TORO NSN®

Training Department

Lynx Level 1 Class Agenda

Day One

7:30 AM	Student begin to arrive for class.
8:00 AM	Class Begins – Introductions and Format
8:30 AM	File Manager and Saving your Database
9:30 AM	Map Importation and Tools
10:30 AM	Watering Plan
11:30 AM	Instant Programs
12:00 PM	Lunch
1:00 PM	Auto Cycle
1:45 PM	Work Orders
3:00 PM	Preferences and Hardware
4:30 PM	Final Exercise, Projected Flow and Synchronize
5:00 PM	First day of class ends
6:00 PM	Students meet for dinner

Day Two

8:00 AM	Course Report and Troubleshooting
9:00 AM	Reports
10:15 AM	Manual Irrigation
11:00 AM	Mobile Operations
11:30 AM	NSN Customer Portal
12:00 PM	Lunch
1:00 PM	Lynx Map App Setup
1:45 PM	Overview-Advanced Setup/Utilities/Daily Operation
2:15 PM	Add a Station
2:45 PM	Favorites
3:00 PM	Reinforcement Exercises
5:00 PM	Lynx Level 1 Regional Training ends.

TORO NSN® REGIONAL LYNX LEVEL 1 TRAINING

Class Outline

A. Operational

- The Operational part of Lynx allows the user to Schedule and Manage Irrigation, Expand Irrigation, Utilize the Map features, View and Send Reports, Weather Station integration, Pump Station integration, and Turf Guard integration.
- The sections of the Operational Screen are: Along the left side are the various screen tabs; across the top is the Rainhold, Pump Station information and Weather Station information; though the center is the work space for each screen; the bottom left are the various icons and the Toro NSN button, along the bottom right is the map view.

1. Watering Plan
    - The Watering Plan allows the user to Schedule and Manage Irrigation.
    - Program Level
        - Site Adjustment – This allows the user to change the percentage of the entire system.
        - Course Adjustment – This allows the user to change the percentage of a course.
        - Search By Hardware Address – This allows the user to search the system for a specific Station within the Watering Plan. If the Station is not in the system, Lynx will indicate None.
        - Start Time Shift – Allows the user to adjust the Start Time for the ENTIRE System in minutes either forward or backward. Place the adjustment in the cell then click the Adjust button. The user will see the adjustment in the Start Time column.
        - Program – This column is the Areas or Instant Programs of the facility. The water drops are color coded. Green indicated irrigation is scheduled and ready to water. Blue indicates no active days. Red indicates no active Start Times or Disabled. There may also be a shadow color behind the drop. This indicates Holes or Stations may not be scheduled to irrigate. When the Area is drilled down, it shows each Hole. When the Hole is drilled down, it shows each Station
        - # - This column shows the Program Number.
        - On – This column allows the user to turn a Program On or Off. When on, the dot is green with a check. When off, the dot is red with no check.
        - Auto Cycle – This column allows the user to turn on or off the Auto Cycle for a Program. Auto Cycle was setup in either Course Configuration or Control System in Advance Setup.
        - Last RT – This column shows the Runtime for the Stations in the Area the last time it irrigated. It may show 2 numbers; the high and low runtimes.
        - Next RT – This column shows what the next runtime is scheduled for the Stations in the Area. This number is adjustable. It may show 2 numbers; high and low runtimes.
        - Adj. RT. – This column shows the adjusted runtime from percentage adjustments.

- Last Amt. – This column shows the amount of water irrigated for the Stations in the Area the last time it irrigated. It may show 2 numbers; high and low amounts.
- Next Amt. – This column shows the amount of water scheduled for the Stations in the Area. This number is adjustable. It may show 2 numbers; high and low amounts.
- Adj. Amt. – This column shows the adjusted amount from percentage adjustments.
- Pct. Adjust – This column shows the percentage adjustment for each Program. This is adjustable.
- Start Time – This column allows the user to set the start time for each Program. When the user clicks on the cell, a drop down appears. From this drop down, Start Times are set.
    - Add – The user clicks on the add button to add a Start Time. The user can add multiple Start Times.
    - Delete – The user can remove a Start Time by clicking on the Start Time and click Delete.
    - Done – Done button closes the Start Time screen.
    - On – This column allows the user to turn on/off a specific Start Time.
    - Related To: – This column allows the user to set the Start Time relative to Time, Sunrise, or Sunset.
    - Value – This column allows the user to set the specific time or the plus or minus in minutes from Sunrise/Sunset.
    - Stop – This column allows the user to set a specific Program to run as a Stop At not a Start At. If a Stop At is selected an indicator is placed under the Start Time.
- Priority – This column allows the user to set Programs Priorities. If all Programs are starting at the same time, this allows the user to designate which is scheduled first. Priorities are A to Z.
- Active Days – This column shows the next 7 days. If the Days are Blue, they are active. If the Days are Grey, they are non-active. To activate days, click on the drop down.
    - Calendar – The user can click on the individual days, they wish to have active.
    - Set All – This button allows the user to activate all days for the nest year.
    - Interval days – this allows the user to set the frequency and what day they want the interval to start on.
    - Clear All – This button removes all active days.
    - Done – This button closes the Active Days drop down.
- RT Calc – This allows the user to set the Runtime Calculation method. There are 2 methods; User Defined or ET Auto Calc.
- ET Mode – This allows the user to set an ET Mode when utilizing ET Calculate. There are 2 modes: Daily or Checkbook.
- ET Source – This allows the user to select an ET Source when utilizing ET Auto Adjust or ET Calculate. There are up to 4 sources: Historical, Manual, Manual Temperature, or Weather Station.
- Rainfall – This column shows the rainfall from a Weather Station.

- Turf Guard – This column shows an alert to the user when they have Turf Guard sensors linked in their system. The alert shows if there are stations scheduled to irrigate but the sensor moisture level is higher than the upper threshold level or if a station is not scheduled but the sensor moisture level is lower than the lower threshold level.

