**Hewlett Packard Enterprise**

# VMWARE VSPHERE VIRTUAL VOLUMES ON HPE NIMBLE STORAGE IMPLEMENTATION GUIDE

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# EXECUTIVE SUMMARY

VMware vSphere® Virtual Volumes™ (hereinafter referred to as vVols) is a storage policy-based framework introduced in VMware vSphere® 6.0 based on the vStorage APIs for Storage Awareness (VASA) management protocol. vVols are unique in that each virtual disk in a Virtual Machine (VM) is implemented with its own volume on the array. Storage Policy Based Management (SPBM) allows for protection and tuning at a much more granular level than is afforded by a monolithic Virtual Machine File System (VMFS) datastore. vVols consume storage from a resizable container on the array, which alleviates the requirement to manage, provision, and present multiple Logical Unit Numbers (LUNs) for varying workloads.

Benefits of vSphere Virtual Volumes:

- Greater application control: Before the availability of vVols with VMFS, a storage array had no visibility into the virtual machine disk (VMDK) files on a VMFS volume; subsequently, storage array features like QoS and snapshots could only be performed on an entire VMFS volume. Any storage array feature that is supported with vVols can now be implemented at the individual VM level to provide the best possible efficiency and control of storage resources. Your applications directly benefit from this new, fine-grain level of interaction with critical storage resources.

- Enhanced performance: vVols enable vSphere to offload more tasks to storage that can be performed faster and more efficiently directly at the storage layer. Tight storage integration enables the completion of common tasks directly on the array to minimize data movement and improve application performance.

- Reduced capacity: With vVols, you use only the space that VMs need on a storage array because you no longer have to allocate large chunks of disk space to VMFS volumes. Automatic space reclamation when VMs are deleted or moved ensures that no space is wasted and the array maintains a thin footprint.

- Simplified management: VMware's SPBM eliminates common storage management tasks like LUN provisioning and management. By using policies to automatically provision LUNs at the time of VM creation, no pre-provisioning of datastores is required and administrative costs are reduced by eliminating tedious tasks. A single storage container is created on the storage array and is henceforth managed by the vSphere administrator instead of the storage administrator.

Distinguishing features for VMware vVols on HPE Nimble Storage:

- Simplified integration with VMware vCenter®, configured and deployed in a single UI dialog. As seen in the next section, Benefits of VMware Virtual Volumes with HPE Nimble Storage, the VASA provider is embedded in the array and is enabled with a single checkbox in the UI.

- Simplified workflows for snapshots, replication, and cloning of vVol-implemented VMs. All of these operations are performed on the array—eliminating unnecessary data transfer to the host.

- HPE Nimble Storage Performance Policies, both default and user-defined, are made available for specification in VMware Storage Policies. The performance policy specifies a specific application type as well as other array-based features, such as block size, compression, and deduplication. Each of these attributes can be tuned on a per-virtual-disk basis.

**Target audience**: IT Administrators, VMware vSphere administrators, storage administrators, and solution architects planning a server virtualization deployment with HPE Nimble Storage.

# SOLUTION OVERVIEW

The environment for this solution consists of two discrete VMware vSphere environments, named *primary site* and *replicated site,* as shown in FIGURE 1. Each site has its own VMware vCenter Server® Appliance™ and HPE Nimble Storage array. The primary site utilizes an HPE Nimble Storage AF1000 All Flash array and the replicated site utilizes an HPE Nimble Storage CS3000 Adaptive Flash array. The management network is 1 GbE Ethernet for VMware ESXi™ hosts and the arrays. There is also a 10 GbE network link between arrays to handle replication operations. As noted below in the prerequisites, the HPE Nimble Storage arrays are each running NOS 5.0.1.0 and the vSphere software is updated to v6.5 Update1d.
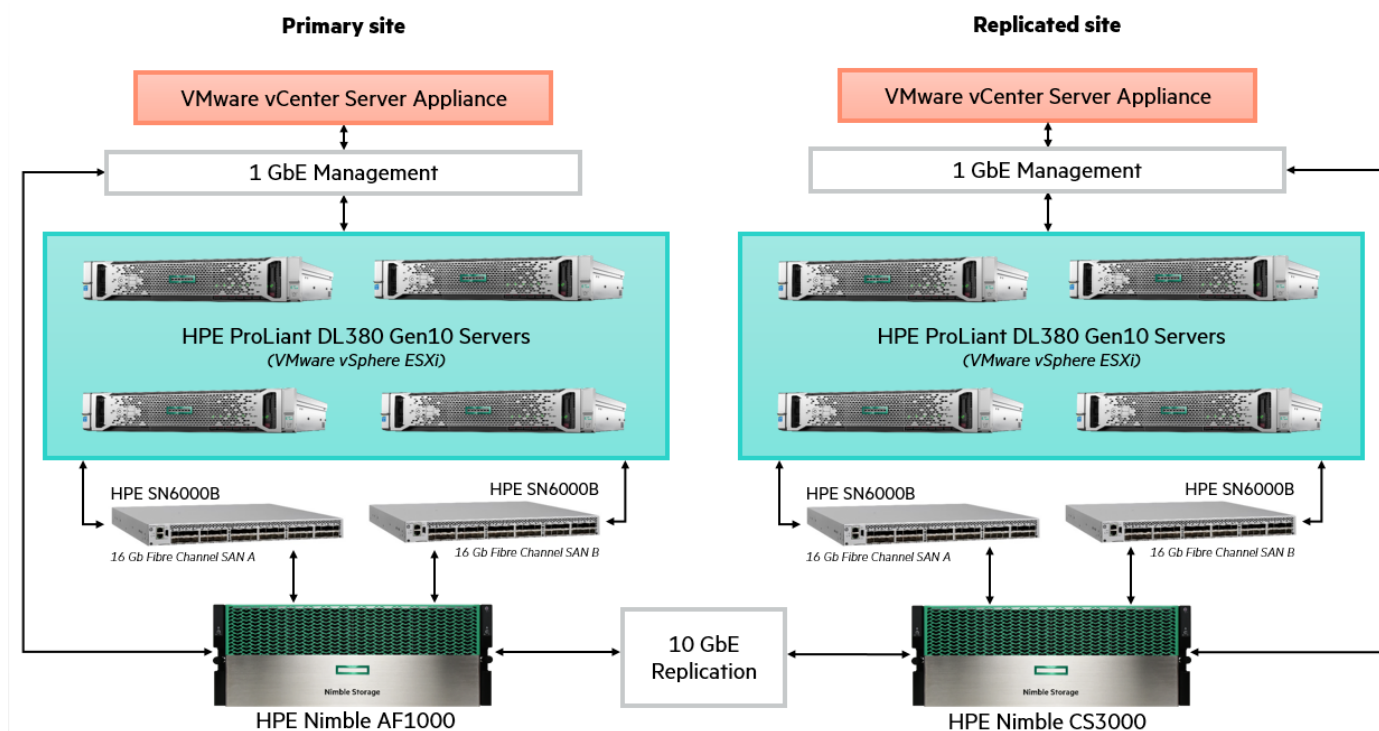
**FIGURE 1.** VMware vSphere environments

## Benefits of VMware Virtual Volumes with HPE Nimble Storage

### Embedded vSphere APIs for Storage Awareness Provider

The embedded VASA Provider runs on the array and as a result is highly available. There are no additional resources to manage or maintain.

### VASA Provider management

The VASA Provider is enabled when registering the HPE Nimble Storage array with vCenter, only requiring a checkbox to turn it on. See FIGURE 8 for an example of enabling the VASA Provider. Protocol endpoints and host access control management are orchestrated by the array.

### HPE Nimble Storage folders = VMware storage containers

HPE Nimble Storage folders are analogous to VMware storage containers. They can be resized dynamically to grow or shrink. Create a folder on the HPE Nimble Storage array and add it as a "VVol Datastore" in vCenter. Host presentation is handled entirely in vCenter.

### Backup and recovery

Native array-based replication for VMware vVols has existed since vSphere 6.0. This continues with vSphere 6.5/vVols 2.0 and HPE Nimble Storage OS 5.0. With vSphere 6.5, VM storage policies can be preconfigured with replication enabled for disaster recovery.

New for HPE Nimble Storage OS (NOS) 5.0 are simplified workflows for restoring and cloning both local and replicated vVol-based VMs, allowing for partial or complete VM recovery. This implementation guide provides details about all of them.

### HPE Nimble Storage vCenter Plug-in

After integrating the HPE Nimble Storage array with vCenter, the HPE Nimble Storage vCenter Plug-in can be utilized to simplify a number of vVol-related workflows:

- Granular restore based on selectable recovery points

- Restore in place or clone a VM from local snapshots

- Restore individual disks or attach cloned disks to another VM

- Bring up a VM at a replication site (via a clone)

- 72-hour protection against accidental deletion of VMs (primary or replication site)

- Application-consistent snapshots for SQL Server or Exchange (using VSS for vVols)

The plug-in is supported in both the vCenter Flash UI as well as the HTML5 UI. All of these workflows are detailed later in this guide.

**Storage Policy Based Management – rich integration between vSphere and array**

VMware SPBM is a natural fit for vVols. Several array features are exposed during VMware Storage Policy creation:

- Application policy – These are performance policies on the array. In addition to the 20+ included out of the box, user-defined policies are also made available.

- Protection (snapshot) and replication schedule – The frequency, scheduling, and retention are all defined/tuned when creating the policy.

- Deduplication – Though specified in the performance policy on the array, this can be overridden by the policy.

- Data encryption – Allows for encryption on a per-virtual-disk basis.

- All-Flash – Depending on the rule, can require all-flash, require hybrid, or whichever is available.

- This implementation guide provides instructions for the creation and application of VMware Storage Policies containing application policy, snapshots, and replication.

**Planning considerations for using vVols**

It is important to note that a deployment does not have to be entirely VMFS or entirely vVol; the two datastore types can co-exist. To begin utilizing vVols, an HPE Nimble Storage folder is created on the array and an (adjustable) size limit placed on it. vVol-based VMs allow for granular control of the individual virtual disks. Some of the automated workflows exposed by the HPE Nimble Storage vCenter Plug-in are available for vVol VMs only.

## SOLUTION COMPONENTS

### Hardware

#### HPE Nimble Storage array

The HPE Nimble Storage platform leverages flash storage and the power of predictive analytics to deliver fast and reliable access to data. This approach closes the app-data gap and radically simplifies operations. HPE InfoSight predictive analytics predict and prevent issues to deliver guaranteed 99.9999% availability. Utilize a single multicloud architecture to flexibly deploy workloads on flash arrays, converged infrastructure, and the public cloud.
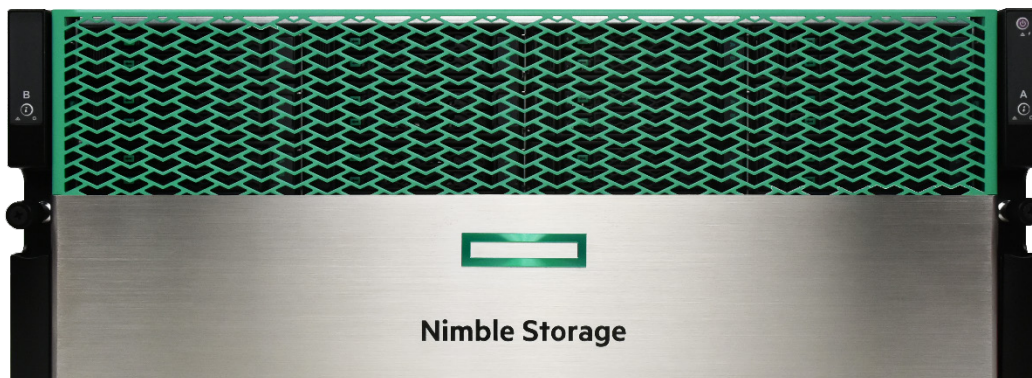


**FIGURE 2**. HPE Nimble Storage array

### HPE Nimble Storage AF1000 All-flash array

HPE Nimble All Flash storage arrays combine flash performance with radical simplicity for a wide variety of performance sensitive workloads. All Flash Arrays are cloud-ready—providing an easy on-ramp to the cloud through HPE Cloud Volumes. Backed by our Timeless Storage guarantee, optional software is included and forklift upgrades can become a thing of the past.



**FIGURE 3.** HPE Nimble Storage All Flash array

### HPE Nimble Storage CS3000 Adaptive Flash array

HPE Nimble Adaptive Flash hybrid storage arrays combine affordable flash performance with radical simplicity for mixed, mainstream workloads. Adaptive Flash Arrays are cloud-ready—providing an easy on-ramp to the cloud through HPE Cloud Volumes. Backed by our Timeless Storage guarantee, optional software is included and forklift upgrades are a thing of the past.



**FIGURE 4.** HPE Nimble Storage Adaptive Flash array

### HPE ProLiant DL380 Gen10 server

The HPE ProLiant DL380 Gen10 server delivers the latest in security, performance, and expandability. It is backed by a comprehensive warranty and ideal for any server environment. Standardize on the industry's most trusted compute platform. The HPE ProLiant DL380 Gen10 server is securely designed to reduce cost and complexity with a broad range of compute options. HPE Persistent Memory, optimized on HPE ProLiant servers, offers unprecedented levels of performance for databases and analytic workloads. You can run everything from the most basic to mission-critical applications and deploy with confidence.

Key features:

- Flexible design to expand investment as your business needs grow

- An adaptable chassis, including new HPE modular drive bay configuration options with up to 30 Small Form Factor (SFF) hard drives, up to 19 Large Form Factor (LFF) hard drives, or up to 20 Non-Volatile Memory Express (NVMe) drive options, along with support for up to three double-wide graphics processing unit (GPU) options.

- HPE Persistent Memory, with up to 27x faster application checkpoint operations and 20x faster restores—the fastest persistent memory in the market at terabyte (TB) scale.

- Redesigned HPE Smart Array Controllers so you can choose the most optimal 12 Gb/s controller for your environment and operate in both SAS and HBA mode.

- Your choice of HPE FlexibleLOM or PCIe standup adapters, which offer networking bandwidth options (1 GbE to 40 GbE) and fabric, so you can adapt and grow to changing business needs.

- Support for a wide range of operating environments from Azure to Docker to ClearOS, in addition to traditional operating systems.

- See HPE ProLiant DL380 Gen10 server on hpe.com for more details.



**FIGURE 5.** HPE ProLiant DL380 Gen10 server (front facing, SFF drives)

### HPE SN6000B Fibre Channel switch

This solution utilizes two HPE SN6000B 16 Gb 48-Port Fibre Channel (FC) switches, a single 2-port FC HBA for each HPE Nimble Storage controller, and a single 2-port HBA in each host for SAN connectivity.

The HPE SN6000B FC switch meets the demands of hyper-scale, private cloud storage environments by delivering market-leading 16 Gb Fibre Channel technology and capabilities that support highly virtualized environments. Designed to enable maximum flexibility and investment protection, the HPE SN6000B FC switch is configurable in 24, 36, or 48 ports and supports 4, 8, 10, or 16 Gbps speeds in an efficiently designed 1U package. It also provides a simplified deployment process and a point-and-click user interface making it both powerful and easy to use. The HPE SN6000B FC switch offers low-cost access to industry-leading Storage Area Network (SAN) technology while providing "pay-as-you-grow" scalability to meet the needs of an evolving storage environment.

