storage* table (section 4.5.7 part B)
OCL variable	**dStorB** (section 4.7.4)

G. *STC* variable

Code	`STC`*[nnn]*
Definition	The storage in zone C of reservoir node *[nnn]*. This variable is not included for single-zone reservoir nodes. See section 2.4.0 part H.
Example	`STC455` – The storage in zone C reservoir node 455.
Upper bound	Upper rule minus lower rule at node *[nnn]* (section 2.4.0 part H).
Lower bound	Zero
Obj. Weight	*Weight: Storage* table (section 4.5.7 part B)
OCL variable	**dStorC** (section 4.7.4)

H. *STD* variable

Code	**STD** *[nnn]*
Definition	The storage in zone D of reservoir node *[nnn]*. This variable is not included for single-zone reservoir nodes. See section 2.4.0 part H.
Example	**STD455** – The storage in zone D reservoir node 455.
Upper bound	Maximum storage minus upper rule at node *[nnn]* (section 2.4.0 part H).
Lower bound	Zero
Obj. Weight	*Weight: Storage* table (section 4.5.7 part B)
OCL variable	**dStorD** (section 4.7.4)

I. *DEL* variable

Code	**DEL** *[nnn]*
Definition	The delivery to demand node *[nnn]*. See section 2.4.0 part D.
Example	**DEL022** – The delivery to demand node 22.
Upper bound	Demand at node *[nnn]* (section 2.4.0 part D).
Lower bound	Zero
Obj. Weight	*Weight: Demand* table (section 4.5.7 part C)
OCL variable	**dDelivery** (section 4.7.4)

J. *UDEF* variable

Code	`UDEF`*[xxx]*
Definition	OCL User-defined decision variable number *[xxx]*. The number *[xxx]* is automatically assigned by OASIS. You can find what the udef numbers are by looking in the summary of udefs in the OCL output (section 5.3.1).
Example	`UDEF003` – Udef number 3.
Upper bound	Given in the *udef* command (section 4.7.2 part B).
Lower bound	Given in the *udef* command (section 4.7.2 part B).
Obj. Weight	None, except variables used in the *minimax* command receive a weight from the *penalty* field of the *minimax* command (section 4.7.2 part H).
OCL variable	**d***[udef name]* (section 4.7.4)

K. *POBJ* variable

Code	`POBJ`*[xx]*
Definition	The priority objective for priority level number *[xx]*. See section 2.2.6 for an introduction to priority levels. See section 7.3.0 part A for explanation of the use of this variable.
Example	`POBJ02` – Objective function for priority level number 2.
Upper bound	Unbounded
Lower bound	Before priority level *[xx]* has been solved it is unbounded. After priority level *[xx]* has been solved, the lower bound is the solved value of POBJ*[xx]*. See section 4.7.2 part I for more information on the *solve* command. If the *cancel* command (section 4.7.2 part J) is evaluated for priority level *[xx]*, then the lower bound is removed so that the variable is again unbounded.
Obj. Weight	Not applicable
OCL variable	None

L. *SLAK* variable

Code	`SLAK` *[xxx]*
Definition	The slack variable for *target* command number *[xxx]* (Section 2.5.1 part E). This is the deviation when the target expression is less than the target value. This variable is not included if the entry in the *penalty-* field is *bound*. OASIS automatically assigns target numbers. Find the target numbers by looking in the summary of targets in the OCL output (section 5.3.1). The value of this variable is reported in OCL output in the report of target and minimax results (section 5.3.3).
Example	`SLAK121` – Slack variable for target number 121.
Upper bound	Unbounded
Lower bound	Zero
Obj. Weight	*Target* command *penalty-* field (section 4.7.2 part E)
OCL variable	None

M. *SURP* variable

Code	`SURP` *[xxx]*
Definition	The surplus variable for *target* command number *[xxx]*. See section 2.5.1 part E. This is the deviation when the target expression is more than the target value. This variable is not included if the entry in the *penalty+* field is *bound*. OASIS automatically assigns target numbers. You can find what the target numbers are by looking in the summary of targets in the OCL output (section 5.3.1). The value of this variable is reported in OCL output if you are printing the report of target and minimax results (section 5.3.3).
Example	`SURP121` – Surplus variable for target number 121.
Upper bound	Unbounded
Lower bound	Zero
Obj. Weight	*Target* command *penalty+* field (section 4.7.2 part E)
OCL variable	None

N. *MMS* variable

Code	`MMS`*[xxx]*
Definition	The minimax surplus variable for *constraint* command number *[xxx]*. See section 4.7.2 part H for description of the *minimax* command. See section 7.3.0 part H for a description of the use of this variable. This is the deviation of the minimax variable from the quantity that is being equalized. OASIS automatically assigns constraint numbers. You can find what the constraint numbers are by looking in the summary of constraints in the OCL output (section 5.3.1). The value of this variable is reported in OCL output if you are printing the report of target and minimax results (section 5.3.3).
Example	`MMS081` – Minimax surplus variable for constraint number 81.
Upper bound	Unbounded until the constraint is removed from the minimax process. When the constraint is removed, the upper bound becomes the solved value of MMS*[xxx]*.
Lower bound	Zero until the constraint is removed from the minimax process. When the constraint is removed, the lower bound becomes the solved value of MMS*[xxx]*.
Obj. Weight	None
OCL variable	None

O. *B* variable

Code	`B`*[xx][ii]*
Definition	The binary variable that maintains the segment ordering at segment boundary number *[ii]* for *segment* command number *[xxx]*. This variable is not included if the flag *NOBINARY* is entered in the *segment* command (section 4.7.2 part C).
Example	`B0203` – Binary variable that maintains the order at boundary number 3 for *segment* command number 2.
Upper bound	One
Lower bound	Zero
Obj. Weight	None
OCL variable	None

7.3.0 CONSTRAINTS

Every constraint has a name that follows a coding system, so that you can identify the constraint's purpose. Constraints are entered into XA in a form where all decision-variable terms are on the left-hand side of the constraint, and all constant terms are on the right-hand side of the constraint. If you look at the constraints in the LP output file (section 5.5.1), you will see that all of the constant terms have been summed into a single term on the right-hand side.

In the generalized forms below, text in **bold** is literally as it appears in the LP. Italic text in *[brackets]* describes what you would place in that position.

