EAM/BDIS RFP Attachment C

Concept of Operations

New York State
Department of Transportation
Enterprise Asset Management Program
Bridge Data Information System

April 9, 2010
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1. **INTRODUCTION**

This document describes a notional Bridge Data Information System (BDIS) in terms of the user needs it will fulfill, its relationship to existing NYSDOT systems or business processes, and the ways it will be used by the NYSDOT. The purpose of this attachment is to augment the functional requirements contained within the RFP, providing a high-level notional description of how NYSDOT envisions the use of the BDIS. This will help offerors understand the operational concept of the BDIS and how it will be integrated into the work processes of the agency.

1.1 **Overview**

This attachment outlines the operational concepts needed to achieve NYSDOT’s vision for a comprehensive BDIS application. The vision identified by NYSDOT is to have a single application that meets the functional needs of the NYSDOT Office of Structures, replacing the current collection of loosely coupled separate applications and databases used to collect, store, and process inventory and inspection data on New York State bridges and large culverts.

This document summarizes the results of numerous project team meetings and work sessions to understand the current NYSDOT bridge management system and the changes needed to evolve it into the envisioned Bridge Data Information System. This document was primarily developed to address the capabilities needed by bridges. While Large Culverts, Sub-Structure Units, and Fathometer Inspections (surveys) are mentioned throughout this document, the required capabilities for these inspections have not been rigorously reviewed. Additionally, the processes defined in this document continue to evolve and will need to reviewed prior to implementation. This concept of operations is described in terms of: the operational needs that the new system will fulfill; its relationship to existing systems or procedures; and the manner in which it will be used.

- Section 1, Introduction, provides background on the purpose and content of this document.
- Section 2, Current System (As-Is), summarizes relevant information about the current business process and systems used to support NYSDOT bridge management.
- Section 3, Operational Concept, provides a high-level view of the proposed new system and illustrates in a conceptual way how the system should be structured to meet project stakeholder needs.
2. CURRENT SYSTEM

2.1 Background

The NYSDOT is responsible for managing bridges and large culverts (henceforth referred to collectively as structures) by regional jurisdiction in accordance to NY State and Federal regulations. Bridges are structures that have a span of over 20 feet. Large culverts are structures that have a span of between 5 and 20 feet. The eleven NYSDOT regional offices are responsible for managing the inspection of the structures. NYSDOT regional offices and consultants are responsible for scheduling and conducting structure inspections, inventory verification, issuing flags, and other assorted field activities. NYSDOT Main Office oversees these activities to ensure that all structure activities are thorough, performed, and recorded on time.

2.1.1 Structure Management Systems

The applications that comprise NYSDOT’s existing structure management system were slowly built through years of in house development based on the business needs and technology available to the program area at that time. The structure management system’s main functions were to manage, track, report and store inspection and inventory information for bridges and large culverts. The current structure management system is comprised of many separate applications and databases including:

- BDMS (Bridge Data Management System)
- BIPPI (Bridge Inspection Program – Pen Information)
- CISBOLTS (Culvert Inspection System Bridge Online Transaction System)
- Collision Vulnerabilities Database
- Concrete Details Vulnerabilities Database
- Data extracts (Visual Basic, PL SQL and Access)
- Diving Inspection Database
- Flag Tracker
- Flood Watch List
- Historic Bridge Data Database
- Hydraulic Vulnerability Database
- LCIS (Large Culvert Inspection System)
- Overload Vulnerabilities Database
- Post Flood Inspection ListScour Critical database
- Seismic Vulnerabilities Database
- Steel Details Vulnerabilities Database
WinBOLTS (Windows Bridge Online Transaction System)

VIRTIS Database

BIPPI was first used by NYSDOT inspection teams in 1998 to help electronically manage inspection data. Over the years, inspection teams have devised countless timesaving techniques ranging from simple but effective modification of standard forms, to the use of copiers and computers to reduce handwriting and transcription. WinBOLTS was leveraged by NYSDOT as an inventory management solution to store, edit, and display bridge inventory data. CISBOLTS was leveraged by NYSDOT as an inventory management solution to store, edit, and display large culvert inventory data.

Flag Tracker is an in-house developed Microsoft Access Database used to track defects (flags) on structures with issues that need to be resolved.

BIPPI was recently modified for use in performing large culvert inspections. CISBOLTS was also recently developed, based on WinBOLTS, for use in managing large culvert inventory.

VIRTIS is an AASHTOware product that is used to calculate load ratings on bridges.

Other unsupported dBASE and Access Databases have been developed by various NYSDOT departments to leverage the bridge information technology to meet the specific needs and responsibilities of that organization. However, many of NYSDOT’s departments have minimal direct contact/access with the centralized electronic storage of the bridge inventory and inspection data, and are reliant upon custom designed updates being pushed out to the user community on a scheduled basis for each of the specific user groups.

2.1.2 Other Related NYSDOT Systems

2.1.2.1 Roadway Inventory System (RIS)

The New York State Roadway Inventory System (RIS) is NYSDOT's primary web application for storing, maintaining and reporting highway condition, characteristic, pavement and administrative data. The RIS system is comprised of an online data maintenance application and data store for reporting. The Highway Data Services Bureau (HDSB) is the main user group for the RIS application.

HDSB uses RIS to define, store and maintain NYSDOT's Milepoint linear referencing system. Information from RIS is distributed to NYSDOT Main Office and Regional users in annually recurring reports, which include state and federal reports and ad hoc data extracts.

HDSB and the ITD GIS unit work to keep the RIS LRS and GIS route system in synch on an annual basis. All of RIS' state routes and federal-aid eligible roads are mapped in GIS. The GIS representation of RIS' routes and roads provides the foundation for other data sets to be integrated spatially to the Milepoint LRS.

BDIS users will record Milepoint information obtained from RIS related to a structure location.
2.1.2.2 Safety Information Management System (SIMS)

The New York State Safety Information Management System (SIMS) is used to organize and access the sufficiency data, volume data, and accident data in a series of relational tables that allow users to log into the system and perform a number of queries necessary for Highway Safety Investigations, special investigations and Capital projects. This system requires a linear referencing system to create geographic locations for all the features to be used in the application.