- Hole Level
  - Hole – This column shows the Hole Number and Name.
  - On - This column allows the user to turn a Hole On or Off. When on, the dot is green with a check. When off, the dot is grey with no check.
  - Auto Cycle – This column allows the user to turn on or off the Auto Cycle for a Hole. Auto Cycle was setup in either QS or Course Configuration in Advance Setup.
  - Last RT – This column shows the Runtime for the Stations in the Hole the last time it irrigated. It may show 2 numbers: the high and low runtimes.
  - Next RT – This column shows what the next runtime is scheduled for the Stations on the Hole. It may show 2 numbers: high and low runtimes.
  - Adj. RT. – This column shows the adjusted runtime from percentage adjustments.
  - Last Amt. – This column shows the amount of water irrigated for the Stations on the Hole the last time it irrigated. It may show 2 numbers: high and low amounts.
  - Next Amt. – This column shows the amount of water scheduled for the Stations on the Hole. It may show 2 numbers: high and low amounts.
  - Adj. Amt. – This column shows the adjusted amount from percentage adjustments.
  - Pct. Adjust – This column show the percentage adjustment for each Hole. This is adjustable.
  - Offset – This column allows the user to set time offsets from the Area Start Time for each Hole.
  - ET Source – This allows the user to select an ET Source when utilizing ET Calculate. There are up to 4 sources: Historical, Manual, Manual Temperature, or Weather Station.
  - Rainfall – This column shows the rainfall from a Weather Station.
  - Max Station – This column allows the user to set the maximum number of simultaneous stations on this Hole in this Area.
  - Turf Guard – This column shows an alert to the user when they have Turf Guard sensors linked in their system. The alert shows if there are stations scheduled to irrigate but the sensor moisture level is higher than the upper threshold level or if a station is not scheduled but the sensor moisture level is lower than the lower threshold level.

- Station Level
  - Station – This column shows the Station Tag. Example 1GR1; 1 Hole, GR Program/Area, 1 Station Location.
  - On - This column allows the user to turn a Station On or Off. When on, the dot is green with a check. When off, the dot is red with no check.

- Auto Cycle – This column allows the user to turn on or off the Auto Cycle for a Station. Auto Cycle was setup in either QS or Course Configuration in Advance Setup.
- Last RT – This column shows the Runtime for the Station the last time it irrigated.
- Next RT – This column shows what the next runtime is scheduled for the Stations.
- Adj. RT. – This column shows the adjusted runtime from percentage adjustments.
- Last Amt. – This column shows the amount of water irrigated for the Station the last time it irrigated.
- Next Amt. – This column shows the amount of water scheduled for the Stations.
- Adj. Amt. – This column shows the adjusted amount from percentage adjustments.
- Pct. Adjust – This column shows the percentage adjustment for each Station. This is adjustable. A drop down allows the user to adjust the station for a duration in days with a set return percentage adjustment.
- Suspend – This column allows the user to set a timed suspension for a Station. This is set in days.
- C Time – This column shows the cycle time for a station. The cycle time is how long a station runs each time. This can be adjusted by utilizing Auto Cycle feature.
- Volume – This column shows the amount of water the Station utilizing.

2. Turf Guard – This column shows the moisture level for the Turf Guard sensor linked to this Station.

Instant Program

- The Instant Program allows the user to build programs quickly by selecting either the Stations by area or by Map.
- On the Working Area of the screen, the user has the Areas or hardware addresses previously selected on the left, Selection Arrows in the middle, the naming of the Instant Program on the right and the Map along the bottom.
  - The user must select the type of Instant Program they wish to build; Standard or Sequential.
    - Standard – Operates the program normally
    - Sequential – Operates the program in a specific order the users selects.
  - Naming the Instant Program
    - When the user first opens the Instant Program screen, the New Program is highlighted. The user then can name the Instant Program by typing over <<New Program>>.
  - Assigning station to Instant Program
    - Assigning Station can be accomplished by utilization of either the Stations in existing Areas or via the Map.
      - Assigning Stations via existing Areas: the user can select the entire Area by placing a check (✓) in the box next to the Area.
      - Assigning Stations via existing Areas: the user can select an individual Hole by expanding the Area then by placing a check (✓) in the box next to the Hole.

- Assigning Stations via existing Areas: the user can select individual Stations by expanding the Area and Hole then by placing a check (✔) in the box next to the Stations.
- Once the Stations have been selected, they are then assigned to the Instant Program by the use of the Assign Arrow to the right of the Stations by Area column. The Stations will appear under the Current Program and New Program name.
- Assigning Stations via the Map: the user clicks the Enable Map Select on the top left corner of the Map. This allows the Map selection to become active.
- Assigning Stations via the Map: the user can utilize the polygon to select the Stations to assign to the Instant Program.
- Assigning Stations via the Map: the user clicks to set each corner of the polygon surrounding the Stations to assign to the Instant Program. Once all corners are set the user double left clicks the mouse and those Stations within the polygon are assigned to the Instant Program.
- In both techniques, the Stations selected will be designated by green wedges on the Map.
- The user clicks the Save Program at the bottom of the Current Program column to lock in the Stations in the Instant Program.
- If the user wishes to remove an Instant Program, select the Program from the drop down, then click the Delete Program button at the bottom of the Current Program column.

3. Course Report
    - The Course Report shows what is irrigating, what irrigated, what did not irrigate, what was on Hold, what was Disabled and Current Alerts.
    - The Course Report Working Area is divided into two areas: Current Operation and Current Alerts.
        - The Current Operation area header shows when irrigation will be completed, when it was last updated and a Refresh Status button.
            - Area Level
                - Area – Indicates Areas that will be or have irrigated via normal or manual irrigation. Drops are color coded: Green indicates irrigation is scheduled, running or finished and Red indicates irrigation has not run or was cancelled.
                - Complete At – Indicates when each Area will finish irrigating.
                - Automatic
                    - Running – Indicates the number of Stations currently irrigating via automatic irrigation.
                    - Completed – Indicates the number of Stations that have completed automatic irrigation.+/- - Indicates

stations that ran more or less than their scheduled run time.

- Manual
  - Running - Indicates the number of Stations currently irrigating via manual irrigation or Group Multi Manual (GMM) sent from the central, hand held radio interface, or satellite timer.
  - Complete - Indicates the number of Stations that have completed manual irrigation via manual irrigation sent from the central, hand held radio interface, or satellite timer.
  - +/- - Indicates stations that ran more or less than their scheduled run time.
- On Hold
  - Indicates the number of Stations in an Area on Hold.
- Disabled
  - Indicates the number of Stations in an Area that are Disabled.

- Hole Level
  - Hole – Indicates Holes that will be or have irrigated via normal or manual irrigation. Drops are color coded; Green indicates irrigation is scheduled, running or finished and Red indicates irrigation has not run or was cancelled.
  - Complete At – Indicates when each Hole will finish irrigating.
  - Automatic
    - Running – Indicates the number of Stations currently irrigating via automatic irrigation.
    - Completed – Indicates the number of Stations that have completed automatic irrigation.
    - +/- - Indicates stations that ran more or less than their scheduled run time.
  - Manual
    - Running - Indicates the number of Stations currently irrigating via manual or GMM irrigation sent from the central, hand held radio interface, or satellite timer.
    - Complete - Indicates the number of Stations that have completed manual irrigation via manual irrigation or GMM sent from the central, hand held radio interface, or satellite timer.
    - +/- - Indicates stations that ran more or less than their scheduled run time.
  - On Hold
    - Indicates the number of Stations on a Hole on Hold.
  - Disabled
    - Indicates the number of Stations on a Hole that are Disabled.