For more details, see the *HPE SN6000B Fibre Channel Switch QuickSpecs* at hpe.com/V2/GetDocument.aspx?docname=c04111492.



**FIGURE 6.** HPE SN6000B Fibre Channel switch (rear view)

## Software
### VMware software
The VMware software components used in this solution are:

- vSphere 6.5 Update 1d

- vCenter Server Appliance

### Microsoft software
The Microsoft® software components used in this solution are:

- Microsoft Windows Server® 2016

- Microsoft SQL Server 2017 Enterprise Edition

The OS and database play a supporting role in this guide as example workflows.

# CONFIGURATION GUIDANCE

## Implementing and configuring vVols

The following sections are intended to be completed in order to simplify the administration and management workflows later in this guide. At a high level, make sure hardware and software versions meet minimum requirements, configure the HPE Nimble Storage vCenter integration, create folder/containers on the arrays, and if applicable to your environment, configure replication partnerships between HPE Nimble Storage arrays.

### Prerequisites

Below are a few required items to be verified or configured. This includes the HPE Nimble Storage arrays, attached vSphere environment, host HBAs, and Fibre Channel SAN configuration.

#### Nimble arrays

- The HPE Nimble Storage OS (NOS) must be updated to NOS 5.0 or greater. NOS 5.0.1.0 was used for this guide.

- The HPE Nimble Storage array must be installed and set up. The "default" pool of storage is available at a minimum.

- Make sure time is set accurately, preferably via Network Time Protocol (NTP).

- For environments that will utilize replication, the arrays at each site should have a unique Nimble Group name. Take note of these group names.

- Firewall ports (NOS v5.0.x Documentation) must be opened, particularly to enable VM statistic data to make it back to HPE InfoSight. And also for replication if the arrays are not on the same side of the firewall.

#### vSphere and vCenter

- vSphere 6.5 is required for the latest vVol 2.0 features, such as array-based replication. vSphere 6.0 is also supported. vCenter Server v6.5 Update1d was used for this guide.

- For environments utilizing replication, the vCenter version must be the same at both sites.

- vCenter setup must be complete and a cluster of hosts available.

- Make sure that vCenter and ESXi host times are set accurately, preferably via NTP.

#### Host hardware

Make sure HBAs and associated firmware are compatible with vVols. See the VMware Hardware Compatibility Guide and search under **IO Devices**, selecting **Secondary LUNID (Enables vVols)** under the **Features** section, as shown in FIGURE 7.

# VMware Compatibility Guide



**FIGURE 7.** VMware Hardware Compatibility Guide

## Fibre Channel SAN

Though iSCSI is a valid and supported SAN option for both HPE Nimble Storage and vSphere, Fibre Channel was utilized. It is assumed that the hosts and arrays are zoned appropriately. For this guide, there are two "sites." Each site is configured similarly: four vSphere ESXi hosts, one vCenter Server, and one HPE Nimble Storage array. SAN zoning is isolated to each site. The array-to-array communication occurs over Ethernet.

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**TIP**

There is no need to present the HPE Nimble Storage folder (container) to the hosts. This is handled by the HPE Nimble Storage vCenter integration and VASA provider.

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## VMware vCenter Integration

These next steps must be performed on the HPE Nimble Storage array *at each site*. Authenticate to the HPE Nimble Storage UI. From the top menu, select **ADMINISTRATION**, then **VMWARE INTEGRATION**. Provide access details to your vCenter. The **Thick Client** is left unchecked as it does not pertain to vSphere 6.5 environments. Be sure that **Web Client** and **VASA Provider (vVols)** is checked. FIGURE 8 shows the primary site used in this guide.

**FIGURE 8.** VMware Integration dialog for primary site

After submitting the configuration, the connection and configuration can be tested. See FIGURE 9 for the result after clicking **TEST STATUS**.



**FIGURE 9.** Test Nimble to VMware vCenter communication

**Create HPE Nimble Storage folders (storage containers)**

Instead of presenting a LUN to the ESXi hosts as you would for a traditional VMFS datastore, create an HPE Nimble Storage folder (also called storage container in VMware). Create a folder (named "nimbleVVol") on each HPE Nimble Storage array, each with the same name. Though not a requirement, this helps organize replication operations between the two arrays. See FIGURE 10 and FIGURE 11 depicting folder creation on each of the arrays. Make sure to set **MANAGEMENT TYPE** to **VMware virtual volumes (VVols)** and specify the appropriate vCenter Server. The folders are thin provisioned but still require a limit to be set.

**FIGURE 10.** Folder/container specification on primary array



**FIGURE 11.** Folder/container specification on secondary array

After the folder is created, it can be added into VMware vCenter as a VVol datastore. Repeat this process in both vCenter environments:

1.  Authenticate to vCenter Server UI.

2.  Click **Home → Hosts and Clusters**.

3.  On the left-side navigation, right click the applicable datacenter or cluster and choose **Storage → New Datastore…**

4.  Wizard step 2: **Type**. Select **VVol**
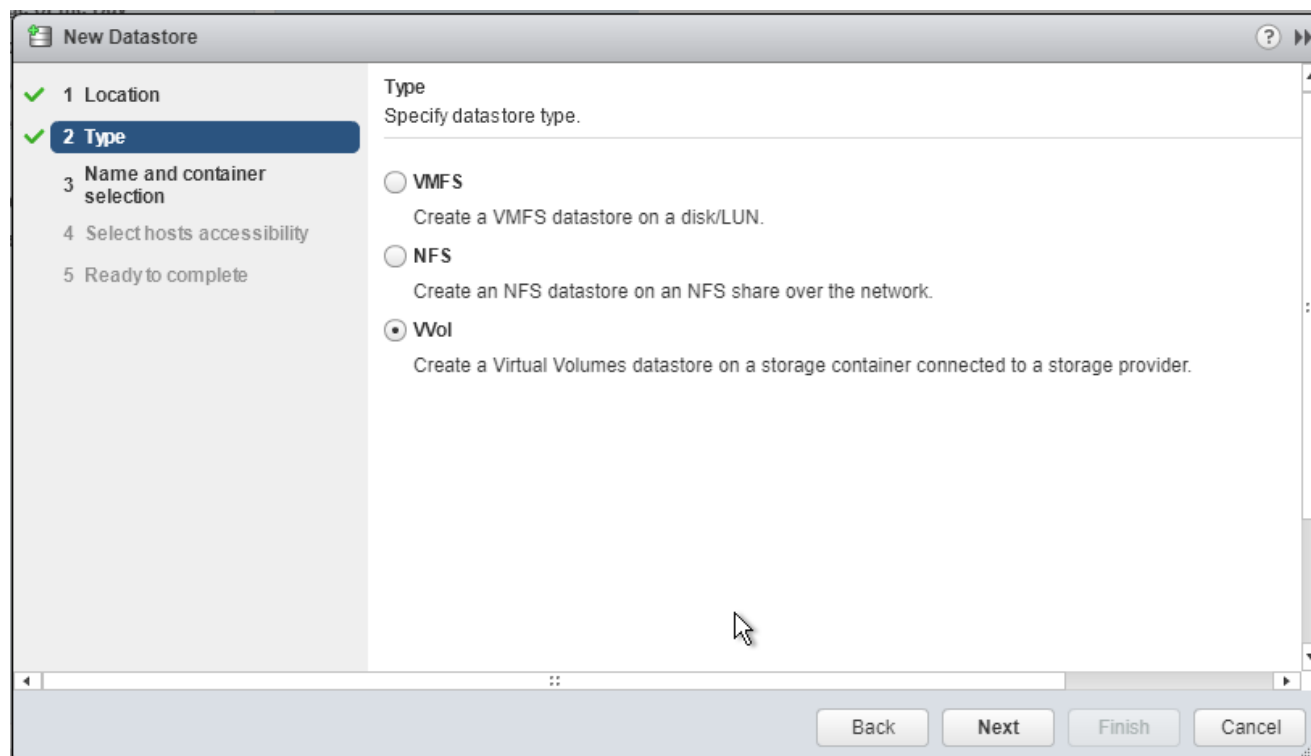


**FIGURE 12.** Specify "VVol" for the datastore type

5.  Wizard step 3: **Name and container selection**. The name is arbitrary, but the same name can be used as the folder name on the array ("nimbleVVol"). Select the "nimbleVVol" backing storage container.
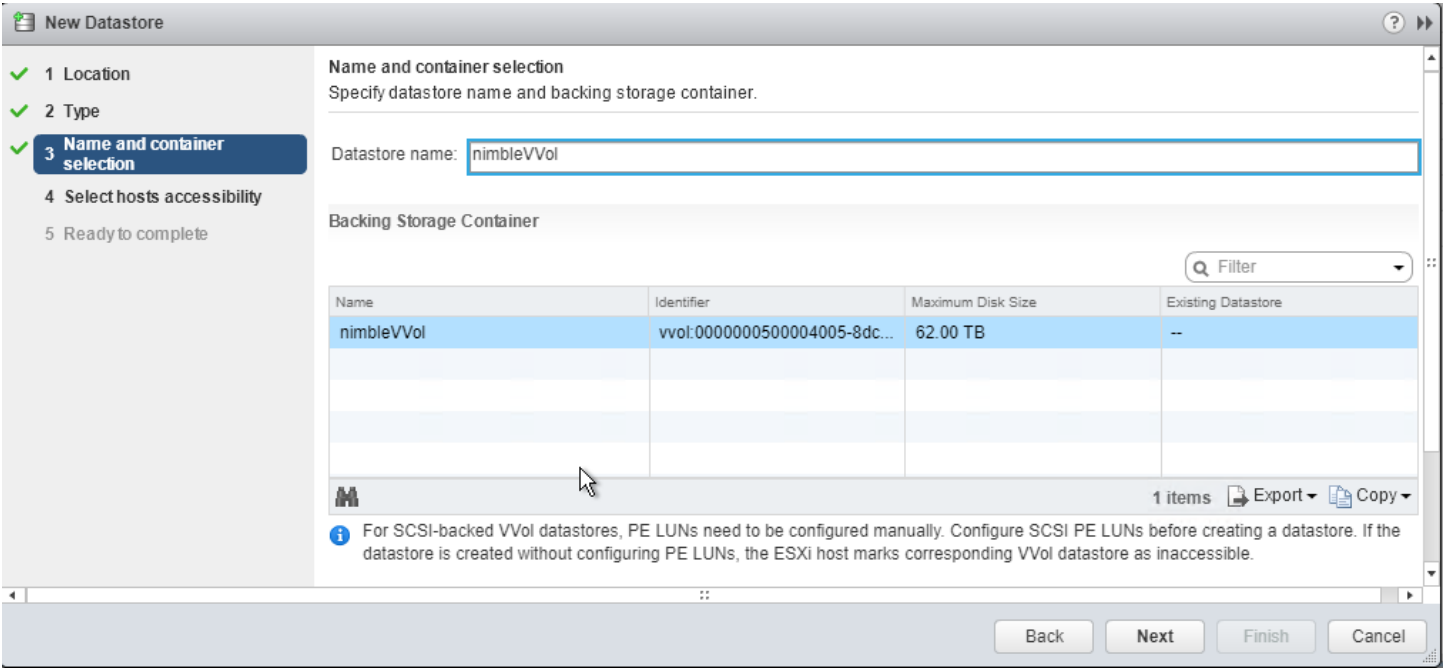


**FIGURE 13.** Specify datastore name and select container

6.  Wizard step 4: **Select hosts accessibility**. Make sure that all hosts are selected.
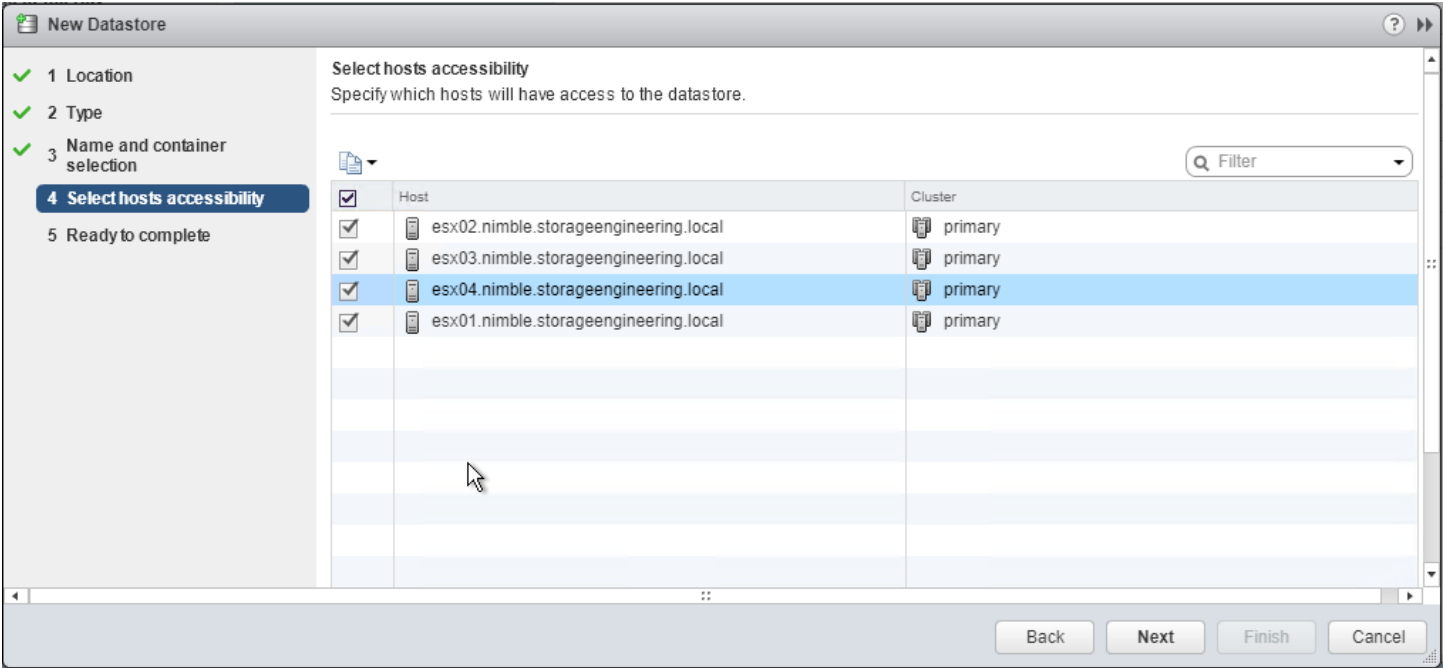