A. Objective function and priority objectives

The **objective function** is always labeled *OBJ*. OASIS always sets the objective function equal to one of the priority objectives. A **priority objective** is simply the sum of all of the terms that go into the objective function for a given **priority level**. See section 2.2.6 for an introduction to priority levels. Thus, the objective function is always written:

OBJ: POBJ*[xx]*

Where *[xx]* is the priority level number for which the LP is being solved.

For each priority object, *[xx]*, there is a constraint:

POBJ*[xx]***: - POBJ***[xx]* **+** *[W1]* ***** *[DVAR1]* **+** *[W2]* ***** *[DVAR2]* + *[...]* **= 0**

Where *[W*n*]* is the **weight** on *[DVAR*n*]* determined by user input. The tables in section 7.2.0 tell how weight can be assigned to each type of decision variable. Wherever weight input is given, you also enter a priority level, which determines which priority level *[xx]* this weight term is written to.

Notice that *POBJ[xx]* is the name of the constraint *and* the name of the variable.

See section 7.2.0 for definitions of the decision variables.

B. Continuity constraint

See section 2.2.4 for a discussion of the continuity constraints. OASIS writes a continuity constraint for every node except for **terminal nodes** (section 2.1.4). See section 7.2.0 for definitions of the decision variables.

For a **junction node** number *[nnn]*, the continuity constraint is:

```
CON[nnn]: - QT[xxa][nnn] - QT[xxb][nnn] - [...]
          + QT[nnn][yya] + QT[nnn][yyb] + [...] = [unregulated inflow]
```

Where:

[xxa], [xxb], [...] are node numbers of nodes connecting to node *[nnn]* from upstream.

[yya], [yyb],[...] are node numbers of nodes connecting to node *[nnn]* from downstream.

For a **reservoir node** number *[nnn]*, the continuity constraint is the same as for a junction node, but to the left-hand side add:

```
+ STO[nnn]
```

To the right-hand side, add:

```
- [evaporation] + [beginning-of-period storage]
```

For **demand node** number *[nnn]*, the continuity constraint is:

```
CON[nnn]: - QT[xxa][nnn] - QT[xxb][nnn] - [...]
          + DEL[nnn] = [unregulated inflow]
```

Where:

[xxa], [xxb], [...] are node numbers of nodes connecting to node *[nnn]* from upstream.

The difference between the continuity constraints for demand nodes and a junction nodes is that the flow in arcs that leave the demand node are not included, and the delivery decision variable has been added. Note that if there are arcs leaving the demand node, they are not automatically constrained by the continuity constraint or any other constraint. See section 2.5.2 for more information.

C. Flow-splitting constraint

For each arc which is assigned a standard minimum (target) flow (section 2.4.0 part B), OASIS writes a **flow-splitting** constraint to the LP. This is a type of segmentation, similar to that of the OCL *segment* command (section 2.5.1 part B). The segmentation is done so that segment A (below minimum flow) can receive a higher weight than segment B (above minimum flow). No flow-splitting constraint is written for arcs that do not have a standard minimum (target) flow.

See section 7.2.0 for definitions of the decision variables. The flow-splitting constraint for the arc that goes from node *[bbb]* to *[eee]* is written:

```
    FSP[bbb][eee]:   - QT[bbb][eee] + QA[bbb][eee] + QB[bbb][eee] = 0
```

D. Storage-splitting constraint

For each reservoir node which is uses four standard storage zones (section 2.4.0 part H), OASIS writes a **storage-splitting** constraint to the LP. This is a type of segmentation, similar to that of the OCL *segment* command (section 2.5.1 part B). The segmentation is done so that each segment, or zone, can receive a weight higher than the segment above it. No storage-splitting constraint is written for reservoir nodes that have only a single standard zone.

See section 7.2.0 for definitions of the decision variables. The storage-splitting constraint for reservoir node number *[nnn]* is written:

```
    SSP[nnn]:   - STO[nnn] + STA[nnn] + STB[nnn] + STC[nnn] + STD[nnn] = 0
```

E. *Target*-command constraint

For each *target* command (section 2.5.1 part E), OASIS writes a constraint to the LP. This constraint defines the relationship between the target expression, the target value, and the deviation. The deviation is represented by the slack (*SLAK*) and surplus (*SURP*) variables.

See section 7.2.0 for definitions of the decision variables. OASIS automatically assigns numbers to the *target* commands, which you can find in the summary of targets in the OCL output (section 5.3.1). The constraint for *target* command number *[xxx]* is written:

```
    TARG[xxx]: [Target expression of xxx]
                    - SURP[xxx] + SLAK[xxx] = [Target value of xxx]
```

Note that *[Target expression of* xxx*]* includes decision variable terms, as given in the *target* command. It may also include constant terms that are moved to the right-hand side of the constraint. The slack term (*SLAK*) is not written if *bound* is given in the *penalty-* field of the *target* command. The surplus (*SURP*) term is not written if *bound* is given in the *penalty+* field of the *target* command. If no condition expressions have evaluated true for this *target* command, then the constraint is unbounded for the time step.

F. *Constraint*-command constraint

For each *constraint* command (section 2.5.1 part D), OASIS writes a constraint to the LP.

See section 7.2.0 for definitions of the decision variables. OASIS automatically assigns numbers to the *constraint* commands, which you can find in the summary of constraints in the OCL output (section 5.3.1). The constraint for *constraint* command number *[xxx]* is written:

```
        CSTR[xxx]: [Constraint expression of xxx]
```

[Constraint expression of xxx*]* includes decision variable terms on the left-hand side, an equality or inequality operator, and constant terms on the right-hand side, as given in the *constraint* command. If the condition expression has evaluated false for this *constraint* command, then the constraint is unbounded for the time step.

If the *constraint* command includes a minimax variable, then OASIS automatically modifies the constraint in the LP, as discussed below (section 7.3.0 part H).

G. *Segment*-command constraints

For each *segment* command (section 2.5.1 part B), OASIS writes a constraint to the LP to define the segmented variable as the sum of its segments.