- Station Level
  - Station– Indicates if the Station is irrigating or has irrigated via normal or manual irrigation. Drops are color coded; Green indicates irrigation is scheduled, running or finished and Red indicates irrigation has not run or was cancelled.
  - Complete At – Indicates when the Station will finish irrigating.
  - Automatic
    - Running – Indicates if the Station is currently irrigating via automatic irrigation via a blue water drop.
    - Completed – Indicates if the Station has completed automatic irrigation.
    - +/- - Indicates stations that ran more or less than their scheduled run time.
  - Manual
    - Running - Indicates if the Station currently irrigating via manual irrigation or GMM sent from the central, hand held radio interface, or satellite timer via a blue water drop.
    - Complete - Indicates if the Station has completed manual irrigation via manual irrigation sent from the central, hand held radio interface, or satellite timer.
    - +/- - Indicates stations that ran more or less than their scheduled run time.
  - On Hold
    - Indicates if Station is on Hold.
  - Disabled
    - Indicates if the Station is Disabled.
- The Current Alerts area shows alerts that will indicate an issue with the irrigation system and the time of occurrence.
  - Communication Failures
    - Irrigation commands that were prevented by communication failures. These Stations will be placed in the Disabled column. NW GDC and OSMAC
    - Irrigation Commands that were not successfully transmitted and are summarized in the Course Report by Area and Hole. At the station level, these are shown as ran less for the entire scheduled irrigation cycle. NW VP
  - Diagnostic Failure – Irrigation commands that were prevented by shorted or open failures. These Stations will be placed in the Disabled column. NW GDC
  - Current Sensing – Irrigation commands that were not transmitted to stations because of an over current tolerance condition. These Stations will be placed in the Disabled column. Under current tolerance are only reported in the Current Alerts. NW VP
  - Satellite Faceplate Disabled – Irrigation commands that were prevented by Stations disabled at the Satellite faceplate are placed in the Disabled column. NW VP

4. Map Usage

5. Map Importation

    a. See document.

6. Basic Station additions to Map

7. Operational Screen Review - Detailed
    a. Manual Irrigation
        - Allows the user to run, stop, pause, resume, or hold stations or run and stop switches or satellite programs.
        - View – User can view this screen either by Hardware, Program/Area or Switches.
        - Selection List – Shows and allows the user to select items available via one of the three views listed above. Selection is accomplished by checking item or drilling down to the specific item. If the user needs to clear the selection checks, click the Clear All Checks button.
        - Arrows – Add or remove selected items to the Selected List.
        - Selected List – Shows the selected items from the Selection List. To clear all selected items click on the Clear All button.
        - Operations – There are six operations to select from.
            - Run – Allows the user to start selected items. Options allows user to set a Start Delay from 0 to 100 minutes.
            - Stop – Allows the user to stop selected items.
            - Pause – Allows the user to pause selected items. Options allow the user to set Duration from 1 to 255 minutes.
            - Resume – Allows the user to resume paused items.
            - Hold – Allows the user to place a hold on selected items. Options allow the user to set the Duration from 1 to 30 days or permanent.
            - Remove Hold – Allows the user to remove a hold from selected items.
        - Send – Allows user to implement selected Operation on checked items on Selected List.
        - Map – Allows user to populate the Selected List by clicking on the specific items once the user clicks the station. The Map also highlights the selected items with a white overlay.

    b. Projected Flow
        - Allows the user to graphically view past or present flow information. It provides color coded minute by minute flow information down to the station level. It graphs Actual Flow along with Projected Flow. It animates the water schedule on the map.

- Graph can be generated by 6 different options: Sources, Courses, Areas/Programs, Holes, Master Groups and Station Groups.
    - Sources – Allows user to select a water source or sources to do a projected flow. Allows user to include the actual flow from a linked pump station's software.
    - Courses – Allows user to select a course or courses to do a projected flow.
    - Programs - Allows user to select an Area/Program, multiple Areas/Programs or all Area/Programs.
    - Holes – Allows user to select a Hole, multiple Holes or all Holes.
    - Master Groups – Allows the user to select a Multi Manual Master Group, multiple Master Groups or all Master Groups.
    - Station Groups – Allows the user to select a Multi Manual Station Group or multiple Station Groups or all Station Groups.
- Graph Area – Graph shows the user the projected flow for that specific time selected.
    - Time Line – This dashed line is set at the time the graph is generated. The line can be moved to a time in the future or past to show irrigation projected at that time. To move the line click and hold the curser on the line and slide it to a specific time.
    - Update Graph – This button used with either Use Downloaded Data or Recalculate Flow will generate a new Projected Flow.
    - Recalculate Flow – Used with the Update Graph button, will generate a new Projected Flow with changes made in the System but not Synchronized with the Field Control.
    - Use Downloaded Data – Used with the Update Graph button, will generate a Projected flow utilizing the data currently Synchronized with the Field Control.
    - Show Running in Map – Used to demonstrate Stations irrigating on the map during a Projected Flow. Need to be checked to activate 'Dry Run' on map.
    - Projected Schedule – Allows user to see the Start Time, End Time and Duration for each Station scheduled in the System. This screen can be sorted by Start Time, End Time, Duration, Station Tag and/or Program.
    - Scale in Days – Used to display the Projected Flow in a time frame range of 4 hours to 7 days.
    - 'Dry Run' – This allows the user to show via the Map what is irrigating during the irrigation cycle. (bottom right of graph)
        - Pause Button – Allows the user to pause the Projected Flow 'Dry Run'.
        - Play/Stop Button – Allows the user to start or stop the Projected Flow 'Dry Run'.

- Accumulate Graphics – Allows the user to highlight and keep highlighted the Stations as they irrigate during the irrigation cycle.
- Rate – Allows the user to set the speed of the 'Dry Run'.

▪ Legend
- Total – Shows the amount of water irrigated and the amount at the Time Line.
- Chart Legend – Shows the items graphed with amounts of water irrigated and amount at the Time Line.
- Running Stations
  - Shows time and date where the Time Line is located
  - Now – Allows user to set the Time Line back to the current time.
  - Center – Resets the Time Line to the center of the current graph.
  - Shows the Stations irrigating and the flow at the Time Line location.

c. Control System – Is the hardware oriented field information.
   i. Group/Gateway
      - Group/Gateway number – Utilized to identify groupings of Satellites and Stations or grouping of Station Groups and Stations. Group numbers can be 1 to 50, Gateway numbers are 1 to 4 and Remote Gateways are 1 to 9.
      - Name – Identifies Group/Gateway for the user.
      - Link – Identifies the communication paths
      - Note – Group/Gateway can be added or deleted by right mouse clicking on the number cell. It will add it to the end and can be re-numbered at the time. Once added or deleted click Apply button in the bottom right.
   ii. Satellite/Station Group
      - Satellites/Station Group number – Utilized to identify Satellite or groupings of Stations. Satellite numbers can be 1 to 255 and Station Group number can be 1 to 2.
      - Name – Identifies the Satellite/Station Group for the user.
      - Number of Stations – Indicates the number of Stations utilized in each Satellite/Station Group.
      - Simultaneous Stations – Number of Stations that can irrigate at the same time during the irrigation cycle.
      - Maximum Stations – Indicates the maximum available Stations in each Satellite 64/Station Group 800/Remote Gateway 1000.
      - Amps – Indicates the maximum Amperage draw available in Satellite.
   iii. Stations
      - Station number – Utilized to identify Station.
      - Name – Identifies the Station for the user.