**FIGURE 14.** Make sure all hosts are selected

7.  Wizard step 5: **Ready to complete**. Verify the summary is correct, particularly the name, array, and hosts. FIGURE 15 shows the summary for the primary site and FIGURE 16 is for the secondary site.
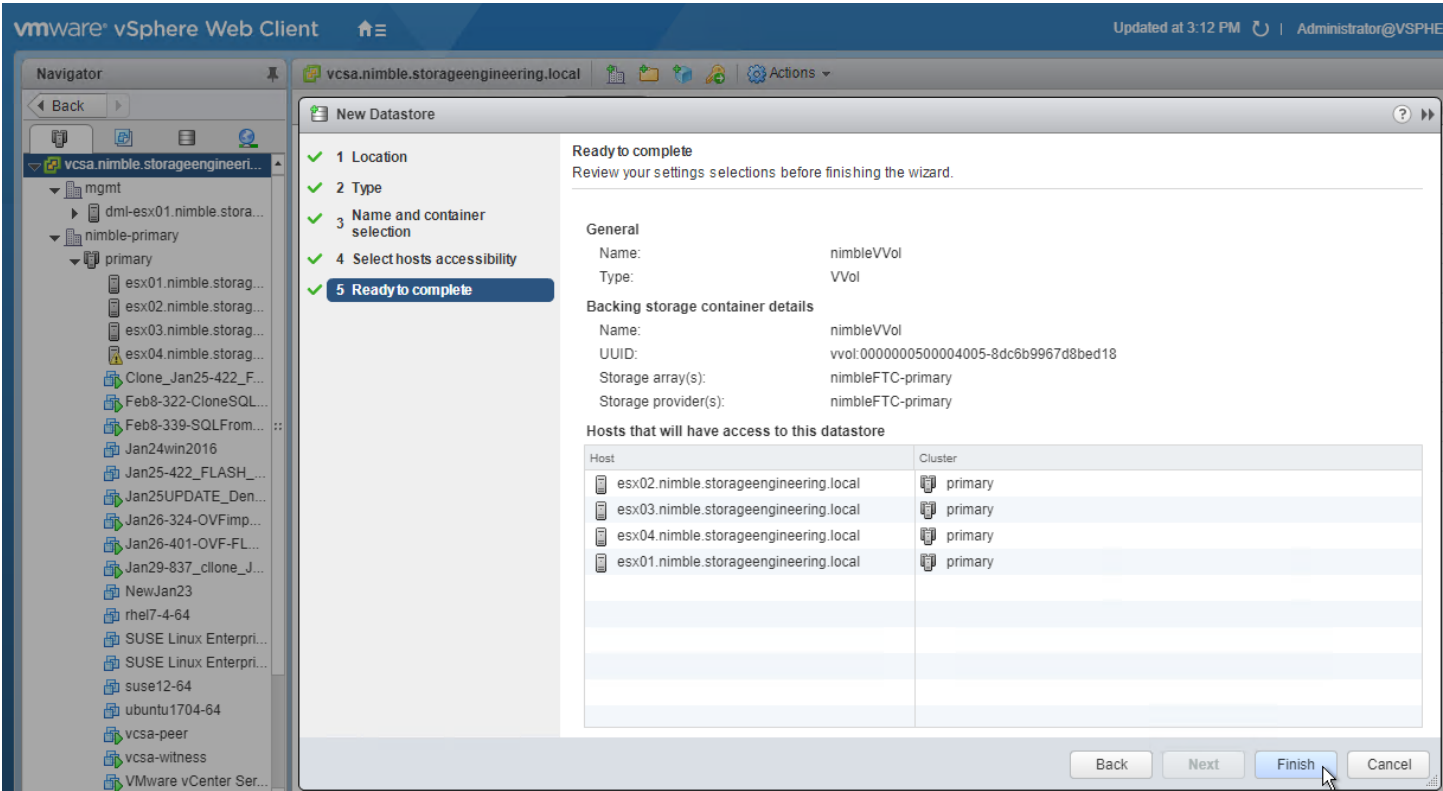


**FIGURE 15.** New Datastore summary for primary site
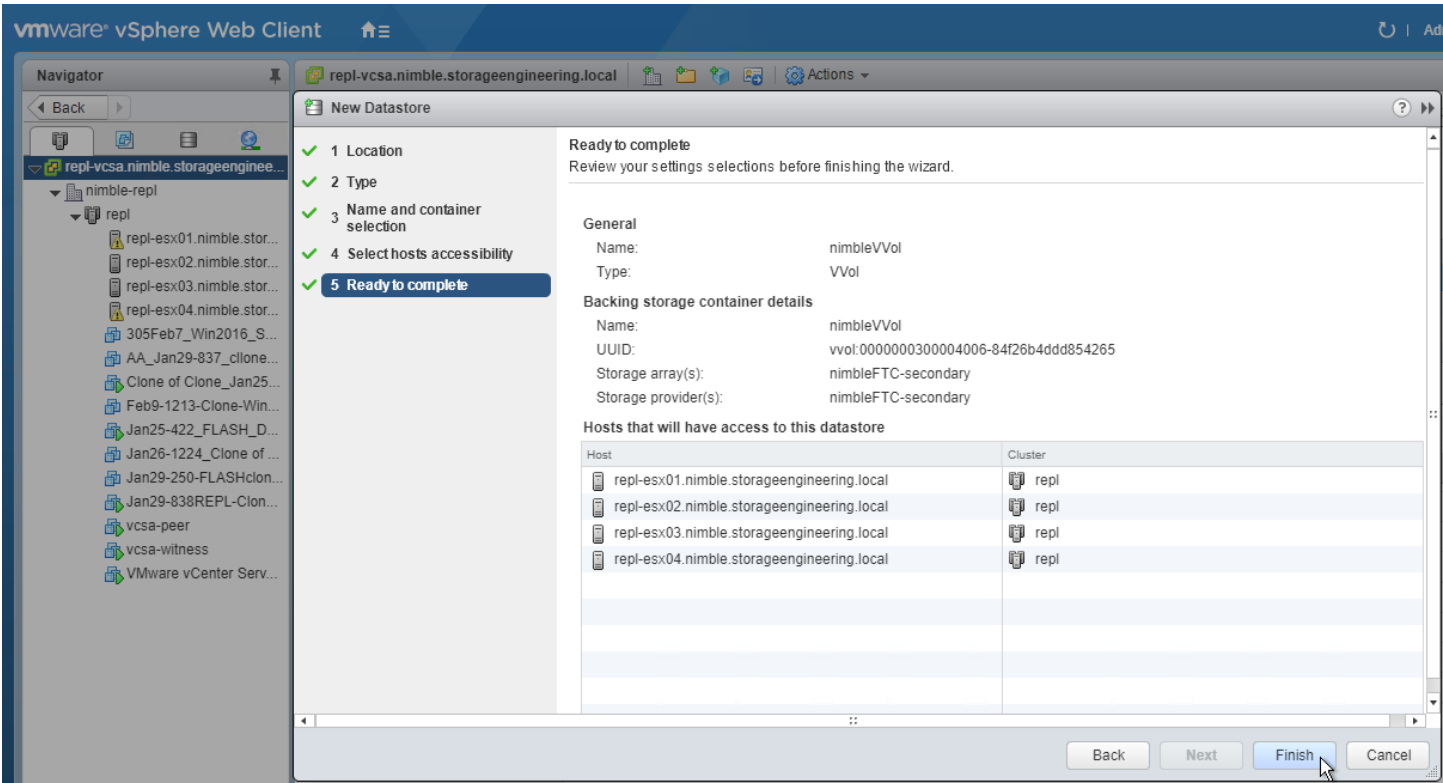


**FIGURE 16.** New Datastore summary for secondary site

The vVol datastore is now ready for use. If replication will be utilized, configure it before creating storage policies.

**Configure replication between sites**
Complete the following steps for all applicable HPE Nimble Storage array groups. For this guide, there are two groups, each group containing a single array.

1. Log in to the UI for the HPE Nimble Storage array.

    a. From the top navigation, select **MANAGE → DATA PROTECTION**.

    b. From the left-hand navigation, select **REPLICATION PARTNERS**.

    c. Click **+** to add a partnership.

    d. Define the partnership (see FIGURE 17 and FIGURE 18 ):

        I.  **PARTNER NAME**: This is the group name for your arrays. The Group name must be unique among replication partnerships.

        II. **SHARED SECRET**: This can be any value but needs to be specified in each replication configuration.

        III. **REPLICATION NETWORK**: Preferably a fast Ethernet link, separate from management network, though not required.

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**TIP**
Replication always occurs over Ethernet, regardless of FC zone configuration.

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        IV. **INBOUND LOCATION**: Specify the inbound location. There is a requirement that replicated vVols remain on vVol-enabled Folders. Otherwise, replicated VMs from the HPE Nimble Storage vCenter Plug-in cannot be cloned. This can be accomplished in two ways:

        Set the default inbound location to a vVol Folder ("nimbleVVol" in the case of this guide).
        However, this might not be desirable if the array is replicating content other than VMware vVols.

        Alternatively, you can leave the inbound location set to the "default" pool and check the box below. To satisfy the above-mentioned requirement, each array must have vVol folders with the same name under the same pool. Replicated content will then stay in like-named, vVol-enabled folders.

        V.  Specify a QoS Policy if desired. Defaults were used in this environment.

**FIGURE 17.** Partnership creation on primary array

**FIGURE 18.** Partnership creation on the secondary array

After the partnership is created you can test the connection state or pause/resume. The **STATUS** column should report active. The traffic column will report either inbound/outbound or bi-directional depending on your active replication schedules. Clicking the replication partner will display more details. FIGURE 19 shows the partnership configuration, as configured on the primary array. The configuration section confirms **INBOUND LOCATION** and **TRY TO MATCH SOURCE LOCATION** attributes.
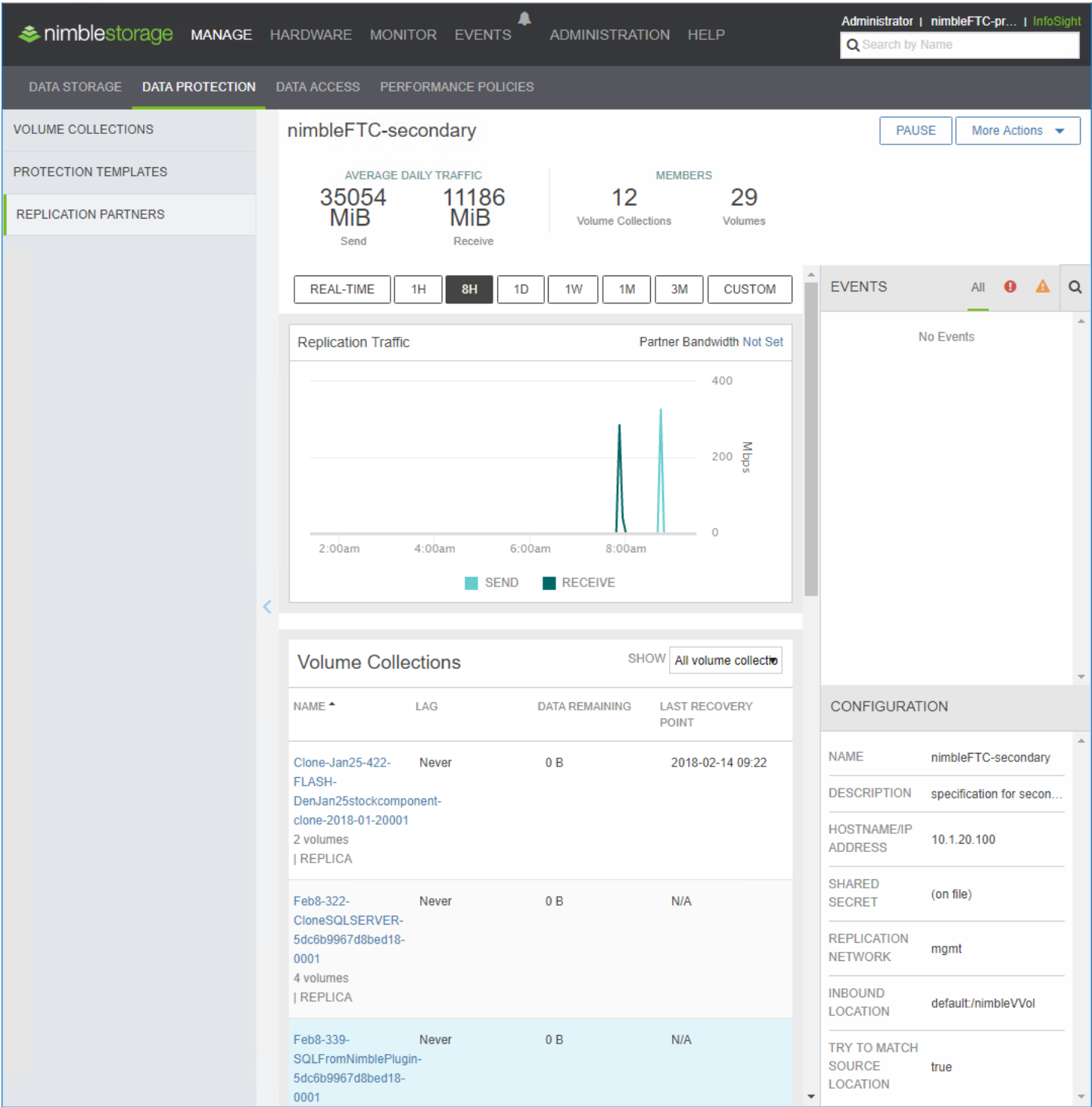
**FIGURE 19.** Partnership configuration details, as configured on primary array

**HPE Nimble Storage volume collections**

Volume collections are sets of volumes that share data protection characteristics, such as snapshot and replication schedules. The volume collections are automatically created for the vVol VM and all the disks/volumes associated with that vVol VM are automatically placed in the volume collection, depending on the protection schedule. An example list of volume collections is shown in FIGURE 19.

**Create VMware storage policies**

VMware provides a default (and unmodifiable) "VVol No Requirements Policy" policy. This is the default policy applied to vVol-enabled VMs. Create your own storage policies to take advantage of array-based snapshots, replication, application synchronization, and more. Storage policy examples are provided in the following sections.

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**TIP**

The HPE Nimble Storage vCenter Plug-in is supported on both the Flash and HTML5 vCenter UI. However, there are VMware storage policy workflows that are not yet supported on the HTML5 client, particularly applying storage profiles or a vVol datastore specification to newly created or imported VMs. Check Functionality Updates for the vSphere Client for a full list of supported and unsupported functionality in the HTML5 client.

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Begin each of the policy creation examples below with the following:

1. From the vCenter UI, click **Home**, then **Policies and Profiles**.

    a. Select **VM Storage Policies** from the **Navigator** pane.

    b. Select **Create VM Storage Policy...** from the **VM Storage Policies** tab.

    c. Wizard Step 1: **Name and description**. Specify something like "30 Minute Snapshot" or "Hourly Replication."

    d. Wizard Step 2b: Expand **Policy structure** and select **2b Rule-set 1**.

       I. Set **Storage Type** to "NimbleStorage."

       II. There are various features available in the **<Add rule>** drop-down list. Snapshots, replication, and VSS/ApplicationSync are detailed below.

    e. Wizard Step 3: **Storage compatibility**. Make sure the vVol datastores are displayed in the "Compatible" list. If the desired vVol datastore shows as incompatible:

       I. Verify the connection state of the vVol datastore. Click the double-arrows at the top right of the wizard to minimize it while the datastores are inspected.