See section 7.2.0 for definitions of the decision variables. OASIS automatically assigns numbers to the *segment* commands. The constraint for *segment* command number *[xx]* is written:

```
        SEG[xx]: - [dvar being segmented]
                   + UDEF[xyz] + UDEF[xyz+1] + [...] + UDEF[xyz+n-1]
                      =  - [bound 0 value]
```

Where:

[xyz] is the udef number of the first segment. You can find what the udef numbers are by looking in the summary of udefs in the OCL output (section 5.3.1).

[n] is the number of segments.

Additional constraints are written if the binary option is used. If the flag *NOBINARY* is given in the *segment* command, then these constraints are not written. These constraints use binary variables to ensure that the segments are assigned in the right order. For example, segment 3 can not have a value until segment 2 is at its upper bound. Except for the first and last segments, each segment has an upper bound constraint and a lower bound constraint.

See section 7.2.0 for definitions of the decision variables.

An upper-bound constraint is written for all but the last segment. For segment *[ii]*, it has the form:

BU*[xx][ii]***:** **UDEF***[xyz+ii-1]* / *[bound* ii *value - bound* ii-*1 value]* **- B***[xx][ii+1]* > **0**

A lower-bound constraint is written for all but the first segment. For segment *[ii]*, it has the form:

BL*[xx][ii]***:** **- UDEF***[xyz+ii-1]* / *[bound* ii *value - bound* ii-*1 value]* **+ B***[xx][ii]* > **0**

H. *Minimax*-command constraints

If a *constraint* command expression contains a minimax variable, then OASIS writes it to the LP in a special form. See section 7.3.0 part F for a description of how OASIS ordinarily writes a *constraint*-command constraint the LP. See section 2.5.1 part F and section 4.7.2 part H for discussion of the *minimax* command and the minimax process.

See section 7.2.0 for definitions of the decision variables. If constraint number *[xxx]* contains udef number *[mmm]*, which is a minimax variable, then it *would* have been written like this *under the ordinary rules*:

```
CSTR[xxx]: [dvar terms of xxx] + UDEF[mmm] > [constant terms of xxx]
```

But because of the presence of the minimax variable, OASIS makes this substitution when it writes the LP:

```
CSTR[xxx]: [dvar terms of xxx] + UDEF[mmm]
                - MMS[xxx]  =  [constant terms of xxx]
```

Because the *MMS* variable has a lower bound of zero, and no upper bound, the substitution is algebraically equivalent to the way the constraint would have been written under the ordinary form.

After the first solve at the priority level, constraint *[xxx]* may be found to be **binding**. If it is found to be binding, OASIS fixes the *MMS* variable by changing its bounds. It also changes the coefficient on *UDEF*[mmm] to zero in *CSTR*[xxx]. These changes effectively remove constraint *[xxx]* from the minimax process.

7.4.0 MULTIPLE-PERIOD OPTIMIZATION (MPO)

Multiple-period optimization is discussed in section 2.2.7. If the number of MPO steps is zero, then OASIS does not write or solve an LP. The default situation is that there is one MPO step for every simulation time step. In this case, nothing special is added to the variable and constraint names described in sections 7.2.0 and 7.3.0. However, **if the number of MPO steps is greater than one**, the following modifications apply:

Variable names are the same as in section 7.2.0, but the text #*[mm]* is added to the end of every variable name, where *[mm]* is the number of the MPO step with which the variable is associated, and there is an instance of the variable for each MPO step. This is true for all variables *except* the *POBJ* variable, for which there is only one instance per LP solution.

For example, **DEL333#02** represents the delivery at node 333 during the second MPO step.

Constraint names are the same as in section 7.3.0, but the text #*[mm]* is added to the end of every constraint name, where *[mm]* is the number of the MPO step with which the constraint is associated, and there is an instance of the constraint for each MPO step. This is true for all constraints *except* the *POBJ* constraint, for which there is only one instance per LP solution.

For example, **SSP150#01** is the name of the storage-splitting constraint at node 150 for the first MPO step. This constraint would say that the sum of the storage zones at reservoir node number 150 during the first MPO step must equal the total storage at node 150 during the first MPO step.

CHAPTER 8
REFERENCE: BATCH PROGRAM

8.0.0 BATCH PROGRAM

The OASIS batch program allows you to run a series of OASIS model runs and post-processor runs automatically. This is similar to using an MS-DOS batch file. The batch program was created because when an MS-DOS batch file is executed, it does not wait for OASIS to complete its execution before executing the next command in the batch file. This is a significant problem because a model run must be complete before post-processors can read the model results. The batch program will execute any command that can be executed from an MS-DOS prompt *and* it waits for the program to finish if that program is OASIS's *model.exe* **or any other DOS or Windows program**.

The program file is *batch.exe*, and it should be in the same directory as OASIS and the post-processors. The only input file that this program reads is a single **batch file**. You tell it the name of the batch file by using the first, and only, command line argument. For example, if the batch file is called *batch1.txt* and it is in the lower directory called *ProjectX*, we can execute our batch with this line:

```
batch ProjectX\batch1.txt
```

Techniques for entering a command line with Windows are given in section 4.1.0. The techniques described there work for the batch program the same as for OASIS.

8.1.0 BATCH FILE

The input file for the OASIS batch program is called a **batch file**. It is an ASCII text file. The batch program reads this file according to **lines** and **pipe characters**. All text that follows a pipe on a single line in the batch file is considered to be a single command line (see section 4.1.0 for reference on OASIS command lines). The batch program ignores lines that do not contain a pipe character. All text on a line that precedes a pipe character is ignored. Here is an example batch file:

```
This is a batch file
There is no pipe, so these lines are ignored

  This       |  model dir=run1
   is        |  Onevar dir=run1 in=Onevar\pp1.dat
 comment     |  Onevar dir=run1 in=Onevar\pp2.dat

   |  model dir=run2
      Onevar dir=run2 in=Onevar\pp1.dat
      Onevar dir=run2 in=Onevar\pp2.dat
   |  "c:\program files\accessories\wordpad" run2\balance.out
```

This example tells the batch program to run OASIS on the run directory named *run1*. Then run two Onevar files, *pp1.dat* and *pp2.dat* on the same directory. Next, run OASIS on the run directory named *run2*. It does not tell the batch program to run Onevar on the second run directory. There are commands to do those Onevar runs, but they are ignored because there are no pipe characters preceding them. However, there is a pipe before the command to open the *balance.out* file for the second run using *WordPad*, so this command is executed.