- Area – Utilized to assign the Station to an Area/Program.
- Hole – Utilized to assign the Station to a Hole Number.
- Station Tag – Utilized to organize the Stations in the Hole>Area.
- Decoder Offset – Decoder zone number 1 to 4.
- Decoder Address – Decoder identification number.
- Number of Sprinklers – Identifies the number of Sprinklers irrigating when the Station irrigates.
- Amps – The power draw per station.
- Tolerance (mA) – The level of acceptance before triggering an alert.
- Station Volts – Indicates the voltage utilized by the Station (GDC only).
- Sprinkler Model – Identifies the Sprinkler model utilized on the Station.
- Nozzle Model – Identifies the Sprinkler Nozzle set utilized on the Station. These are color coded.
- Arc – Identifies the Arc of the Sprinkler utilized on the Station.
- Pressure – Identifies the pilot valve or pressure regulating value output pressure.
- Nozzle Flow – Indicates the flow of the Sprinkler with the specific Nozzle set and Pressure.
- Station Flow – Indicates Nozzle Flow times Number of Sprinklers.
- Pattern – Indicates Sprinkler pattern, Triangle (sprinkler spacing), Rectangle (sprinkler and row spacing), Inline (sprinkler and row spacing), and Area (total area).
- Sprinkler Spacing – Indicates the spacing of Sprinklers. Utilized with Triangle, Rectangle and Inline spacing.
- Row Spacing – Indicates the Sprinkler row spacing. Utilized with Rectangle and Inline spacing.
- Precip. Rate – Indicates the application rate of water for the Station. Takes into consideration Nozzle Flow and Total Area.
- Turf Guard – Utilized to assign the Turf Guard sensor to the Station. Not available if Turf Guard sensors are not setup.
- Site Codes – Utilized as an adjustment factor or to assign Stations in Instant Program.
- Auto Cycle – This was defined earlier in Quick Start.
- Auto Cycle Min Soak – This was defined earlier in Quick Start.
- Switch – Utilized to assign a Station to a Switch Program.
- Total Area – From the Pattern and respective spacings, this is calculated. If Area is utilized, the Total Area must be inputted.

Note – Green colored columns indicate that the field is multi-editable. Use the Shift or Ctrl keys to select multiple rows.

Note – Columns in grey are non-editable.

d. Favorites
   - Allows the user to place the frequently utilized screens in one area for ease of access. To add screens to Favorites, right mouse click and click Add to Favorites. To remove, right mouse click and Remove from Favorites.

8. Turf Guard
   - The Turf Guard Soil Sensors are linked to Lynx via SiteVision. There are 7 tabs to view the data generated by the Turf Guard Sensors.
     i. Dashboard – Displays Alerts, Current Weather and current sensor data for the selected level and area.
     ii. Data Charts – Displays a line chart for selected sensors (Upper, Lower, or Both Levels) and type of information (Moisture, Temperature and/or Salinity) over a selected timeframe.
     iii. Daily Trends – Displays a line chart for daily trends for selected sensors (Upper or Lower) and type of information (Moisture, Temperature or Salinity) for a set number of days.
     iv. Weather Forecast – Displays the current weather and a 2 day forecast for the location set in Preferences.
     v. Device Properties – Allows user to setup new Sensors or adjust thresholds of existing Sensors. Adding a New Sensor, click on New. Enter New Node ID – this is the Sensor identification number. Enter the remaining information on the center portion of the screen.
     vi. Preferences – Allows user to customize the setting for the SiteVision system.
     vii. Tabular Data – Allows user to organize SiteVision data in a tabular format.

9. NSN, NSN Portal, and Lynx Mobile Operations

10. Exercise – Student performs reinforcement exercises to hone skills learned.

TORO NSN®

Training Department

NSN Regional Lynx Level 1 Training

Student Goals

It is our goal at the Toro National Support Network® that upon completion of this 2-Day Regional training course, all attending students should have a functional knowledge of the following set up and operational features of the Toro Lynx Central Control Software:

- How Lynx operates and controls data
- Watering Plan operation
- Creating, modifying and deleting Instant Programs
- Utilizing Course Report information
- Explanation of how images and/or maps are imported to Lynx for irrigation operation
- Adding stations to an image/map
- Comprehensive review of operation and reporting screen
- Toro Turf Guard operation and Lynx integration
- Toro NSN, Customer Portal and Mobile control of the Lynx System

Students will learn these functions and operations through demonstration, instructor lead exercises, and a series of self-paced exercises at the end of classroom instruction. Every student who participates in this regional training event will use a laptop computer for the full two days to follow along with and to utilize while completing exercises.

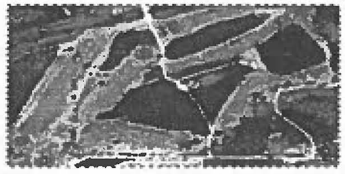
Training Department

Lynx Level 1 Map Importation

Lynx has the ability to incorporate an overhead picture of your facility, or your previous CAD/TMap layers to show Lynx operations. You will need to manually place Satellites, Stations, Turf Guard Sensors, and Switches on the map.

To use these features of Lynx, you will need:

1. Any graphical representation of the facility (overhead photo, satellite image, scanned scorecard, etc.)
   - This file must be in one of the following formats:
     - •JPG
     - •BMP
     - •TIF (these files may be very large)



MY_COURSE.JPG

2. A world file
   - This file must have the **exact same name** as the picture file
   - A world file is simply a text file with coordinates in it.
   - The file extension is reflective of the picture type:
     - •If picture is JPG; the extension of the World File is "JGW"
     - •If picture is TIF; the extension of the World File is "TFW"
     - •If picture is BMP; the extension of the World File is "BFW"

MY_COURSE.JGW

To incorporate the overhead picture of the facility and its World File in Lynx:

1. Close Lynx and save the data utilizing the Lynx File Manager
2. Navigate to: C:\Toro_Lynx\Output\Client\bin\Addins\data\Mapfiles
   - Copy your picture and the World File into this directory (Note: There are 2 files that already exist; Map.XML and MapSettings.XML. **DO NOT DELETE** these files.
3. Close Explorer window and restart Lynx
4. Go to: Advanced>Map>General
5. For an Image: In the Background box, select the Image Name then click Save.
6. For a TMap: In the Available Layers, select the Layers and drag them to Layer on Map then click Save.