       II. Go back and inspect the rule-set for an unsupported configuration. For example, with VSS enabled, snapshots cannot be taken more frequently than 30 minutes.

    f. Wizard Step 4: **Ready to complete**. Review the full summary.

**Snapshot (protection) "Rule-set" example**

Select **Protection schedule (minutely)** from the **<Add rule>** drop down list. FIGURE 20 depicts taking a snapshot every 30 minutes, 24x7. This configuration specifies having eight hours of snapshots available (retain sixteen 30-minute snapshots).

**FIGURE 20.** Take snapshot every 30 minutes and retain 16 of them

**Replication "Rule-set" example**

Next, add replication parameters to the protection schedule. Select the replication partner (this will be available in the drop-down list after you configure the replication partnership between arrays), how often to replicate, how many replicas to retain, and whether or not replicas should be deleted from the partner. See FIGURE 21 for the replication details.

**FIGURE 21.** Replication details

**Application-synchronized replication "Rule-set"**
These profiles build on the previous two. Add an **Application policy** rule (OS, SQL Data, or SQL Logs) and specify the VSS flag in the
**Protection schedule → Application synchronization** section for each. For demonstration purposes, a SQL Server VM with three virtual
disks is configured: OS, SQL Data, and SQL Log. Create a storage policy for each of these disks.
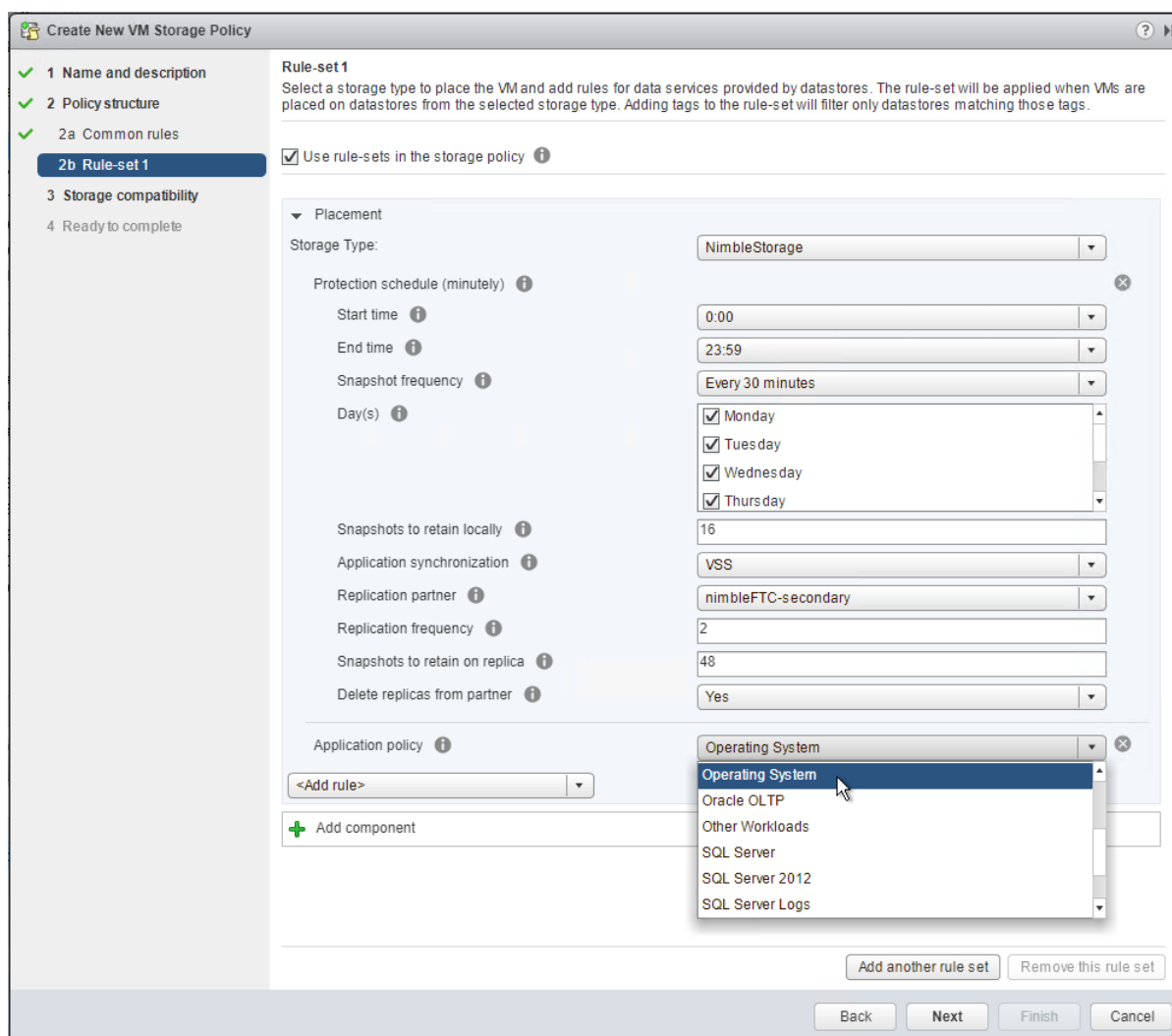
**FIGURE 22.** VM Storage Policy creation, specifying protection schedule and application policy

Create the **Operating System** policy first, per FIGURE 22. After it is complete, select the newly created policy, then click **Clone...** to create the SQL Data and SQL Log policies. This will help ensure that the protection schedule is exactly the same for all three. As a result, a single volume collection is created on the HPE Nimble Storage array for the VM. A single volume collection enables efficient cloning and replication operations.
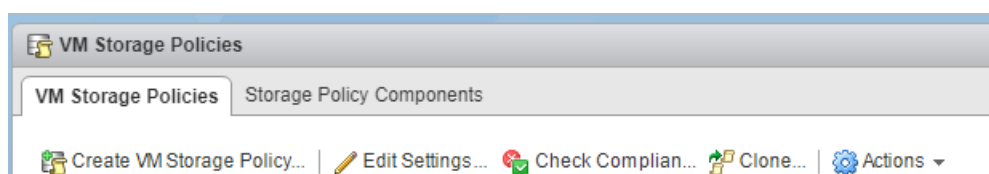


**FIGURE 23.** Clone button in vCenter UI

On the **SQL Data** policy, change the name and description appropriately, and select **SQL Server 2012** for the Application policy. This choice is applicable for modern SQL Server versions as well. For the **SQL Log** policy, select **SQL Server Logs** for the Application policy.

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**TIP**
Snapshot/replication frequency for VSS-enabled policies must be 30-minute intervals or longer.

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**HPE Nimble vVol block size considerations**

**TIP**
The HPE Nimble performance policy has a direct effect on the block size of the volume. Though the performance policy can be changed for an existing volume, the block size cannot change.

In the prior section, VMware Storage Policies **SQL Server** and **SQL Server Logs** were defined. Each of these specified an application policy accordingly. An application policy has a direct effect on the resulting block size of the HPE Nimble Storage volume. For example, the **SQL Server** policy uses a block size of 8 KiB, yet the **SQL Log** policy uses 4 KiB.

**After a volume is created, this block size cannot be changed.** Thus, when adding disks to an existing VM, migrating or cloning a VM over to a vVol datastore, or creating a new VM, make sure the correct storage policy (particularly, the application policy within) is applied. The default block-size is 4 KiB. This is used for the default VMware Storage Policy **VVol No Requirements Policy** and is appropriate for OS disks. Finally, modifying application or performance policies on an HPE Nimble Storage volume is allowed as long as the block size does not change between policies.

Application policies (called performance policies in the HPE Nimble UI—there are more than 20 stock performance policies) can be viewed from the HPE Nimble Storage UI: **MANAGE → PERFORMANCE POLICIES**. Block size and other attributes can be viewed for each policy, per FIGURE 24. Custom performance policies can be created by the storage admin depending on the application requirement.

**FIGURE 24.** HPE Nimble Storage performance policies

## Administration and management of vVols

In the Implementing and configuring vVols section, a foundation was created, including integrating the HPE Nimble Storage array with vCenter, creating a vVol datastore ("nimblevVol"), creating VMware storage policies, and configuring replication among HPE Nimble Storage arrays. The proceeding workflows build upon that foundation.

### Migrate VMFS VM to VVol datastore

Existing VMs can be easily migrated to a vVol datastore (container). The following wizard can move compute resources (if necessary) and storage. The vVol destination as well as the desired storage policy can be selected. As new volumes are created for each virtual hard disk,

review the HPE Nimble vVol block size considerations section to be certain block-size is set appropriately. Start the VM migration wizard from VMware vCenter by right clicking the desired VM and selecting **Migrate...** The wizard follows:

1. **Select the migration type**: "Storage and Compute"

2. **Select a compute resource**: Select the cluster that has your vVol datastores presented.

3. **Select storage**: Under the **VM storage policy** drop-down list, select either a specific policy or the **VVol No Requirements Policy**. Next, select from the list of compatible datastores. If your VM has multiple hard disks and you want to specify a separate policy for each, click the **Advanced>>** button as shown in FIGURE 25.
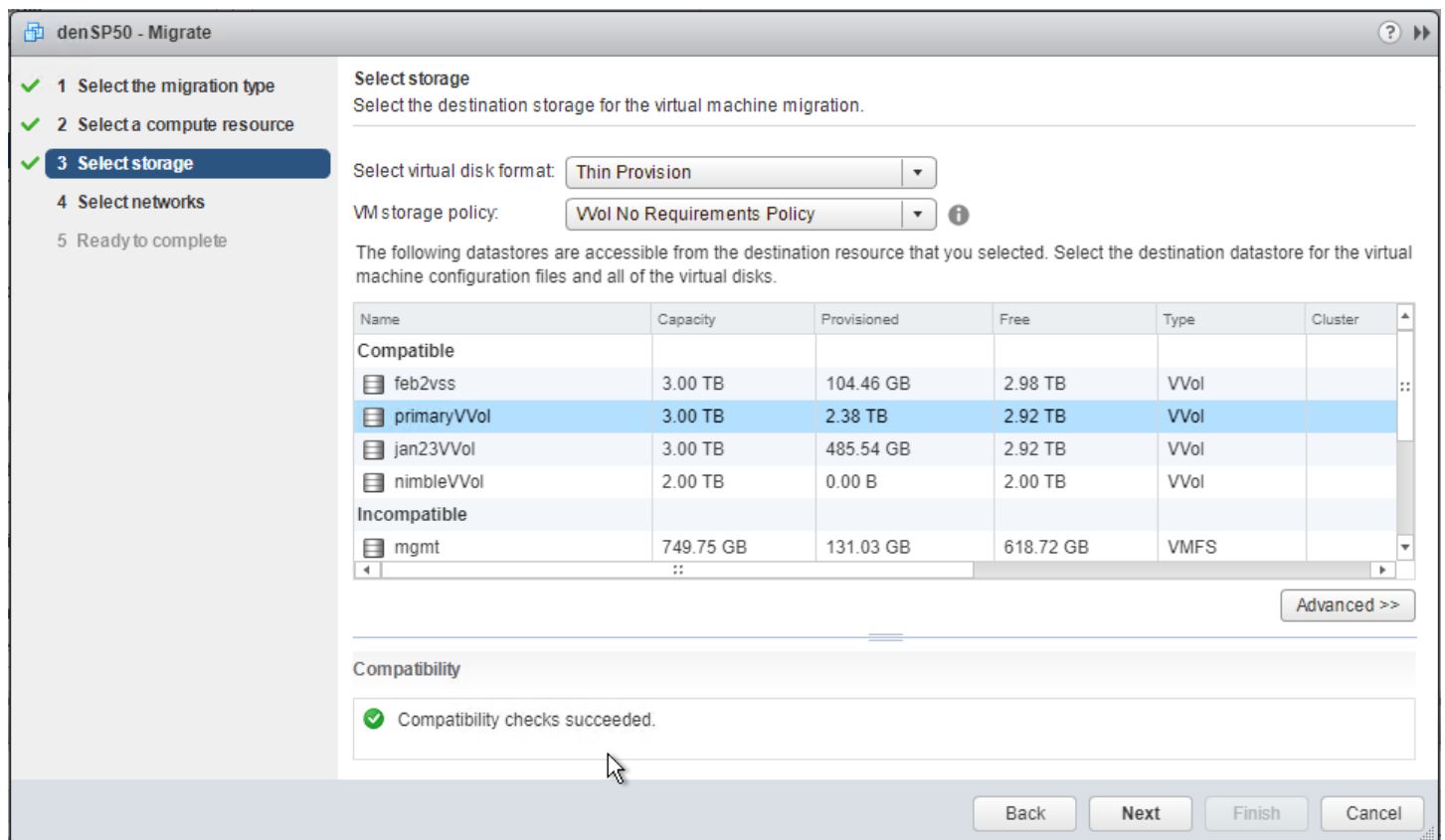
**FIGURE 25.** Specify VM storage policy and destination datastore

4. **Select networks**: Review network mapping and adjust if necessary.

5. **Ready to complete**: Review the summary and click **Finish**.