The text “this”, “is”, and “comment” are ignored because they come before the pipe. Note that there is no way to put comments on the same line after the pipe.

CHAPTER 9
REFERENCE: POSITION-ANALYSIS PROGRAM

9.0.0 POSITION ANALYSIS WITH OASIS

A **position analysis** (PA) is a study which includes several modeling runs, all with the same operating rules and initial conditions. Each component run, or **trace**, of the PA has an equal number of time steps. The only thing that varies from trace to trace is the hydrologic scenario. The purpose of PA is to find the likelihood of the system being at a certain state at some future time, given the current state ("position") of the system.

HydroLogics has developed a program that allows you to do a PA with OASIS. The PA program executes OASIS repeatedly to produce the large number of trace runs that comprise a PA. While this occurs, OASIS has no special information to indicate that it is doing a position analysis, nor does it need any. The PA program automatically modifies the OASIS input for each trace, and when the trace is complete, it renames the output file to ensure that it does not get overwritten by subsequent runs.

The program is contained in the file *PosAnalysis.exe*. This file must be found in the same directory as *model.exe*. You may execute the program with command line parameters (section 4.1.0).

The OASIS-PA program has been designed so that the time-varying data can be retrieved with two different methods. The *historical* method makes it easy to use the historical time-series data. The data comes from a single set of time series, and each trace uses a portion of this data coming from a different section of time. In the *generated* method, a unique set of time series must be developed for each trace. See section 9.1.0 for details.

When the PA is done, you will need to process the results with Onevar or Plot. The desirable forms for the output data are quite different for a PA compared to a single run. See 9.4.0 for more information.

9.1.0 SOURCE OF TIME-VARYING DATA FOR POSITION ANALYSIS

There are two different methods for the Position Analysis (PA) program to get time series data, *HISTORICAL* and *GENERATED*. You designate which method to use in the *Run* table (section 4.5.2 part B). See 4.6.0 for information about time series input in general.

In the **HISTORICAL** method, no new data needs to be developed. The data comes from a single set of time series. Presumably, this is the set of time-series from the historical record. With the historical method, you should be able to easily use the same data set for a position analysis or for a single period-of-record run.

In the historical method, each time the PA program executes OASIS, it modifies the time range information in the *Range* table (section 4.5.2 part A). Thus, each trace of the PA uses a different time section of the single set of time series. Each trace starts on the same day of the year, but nominally in a different year. Each trace is identified by the year number in which it begins. It is not prohibited for the end of one trace to overlap the beginning of another. Under the historical method, the PA program does *not* change the F-part of the DSS pathnames.

When doing a historical-data PA:

> Enter the start position of the PA in the *START* record of the *Range* table (section 4.5.2 part A). The PA program ignores the year number.
>
> The PA program ignores the *STOP* record of the *Range* table.
>
> In the *PosAnalysis* table, enter the year numbers for trace numbers.

In the **GENERATED** method, a separate set of time-series inputs must be developed for each trace. Typically, each set of time series is a stochastically generated, equally likely forecast of hydrologic conditions. In this method, the PA program applies the exact same time range to each trace (that is, it does not alter the year as in the historical method). The different sets of time-series inputs should be stored in the same database, differentiated by the F-parts of their DSS pathnames. We suggest that you number your traces beginning at one. However, any integers are permissible for the trace numbers.

When doing the generated method, there may be some time-series data which varies by trace, and other time-series data which does not. You only need one set of the time series which do not vary by trace.

When doing a generated-data PA:

> Enter the start position of the PA, including the correct year number, in the *START* record of the *Range* table (section 4.5.2 part A).
>
> The PA program ignores the *STOP* record of the *Range* table.
>
> For each time series that varies by trace, set the F-part of the DSS pathname (4.6.1) to the trace number.
>
> For each time series which varies by trace, enter the information for the time-series record into the *Declare Timeseries* table (section 4.5.3 part P). In the *F Path* field, enter */F1*.
>
> Do not try to use the */F1* option in the *F Path* field for anything but the trace number.
>
> For a time-series input which does not vary by trace, do not enter */F1* into the *F Path* field.

When the PA program is run in *generated* mode, it passes the *F1* command-line parameter to OASIS. It thereby sets the F-part of the pathname to the trace number for all time series which have */F1* entered in the *Declare Timeseries* table. *The time-series inputs which use the* /F1 *flag are the only inputs which differ between traces.*

9.2.0 INPUT FOR THE POSITION ANALYSIS PROGRAM

The Position Analysis (PA) program only needs a few time parameters for input, for the PA program only manages OASIS so that OASIS can do the multiple runs that comprise a PA. The input which the PA program needs is described in the sections that follow.

9.2.1 RUN DIRECTORY

The entire PA is based in a single OASIS run directory (section 2.3.1), and all individual runs re-use the same input files. The PA program reads the model pointer file (section 4.3.0) to learn the name of the current run directory. You may enter the command line parameter *DIR* (section 4.1.0) to bypass the model pointer file.

9.2.2 CONTROL FILE

The PA program reads the control file named *model.cf* (section 4.4.0) in the run directory. You may specify a control file with a name other than *model.cf* using the command-line parameter *CF* (section 4.1.0).

The PA program creates a temporary copy of the control file. Then it passes a command-line parameter to OASIS, so the trace runs of OASIS will read the temporary file, not *model.cf*. The temporary file contains all the same information as the original, except the name of the time-parameters database (section 4.5.2) and possibly the initial conditions database (section 4.5.6) are changed. The PA program does not modify the original copy of the control file.

9.2.3 TIME-PARAMETERS DATABASE

The PA program requires some time input that OASIS does not read: the *PosAnalysis* table (section 4.5.2 part F) and the *PosAnal NumSteps*, and *PosAnal DataSource* fields in the *Run* table (section 4.5.2 part B).

Use the *PosAnalysis* table to specify the identities of the traces. Use the *PosAnal NumSteps* field in the *Run* table to specify the length of a trace (all have an equal number of time steps in length). The *PosAnal DataSource* field in the *Run* table specifies whether the data is read using the historical or generated method (section 9.1.0). The PA program only reads the *START* record from *Range* table (section 4.5.2 part A). For historical-data runs, the year in the *Range* table is ignored, but it is important for generated-data runs.