As part of the SIMS application, NYSDOT maintains a database of motor vehicle crashes occurring on both the state and local systems. Two different linear referencing systems were created to identify the location of these crashes. The reference marker system was created and installed along New York State Touring routes and other highway facilities that are New York State maintained and a Link/Node system was developed for those roadways under local jurisdiction.

For the state system, using Reference Markers to geographically locate traffic accidents makes it possible to identify the highway characteristics that are associated with these traffic accidents and creates historical traffic accident data that can be used in benefit/cost analyses of particular treatments. The reference markers are spaced approximately 1/10th of a mile apart and are identified by a unique id consisting of Region, route, county, municipality and sequence information. The SIMS interface allows users to enter a reference marker or range of reference markers and a time period, and produces a number of different reports listing or summarizing the crash data for that segment of highway. Other aspects of the application run complex analyses of the entire state system to identify the high accident locations (HAL’S) and Priority Investigation Locations (PIL’S), and calculates average accident rates for each type of highway (i.e. Divided, undivided, rural, urban, arterial, collector, etc.). The system also allows select users to update or add Reference Markers when new routes are created or roadway realignments occur, keeping the database current and accurate.

BDIS users will record Reference Marker information obtained from SIMS related to a structure location.

2.2 Description of Current Processes

The current structure management system processes are utilized by NYSDOT staff as well as contractors to perform the following functions:

- Schedule and assign the inspections to state and consultant inspection teams.
  - NYSDOT staff works to ensure that all bridge inspections, large culvert inspections, underwater inspections, and fathometer inspections (surveys) are scheduled according to each structure’s specified intervals.
  - Currently, inspections are scheduled each year through a process involving draft schedules generated by the main office and reviewed and modified and certified by regional offices or authorities. The main office sends out the certified schedule to the regional offices, consultants, and authorities via a Monthly Progress Report database. The Inspection Team Leaders are assigned bridge inspections to perform along with due dates.
Underwater Inspections are currently scheduled for each sub-structure unit as required, using a separate scheduling database. The schedule is routed to the regional offices for comments in the same manner as the Bridge Inspection schedule prior to the distribution of the certified schedule to the consultants.

Fathometer inspections (surveys) are currently scheduled for each bridge as required, using a separate scheduling database. The schedule is routed to the regional offices for comments in the same manner as the Bridge Inspections.

- **Issue Flags**
  - During any inspection or visit to the structure, any structural defects or safety issues will be noted and recorded as flags. In the event that the identified condition requires Prompt Interim Action, the person that identified the condition will contact the Regional Flag Coordinator immediately to arrange for the condition to be addressed.

- **Perform Inspections.**
  - The inspection teams will perform the scheduled inspection as well as record any structure inventory updates identified while at the bridge site, and then submit the inspection report to Quality Control for review and approval. As part of the inspection, any necessary safety assessments will be performed.
  - Quality Control (QC) will either approve the inspection report or return it to the Inspection team for correction.
  - QC approved inspection reports will go to Quality Assurance where they will receive a full review, a partial review, or a pass. Any inventory updates will be reviewed by BDSU. If the inspection report is accepted by QA, and any inventory updates are accepted by BDSU, the data will then go to the Bridge Data Systems Unit to be uploaded into BDMS. QA may reject the inspection report back to Quality Control for correction. BDSU may reject the inventory updates back to Quality Control for correction.
  - Accepted inspection data cannot be uploaded to BDMS until pending inventory edits for inspected bridges have been accepted and uploaded to BDMS by the Bridge Data Systems Unit.
  - Underwater Inspections include diving videos. Underwater Inspection reports currently include photos and are submitted in paper form only. Video and photos are part of inspection, but video is not included in the reports.
  - Inspectors will complete bridge vulnerability reassessment forms, if needed.

- **Maintain structure inventories**
The Bridge Data Systems Unit will maintain the inventory of structures in the Bridge Data Management System (BDMS) database. All modifications to structure inventory are reviewed and approved by BDSU staff prior to being included in the official NYSDOT inventory.

- Perform structure vulnerability assessments.
- Perform load ratings.
  - Determination of the live load carrying capacity of a newly designed or existing bridge will be performed by developing a fully documented engineering analysis (Level I), a computer generated analysis (Level II), or by estimating the capacity of the bridge (Level III) using a provided algorithm.
- Perform Post Flood Inspections.
  - Bridges are added to a flood watch list if they have a high susceptibility to failure from hydraulic forces. Bridges on this list need to be continually or periodically monitored during periods of Flood Warning as issued by the National Weather Service.
  - Bridges on the flood watch list need to be inspected for damage following a major flood event.
- R-posting.
  - Users R-Post bridges to restrict specific overweight permit vehicles. Specific R-Posted bridges can be determined to be acceptable to allow specific lighter divisible load vehicles, and thus be designated as a waivered R-Posted bridge.
- Posting.
  - Regional users can change posting information for a structure.
- Permits.
  - Load Rating Engineers can designate a load capacity rating to utilize for permitting, as well as provide note information to be utilized when reviewing overweight permits.
- Receive and record bridge inspection reports for bridges not inspected by NYSDOT located within New York State.
- Generate the required bridge owner Federal, State, and Department reports. NYSDOT is responsible for reporting on all bridges located within New York State.
The Bridge Data Management System (BDMS) database currently serves as the central repository for the inventory and inspection data, receiving the data from a number of internal and external sources as depicted below in Figure 1. The BDMS only provides the ability to manage the data, and does not provide workflow processing capabilities. The workflow processing needs of the inventory and inspection processes are currently handled outside the system via individual database applications, email and phone calls as necessary. The detailed processes used for the inventory and inspection of the bridges and large culverts are described in detail in the manuals noted in Table 1 of Attachment B, System Requirements.

![Figure 1 Current BDMS Data and Process Flow](image-url)
2.3 Current System Users

There are a number of different users of the current BDMS data, and bridge related applications as shown in Table 1. Some of these are direct users of the system or data, which means they actively use the system to create, modify, or integrate the data in the performance of their duties. Others are indirect users, such as the Thruway Authority, who provide the data from their bridge inspections to the system but do not directly access the system.