If the Map does not appear, click the "Zoom to Extends" button at the bottom on the Map screen.

TORO NSN®

Training Department

NSN Regional Lynx Level 1 Training

Class Exercises

I. Exercise – File Manager

a. Open Lynx Level 1 (your hardware) Day 1.lzip.
b. Save database with new name.

II. Exercise – Addressing Station Exceptions

a. Student follows instructor changing station information for Station Exceptions on Hole Two of the NSN Training Center.
b. Student follows instructor in review and modification of Course Configuration.
c. Student follows instructor's demonstration of how to add groups, satellites and stations to the database as well as using some of the other editing tools of the Control System.
d. Student follows instructor's demonstration of adding areas and moving stations from one area to another.
e. Self-Paced: Complete the remaining exceptions on Hole Two.
f. Self-Paced: Adjust Auto Cycle for Fairways, 6 minute Auto Cycle Max Runtime, 12 minute Auto Cycle Min Soak.

III. Exercise – New Stations and Hydraulics

a. Students review with instructor what the Quick Start default Hydraulic system is, how amendments are made, how new stations are assigned to the Hydraulic system.
b. Students will learn about Precipitation Management Groups (PMG) and how they are calculated by the Lynx Flow Management.
c. Self-Paced: Change the PMG settings on the #2 Fairway so that heads on the same lateral don't irrigate at the same time.

IV. Exercise – Daily Operation

a. Watering Plan
    1. Student follows the review of the operation of the Watering Plan.
    2. Self-Paced: Set up the remainder of the Water Plan as follows;
        i. Greens – 0.1 inches, Stop At 5:00 am, all days active.
        ii. Tee – 8 minutes, Start At 8:00 pm. all days active
        iii. Fairways – 20 minutes, Start At 6:00 pm, all days active.
        iv. Surrounds –10 minutes, Start At 8:00 pm, all days active.
        v. Club House – 45 minutes, Start At 2:00 am, every **other** day active.
        vi. Driving Range – 15 minutes, Start At 8:00 pm, all days active.

vii. Driving Range Tee – 15 minutes, Start At 8:00 pm, all days active.
viii. Practice Greens – 0.12 inches, Stop At 5:00 am, all days active, Auto Cycle active.

b. Instant Program

1. Student follows the review of the operation of Instant Program.

2. Self-Paced: Build Instant Programs and schedule as follows;
   i. Write a standard New Sod program for Hole 2 Tee with 4 starts per day, 4 minutes each start, all days active, 2 stations at a time.
   ii. Write a sequential Driving Range Tee program with 1 start, 3 minutes each start, next Monday active, 3 stations at a time, pattern 1, 4, 7, 10, 2, 5, 8, 11, 3, 6, 9, and 12.
   iii. Write a Hot Spots supplemental program with 10 stations in it running for 6 minutes and Program number 800.

V. Exercise – Map

a. Student follows operation of map importation.
b. Student follows along and adds stations to Hole 1 Green, Surround and Club House.
c. Self-Paced: Add stations to map for Practice Green, Driving Range Tee, Driving Range, Hole 1 Tee, Hole 2 Green, Surround, Tee and Fairway.

VI. Exercise – Projected Flow and Synchronize

a. Open NSN Golf Club (your hardware).lzip.
b. Schedule irrigation for tonight.
c. Do a Projected Flow to observe what is irrigating and any errors.
d. Synchronize system.

VII. Exercise – Self Paced Reinforcement Exercises

a. File Manager – Open Lynx Level 1 (your hardware) Day 2.lzip. Save database as Country Club of Texas.
b. The Watering Plan – Set up the entire Watering Plan using your own preferences so the irrigation cycles will run beginning tonight.
c. Instant Program – Write an Instant Program called Mounds, add 6 Fairway stations, schedule for 9 minutes every 3 days.
d. Adding Stations – Add 2 new Driving Range Tee station to the database using hardware address 1-2-7 and 1-2-8, assign to Hydraulics and place on map in the center of each tee.
e. Adding a New Area – Add a new area for Approaches to your system that utilizes 835-46-378 adjusted to full circle and spaced in a rectangle pattern at 70 ft by 70 ft. Change stations 1-3-11 and 1-3-12 from Fairways to Approaches. Set up Approaches to irrigate tonight as you would at your course.
f. Water in a product – Change the application amount on all the Greens stations to 0.15 inches for tonight's irrigation.
g. Get a Flow – Run a Projected Flow on the system to see if everything will be scheduled. Leave final Projected Flow on the screen for instructor's review.

TORO NSN®

Training Department
Lynx Level 1 Pipe Flow Chart

Maximum recommended flow for given pipe size

(based on a velocity of 5 feet/second)

Nominal Pipe Size (inches)	Water Flow (gpm)
2	40
2.5	80
3	120
4	200
6	450
8	750
10	1000
12	1600
14	2000
16	2500

The above values are based on Class 200 SDR 21 PVC sizes 2"-12" and C905 PVC for 14"-16" in new condition but apply to all pipe types.

More detailed information on piping and velocity is available in the Toro Golf Design Manual.

Toro Golf Irrigation

Friction Loss for Common Pipe Types per 100' (lbs./sq. in.)