The PA program creates a temporary copy of the time-parameters database, which is used by the individual trace runs of OASIS. The program automatically enters different start and end times for each trace into the *Range* table of this database. The PA program does not modify the original copy of the time-parameters database.

9.2.4 INITIAL CONDITIONS

You may run the PA program with a different set of initial conditions for each trace. Note that this would not be a true *position analysis*, because, by definition, all traces of a PA have the same set of initial conditions, or *position*. However, you may wish to do studies that are similar to a PA, but have varying initial conditions.

You may name a different initial-conditions file in each record of the *InitCond file* field in the *PosAnalysis* table (section 4.5.2 part F). If a record is blank in this field, then that trace will use the initial-conditions file named in the control file (section 4.4.0). Leave all records blank in this field to do a true PA.

9.3.0 OUTPUT OF THE POSITION ANALYSIS

Each trace run of OASIS writes an entire time-series output database (section 5.6.0). The trace runs do not produce balance-sheet output, OCL output, or LP output (Chapter 5). In order to get those output files, you have to run OASIS for the trace that you want *without the PA program*.

The trace run of OASIS writes the time-series output database with the name given in the control file, *model.cf* (section 4.4.0). However, when each trace is complete, the PA program renames the file with a unique name, so that it will not be overwritten. If the original name of the output file is:

```
        [name].[extension]
```

then the new name is:

```
        [name][trace number].[extension]
```

Since there is one output file for each trace, and there are many traces, you may find it convenient to have all of the output files written into a special subdirectory. In the control file, you can write the name of the output file with a relative path to a subdirectory, and all of the output files will go into that same subdirectory. For example, the line in the control file may look like this:

```
    |  output\Output.DSS
```

and all of the output files will be found in the subdirectory *output*. This convention is considered standard for use with the OASIS GUI (section 3.3.7).

9.4.0 POST-PROCESSING THE POSITION ANALYSIS

Onevar and Plot can process the results of a position analysis (PA) if you give them the **command-line parameter *POSANALYSIS*** (section 4.1.0). When given this parameter, the post-processors take special steps to read the PA output. There are restrictions on the way that output can be presented from a PA.

If you have a completed a successful PA run, then there is enough information for the post-processors to read the results. Other than passing the command-line parameter *POSANALYSIS*, you do not need to take special steps to run the post-processors. Do not try to use the command-line parameter *F1* when post-processing a generated-data PA.

9.4.1 ONEVAR WITH POSITION ANALYSIS

To correctly process PA output, you must give Onevar the command line parameter *POSANALYSIS* (section 4.1.0). If you are using the generated-data method, do not give it the command-line parameter *F1*. If you are using the OASIS GUI (Chapter 3), the command-line parameters are automatically handled for you.

The format of Onevar tables is somewhat restricted due to the large amount of data in a PA. With one exception, the only output format that Onevar can produce for a PA is the *TABLE* format (section 6.1.4). In the *TABLE* format for a PA there is one row per trace. The length of the row is always the number of periods in the trace. For example, if there are 3 time steps per trace, the table has 3 columns. If there are 47 time steps per trace, the table has 47 columns.

You may enter any value into the *:STEP:* field (section 6.1.7 part I) with the *TABLE* format.

You may apply a *trace filter* to your Onevar output in order to display only selected traces, or to sort the traces in a special way. See section 9.4.3.

Format types other than *TABLE* can be produced only if the value in the *:STEP:* field is *WHOLERUN* (section 6.1.7 part I). When the post-processor time step is *WHOLERUN*,

in the *COLUMN and SEQUENTIAL* formats, each output row represents one trace.

in the *REPORT* format, there is one report block per trace.

9.4.2 PLOT WITH POSITION ANALYSIS

To correctly process PA output, you must give Plot the command line parameter *POSANALYSIS* (section 4.1.0). If you are using the generated-data method, do not give it the command-line parameter *F1*. If you are using the OASIS GUI (Chapter 3), the command-line parameters are automatically handled for you.

Plot can present PA output only in one of two ways:

> Enter *WHOLERUN* in the :STEP: field and *PROBABILITY* in the *:SORT:* field. When this is done, the plot contains one value per PA trace.
>
> Use a trace-filter (section 9.4.3). When this is done, the plot contains one time-series line for each trace. However, you cannot plot multiple runs on the same plot with a trace-filter.

9.4.3 USING A TRACE FILTER

Using a trace filter in your post-processor output allows you to

> sort the display of PA traces by some criteria other than the values of the output being displayed
>
> and/or
>
> display some of the PA traces but exclude others.

The trace filter is defined in the Onevar input file. See section 6.1.10 for complete information about using a trace filter. Note that using a trace filter is the only way you can get Plot to display time-series output for individual traces.

GLOSSARY

Absolute Period. A counter which equals 1 for the first simulation **time step** and is incremented by one for every time step thereafter. This counter is never reset. It may be referred to with the OCL **absolute period** variable (section 4.7.4).

Absolute Time-Step Index. (section 4.7.4 part A) You add this as a suffix to an OCL variable to refer to a **time step** other than the current step. Your reference is not relative to the current step. This is in contrast with a **time lag**.

Access (section 4.5.0) **(Microsoft Access or MS Access).** A database program written by Microsoft, or the file format created by this program. OASIS' standard input files are in Access format.

Alternate Optima. (section 2.2.5) Multiple sets of solutions to the **decision variables** which would all give an optimal solution to the **LP routing** problem.

Arc. (section 2.1.2) An element of an OASIS model which represents the flow of water from one location (or **node**) to another.

Area. (section 2.4.0 part F) The surface area of a reservoir, which varies with the amount of water in storage.

Balance Sheet. (section 5.2.0) A report of all of the inflows and outflows for all the **nodes** in the system for a portion of the simulation **time range**. OASIS automatically writes these in the balance-sheet output file.

Branched Condition. (section 4.7.2 part A) A **condition** block in an OCL command that is actually a superset of more condition blocks, called the branches. The branches can only be evaluated if the condition upon which the branch is based is found true.

Category. (section 3.7.1 part B) As in **node category**, **arc category**, and **inflow category**. A user-defined classification for a node, arc, or node inflow used by the OASIS GUI. Each category is represented on the schematic by a symbol of distinct shape and color. The *category* concept should not be confused with *node type*. Although each node category can only represent one node type, a node type might be represented by many different node categories.