---

**TIP**
A vVol-based VM can be migrated back to a VMFS-based VM if required.

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**Assign a storage policy to a VM**

A storage policy can be easily changed for a vVol-based VM. After adjusting the policy, it needs to be reapplied to make sure the resulting configuration is compliant. To change the storage policy for a VM, from VMware vCenter, right click the VM and select **VM policies → Edit VM Storage Policies...** Select the desired storage policies for each disk. You can apply the same policy across all storage objects or tune them specifically, as shown in FIGURE 26.
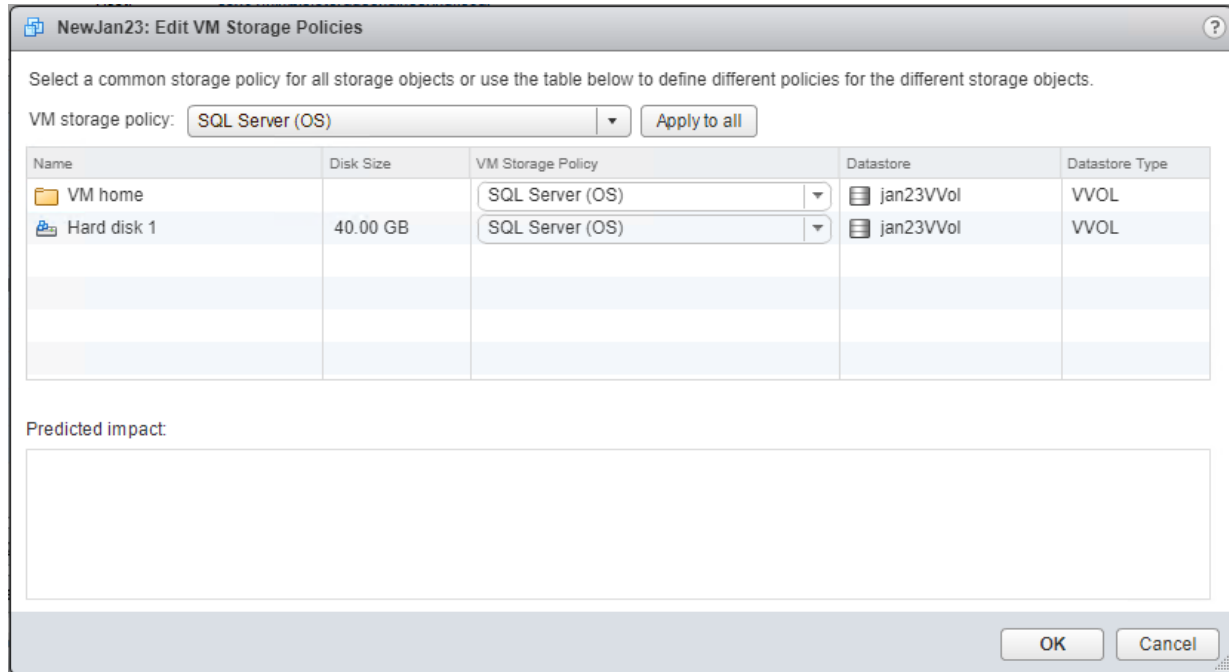


**FIGURE 26.** Edit VM Storage Policies

After applying the changes, click the **Summary** tab and view the VM Storage Policies sub-window. The policy should show as compliant. If not, click **Check Compliance**. As a troubleshooting exercise, a noncompliant policy is displayed in FIGURE 27.
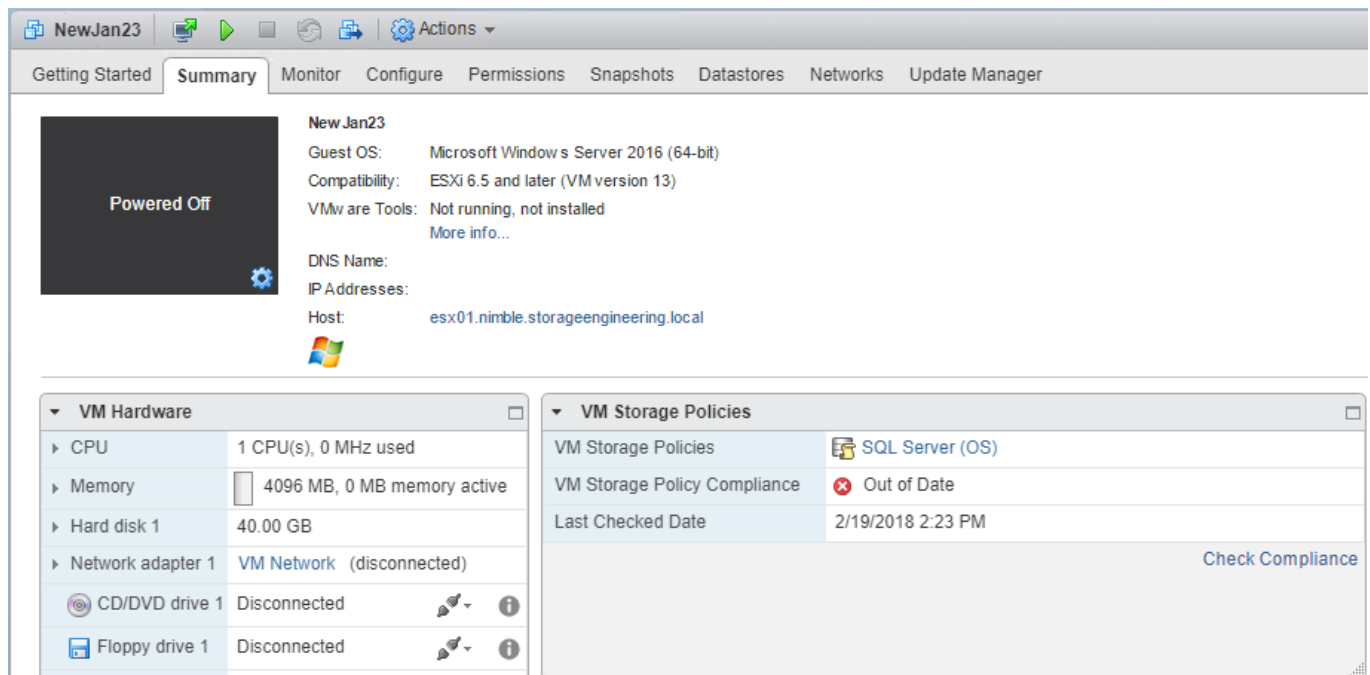


**FIGURE 27.** "Out of Date" policy noncompliance

To get more information, click the storage policy link, in this case **SQL Server (OS)**. This will load the policy's **Monitor** tab. Highlight the offending entry and observe the compliance failures section, as shown in FIGURE 28. An IP is expected, but none has been configured. In this example, the policy has the application synchronization feature enabled and needs to be configured via the HPE Nimble Storage vCenter Plug-in.
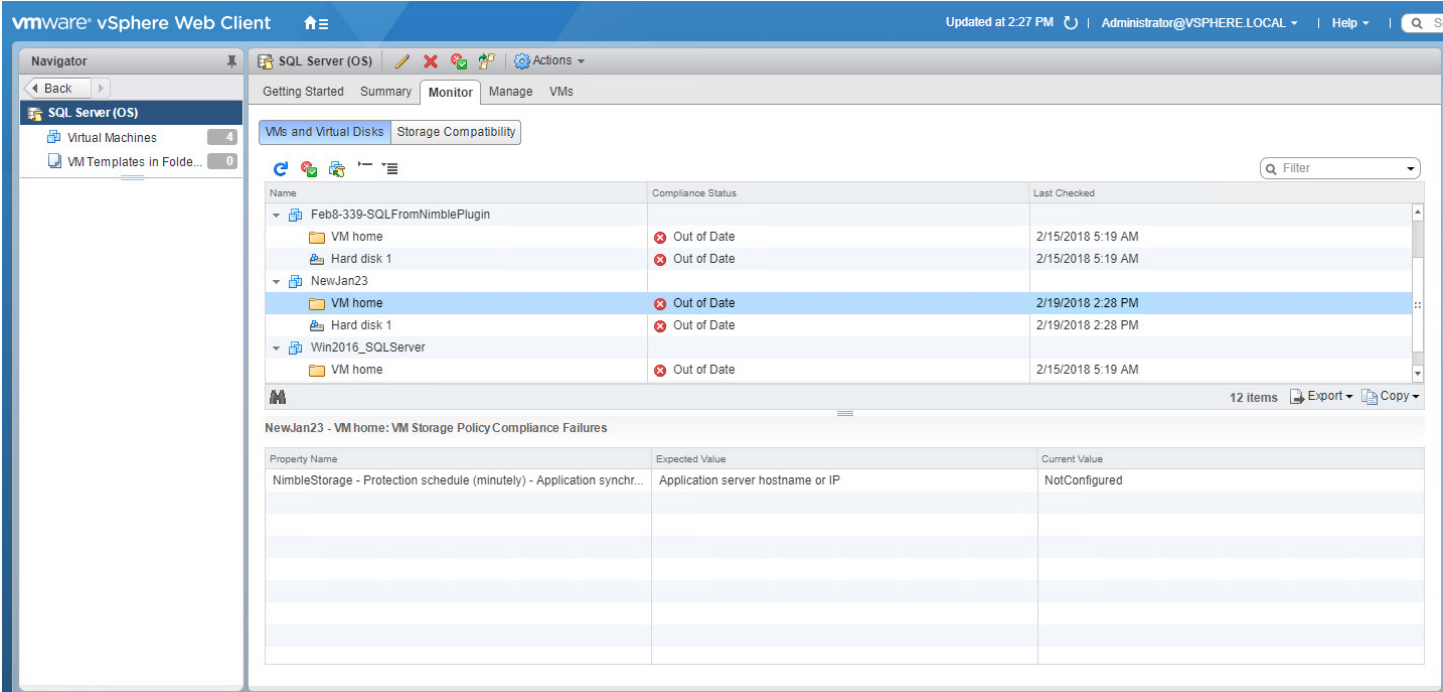


**FIGURE 28.** Detail on "Out of Date" noncompliance

### Restoring a VM via the HPE Nimble Storage Plug-in in vCenter

After applying a storage policy that configures HPE Nimble Storage snapshots, a VM can be restored from the snapshot history. From VMware vCenter, navigate to the **Home** menu, then to **Nimble Storage** (see FIGURE 29).
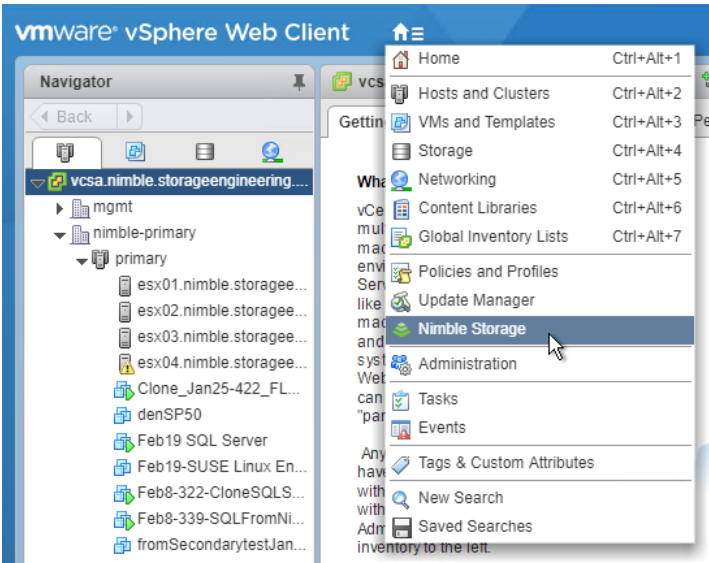


**FIGURE 29.** Launching the HPE Nimble Storage vCenter Plug-in

<u>FIGURE 30</u> depicts three tabs: **LOCAL**, **REPLICATED**, and **DELETED**. While viewing the **LOCAL** tab, click the box next to the VM to be restored and then click the **RESTORE** button. This launches the **RESTORE VM/DISK** dialog, as shown in <u>FIGURE 31</u>. The clone can replace the existing VM or be cloned to a new VM. Just select the particular snapshot to use. The same storage policy will be applied to the new VM; follow the <u>Assign a storage policy to a VM</u> workflow if you want to change policies. (That is, change the policy to a different snapshot or replication schedule.)
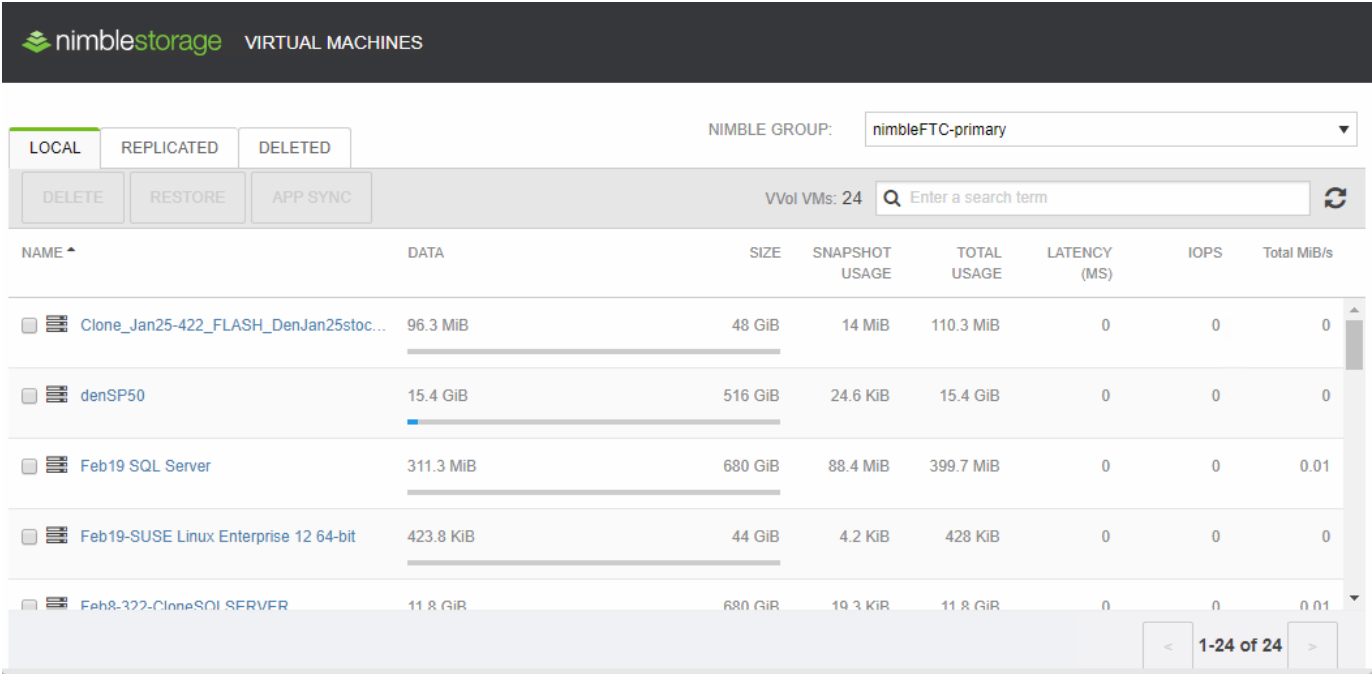