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Administrator</td>
<td>Staff responsible for managing the BDMS, providing system assistance, and maintaining security levels.</td>
</tr>
<tr>
<td>Bridge Data Systems Unit (BDSU)</td>
<td>Main Office staff responsible for overseeing bridge inventory, processing the electronic file (inventory and inspection data), excluding the load rating data, reviewing inventory updates and performing systemic checks on data.</td>
</tr>
<tr>
<td>Bridge Design Unit or Consultant</td>
<td>Responsible for providing Level I Load ratings to BDMS.</td>
</tr>
<tr>
<td>Bridge Inspection Unit (BIU)</td>
<td>Main Office staff responsible for oversight of all Bridge Inspection Data including Underwater and Fathometer Data and generates schedules, reports and training materials. Manages Bridge Flag Database. Performs inspection QA.</td>
</tr>
<tr>
<td>Bridge Maintenance Engineer (RME)</td>
<td>Responsible for resolution of flags initiated.</td>
</tr>
<tr>
<td>Bridge Safety Assurance Unit (BSA)</td>
<td>Main Office staff assigned to oversee bridge vulnerabilities, permits and includes the Load Rating Unit.</td>
</tr>
<tr>
<td>Underwater Inspection Consultant</td>
<td>Responsible for submission of Underwater Inspection Data, reports, photos, texts, sketches and Flags</td>
</tr>
<tr>
<td>Underwater Project Manager</td>
<td>Responsible for reviewing the underwater inspection results submitted by the Underwater Inspectors.</td>
</tr>
<tr>
<td>Inspection Team Leader (TL)</td>
<td>For Structures designated as Bridges: Responsible for generating inspection reports, updating inventory data, initiating/editing flags, uploading photos, uploading sketches, updating VIRTIS Files. May be state or consultant staff.</td>
</tr>
<tr>
<td>Assistant Team Leader (ATL)</td>
<td>Assists the Inspection Team Leader by updating inventory data, renaming/uploading photos, managing sketches. May be state or consultant staff.</td>
</tr>
<tr>
<td>Load Rating Unit</td>
<td>Main office staff responsible for approving load ratings submitted by the regional office load rating unit.</td>
</tr>
<tr>
<td>Main Office Liaison Engineer (MOLE)</td>
<td>Main Office staff that performs QA review and checks each submission, creates and distributes reports, reviews and submits Authorities (including the Thruway Authority) inspection data into BDMS.</td>
</tr>
<tr>
<td>Other Authority Scheduler</td>
<td>Other Authority staff who provide inspection schedule data once per fiscal year.</td>
</tr>
<tr>
<td>Quality Control Engineer</td>
<td>Reviews each Bridge Inspection Report, returns to inspector or approves and creates a submission of one or more Inspection reports. May be State or consultant staff.</td>
</tr>
<tr>
<td>Regional Bridge Inventory &amp; Inspection Coordinator (RBIIIC)</td>
<td>Responsible for updating the inventory, oversee the collection and processing of the data in the regional offices</td>
</tr>
<tr>
<td>Regional Flag Coordinator</td>
<td>Responsible for tracking and reporting Flags</td>
</tr>
<tr>
<td>Title</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Regional Inspection Unit</td>
<td>Regional staff responsible for regional bridge inspections.</td>
</tr>
<tr>
<td>Regional Load Rating</td>
<td>Responsible for inputting load ratings into the queue for the Main Office Load Rating Unit to perform quality assurance on.</td>
</tr>
<tr>
<td>Engineer</td>
<td></td>
</tr>
<tr>
<td>Regional Offices</td>
<td>Responsible for update of Department Bridge Inventory Data System, create and maintain Bridge Flag database.</td>
</tr>
<tr>
<td>Regional Office Staff</td>
<td>Regional Office Staff are responsible for maintaining bridge information for the regional NYSDOT Offices. Regional Office Staff may roles include:</td>
</tr>
<tr>
<td></td>
<td>• Regional Bridge Management Engineer</td>
</tr>
<tr>
<td></td>
<td>• Regional Bridge Evaluation Engineer</td>
</tr>
<tr>
<td></td>
<td>• Regional Structures Engineer</td>
</tr>
<tr>
<td></td>
<td>• Regional Load Rating Engineers</td>
</tr>
<tr>
<td></td>
<td>• Regional Hydraulic Engineer</td>
</tr>
<tr>
<td>Regional Schedule Manager</td>
<td>Regional staff who oversee and manage a respective NYSDOT region’s scheduling of bridge inspections, maintaining the on-going status of each inspection and providing monthly status updates to the Main Office.</td>
</tr>
<tr>
<td>Schedule Manager</td>
<td>The Main Office staff assigned to oversee and manage schedule information.</td>
</tr>
<tr>
<td>Senior Culvert Inspector (SCI)</td>
<td>For Structures designated as Large Culverts: Responsible for generating inspection reports, updating inventory data, initiating/editing flags, uploading photos, uploading sketches. May be NYSDOT staff or consultant staff.</td>
</tr>
<tr>
<td>Assistant Culvert Inspector (ACI)</td>
<td>Assists the Senior Culvert Inspector by updating Inventory data, renaming/uploading photos, managing sketches. May be State or Consultant staff.</td>
</tr>
<tr>
<td>State Design Engineers (SDE)</td>
<td>Responsible for Project Data.</td>
</tr>
<tr>
<td>Thruway Authority Scheduler</td>
<td>Thruway Authority staff who oversee and manage Thruway Authority scheduling of bridge inspections, maintaining the on-going status of each inspection and providing monthly status updates to NYSDOT main Office.</td>
</tr>
<tr>
<td>View-only User</td>
<td>Staff with view-only rights to schedule data.</td>
</tr>
</tbody>
</table>
Table 2 shows an estimate of the current user volume for the suite of applications and databases that supports the structure inventory, inspection, and safety activities.