Nominal Size (inches)	2				2.5				3				4				6			8		10		12		14	16
Material	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Class/Schedule	Sch. 40	CL160	CL200	CL315	Sch.40	CL160	CL200	CL315	Sch. 40	CL160	CL200	CL315	CL160	CL200	CL315	C900	CL200	CL315	C900	CL200	C900	CL200	C900	CL200	C900	C905	C905
C Factor	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Outside Diameter (inches)	2.375	2.375	2.375	2.375	2.875	2.875	2.875	2.875	3.500	3.500	3.500	3.500	4.500	4.500	4.500	4.800	6.625	6.625	6.900	8.625	9.050	10.750	11.100	12.750	13.200	15.300	17.400
Inside Diameter (inches)	2.067	2.193	2.149	2.023	2.469	2.655	2.601	2.449	3.068	3.230	3.186	2.982	4.154	4.072	3.834	4.114	5.993	5.643	5.914	7.805	7.758	9.726	9.514	11.536	11.314	13.500	15.460
Wall Thickness (inches)	0.154	0.091	0.113	0.176	0.203	0.110	0.137	0.213	0.216	0.135	0.167	0.259	0.173	0.214	0.333	0.343	0.316	0.491	0.493	0.410	0.646	0.512	0.793	0.607	0.943	0.850	0.970
Flow in GPM 20	0.36	0.27	0.30	0.40																							
25	0.55	0.41	0.45	0.60																							
30	0.77	0.57	0.63	0.85	0.32	0.23	0.25	0.33																			
35	1.02	0.76	0.84	1.12	0.43	0.32	0.33	0.44																			
40	1.31	0.97	1.07	1.44	0.55	0.40	0.42	0.57																			
50	1.98	1.47	1.62	2.18	0.84	0.63	0.64	0.86																			
60	2.79	2.06	2.27	3.05	1.17	0.88	0.90	1.20																			
70	3.70	2.74	3.02	4.06	1.55	1.16	1.19	1.60	0.54	0.42	0.46	0.61															
80	4.72	3.51	3.87	5.20	2.00	1.48	1.53	2.05	0.70	0.53	0.59	0.79															
90	5.88	4.36	4.82	6.46	2.49	1.84	1.90	2.55	0.87	0.66	0.73	0.98	0.19	0.21	0.29	0.20											
100	7.14	5.30	5.85	7.86	3.00	2.24	2.31	3.10	1.05	0.80	0.89	1.19	0.24	0.26	0.35	0.25											
110					3.59	2.63	2.76	3.70	1.25	0.96	1.06	1.42	0.28	0.31	0.42	0.30											
120					4.22	3.16	3.24	4.34	1.46	1.13	1.24	1.66	0.33	0.37	0.49	0.35											
130					4.90	3.68	3.76	5.04	1.70	1.31	1.44	1.93	0.38	0.42	0.57	0.40											
140					5.60	4.18	4.31	5.78	1.95	1.50	1.65	2.21	0.44	0.49	0.65	0.46											
150					6.40	4.76	4.90	6.56	2.23	1.71	1.88	2.52	0.50	0.55	0.74	0.52	0.08	0.11	0.09								
160									2.50	1.92	2.12	2.84	0.56	0.62	0.83	0.59	0.09	0.13	0.10								
170									2.80	2.15	2.37	3.17	0.63	0.70	0.93	0.66	0.11	0.14	0.11								
180									3.10	2.39	2.63	3.53	0.70	0.77	1.04	0.74	0.12	0.16	0.13								
190									3.43	2.64	2.91	3.90	0.78	0.85	1.15	0.81	0.13	0.17	0.14								
200									3.78	2.91	3.20	4.29	0.85	0.94	1.26	0.89	0.14	0.19	0.15	0.04	0.04						
220													1.02	1.12	1.50	1.07	0.17	0.23	0.18	0.05	0.05						
240													1.20	1.32	1.77	1.25	0.20	0.27	0.21	0.06	0.06						
260													1.39	1.53	2.05	1.45	0.23	0.31	0.25	0.06	0.07						
280													1.59	1.75	2.35	1.67	0.27	0.36	0.28	0.07	0.08						
300													1.81	1.99	2.67	1.90	0.30	0.41	0.32	0.08	0.09						
320																	0.34	0.46	0.36	0.09	0.10						
340																	0.38	0.51	0.41	0.11	0.11						
360																	0.43	0.57	0.45	0.12	0.12						
380																	0.47	0.63	0.50	0.13	0.13						
400																	0.52	0.69	0.55	0.14	0.15	0.05	0.05				
450																	0.64	0.86	0.69	0.18	0.18	0.06	0.07				
500																	0.78	1.05	0.83	0.22	0.22	0.07	0.08				
550																	0.93	1.25	0.99	0.26	0.27	0.09	0.10				
600																	1.10	1.47	1.17	0.30	0.31	0.10	0.12	0.05	0.05		
650																	1.27	1.70	1.35	0.35	0.36	0.12	0.13	0.05	0.06		
700																	1.46	1.95	1.55	0.40	0.41	0.14	0.15	0.06	0.07		
750																	1.66	2.22	1.77	0.46	0.47	0.16	0.17	0.07	0.07		
800																				0.52	0.53	0.18	0.20	0.08	0.08	0.03	0.02
850																				0.58	0.59	0.20	0.22	0.09	0.09	0.04	0.02
900																				0.64	0.66	0.22	0.24	0.10	0.11	0.04	0.02
950																				0.71	0.73	0.24	0.27	0.11	0.12	0.05	0.03
1000																				0.78	0.80	0.27	0.30	0.12	0.13	0.05	0.03
1200																				1.09	1.12	0.37	0.42	0.16	0.18	0.07	0.04
1400																				1.45	1.50	0.50	0.56	0.22	0.24	0.10	0.05
1600																				1.86	1.92	0.64	0.71	0.28	0.31	0.12	0.07
1800																				2.31	2.38	0.79	0.88	0.35	0.38	0.15	0.08
2000																				2.81	2.90	0.96	1.07	0.42	0.46	0.19	0.10
2500																				4.25	4.38	1.46	1.62	0.63	0.70	0.28	0.15
3000																				5.96	6.14	2.04	2.27	0.89	0.96	0.40	0.21

SDR 26 = Class 160 SDR 21 = Class 200 SRD 13.5 = Class 315 Velocity = 5' per second

Flows indicated beneath the heavy lines may develop surge pressures which could cause damage. Use with caution.

TORO. Count on it.

Irrigation System Winterization and Pressurization Procedures

Introduction

Each winter in many parts of the world, irrigation systems must be completely drained and shut down to prevent damage to system components due to freezing water. In the spring, the irrigation system must be refilled and restarted.

Similar measures must be taken in new irrigation system installations and for repairs that require complete system drainage.

Any time an irrigation system is filled and pressurized, or when the system is drained and water flushed from the system, there is potential for excessive water and air pressures to be present. These high pressures can lead to possible damage of system components. Serious damage to system components and/or personal injury can occur if improper start-up and winterization methods are used.

The Toro Company, therefore, has created this document to detail the required procedures and specifications for start-up and winterization of irrigation systems. This document explains the procedures utilizing components manufactured by The Toro Company, Irrigation Division. Failure to follow these procedures could result in damage to equipment, possible injury to personnel, and could affect your Toro product warranty.

Please take the time to properly plan, prepare and perform these procedures. Always avoid shortcuts that could put personnel and system components at risk.

Please read the entire contents of this document before attempting any of these procedures. If you have any questions regarding the application of these procedures in your area, please contact a Toro distributor or call 1-800-367-8676 for assistance.

THE WINTERIZATION AND PRESSURIZATION OF IRRIGATION SYSTEMS EXPOSE PERSONNEL AND EQUIPMENT TO COMPRESSED AIR THAT MAY REACH PRESSURES MUCH GREATER THAN NORMAL. GREAT CARE SHOULD BE TAKEN ANYTIME THE SYSTEM IS BEING SERVICED OR MANUALLY OPERATED DURING THESE PROCEDURES. NEVER STAND DIRECTLY OVER ANY COMMERCIAL OR LARGE TURF SPRINKLER WHEN FILLING THE SYSTEM OR WHEN ACTIVATING MANUALLY.