Command Line. (section 4.1.0) The command with a list of arguments, that is issued to launch a Windows program.

Comment. (section 4.7.0 part D) A string of text found in OCL input that provides information for users to read, and is not interpreted as OCL code. Special markers indicate to OASIS which text is comment so that it is not interpreted as code. You may put the comment markers around sections of valid OCL code in order to make them inactive.

Condition. (section 4.7.2 part A) An input field of an OCL command containing an **expression** that can be evaluated to either true or false. Other input fields associated with the condition will be accepted only if the condition evaluates true.

Constraint. See **Operating Constraint**.

Continuation. (section 2.8.3) A way of running OASIS that restarts a run that has already been partially or fully run. OASIS reads the results of the previous run and then begins simulating at some point after the starting period of the run, as though the previous run had never been stopped.

Continuity (section 2.2.4) **(Continuity-of-flow).** The modeling criteria which dictates that the volume of water coming into a **node** must equal the change in storage plus the volume leaving the node. Another way of understanding this is that the model must account for all water that enters or leaves the system. OASIS automatically writes continuity-of-flow **constraints** to the **LP router** to ensure that this criteria is not violated.

Control File. (section 4.4.0) An input file whose only role is to identify the major input and output files processed by the model.

Cycle. See **Time Cycle**.

Dead Storage. (section 2.4.0 part H) By convention, this means the water that cannot be drained from a reservoir due to the position of the outlets. OASIS provides a standard feature for entering a dead storage quantity for a **reservoir node**, although it is up to you to define rules that would prevent this water from being drained.

Decision Variable. (section 2.2.1) A variable whose value is decided by the **LP router**.

Delivery. (section 2.4.0 part D) The amount of water actually routed to a **demand node**.

Demand Node. (section 2.1.1 part C) A **node** representing a part of the system where water is removed from the system for some purpose, such as irrigation, municipal supply, or wetlands maintenance.

Demand. (section 2.4.0 part D) The amount of water that will satisfy the purpose at a **demand node**.

DLL. (section 2.5.1 part I) **(Dynamic-Link Library)** A computer file containing executable instructions. Other programs call the DLL to execute these instructions. DLL files are identified by the filename extension *.DLL*.

DSS. (section 4.6.0) **(HEC-DSS)** A database format developed by the US Army Corps of Engineers Hydrologic Engineering Center (HEC), especially designed for handling time-series data. DSS stands for *Data Storage System*.

Elevation. (section 2.4.0 part F) The water-surface elevation of a reservoir, measured from a datum (commonly sea level). It varies with the amount of water in storage.

Executables folder. (section 3.3.3) The folder where the main OASIS executables are found. This folder may or may not be the same as the **home folder**.

Expression. (section 4.7.3) **OCL expression.** A basic element of OCL input; a string of OCL symbols, including constant values, variables, mathematical operators, parentheses, and functions of variables. At simulation time, each expression can be mathematically evaluated to a constant value.

External Module. (section 4.7.7) A separate program which runs in **parallel** with OASIS, and exchanges data with OASIS at the same time. OASIS is seen as just one module, equipped to simulate only certain aspects of a water resources system. The external modules handle computations and simulate phenomena that are outside of OASIS' scope. Some examples of aspects that could be modeled by an external module are snow melt forecasting, hydrodynamics, water quality, and demand reduction.

Feasible. Describing a **routing** solution that satisfies all of the **constraints** given to the **LP router**.

Gaming. (section 3.7.2) A modeling exercise where the modelers stop the model at every **time step** (or at short intervals), evaluate the system, and change the operating rules before continuing to the next time step. The OASIS **GUI** has features that can help you do gaming runs.

Goal. See **Operating Goal**.

GUI. (Graphical User Interface) A program with which you create and modify an OASIS run using graphical controls. The GUI interfaces with computer files so that you don't have to. Thus, the whole modeling process is more user-friendly. While OASIS is completely generalized, HydroLogics can tailor the GUI program to individual clients.

GUI Plugin. (section 3.3.3) A portion of the GUI program which is contained in the file *OASISGUI_Plugin.ocx*. For different projects, different versions of this file can be used, so that while the bulk of the GUI remains the same, a portion contains features that are custom made for a particular project.

HEC-DSS. See **DSS.**

Home folder. (section 3.3.2) The central folder for organizing OASIS data. This folder should contain pointer files and configuration files. Other data is contained in subfolders of the home folder. The home folder may or may not be the same as the **executables folder**.

IHA. (section 3.6.4 part C) *Indicators of Hydrologic Alteration*, a software package created and distributed by the Nature Conservancy which does a variety of statistical analyses on daily hydrologic data.

Imbalance. (section 5.2.0) A condition where inflow, outflow, and storage at a **node** do not obey the **continuity-of-flow** criteria. OASIS' **balance-sheet** is programmed to report any imbalance, although it should only be found if there is no **feasible** solution.

Infeasible. (section 2.2.2) Describing set of **constraints** that cannot all be **satisfied** by the **LP router**.

Inflow. (section 2.1.3) Water that enters the system at a **node**.

Julian Date. A date descriptor which is 1 for the first day of the year and 366 for the last day of the year. May be referenced with the *julian* variable in OCL (section 4.7.4).

Junction Node. (section 2.4.0 part A) A **node** at which water cannot be stored, and is not associated with a **demand**.

Lag. (section 4.7.4 part A) You add this as a suffix to an OCL variable to refer to a **time step** other than the current step. Your reference is relative to the current step. This is in contrast with an **absolute time-step index**.

Linear Program. (section 2.2.0) **(LP)** The set of all the operating rules (**goals** and **constraints**) in the system for the given simulation **time step**. This consists of a set of expressions that are linear with respect to the **decision variables**. You do not create the LP in a direct sense. OASIS automatically builds it from your standard input and OCL input. The **LP solver** takes the LP and returns the values of (*solves*) the decision variables.

Locked Runs. (section 3.4.9) OASIS runs where you or another user has specified that there can be no further changes to the input data.

Logical Operator. (section 4.7.3) The mathematical operators *and* and *or*, for use in OCL.

Lower Rule Curve. (section 2.4.0 part H) **(Lower Rule)** The boundary between the lowest operable zone in a reservoir and the zone above it. OASIS provides a standard input field for you to define this value at any **reservoir node**, but it is up to you to define the rules that limit use of the reservoir zones.