<table>
<thead>
<tr>
<th>Table 2, User Volume</th>
<th>Count</th>
<th>Data Access</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bridges User Volume</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assigned BIPPI Machines (Consultant)</td>
<td>119</td>
<td>R/W</td>
</tr>
<tr>
<td>Assigned BIPPI Machines (State)</td>
<td>67</td>
<td>R/W</td>
</tr>
<tr>
<td>Main Office Inspection/Inventory/Authority Entry Work (MOLES-BDSU)</td>
<td>18</td>
<td>R/W</td>
</tr>
<tr>
<td>Projected extra inspection users requesting access (Consultant Project Managers/Sub Contractors, Extra teams on Engineering Review Boards)</td>
<td>15</td>
<td>R/W</td>
</tr>
<tr>
<td>ITD/user-security-data management.</td>
<td>7</td>
<td>R/W</td>
</tr>
<tr>
<td>WinBOLTS Users (Main office= 310 Region office=1040)</td>
<td>1350</td>
<td>R</td>
</tr>
<tr>
<td>* Local/Authority bridge owners requesting access</td>
<td>728</td>
<td>R</td>
</tr>
<tr>
<td>* State Emergency Management Office/FEMA</td>
<td>20</td>
<td>R</td>
</tr>
<tr>
<td>* Highway/bridge design firms/vendors doing work</td>
<td>20</td>
<td>R</td>
</tr>
<tr>
<td>* Bridge Maintenance and other currently disconnected regional WinBOLTS users in the state</td>
<td>10</td>
<td>R</td>
</tr>
<tr>
<td>* Academic institutions (RPI, Cornell MIT etc)</td>
<td>5</td>
<td>R</td>
</tr>
<tr>
<td><strong>Large Culvert User Volume</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assigned BIPPI Machines (Consultant)</td>
<td>6</td>
<td>R/W</td>
</tr>
<tr>
<td>Assigned BIPPI Machines (State)</td>
<td>25</td>
<td>R/W</td>
</tr>
<tr>
<td>* Main Office Inspection/Inventory/Authority Entry Work (MOLES-BDSU)</td>
<td>3</td>
<td>R/W</td>
</tr>
<tr>
<td>* ITD/user-security-data management.</td>
<td>2</td>
<td>R/W</td>
</tr>
<tr>
<td>* Local/Authority bridge owners potentially requesting access</td>
<td>11</td>
<td>R</td>
</tr>
<tr>
<td>* Bridge Maintenance and other currently disconnected regional WinBOLTS users in the state</td>
<td>11</td>
<td>R</td>
</tr>
<tr>
<td>* Residencies</td>
<td>80</td>
<td>R</td>
</tr>
<tr>
<td><strong>Underwater Inspection User Volume</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Inspection Teams, Quality Control Engineers, Quality Assurance Engineers.</td>
<td>23</td>
<td>R/W</td>
</tr>
<tr>
<td>* Additional users statewide</td>
<td>7</td>
<td>R</td>
</tr>
<tr>
<td><strong>Total User Count</strong></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- ~ indicates users are included in WinBOLTS as Read Only
- * indicates best guess
- R indicates Read Only Access
- R/W indicates Read/Write Access
2.4 **NYSDOT Technical Environment**

The NYSDOT technical environment is managed by the Information Technology Division at the NYSDOT Main Office located on Wolf Road in Albany. The computer hardware and databases used in support of the BDIS will be configured to support multiple processing environments that are logically, and in some cases, physically separated. The separation of computing resources is necessary to prevent ongoing development and testing activities from conflicting with each other or with the production system, and allows the controlled implementation of new functionality and software patches. The NYSDOT technical environment consists of four logical and physical tiers: Development, Test, Quality Assurance and Production.

2.4.1 **Code Migration and Testing Tiers**

2.4.1.1 **Development Tier**

The Development Tier is the environment where integrators will develop, modify and test software code. NYSDOT ITD utilizes the development environment to perform unit testing. Unit testing is the most ‘micro’ scale of testing and validates a particular function or specific section of code. These tests are written and performed by developers, require detailed knowledge of the internal program design and cover things like statements, branches, conditions and paths. Unit test should also include the preliminary testing of interfaces (exchanges of data or control) with other systems.

2.4.1.2 **Test Tier**

The Test Tier is the environment used for Functionality, User Interface, Security and (optionally) System Interface testing. Functionality testing is a collaborative effort conducted by developers, testers and end users which requires no knowledge of the internal design. It is software testing that evaluates the system's overall compliance with its specified functional requirements and behavior versus the expectations of the customer. Intra-system testing includes:

- **Functionality testing** - Verification that the individual components flow and function effectively as one integrated system.

- **User Interface testing** - Verification that the Graphical User Interface (GUI) meets its written specifications, including look and feel ('user-friendliness'), handicap compliance, drop downs, lists of values, validity checking, etc.

- **Security testing** - Verification that the system protects data while enabling functionality as intended. The six basic elements that should be addressed, regardless of the method used to implement security are: confidentiality, integrity, authentication, authorization, availability and non-repudiation.

- **Static testing** – The Intra-system test phase is where activities such as desk checks, code reviews and peer reviews intended to find and fix mistakes should be conducted. Code reviews allow the transfer of knowledge and best practices from the more experienced staff to the less experienced.
• System Interface testing - System Interface testing seeks to validate the quality of the interfaces between independent systems. This includes all exchanges of data or control, file extracts and/or reports into the system being tested, as well as to all other internal and external systems. System Interface testing may also be performed utilizing the Quality Assurance Tier.

2.4.1.3 Quality Assurance Tier

The Quality Assurance (QA) tier is the environment used for system interface (optionally) and enterprise integration testing comprising Performance, Recovery and Operational testing.

Enterprise Integration testing validates that all necessary interfaced enterprise services and components will function as designed in the production tier. Enterprise Integration testing includes:

• Performance testing - a set of tests (stress, load, etc) that are used to determine the stability of the system under a variety of operational conditions, from normal to extreme, often to a breaking point. Performance tests seek to reveal the system’s robustness, availability, and error handling under heavy loads to ensure that the software doesn't crash due to insufficient resources (memory, disk space, number of connections, network capacity, etc), high concurrency, denial of service attacks and the like. Performance tests are also used to determine the speed or effectiveness of a computer, network, software program or device.