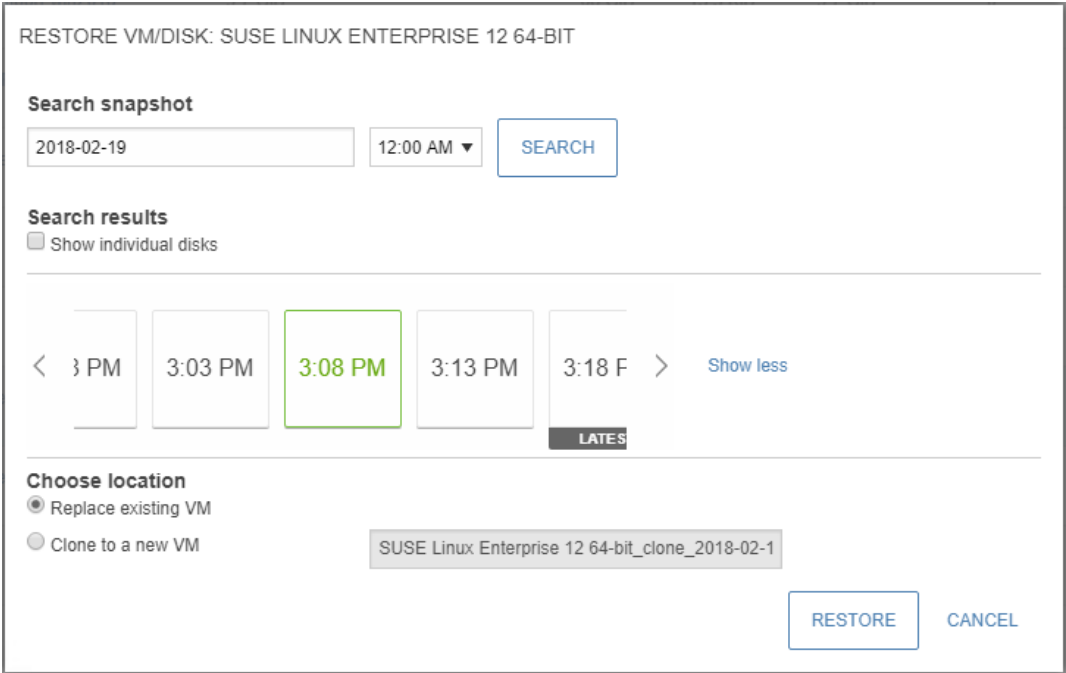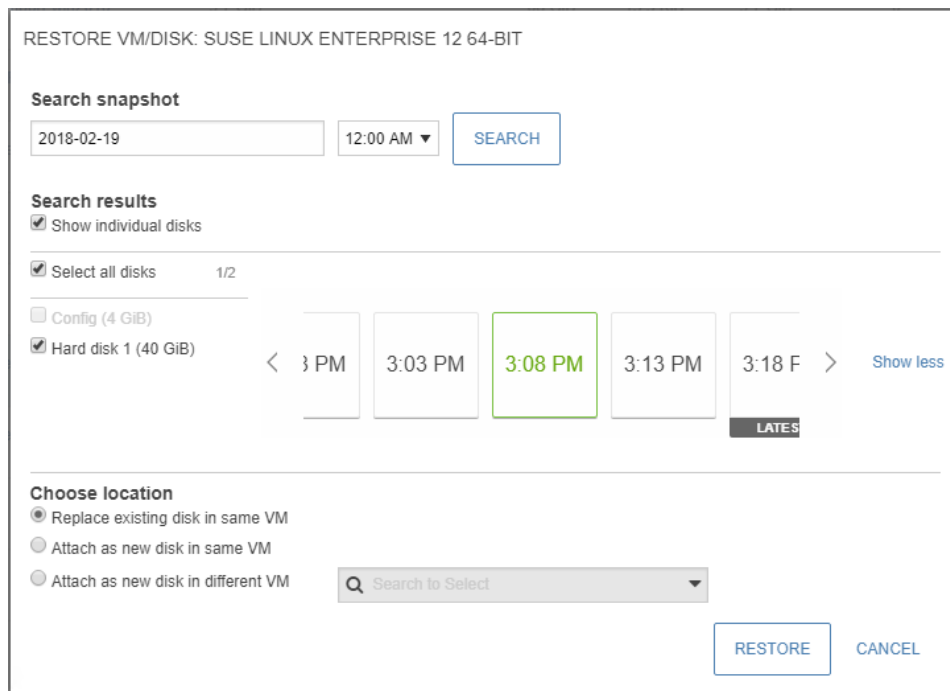**FIGURE 30.** HPE Nimble Storage vCenter Plug-in



**FIGURE 31.** Restore whole VM from snapshot

An individual disk can also be restored from a snapshot. The snapshot can replace the current disk, be added as a new disk in the same VM, or be added to a different VM, as shown in FIGURE 32. This can be helpful in development or test cycles or to create a sandbox environment for debugging production.



**FIGURE 32.** Restore individual disk from snapshot

### Delete and Undelete VMs using the HPE Nimble Storage vCenter Plug-in

By default, a deleted VM can be recovered within a 72-hour window of time. FIGURE 33 shows a sample VM "denSP50deletetest" to be deleted.
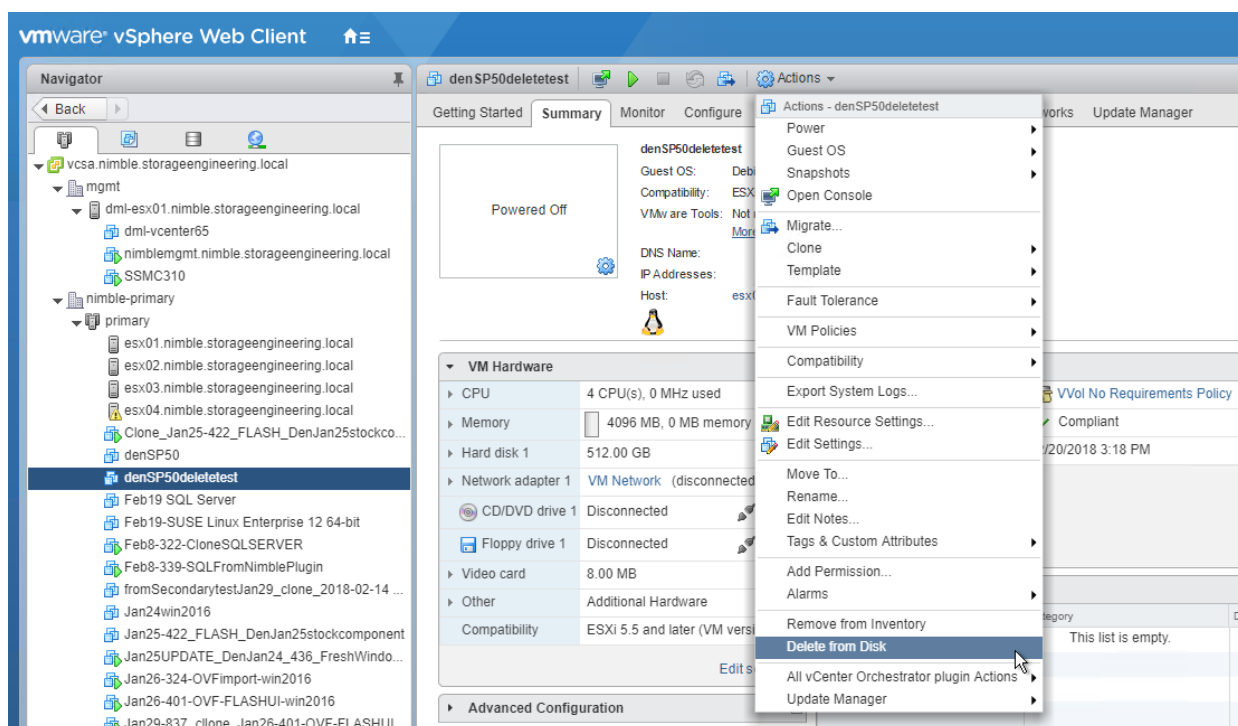


**FIGURE 33.** Delete VM from disk

After the delete task is completed, the HPE Nimble Storage vCenter Plug-in is launched. As shown in <u>FIGURE 34</u>, the VM is selected and the **UNDELETE** button is available. After clicking this button, the VM is automatically restored and re-added to inventory. **PURGE** is the other option, which will remove the VM ahead of its scheduled terminal deletion.
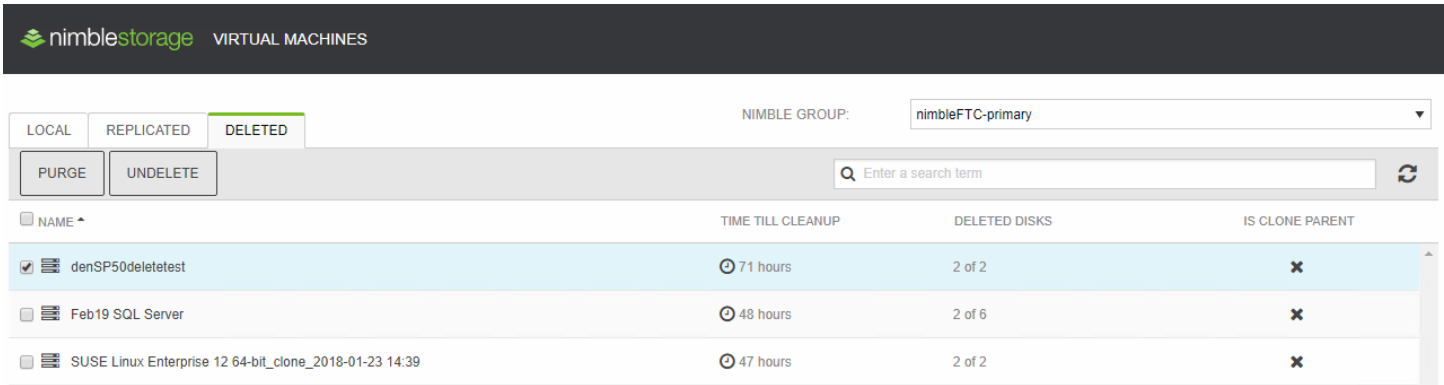


**FIGURE 34.** "DELETED" tab with PURGE" and "UNDELETE" actions

**Clone a replicated VM at the remote site**
Replicated VMs from the primary site can be cloned for use locally at the remote (replicated) site. This is very easy to do from the HPE Nimble Storage vCenter Plug-in. The following workflow and screenshots are taken from the remote site.

1. Log in to the remote site's vCenter, in our example: "repl-vcsa.nimble.storageengineering.local"

2. Activate the HPE Nimble Storage vCenter Plug-in: **Home → Nimble Storage**. Note that per <u>FIGURE 35</u>, the **NIMBLE GROUP** shows as "nimbleFTC-secondary." This is the replicated site's array group.

3. Click the **REPLICATED** tab to see a list of replicated VMs from the primary site. Select a VM, in this case "denSP50," and click **CLONE**.
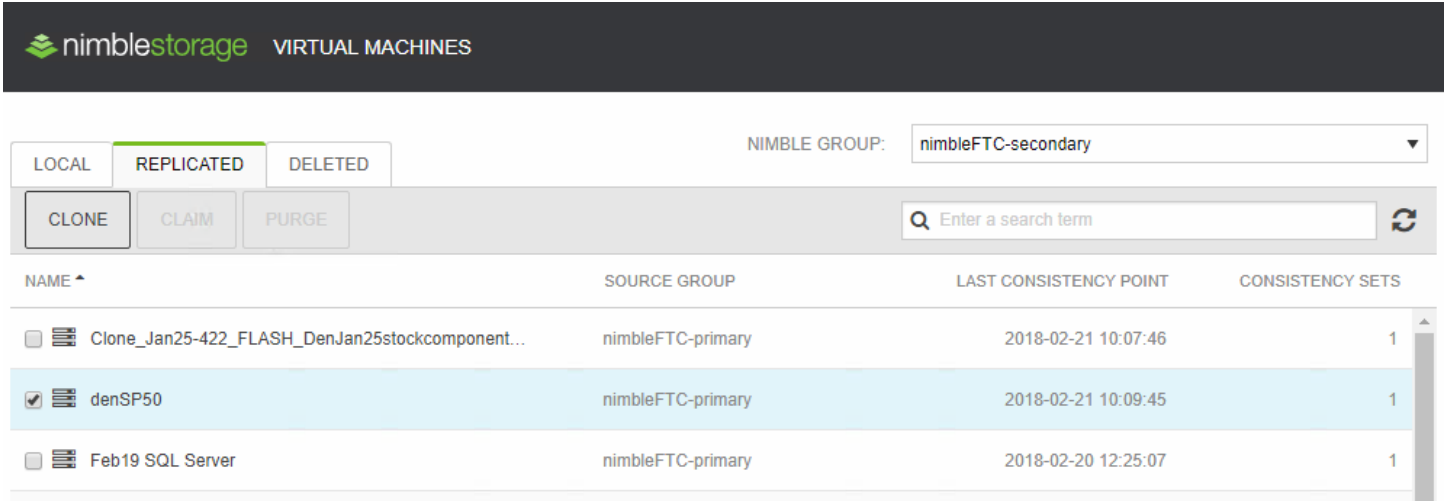


**FIGURE 35.** List of replicated VMs at remote site

4.  This launches a similar dialog to the RESTORE workflow seen earlier, except that a snapshot to clone to the inventory of the local vCenter will be selected. Select the latest replication and click **CLONE**, as shown in FIGURE 36.
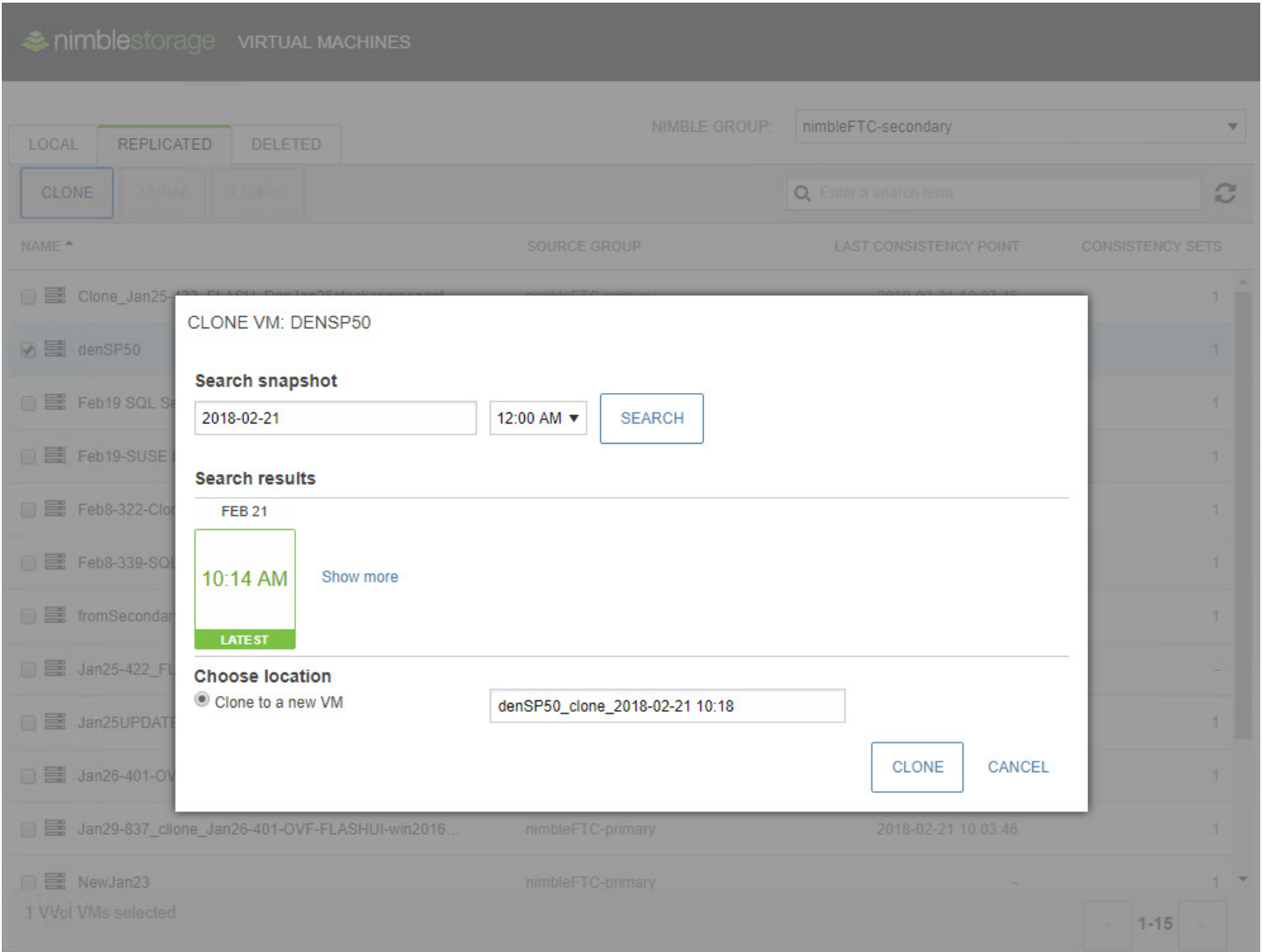


**FIGURE 36.** Clone to local inventory at remote site

After the clone and registration tasks complete (observe the **Recent Tasks** output), you can operate on the VM locally. A confirmation dialog cautions that this VM is an exact clone of the one at the remote site. Therefore, an IP change or MAC address might be necessary if it is to be powered up concurrently with the original.