LP. See **Linear Program.**

LP Router. (section 2.2.0) The part of OASIS which converts the operating rules into an **LP** and then solves the LP in order to compute the values of the **decision variables**.

LP Solver. (section 2.2.0) A computer algorithm that finds the values of the **decision variables** that optimize the objective function of an **LP** without violating the **constraints**. OASIS uses the software package **XA** as its LP solver.

Maxim m Flow. (section 2.4.0 part A) The highest flow rate that can be routed through an **arc**, which OASIS treats as a **constraint**. This is most often used to model a physical flow capacity.

Maximum Storage. (section 2.4.0 part H) The storage capacity at a **reservoir node**, which OASIS treats as a **constraint**.

Maximum Reverse Flow. (section 2.4.0 part C) The lowest flow rate that can be routed through an **arc**, which OASIS treats as a **constraint**. This is used to model a physical flow capacity in the reverse direction. Generally, the lowest flow rate through an arc is zero, but defining a negative maximum-reverse-flow value enables water to flow both ways in an arc.

Message Queue. (section 2.5.1 part I) A list of messages being transmitted between Windows applications. Applications can send messages to other applications via the queue and also receive them. Each message consists of just a few bytes of data.

Meta Command. (section 4.7.0 part F) An OCL command that serves a purpose other than being evaluated at simulation time. Keywords for meta commands are distinguished by the fact that they end and start with a colon.

Minimax. (section 2.5.1 part F) A technique for setting an **LP goal** of making several quantities equal to each other. Minimax works by minimizing the maximum of the quantities. The OCL *Minimax* command allows you to define a minimax.

Minimum Flow. (section 2.4.0 part B) The lowest desired flow rate that should be routed through an **arc**, which OASIS treats as a **goal**.

Mode. (section 3.4.7) The OASIS GUI has two available modes: simulation mode (single-trace, long-term studies) and **position-analysis** mode (multiple-trace, short-term studies). The **GUI** provides some different input and output management for the different modes.

Module. See **External Module**.

MPO Step. (section 2.2.7) One **time step** of the set of time steps (the optimization horizon) that are to be solved simultaneously in a single call to the **LP solver** (see **MPO**). OASIS numbers the MPO steps 1, 2, 3...etc.

MPO. See **Multiple-Period Optimization**.

Multiple-Period Optimization. (section 2.2.7) **(MPO)** A simulation technique where OASIS solves for the values of the **decision variables** of more than one **time step** in a single call to the **LP router**. This is distinct from the standard case, where OASIS only solves one time step at a time.

Node. (section 2.1.1) An element of an OASIS model which represents a location of interest in the system. OASIS tracks the inflow and outflow to the node. Flows to and from other parts of the system occur in **arcs** and flows in and out of the system are shown as **inflows**.

Non-decision Variable. (section 4.7.4) A variable whose value is not decided by the **LP router**. Generally, the values of non-decision variables are known and entered as constants to the LP router.

OASIS. The generalized modeling program developed by HydroLogics. OASIS is designed to be flexible for simulating the operating rules of a water-resources system, and to easily connect with other programs that simulate specialized aspects of the system.

Objective Function. (Chapter 7) A linear expression of **decision variables** expressing the points gained or lost for all of the **operating goals** for the **time step**. The **LP router** solves the **routing** of water by finding the set of values for the decision variables that gives the maximum possible value of the objective function. You do not directly create the objective function; the LP router automatically builds it out of all of the operating goals you define.

OCL. (section 2.5.0) **(Operations Control Language)** A language-based input to OASIS that allows you tremendous flexibility in defining operating rules.

Onevar. (section 6.1.0) The OASIS **post-processor** program that produces custom text-table output.

Onevar input file. (section 6.1.3) A file that contains instructions for what data **Onevar** should write to a text table and how it should be presented.

Operating Constraint. (section 2.2.2) An operating rule entered into the **LP router** that cannot be violated. Failure to meet a constraint results in an **infeasible** LP. All operating rules entered into the LP router are either constraints or **goals**. The OCL *Constraint* command is a general way of entering a constraint into the model, although there are many other ways to define a constraint.

Operating Goal. (section 2.2.3) An operating rule that the **LP router** must try to meet, but which must compete with other goals. Failure to meet a goal does not result in an **infeasible** solution.

Optimize. (section 2.2.0) To find the best possible **routing** for the given set of operating rules. OASIS optimizes the routing with an **LP solver**.

PA. See **Position Analysis**.

Parallel. (section 4.7.7) **(Running in Parallel)** Said of OASIS and **external modules** because they can compute each simulation **time step** together and exchange information before proceeding to the next time step. A more primitive way of combining models would be to run them in *series*, doing a complete run of one model, and then making the results available to another model. Running in parallel can provide much more accurate results by allowing conditions in one model to respond to conditions in another.

Parent Module. (section 4.7.7 part C) The **module** that is initiated first and is thus responsible for initiating the other modules.

Pattern Variable. (section 4.5.1) An input variable whose values may vary within the year, but repeat from year to year.

Penalty. (section 2.2.3) A **weight** with negative value.

Plugin. See **GUI Plugin**.

Pointer File. (section 2.3.2, section 6.1.2, section 6.2.1) A file which tells OASIS which run to execute, or tells the post-processor which input file to use.

Position Analysis. (Chapter 9) **(PA)** A study composed of several model runs, all with the same operating rules and initial conditions. Each component run, or **trace**, of the PA has an equal number of **time steps**. The only thing that varies from trace to trace is the hydrologic scenario.

Post-processing. (Chapter 6) Reading OASIS input and output, performing computations upon it, and presenting it in tables or graphical plots so that the analyst can evaluate the performance of the simulated system.

Post-processor steps. (section 6.1.7 part I) By default, post-processors present data at the same **time steps** that were used for simulation. However, you may use the *:STEP:* field in the Onevar header to designate another set of time steps, which we call *post-processor steps*. Post-processor output is first computed at simulation time steps, then redistributed to the post-processor steps.

Post-shift tables. (section 6.1.8) tables that Onevar does not evaluate until after the other tables have been redistributed to post-processor steps. Designate such tables by placing them after the *:TIMESHIFT:* marker.