• Recovery testing - the activity of testing how well an application is able to recover from crashes, hardware failures and other similar problems.

• Operational testing - verifies that all enterprise components that were insufficiently tested, or not tested at all, during prior phases are functioning as intended, including: Citrix, GIS, LDAP or OID, mobile devices, Portal, Tidal, Business Objects, etc.

• User Acceptance testing - User acceptance is the point in time when the customer, using as a basis the collective results of prior testing and exposure to the system, acknowledges that the system meets the predefined criteria for that phase and may move to the next phase of an implementation.

• Regression testing - Regression testing focuses on finding defects (previously working functionality that has stopped working) after changes to the code or the operating environment have taken place. The extent of testing will depend on the magnitude of the changes and/or the level of risk to the organization should the software fail. NYSDOT strives to fashion easily repeatable, preferably automated, tests to help streamline regression testing efforts. A sanity test or sanity check is a basic type of regression test used to quickly assure that the application or system works as expected.

2.4.1.4 Production Tier

The Production Tier is the operational environment operational application utilization.
2.4.2 **NYSDOT Technical Environment Access Rules**

Applications that require customizations will be installed, customized, and tested in the Development Tier. Fully tested installation and data migration scripts will need to be provided in order to move applications and data to the Test, Quality Assurance and then Production Tiers.

Commercial applications that do not require any customizations can be installed in the Test Tier by Consultants. Fully tested installation and data migration scripts will be provided in order to move applications and data to the Quality Assurance and then Production Tiers.

2.4.3 **Installation Packages**

NYSDOT requires generic, repeatable installation packages or scripts which contain all necessary application, DDL or data migration logic that can be run with little or no modification on any application server or database tier. Neither developers nor vendors are granted permissions or access to tiers other than development.

Converted data, stored in ASCII text files, must follow standard data loading procedures. Supported options are:

- **Oracle SQL*Loader.** Create a SQL*Loader control file and UNIX shell script to utilize the Oracle SQL*Loader utility for loading the conversion data.

- **Oracle Bulk Load using ‘External Tables’ feature.** Using the ‘External Tables’ feature of Oracle, the conversion data file is treated as though it is a table. Bulk SQL statements such as “insert into … select * from …” can then be used against these files.

- **Oracle PL/SQL package.** Create custom stored procedures which read converted data and then process and populate the target tables. Advantages of this approach are ease of development, customized yet structured data loading, and excellent error handling capabilities.

The selected process developed must be repeatable in Development, Test, QA and finally run against Production. Data will not be “migrated” from development or test environments into the production environment.
2.4.4 Requirements Traceability Management / Software Configuration Management

NYSDOT uses Rational V.7 tools to manage the software development lifecycle. The following modules are currently licensed and preferred by the NYSDOT:

<table>
<thead>
<tr>
<th>Rational Tool</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requisite Pro</td>
<td>Requirements management</td>
</tr>
<tr>
<td>Rose</td>
<td>Systems modeling</td>
</tr>
<tr>
<td>Functional Tester</td>
<td>Automated testing</td>
</tr>
<tr>
<td>Rational Robot</td>
<td>Automated testing</td>
</tr>
<tr>
<td>Clear Quest</td>
<td>Change management</td>
</tr>
<tr>
<td>Clear Case</td>
<td>Software management</td>
</tr>
</tbody>
</table>

2.4.5 Hardware Configuration Management / Data Archiving

Client-side hardware is Intel Pentium 3 or 4 based microprocessors, using a Microsoft Windows XP operating system and Internet Explorer 6 web browser.

The UNIX Application Server environment is a three tiered architecture of client, mid-tier, and database consisting of:

- Operating System – AIX 5.3 TL 8 or higher, AIX 6.1 TL 1 or higher
- Application Server – Oracle 10g Application Server 10.1.2.2 or 10.1.3.5
- Forms and Reports Services – Oracle 10g Application Server 10.1.2.2

The Windows Application Server environment consists of the following:

- Windows Server 2003 with Service Pack 2
- Internet Information Server IIS 6.0
- Vendor Applications

Support for applications running in a virtual environment is preferred.

The current NYSDOT file sharing environment is a Microsoft clustered environment using DFS with SAN attached storage.

Client software distribution is accomplished on the NYSDOT network using LANDesk.
2.4.6 Networks

All network communication is done using the TCP/IP protocol.

For all remote access, web applications run in the DMZ using SSL encryption and application based authentication, or run through Citrix.

Network Standards
- Redundant Checkpoint (on Nokia) firewalls.
- Redundant Juniper ISG 2000, provide VPN/ firewall, at the Main Office.
- Redundant F5 Load Balancing (for External Servers/ Application load balancing).
- Redundant F5 Load Balancing (for Internal Servers/Application load balancing).
- Cisco switch/routers support the Main Office WAN and LAN.
- Juniper Firewall/VPN utilized at remote locations for connectivity and security.
- Cisco switch environments support the Regional Office LANs.
- Redundant Internet connectivity consists of: 1-100 Mb circuit for outbound traffic, and 1-30 Mb circuit for Inbound traffic.
- Internal client internet access is configured utilizing ISA proxy servers.
- Enterprise data center in Albany. Network architecture via hub and spoke environment.
- 10 Regional offices with 100 Mb WAN connectivity via NYENET. (New York State private network).
- Approximately 300 remote sites throughout the state connected via T1, Broadband, or DSL.
- Wireless Air-cards are in use for mobile connectivity.

2.4.7 Database

The NYSDOT maintains several commercial RDBMS’s including DB2 and SQL Server, however the preferred database management system for the BDIS is Oracle 10g, which is the NYSDOT’s enterprise database platform. NYSDOT supports both OLTP and warehouse databases at an enterprise level. Bidders should not include the procurement of Oracle in their cost proposals.

NYSDOT ITD also has developed and maintains a number of Oracle stored procedures for the purpose of pushing data to the various applications and their standalone databases to allow their users to operate from the most recent dataset.

2.4.8 Custom Code

The NYSDOT supports a variety of programming languages. Most preferred for custom coding include Java, PL/SQL and Visual Basic. Less preferred but still supported languages include Power Builder, C and Perl.