The storage policy assigned to the cloned VM is probably the default **VVol No Requirements Policy** policy. If it displays as out of date, reapply the profiles: right click **VM → VM Policies → Reapply VM Storage Policy**. As shown in FIGURE 37, you can change the policy to one that will snapshot and replicate, in this case, back to the primary site. See the Create VMware storage policies section for more detail about storage policy creation.
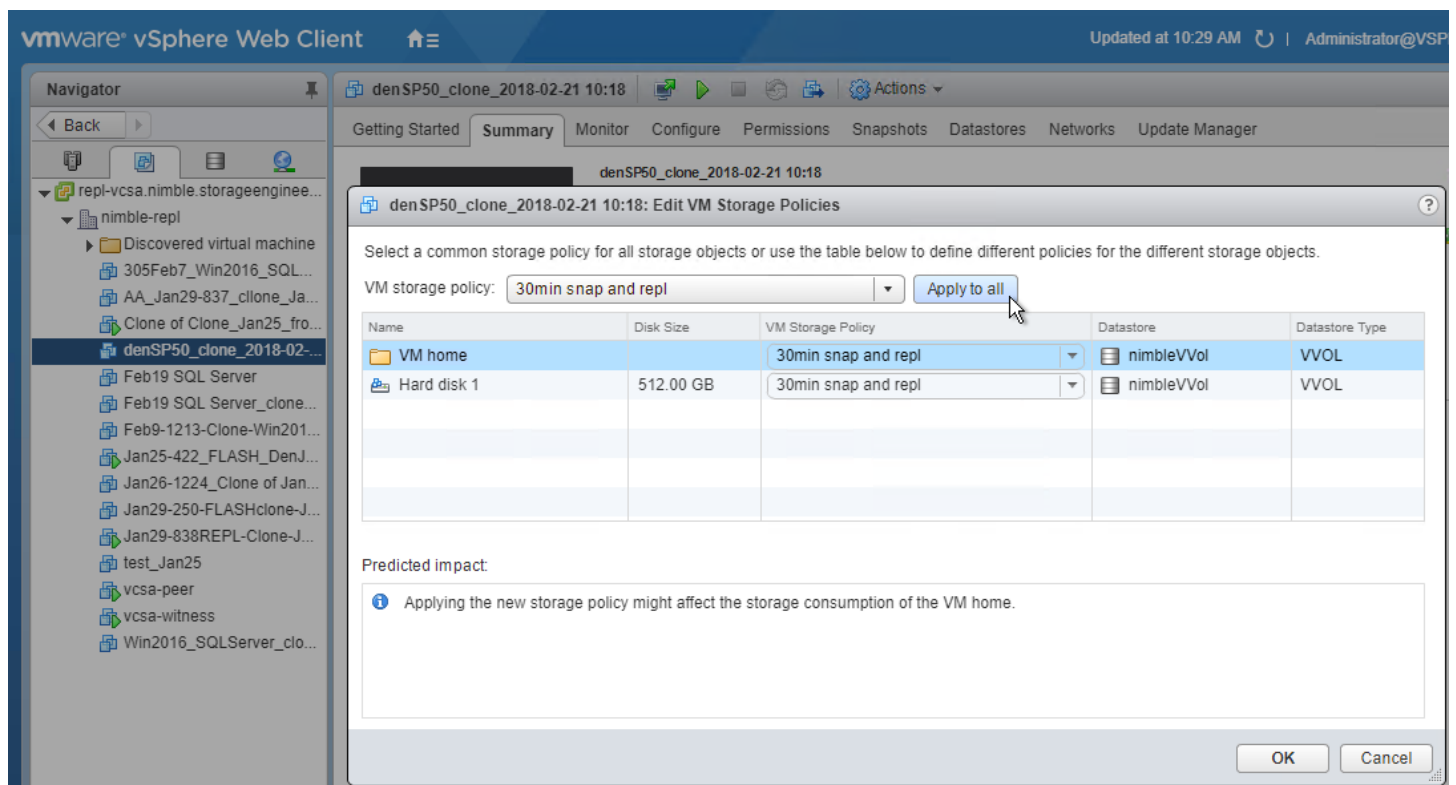
**FIGURE 37.** Apply a storage profile that will snapshot and replicate back to primary HPE Nimble Storage array

For more detail, you can log in to the HPE Nimble Storage array at the secondary site and observe the volume collections: **MANAGE →
DATA PROTECTION → VOLUME COLLECTIONS**, as shown in FIGURE 38. Replicated volume collections are distinguished by the
**REPLICA** notation, as with the original "denSP50" VM. Local volume collections, such as the "denSP50-clone-2018-02-21-10:18" VM, do
not have that identifier.
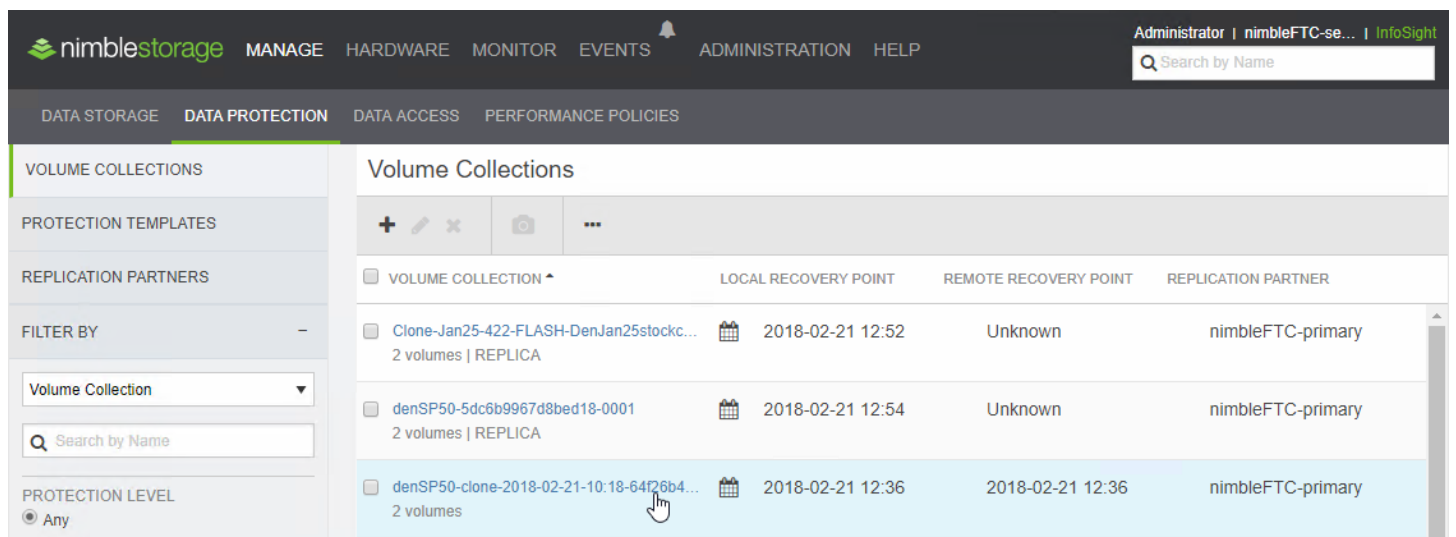


**FIGURE 38.** Volume collection list on remote array. "denSP50" is replicated from primary site while "denSP50-clone" is replicated to primary site

View the replication partnership, **MANAGE→DATA PROTECTION→REPLICATION PARTNERS**, and see that the traffic link is bi-directional, as shown in FIGURE 39.
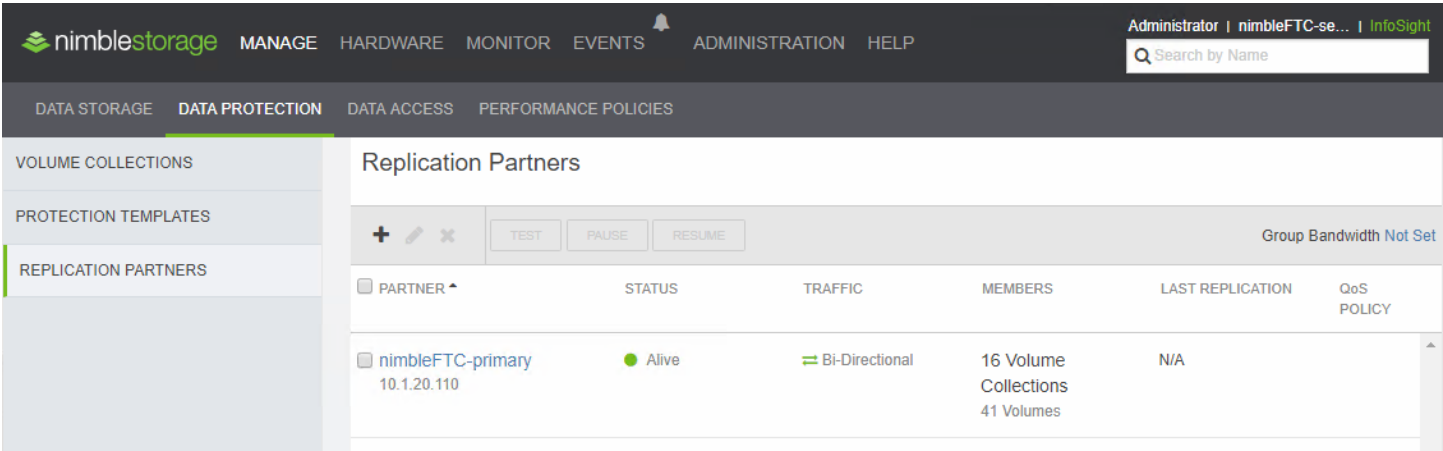


**FIGURE 39.** Bi-directional replication partnership between HPE Nimble Storage arrays

### VSS/AppSync with vVol

This workflow example requires that the three storage policies have been created: OS, SQL Server, and SQL Server Logs. The HPE Nimble Storage AppSync currently supports SQL Server and Exchange; however; only SQL Server is used in this example.

1. Create a Windows Server VM (2008 R2 or newer) and make sure VMware Tools is running.

2. Add additional disks for data and logs: Right click the VM and select **Edit Settings...**

   a. At the bottom of the dialog, click the **New device:** drop-down item and select **New Hard Disk**. Then click **Add**. Do this twice for a total of two disks.

b. Expand the options for each disk. Set the size appropriately and specify the VM storage policies that you created: SQL Server and SQL Server Logs. Setting the policy at this stage ensures the correct application policy is used when creating the volume on the array. See FIGURE 40. Do not change the policy for the OS disk yet. That will be done next.



**FIGURE 40.** Add disks and set VM storage policy

3. Change the policy for the OS disk: right click the VM and select **VM Policies → Edit VM Storage Policies…** Set the OS folder and disk to the "SQL Server (OS)" policy created earlier, as shown in FIGURE 41. Click **OK**. You might notice the storage policy compliance is "Out of Date." This is expected. It will become compliant in a later step when the VM is synchronized with the array.
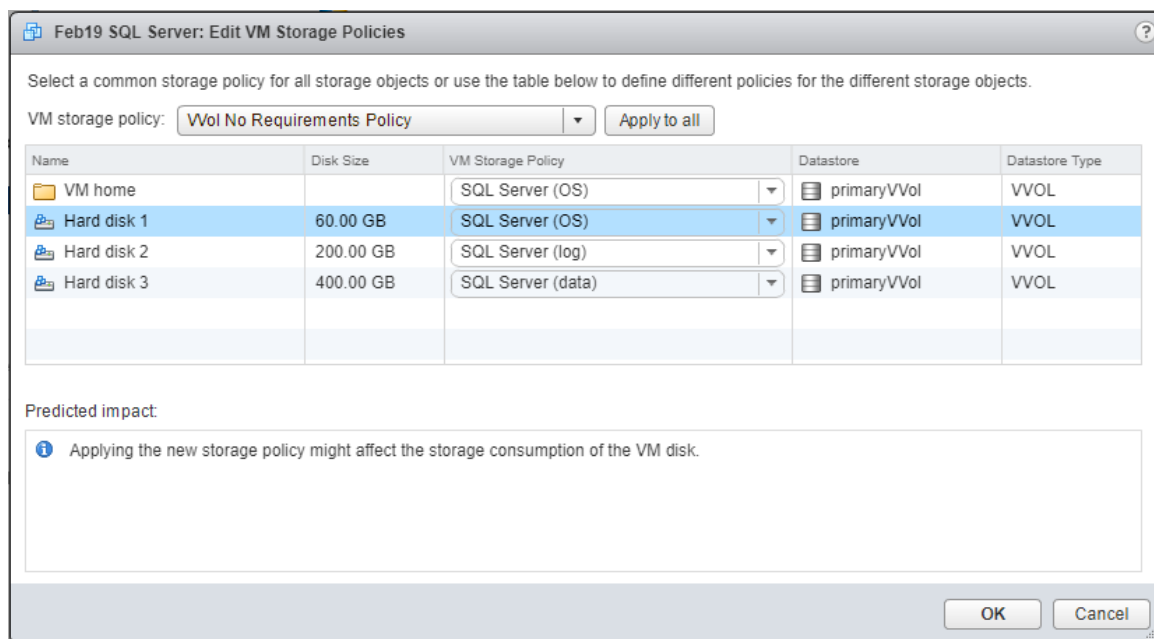
**FIGURE 41.** Modify storage policy for "VM home" and OS disk

4. Install SQL Server. Create or import a database, if desired.

5. Obtain and install the HPE Nimble Storage Windows Toolkit (v5.0.0 or greater)

   a. The latest NWT can be found at infosight.hpe.com/. Navigate to **Resources → Nimble Storage → Software Downloads**.

   b. Find **HPE Nimble Storage Windows Toolkit (NWT)** from the left-hand navigation. Download and run the installer from the SQL Server VM.