Understanding the Effective Use of Compressed Air

Modern irrigation systems, in comparison to older systems, are much more complicated. Typically they have:

- more sprinklers, typically with smaller nozzles
- more single head control
- more pipe
- larger pipe

The process of preparing a modern irrigation system for winter "blow out" is different too.

- Smaller nozzles allow less Cubic Feet per Minute (CFM). Smaller nozzles do not move as much water and/or compressed air.
- Single head control further reduces CFM.
- More pipe means more system volume of air and water
- Larger pipe means more system volume of air and water

An irrigation system that uses riserless bodies allows for an easier blow out process. The benefits include:

- Increased CFM. To clear water from piping, it is the volume of CFM that matters most, not pounds per square inch (psi).
- Most designs use mid-range nozzles. The CFM through a riserless body can equate to that of 7-8 sprinklers (see the chart below). This volume will be much more effective than blowing through nozzled sprinklers.
- Reduces wear and tear on internal conversion assemblies. High air pressure and lengthy blow out times can reduce the life of components.
- Reduces time, labor, and air compressor run-time.

Riserless Body Method

Using the Compressed Air method (described on page 4 of this document), blow out the swing joint and sprinkler head ONCE from water to air. The compressed air pressure should not exceed 50 psi. 50 psi is all that is required to clear water from the swing joint and sprinkler to prevent winter freeze damage. Blowing air through the sprinkler a second or third time is not recommended and may result in component damage.

If a second or third flush is required to clear the piping, use the riserless body method:

Remove the internal or conversion assembly ("internals") and activate those sprinklers as follows:

- FAIRWAYS - Remove one or two internals on each leg of the fairway loop, either in the middle of the lateral run or at a low point on the fairway.
- GREENS – If the green is looped, remove one or two of the internals mid-way on the loop. If the green is *not* looped, remove the end-of-line internals.
- TEES – Remove one of the internals at the end of the line.
- DEAD END PIPING – Remove one or two of the internals at the end of the pipe. On 1½" or 2" piping, one internal removal should be enough. On larger piping, removing two internals may be required.

CFM through open riserless bodies:

1.5" riserless body opening = 340 CFM @ 50 psi
1.0" riserless body opening = 150 CFM @ 50 psi

CFM through sprinkler nozzles:

The chart below shows the CFM for each nozzle set at 35 and 50 psi line pressures, a 1½" body, and nozzle set numbers as shown.

	Sprinkler CFM Use	
Nozzle	35 PSI	50 PSI
51	23	28
52	30	33
53	35	38
54	43	48
55	48	53
56	50	55
57	53	58
58	59	64
59	65	70

Looking at the chart above, a #54 nozzle at 35 psi would receive approximately 43 CFM. Therefore, a riserless 1½" body would give you the equivalent of approximately eight #54 nozzled sprinklers.

Besides a better blow out, the benefits of using riserless bodies are:

- reduced time
- reduced labor
- reduced compressor run time
- reduced fuel costs

Winterizing Golf Courses with Compressed Air

TO PREVENT PERSONAL INJURY, NEVER ATTEMPT TO DISASSEMBLE SYSTEM WHILE UNDER PRESSURE.

TO PREVENT PERSONAL INJURY, DO NOT STAND DIRECTLY OVER ANY LARGE TURF SPRINKLER WHEN ACTIVATING MANUALLY AT THE SPRINKLER.

Do not exceed 50 psi of air pressure in any system. Exceeding 50 psi could result in severe equipment damage and personal injury.

Activate each sprinkler only once!
Subsequent activations with no water in the sprinkler will result in high speed activation and excessive pressure spikes, possibly resulting in equipment damage and personal injury..

Pressure will build if the compressor is left running and no devices are left open to relieve the pressure. This can cause pressure to build to a dangerous level that may damage the irrigation system and create a hazardous situation.

Gravity Drain / Compressed Air Method

The gravity drain/compressed air method utilizes gravity flow to remove water from the mainline through drains, quick couplers and sprinklers at the lowest elevation points and in low-lying areas. Compressed air is then used to move any remaining water that may have collected in the piping system out the open drains. Once the mainline is clear and drains are closed, compressed air is then used to force the remaining water out of each individual sprinkler head.

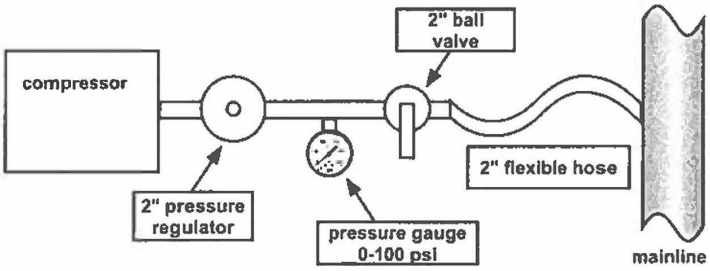
Issues to address before beginning:

- Will the compressor provide enough cubic feet per minute (CFM) for an adequate blow-out (typically 375-900 CFM. See diagram.)
- Are there pressure gauges in the field to monitor fill pressure?
- Can I communicate changes in the field back to the pump/ compressor to ensure that pressure and velocity stay within recommendations?
- Is there an external air pressure regulator with a gauge installed on the compressor? (See **Picture 1**, page 3. Contact your local Toro Distributor to order one.)

Having foreknowledge of the piping system is extremely useful. Please take the time to review the system as-built drawing to identify the locations of all drains, quick couplers, the highest and lowest elevation points and all piping dead ends. Water will always flow to the lowest points first. Develop a plan for how you will sequentially close the high point vent first allowing the compressed air to force the water out of the low point drains. Work from the highest to the lowest points until all vents are closed.

Steps

1. Close main supply water valves.
2. Open drain valves and quick coupler valves. At low and lowest elevation points, remove sprinkler riser assemblies and valves in the system.
3. At the highest elevation points, install quick coupler keys into quick coupler valves or remove the sprinkler riser assembly and valve. This provides the venting required for proper draining.
4. Allow system to gravity drain until all water is removed.
5. Connect the air compressor, sized appropriately for your system (See Table, 2 next page). Use an external pressure regulator adjusted to the lowest possible pressure to remove water from the system. Be sure it is attached to the mainline through a 2" diameter hose, cut to the shortest length possible.



Golf course systems require a high volume air compressor. Excessive heat will be generated at the point of air connections to the system. To avoid damage to PVC piping systems, use a length of 2" galvanized pipe to dissipate the heat prior to the compressed air entering the irrigation piping system.

6. Open ball valve at compressor to allow air to pressurize the piping system and assist in the evacuation of water from the piping system.

The key to successful water removal is volume (CFM) not pressure.