Primary Units. (section 2.9.0) The units of measurement in which OASIS works. In general, values are measured in primary units unless an explicit conversion is done.

Priority Level. (section 2.2.6) A number associated with a **weight** that tells OASIS that the **goal** outranks weights with lower priority and is outranked by goals with higher priority. The **LP router** solves each priority level separately. In most models, the priority level is always equal to one and need not be of concern.

Quick View. (section 3.6.4 part I) A feature of the OASIS GUI that allows you to graphically select a variable, for which the GUI automatically creates post-processor input and output files to view the values of that variable.

Range. See **Time Range**.

Relational Operator. (section 4.7.3) The mathematical operators that determine whether a quantity is less than, equal to, or greater than another candidate (<, <=, =, >=, >).

Reservoir Node. (section 2.1.1 part B) A **node** where it is possible to store water.

Return Flow. (section 2.1.1 part C) The water that comes back into the system from a **demand node**.

Router. See **LP Router**.

Routing. (section 2.2.0) The process of computing how much water flows into, through, and out of the system, with subsequent changes in storage. The simulated routing decision is based on operating rules that express human control and the physical properties of the system. OASIS simulates routing by solving an **LP**.

Rule Curves. (section 2.4.0 part H) The time-varying boundaries between storage zones in a reservoir, including the **lower rule curve** and **upper rule curve**. OASIS provides standard input features for you to define rules curves at a **reservoir node**, although it is your responsibility to create operating rules that treat each storage zone appropriately.

Run Directory. (section 2.3.1) The folder on your computer's file system that is designed to contain all input and output for one OASIS run. Note that there are ways for you to locate your input and output outside of the run directory or in sub-folders of the run directory.

Schematic. (section 2.1.0) A diagram showing the **nodes** and **arcs** in your OASIS model, providing an overview of the system being modeled. The OASIS **GUI** provides an interactive schematic control which is directly linked to your model input.

Segment. (section 2.5.1 part B) A technique for dividing a **decision variable** into parts, called *segment variables*. The sum of the segment variables equals the original variable. The first segment variable represents the first increment of the original variable. The second segment variable has a value of zero until the first segment variable has reached its maximum value. The third segment has a value of zero until the second segment has reached its maximum value, and so forth. The OCL *Segment* command allows you to create segments.

Shortage. (section 2.4.0 part D) The difference between the **demand** and the **delivery** at a **demand node**.

Simulation Command. (section 4.7.0 part E) An OCL command that is evaluated each simulation **time step**.

Solve. (section 2.2.0) To find the values of the **decision variables** that optimize the objective function of an **LP** without violating the **constraints**

Solver. See **LP Solver.**

Splash Screen. (section 3.3.2) A window that is displayed when the OASIS GUI is started. The splash screen provides identification of OASIS and of the project.

Step filter. (section 6.1.9 part E) An optional feature of the **Onevar input file** that allows you to selectively omit certain time steps from the post-processor output.

Subgroup. (section 3.3.8) A subset of the data for your OASIS project, which only includes a subset of the runs, modules, and/or post-processor files of the project. Help you segregate runs that should not be compared with each other. Different subgroups may even represent different water systems. The OASIS GUI has special features that help you manage subgroups.

Substitute. (section 4.7.1 part I) A special string of text (identified with a *substitute name*) that stands in for another string of text in OCL. All substitute names must be enclosed in square brackets. By changing the definition of the substitute, all instances of the substitute are automatically changed.

Surface Area. See **Area**.

Table. [1] (section 6.1.9 part C) A unit of **post-processor** output that defines a time-series output variable and specific formatting information. [2] (section 4.5.0) A conceptual container in a database, which organizes data by fields and records.

Terminal Node. (section 2.1.4) A **node** at which water may flow freely out of the system, as decided by the **LP router**.

Time Cycle. (section 2.8.1) A conceptual framework for defining the size and characteristics of OASIS **time steps**. The cycle is composed of a set of time steps. Each step within the cycle may have a separate size, label, and **MPO** horizon. All time steps are defined by continuous, consecutive cycles, such that the first step of one cycle has the same defining characteristics as the first step of all the other cycles.

Time Lag. See **Lag.**

Time Range. (Section 2.8.2) The simulated time interval from the starting simulation **time step** to the ending simulation time step.

Time Series. (section 4.6.0) A variable with unique values for every **time step**.

Time Step. (section 2.8.1) **(Simulation Time Step)** An interval of time for which OASIS computes results. One value is computed for each model variable for each time step. The time steps are consecutive. For example, if each time step is one day long, then OASIS computes results for one day, and then it computes results for the following day. It never skips a day.

Trace. (Chapter 9) One of the many runs that comprise a **position analysis**. Each trace is associated with a unique hydrologic scenario input, but is otherwise identical to the other traces.

Udef. (section 2.5.1 part A) **(User-defined variable)** A simulation variable created in OCL with a name and a purpose that you determine.

Upper Rule Curve. (2.4.0 part H) **(Upper Rule)** The boundary between the highest zone in a reservoir and the zone below it. OASIS provides a standard input field for you to define this value at any **reservoir node**, but it is up to you to define the rules that limit use of the reservoir zones.

User-defined Variable. See **Udef**.

VEDIT. (section 3.2.0) ASCII-text editing software produced by Greenview Data Inc. VEDIT is very efficient and has much more powerful features than Windows WordPad. The OASIS **GUI** relies on VEDIT to display ASCII files and make them available for editing.

Water Year. (section 2.8.5) A convention used by hydrologists where the year begins on October 1 and ends on September 30. OASIS can run on a water year if you set the **year scheme** appropriately.

Weight. (section 2.2.3) A value you assign to every **operating goal** to express the importance of using water for that goal in comparison to other goals.

Whitespace. (section 4.7.0 part A) a sequence of one or more space, tab, or carriage-return characters. Whitespace can be used to separate words in OCL syntax. Whitespace cannot be used in the middle of a word.

XA. (section 2.2.0) A software package developed, sold, and copyright by Sunset Software Technology. OASIS calls XA to solve the **LP routing**.

Year Scheme. (section 2.8.5) The way in which OASIS determines the beginning and end of the year. For most purposes, we treat January 1 as the beginning of the year, but OASIS allows you to designate any date as the first day of the year.