   c. Make sure that **Nimble Setup Manager** and **Nimble VSS Services** are checked. For VMware/vVol environments, MPIO is handled at the hypervisor level, so there is no DSM needed for the OS. Uncheck those boxes, per FIGURE 42, and finish the install wizard.
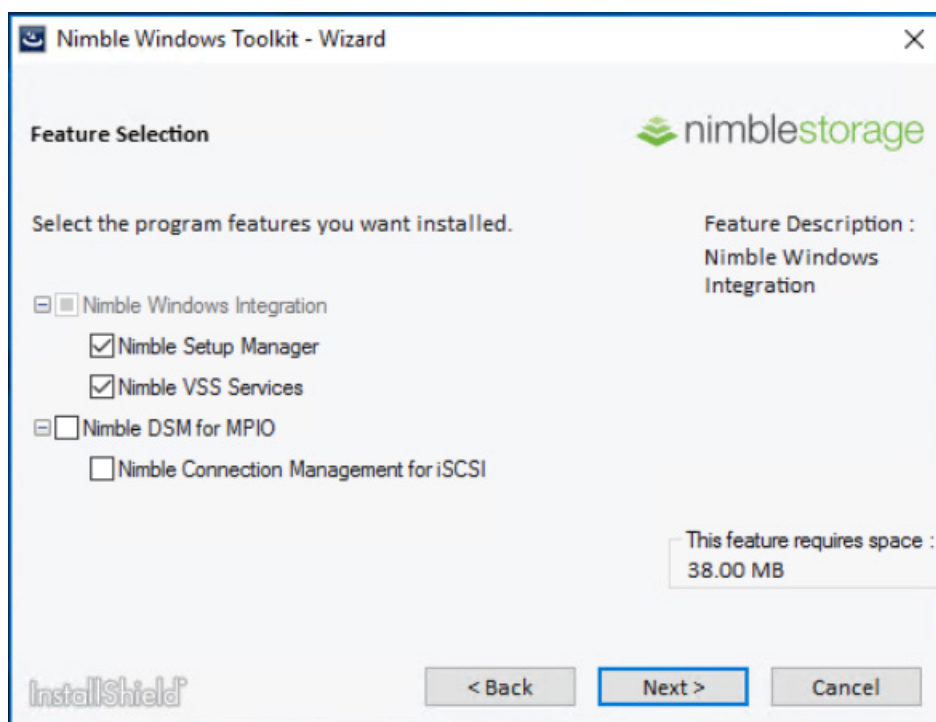


**FIGURE 42.** Enable VSS and uncheck DSM/MPIO

6. From the vCenter UI, invoke the HPE Nimble Storage vCenter Plug-in. Select the SQL Server VM from the list and click the **APP SYNC** button. The **CONFIGURE VSS SYNC** dialog launches, as shown in FIGURE 43. Enter the IP or hostname for the SQL Server and appropriate credentials. Select **MS SQL Server 2016** from the **APPLICATION** drop-down list.
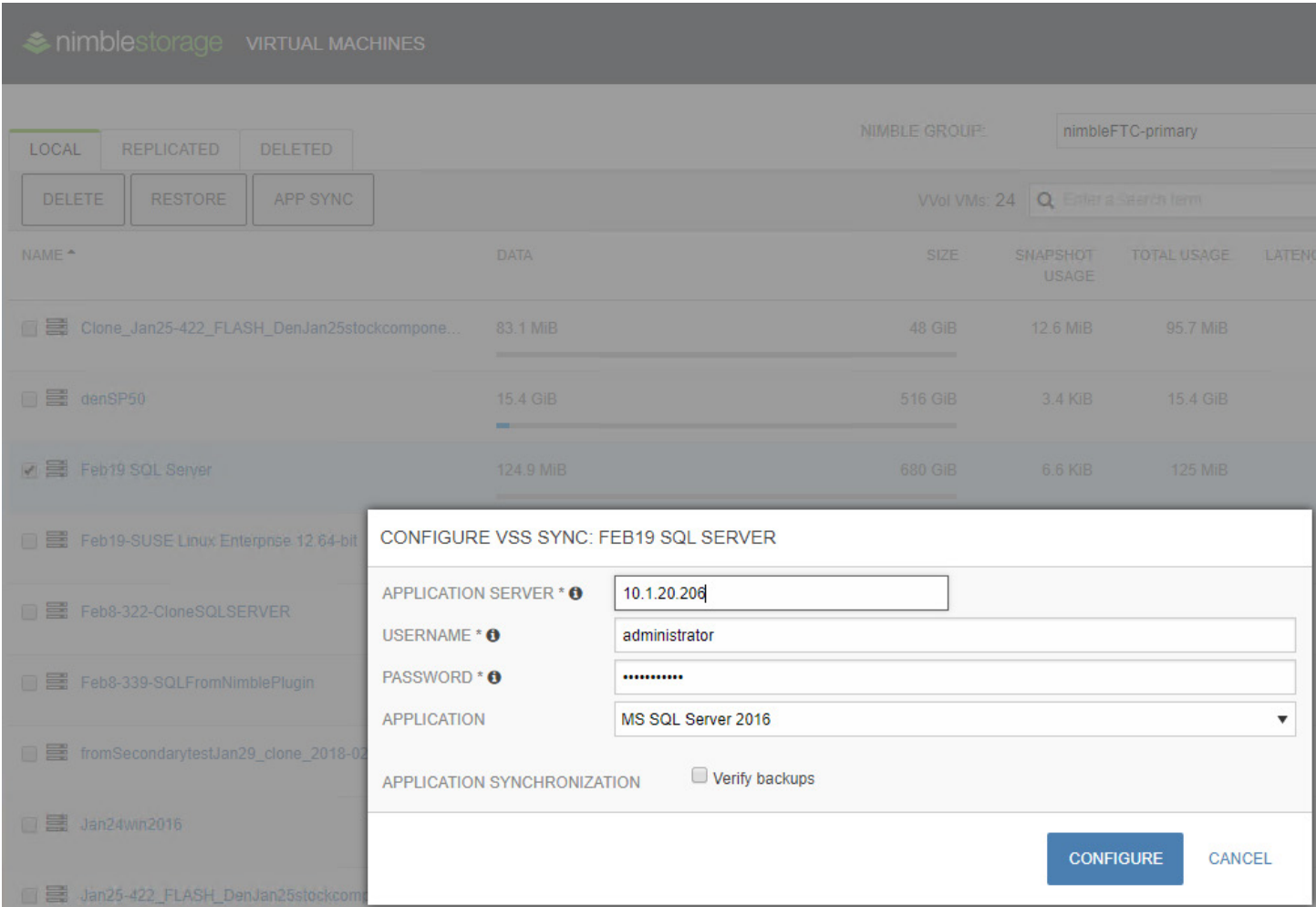


**FIGURE 43.** Synchronize VM with array

7. After the configure VSS tasks are complete, navigate to the VM's **Summary** tab. In the **VM Storage Policies** sub-window, click **Check Compliance**. If this does not refresh the **Last Checked Date**, you might need to reapply the policies. (Right click the VM and select **VM Policies→Reapply VM Storage Policy**.) The policies should now show as "Compliant," as shown in FIGURE 44.
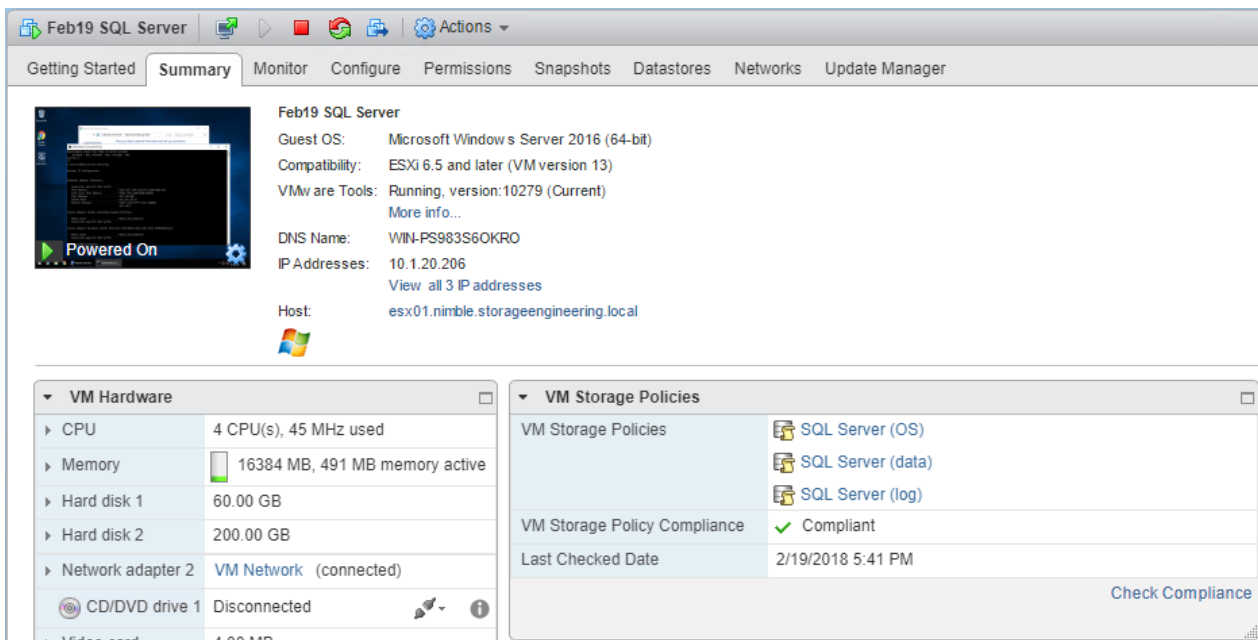
**FIGURE 44.** Policies show as compliant after synchronizing the VM

Snapshots and replication will now occur according to the schedule defined in the storage policies. The volume collection can also be viewed from the HPE Nimble Storage array UI. This is helpful to check status or verify the schedule, as shown in FIGURE 45. No modifications should be made from the array side as everything is managed from vCenter.
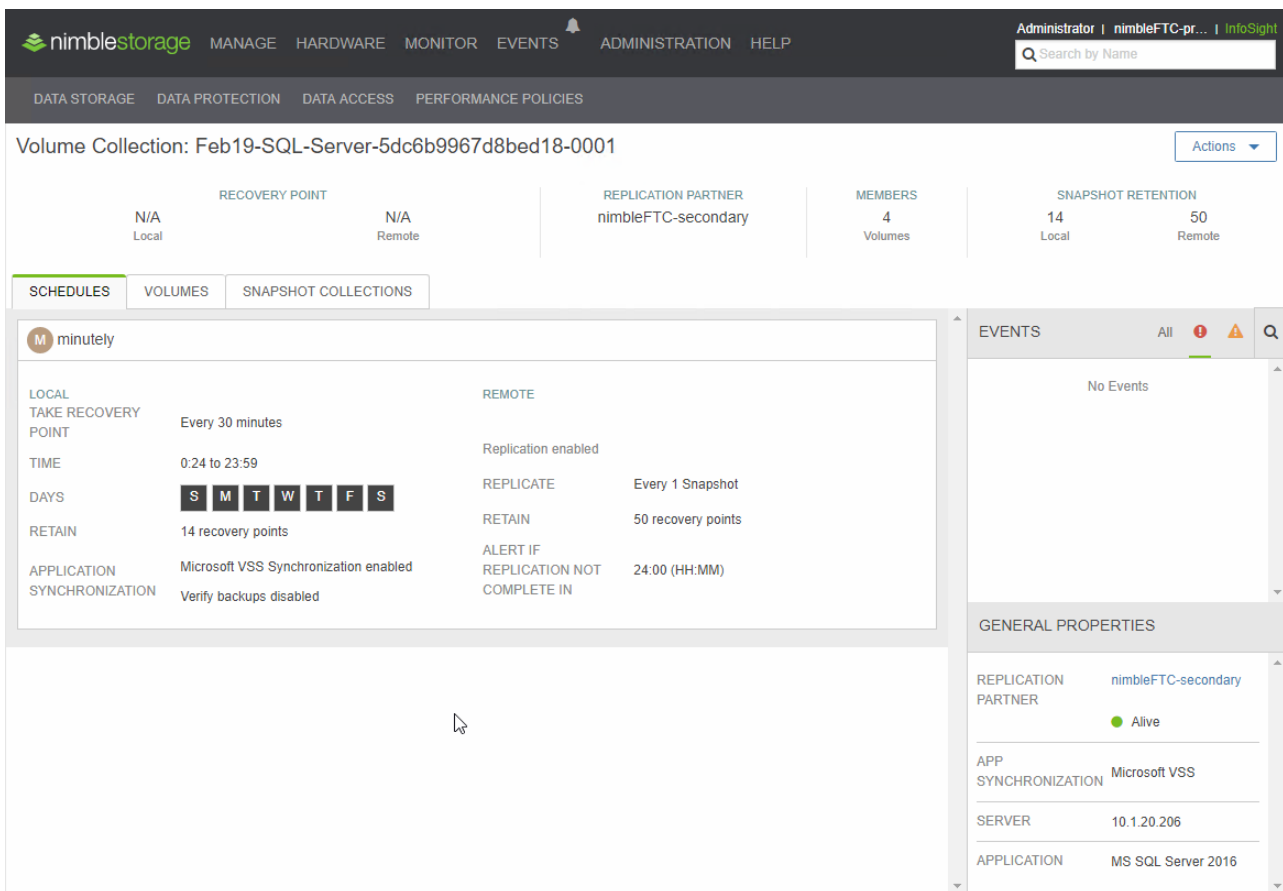


**FIGURE 45.** Volume collection view from array UI

Individual disks can now be cloned from a snapshot, as demonstrated in the second half of this "Recovering a Virtual Disk" video. A potential use case could be to restore a database back to an earlier version, or to clone off a prior state of the database to a new VM for development or test. FIGURE 46 shows the dialog to restore just the data disk, which now shows as "AppSync." Volume restoration is the same process as described above in the Restoring a VM via the HPE Nimble Storage Plug-in in vCenter section.



**FIGURE 46.** Restore only data disk via HPE Nimble Storage vCenter Plug-in

## SUMMARY

VMware vVols increases the granular control and visibility of VMs in deployment. vVols enables the array to perform per-VM operations in the most efficient manner possible, easily configured with VMware's Storage Policy Based Management.

This guide has outlined GUI-based workflows for restoring, undeleting, snapshotting, and replicating individual VMs. After initial configuration, all management is handled from within the vSphere client, without assistance from a storage administrator.

This integration of HPE Nimble Storage OS 5 and VMware vCenter effortlessly combines the full suite of HPE Nimble Storage array features with the latest in vVols capabilities offered in vSphere 6.5.

# RESOURCES AND ADDITIONAL LINKS

HPE Nimble OS 5 GUI Administration Guide,
infosight.hpe.com/InfoSight/media/cms/active/public/pubs_GUI_Administration_Guide_NOS_50x.whz/index.html

HPE Nimble OS 5 VMware Integration Guide,
infosight.hpe.com/InfoSight/media/cms/active/public/pubs_VMware_Integration_Guide_NOS_50x.whz/index.html

HPE Nimble OS 5 Windows Integration Guide,
infosight.hpe.com/InfoSight/media/cms/active/public/pubs_Windows_Integration_Guide_NWT_5_0_0.whz/index.html

HPE Nimble OS 5 and vVols demo video
youtube.com/watch?v=oGEHybTgM10

HPE Nimble OS 5 and Application Snapshots with vVols demo video
youtube.com/watch?v=bJY_zZ8-6MA

HPE Nimble Blog: *eVVolving with the latest NimbleOS 5.0*
community.hpe.com/t5/HPE-Nimble-Storage-Tech-Blog/eVVolving-with-the-latest-NimbleOS-5-0/ba-p/6987781

HPE Nimble Blog: *HPE Nimble Storage brings to life application consistent snapshots using VSS for vVols*
community.hpe.com/t5/HPE-Nimble-Storage-Tech-Blog/HPE-Nimble-Storage-brings-to-life-application-consistent/ba-p/6987801

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