2.4.9 Backup & Recovery / Disaster Recovery / Business Continuity

Oracle - Backup and Recovery of Oracle environments is handled by Oracle's Recovery Manager in conjunction with Tivoli Storage Manager. A combination of full and incremental backups are taken to ensure point in time recovery.
SQL Server - NYSDOT has two distinct backup strategies for SQL Server, simple or full recovery mode. The backup strategy is dictated by the needs of the application.

- 'Simple' recovery mode: one full backup per day.
- 'Full' recovery mode: one full backup per day plus transaction log backups to ensure point in time recovery.

Backups are completed via one of two methods depending on the operating system. All Unix servers and the Windows NAS clusters, are backed up via the IBM Tivoli Storage Manager (TSM). All other (Windows) servers are backed up utilizing the Symantec Backup Exec environment. Oracle databases are backed up via the Unix servers utilizing the IBM RMAN module which sits on top of the TSM client at the server level. SQL databases are backed up using the SQL backup utility, within Microsoft SQL, that creates a backup file which is then picked up by the Backup Exec runs.

2.4.10 Monitoring

The NYSDOT employs the following monitoring tools:

- NMON (Server utilization)
- Oracle GRID Control (Oracle Application Servers)
- Ciscoworks (Networks)
- CA Spectrum/E-Health (Networks)
- Oracle Enterprise Manager GRID Control (Oracle RDBMS)
- Oracle Statspack (Oracle RDBMS)
- CA Database Analyzer for z/OS (DB2 RDBMS)
- CA Plan Analyzer for z/OS (DB2 RDBMS)
- CA SQL-Ease for z/OS (DB2 RDBMS)
- PerfMon (Windows Application Servers)

2.4.11 Job Scheduling

The NYSDOT utilizes the Tidal (Cisco) job scheduling tool.

2.4.12 System Interfaces

The BDIS will interface with a number of other internal and external systems and databases (Oracle, MS Access, Paradox) on various platforms (Unix, Windows Server, Windows XP), and produce extract files for a variety of purposes and users (see Attachment B, Section 3, BDIS Context Diagram).

2.4.13 Other Enterprise Tools (For Informational Purposes Only)

The NYSDOT licenses and supports a variety of tools for the development and delivery of information systems including: Oracle Application Express, Oracle Warehouse Builder, Business Objects Enterprise XI (Crystal Reports and Web Intelligence). For Geographic Information Systems (GIS), the NYSDOT utilizes ESRI software. The external and internal websites use Oracle Portal.

File transfers to exchange bridge data with inspectors and other agencies have traditionally been performed via a scheduled task on a Windows Server using a file
transfer method such as FTP. The NYSDOT has recently implemented a Remote Managed File Transfer capability, which is the preferred solution for the BDIS.
3. **Operational Concept**

The vision of the BDIS is to have a single application across the NYSDOT enterprise with a centralized database that improves workflow activities, provides better data consistency, and resolves a number of process issues implicit in the stovepipe nature of the current applications and disparate databases. The functional capabilities of the current NYSDOT set of applications that make up the structure management system have set the expectations for the BDIS. NYSDOT has documented the expectations in this operational concept for the integrated BDIS in this section.

This operational concept is provided for informational purposes only. The information contained in this operational concept will need to be reviewed and revised for the processes in place at the time of contract award. This concept will also need to be compared to the proposed system and the appropriate gap analysis will need to be performed in order to ensure that the operational system is complete.

The diagrams contained in this section can be resized to improve readability.
3.1 Business Process Modeling Notation

The BDIS Operational Concept has been modeled in Business Process Modeling Notation (BPMN). It includes business process diagrams that identify the events, activities, and results of a process. In addition, the activities are plotted against the part of the organization in which it takes place – these functions represent swimlanes. The sequence flow is indicated by arrows. Figure 2 provides an example of the notation and Table 3 provides a description of the symbols.

![Business Process Diagram Legend](image)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example BPMN Pool</td>
<td>A Pool represents a Participant in the Process. A Participant can be a specific business entity (e.g., a company) or can be a more general business role (e.g., a buyer, seller, or manufacturer).</td>
</tr>
<tr>
<td>Example Lanes</td>
<td>Lanes are used to organize and categorize activities within a Pool. Lanes are often used for such things as internal roles, systems, an internal department, etc. The meaning of the Lanes is up to the modeler.</td>
</tr>
<tr>
<td>Message Event</td>
<td>The Message Event indicates a message of some type will be either sent or received.</td>
</tr>
<tr>
<td>Timer Event</td>
<td>The Timer will indicate the existence of a time related business rule.</td>
</tr>
<tr>
<td>Link Event</td>
<td>The Link Event indicates a process flow link exists. Links may exist to one of more other processes.</td>
</tr>
<tr>
<td>Business Rule Event</td>
<td>The Business Rule Event Type will indicate that business rules will affect the process flow.</td>
</tr>
<tr>
<td>Start Event</td>
<td>A Start Event is the initiator of the process.</td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>End Event</td>
<td>An End Event is the end of the process.</td>
</tr>
<tr>
<td>Interim Event</td>
<td>An Interim Event depicts an event that occurs during the activities.</td>
</tr>
<tr>
<td>Process</td>
<td>A Process indicates an activity that will be performed in order to achieve a result. Note: A &quot;+&quot; sign in a box indicates that the process has been decomposed in attached business process diagrams.</td>
</tr>
<tr>
<td>Gateway</td>
<td>Gateways are used to control how activity flows interact as they converge and diverge to processes.</td>
</tr>
<tr>
<td>Data Object</td>
<td>Data Objects provide information about how documents, data and other objects are associated with processes.</td>
</tr>
</tbody>
</table>

3.2 Manage Inventory

The Bridge Manage Inventory capability will enable users to:

- Enter/edit/delete and otherwise manage bridge inventory data present in BDIS in compliance with business rules already established by BDSU. Management of the bridge data will include the capability to add entire bridges, remove bridges, replacing span information with fewer, the same, or more spans in order to reflect changes made to the bridges.