The Toro Company recommends the use of pressure gauges installed into the areas where sprinklers are being electrically activated. Monitoring this pressure allows you to maintain the appropriate number of activated sprinklers at any one time. Activating too many heads will result in low air pressure and heads will possibly will not operate. Activating too few heads will result in higher pressures and may cause damage to parts of the system and possible personal injury. Each crew should have a pressure gauge that will move with them from location to location to monitor pressure.

7. Starting at the highest elevation locations (A), monitor the drain points for the presence of air. When there is no water present and only air at that drain location, close the drain, remove the quick coupler key and/or select the sprinkler to the manual "AUTO" position. Continue working your way from the highest (A) to the lowest C) elevation points, closing each drain location until all drain locations are closed.

8. Adjust pressure regulator at the compressor to 40 psi in 2 psi increments as needed. Do not exceed 50 psi in the field.

9. Determine the maximum number of sprinklers that can be operated at one time with the compressor in use. See **Table 2** below.

Electric valve-in-head sprinklers require a minimum air pressure of 35 psi to operate and may require additional time to operate.

10. Starting at the highest elevation points (A), electrically activate the maximum number of sprinklers (from step 6) simultaneously.

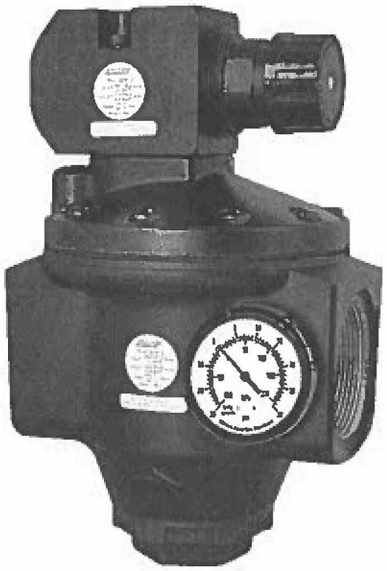
Operate the sprinklers in a logical sequence so that water moves in one direction though the system from high point to low point. Moving from tee to green or green to tee, forcing the water towards low end points will minimize water pockets in low-lying areas (3). When the discharge changes from a stream to a mist, electrically activate the next sprinkler(s) and then turn off the sprinkler(s) that is/are misting. Always turn "ON" the next head(s) before turning the misting head(s) "OFF". Continue this process until every sprinkler has been electrically activated only ONCE.

If you feel there could be more water in a lateral loop, remove the sprinkler riser assembly at the mid-points of the loop and blow again. On a 2", 2.5", or 3" loop, a compressor will easily blow the water through the line. Water will not re-enter the piping system via the sprinkler head.

11. Turn "OFF" the compressor and open low elevation drains (4) to allow residual water to drain and to relieve air pressure.

12. Close all drains.

Picture 1 (Air Pressure Regulator)



Speedaire Dayton Regulator Model 4ZM12 or equivalent

Table 2

	Sprinkler CFM Use		Compressor CFM 250		500		750		1000	
Nozzle	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**	**35 psi**	**50 psi**
0	10	13	25	20	50	40	75	60	100	80
1	23	28	11	9	22	18	33	27	44	36
2	30	33	8	8	17	15	25	23	33	31
3	35	38	7	7	14	13	21	20	29	27
4	43	48	6	5	12	11	18	16	24	21
5	48	53	5	5	11	10	16	14	21	19
6	50	55	5	5	10	9	15	14	20	18
7	53	58	5	4	10	9	14	13	19	17
8	59	64	4	4	8	8	13	12	17	16
9	65	70	4	4	8	7	12	11	15	14

Pressurization and Start-Up Procedures

The following procedure is used anytime water is filling an empty piping system. This applies to new system pressurization, start-up in the spring following a winterization in the fall, or after the piping system has been depressurized for any other reason such as to repair a break. This procedure requires a maximum pressure of 50 psi and a fill rate velocity of less than 2 feet per second. The velocity is the speed at which the water is flowing in the piping system and is determined by the pipe size and the flow rate (See Table 1 below). Velocity is also designed to eliminate pockets of trapped air that could be compressed to pressures much higher than normal, creating personnel safety concerns and possible damage to system components.

When filling with a pump station, please contact the pump manufacturer service representative for best practices with your specific station. Pump stations vary widely and one particular process may not be suitable for all pump stations.

Having foreknowledge of the piping system is extremely useful. Please take the time to review the system as-built drawing to identify the locations of all drains, quick couplers, the highest and lowest elevation points and all piping dead ends. Water will always flow to the lowest points first. Develop a plan for how you will sequentially close the high point vent first allowing the compressed air to force the water out of the low point drains. Work from the highest to the lowest points until all vents are closed.

Issues to address before beginning:

- How do I slowly fill the system at low pressure?
- Is there a pressure relief valve? Can I adjust the variable frequency drive (VFD) pump or outlet valves to control flow and pressure while filling the system?
- Are there pressure gauges in the field to monitor fill pressure?
- Can I communicate changes in the field back to the pump to ensure that pressure and velocity stay within recommendations?

Steps

1. Per your plan, open drain valve(s) in the low areas of the system. At all high points, insert quick coupler keys and/or turn sprinklers to the manual "ON" position at all tees and greens. Same for all dead ends. This will allow air to bleed from system lines during the filling process. Do not compress air and then relieve; bleed air while filling the system.
2. Adjust pressure regulation at the water source to 50 psi maximum. Supply water to the system at a velocity fill rate of less than two feet per second. Reference Table 1 below to determine the maximum gallons per minute for your particular pipe size to maintain less than 2 feet per second.
3. Starting at the locations closest to where the piping system is being filled, and at the lowest elevation points, monitor the open drains, quick couplers and sprinklers that have been selected "ON" for air and water flow. When steady water flow is detected at that location, close the drain, remove the quick coupler key, and/or turn the sprinkler "OFF". Proceed to the next higher location. Repeat this process until air is evacuated, water is present, and all venting locations have been closed.
4. While maintaining a maximum pressure of 50 psi in the field, activate each sprinkler electrically to allow any remaining air to escape. Take this opportunity to identify correct operation and flag any system components that require additional service.
5. Once all air has been removed from the system and system repairs have been verified, adjust system pressure to normal operating pressure.

Tip: Over time it is possible to identify locations where trapped air is a persistent problem and install an air relief valve(s). These areas can be identified by sprinklers running air or air/water mix for a significant amount of time after the system was thought to be completely filled with water.

The following table assumes the piping system has been designed to minimize pipe friction loss and maintain a safe operating water velocity in the pipes at 5 feet per second or less. Select the system pipe size where the fill water is being introduced.

Table 1: System Fill Rate Specification

Pipe Size	GPM	Velocity (feet per second)
1"	5	1.50
1½"	10	1.41
2"	20	1.80
2½"	30	1.84
3"	45	1.86
4"	75	1.87
6"	150	1.73
>=8"	200	<1.50

TORO. **Count on it.**

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