- Identify and record information regarding bridges under construction. There are approximately 200 new bridges erected per year and approximately 100 state bridges under rehabilitation each year.

- Import bridge-related data provided by others both within and outside NYSDOT. Specific types of information to be uploaded include bridge replacement cost information, bridge historical data, and bridge work history.

- Record, view, and maintain the bridge vertical clearance data for each major direction of travel.

Figure 3 depicts the processes associated with managing inventory including potential conflicts that can occur when inventory changes are received.
**Needed Functionality and Capabilities**

**BDSU Inventory Update Review**

The BDSU staff will be responsible for reviewing the updates to the bridge inventory data and approving the changes. If inventory problems are identified, the BDSU staff will have the capability to update the inventory data.

**Update Inventory**

This process will provide the capability for the BDSU to resolve minor bridge inventory conflicts.

**Designer Corrects Data Errors**

This process will enable designers to resolve inventory conflicts that were not correctable by the BDSU.

**Correct Region Inventory**

If region inventory problems are identified, the region will have the capability to update the region inventory data.

**Correct Authority Inventory**

If authority inventory problems are identified, the authority will have the capability to update the authority inventory data.

**Update Inventory in Projects**

The new bridge inventory information will be placed in the temporary inventory and when the bridge is opened, the temporary inventory information will be moved to production.
**Update Inventory from Projects to Production**

The Bridge Identification Number (BIN) is normally assigned by BDSU prior to the design of a bridge. The Design Squad (as part of the PS&E package) fills out the bridge inventory. The BIN and the inventory is included in the design report. The bridge inventory is provided to BDSU. BDSU currently enters the inventory into projects. The BDSU or Regional Offices will upload completed bridge construction information from "Projects" to production when the bridge becomes "In Service."

If the BIN is existing, it may be replaced with the new bridge when the inventory is moved to production. Typically the new bridge will have the same BIN as the old bridge. If building two individual bridges to replace a single bridge, BDSU will normally assign a new BIN.

The move of bridge inventory from "Projects" to "Production" should trigger the "Structure is in Service" event.

### 3.3 Schedule Task

The Scheduling capability will provide scheduling functions enabling users to manage the annual and daily scheduling of inspections, tracking the status of scheduled inspections (scheduled, under inspection, completed, etc…), and ensuring that inspections are performed in compliance with State and Federal bridge inspection rules.

Figure 4 depicts the sequence order of the scheduler business processes.

![Figure 4, Schedule Tasks](image-url)
Needed Functionality and Capabilities

Define Task

Based in the inputs received, the BDIS will identify the task that needs to be scheduled. Tasks can include:

- Schedule Biennial Inspection for a bridge according to NYSDOT business rules
- Schedule an Interim Inspection for a bridge according to NYSDOT business rules
- Schedule an inspection for a large culvert according to NYSDOT business rules
- Schedule an Underwater Inspection for a bridge SSU according to NYSDOT business rules
- Schedule an Underwater Inspection for a large culvert SSU according to NYSDOT business rules
- Schedule a Fathometer Inspection (survey) for a bridge according to NYSDOT business rules
- Schedule a bridge special inspection according to NYSDOT business rules

During the course of an inspection or at the completion of an inspection, the system should be capable of scheduling one or more other tasks.

Assign Task Due Date(s)

The system will assign a due date for the next bridge or large culvert task(s). There are a large number of business rules that will define the triggers for this process.

Example 1: For some events, there will need to be multiple due dates assigned. The system shall automatically schedule bridge inspection due dates and types for the next four inspections at the time the current inspection results become official as identified in the Bridge Inspection Manual and National Bridge Inspection Standards (NBIS).

Example 2: For Large Culverts, if the large culvert was structurally flagged or if the last Inspection Condition Rating was <3, schedule an inspection in 1 year; if the last Condition Rating was >=3 and <5, schedule an inspection in 2 years; if the last Condition Rating was >=5, schedule an inspection in 4 years.

Bridges may be owned by NYSDOT or other entities. BDIS will provide a scheduling capability for all bridges defined in the BDIS bridge inventory.

Currently, only Large Culverts owned by NYSDOT will be included in the database.

Assign Structure Identifier

The BDSU will assign a new structure identifier and record all known mandatory criteria about the structure.

The BDIS will need to identify who the inspection entity will be based on business rules.

Assign Underwater Inspection Frequency

The Underwater Inspection (or Fathometer inspection (survey)) frequency, at times, is adjusted by the Main Office based on professional engineering judgment and is specific
to each bridge or Sub-Structure Unit (SSU). This is in addition to the normal business rules.

**Assign Task Owner**

For most inspections, the Regional Staff will assign the responsible party for the task based on the task type. The owner can be: State forces, Consultant forces working for NYSDOT, or Authority forces. For underwater inspections and fathometer inspections (surveys), the Main Office staff will assign the responsible party for the task.

**Place Task on Schedule**

- A task is within a user defined number of days of being due. BDIS will place the task on the task owners work queue.

**Send Notification to External Task Owner**

The system will notify the external task owner that they have a task to perform on a bridge. This will be a consultant or authority.

**Assign Task to State Staff**

The Region will assign the task to appropriate state staff.

**Assign Task to Consultant Staff.**

The consultant will assign the task to the consultant staff.

**Place Task in Work Queue**

The system will notify the assigned staff that they have been assigned a task.

### 3.4 Inspection

The Bridge Data Information System (BDIS) will provide users with the bridge inspection capabilities defined in the following sections.

Figure 5 depicts the sequence order of the inspection business processes.
Needed Functionality and Capabilities

Perform Inspection

The Inspector will perform an inspection. If the inventory of the structure has changed, the Inspector will perform the inspection based on the inventory updates that they have recorded. Section 3.4.1 describes the Inspection process in more detail.

Perform Quality Control

When tasks have been completed, appropriate users will perform quality control on the inspection results. Section 3.4.2 describes the quality control process in more detail.

Perform BDSU Review

This process will be used by BDSU personnel to perform BDSU review of the inventory updates submitted as part of the completed inspection. Section 3.4.3 describes the review process in more detail.

Perform Inspection Quality Assurance

When quality control has been completed on the task results, appropriate users will perform quality assurance on the task results. Section 3.4.4 describes the quality assurance processes in more detail.

Generate Final Inspection Report

This process will be used to generate the final inspection report. Section 3.4.5 describes the report generation process in more detail.

3.4.1 Perform Inspection

The Perform Inspection process diagram defines the process associated with performing inspections. This process may be used for performing the following inspections:
- General Bridge Inspections, including Biennial and Interim Inspections
- Large Culvert Inspections
- Underwater Inspections for Sub-Structure Units (bridges) and culverts
- Fathometer Inspections (surveys)

Primary users of this process will be either state or consultant inspection team leaders performing bridge inspections, large culvert inspections, underwater inspections, or fathometer inspections (surveys).

Figure 6 depicts the process while connected to the NYSDOT network as well as the remote inspection process.

**Accept Task**

The Inspector will accept the assigned task.

**Download Task Details to Mobile Computer**

While connected to the NYSDOT network, the Inspection Team leader will download selected bridge information to their mobile computer.

**Perform Initial Assessment**

The Inspector will review the inventory of the structure to ensure that the inventory has not changed.
Record Inventory Updates
If the bridge has changed, the inspector will record the changes to the inventory in the inspection record.

Perform the On-Site Inspection
The Inspector will perform the on-site inspection. If the inventory has changed, the Inspector will perform the inspection based on the inventory updates that they have made.

Check Site for Flag Conditions
The Inspector will check the site for new or existing flag conditions.

Generate Flag
The Inspector may generate a flag if necessary.

Upload Flag Info From Mobile Computer
Depending on the flag type, the Inspector will upload the Flag information to the BDIS.

Prepare Inspection Report
The results of the inspection are provided in an inspection report including any flag data generated during the inspection.

Upload Inspection Report Information
Inspectors will upload the inspection report information. For new conditions a new flag will be generated. For existing flags, the flag will be reviewed. The Inspector will choose to close the flag if the condition no longer exists. The Inspector will choose to supersede the existing flag if the condition remains or has changed.

Upload Inspection Report from Mobile Computer
When the Inspection Team leader can connect their mobile computer to the NYSDOT network, they will upload inspection results. For large bridges such as the East River Bridges, Inspection Team leaders may submit partially completed Inspection Reports. This is done for bridges that take the entire year to complete the inspection. The partial inspections will be reviewed by QC or QA.

3.4.2 Perform Quality Control
The Perform Quality Control process diagram defines the process associated with performing quality control (QC) reviews. These QC reviews include reviews of the following:

- General Bridge inspections, including Biennial and Interim Inspections
- Underwater Bridge Inspections of the sub-structure units
- Fathometer Inspections (surveys)
- Large Culvert inspections
- Underwater large culvert inspections
- Bridge or Culvert inventory changes
Primary users of this process will be either state or consultant inspection QC users. Figure 7 depicts the process associated with performing quality control.

**Figure 7, Perform Quality Control**

*Conduct Quality Control Review*

Quality Control will review the inspection report submitted by the Inspection Team Leader. They will record any comments that they have regarding the inspection report. Information currently pertaining to the bridge, previous reports on the bridge, and underwater information on the sub-structure units of the bridge, if available, will be reviewed as part of the review.

*Provide Comments to Inspector*

Quality Control will provide review comments to the Inspector by means of phone calls or face-to-face meetings. Sometimes the review comments will be sent by email.
3.4.3 Perform BDSU Review

Figure 8 defines the process associated with performing the BDSU Review.

**Conduct Inventory Review**

BDSU will review inventory updates to ensure that the inventory and the inspection report match. If minor inventory problems are identified, the BDSU will have the capability to update the inventory data instead of rejecting the inventory back to QA and the Inspector. BDSU may notify QC and the Inspector that they modified the bridge inventory.

**Provide Inventory Comments**

BDSU will provide comments when there are questions regarding the inventory updates.

3.4.4 Perform Inspection Quality Assurance

The Perform Quality Assurance process diagram defines the process associated with performing quality assurance (QA) reviews. QA reviews may include reviews of the following:

- General Bridge Inspections, including Biennial and Interim Inspections
- Underwater bridge Inspections of the sub-structure units
- Large culvert inspections
- Underwater large culvert inspections
- Fathometer Inspections (surveys)
Figure 9 describes the process for performing quality assurance. Primary users of this process will be state NYSDOT QA staff.

![Flowchart of Quality Assurance Process]

**Figure 9, Perform Quality Assurance**

*Conduct Quality Assurance*

A quality assurance review will be performed on the inspection report. For selected bridges (some large complicated bridges), NYSDOT needs to have multiple people performing QA review at the same time. The Regional Office may enter comments to the Main Office to include in their review.

*Provide Comments and/or Notes to QC*

Quality Assurance will provide comments and notes regarding the review of the inspection report to Quality Control.
3.4.5 Generate Final Inspection Report

Figure 10 depicts the processes associated with generating the Final Inspection Report.

![Figure 10, Generate Final Inspection Report]

Generate Final Inspection Report as PDF

The BDIS will generate the Inspection report. The Final approved, accepted and printed bridge or SSU inspection report needs to have correct inventory data.

Make Inspection Report Information Official

The system will make the inspection and inventory information official.

Print and Sign the Inspection Report

Inspector will print and sign the TP349 and TP350.

Note that for some large bridges, QC and QA review will need to be performed on draft partially completed inspection reports in addition to the final completed inspection report.

3.5 Manage Flags

The Manage Flags capability will enable users to document and track bridge conditions and large culvert conditions that may pose a significant danger. Flags are utilized to notify appropriate parties of serious structure deficiencies. The three types of flags are:

- Red Structural Flag: used to report failure or potentially imminent failure of a critical primary structural component. Potentially imminent means that a failure is likely before the next scheduled inspection. A Prompt Interim Action (PIA) required indication can be assigned and will be tracked.
Yellow Structural Flag: used to report a potentially hazardous condition that would probably become a clear and present danger if left unreported beyond the next anticipated inspection. This flag can also be used to report actual or imminent failure of a non-critical structural component, if its failure would reduce the structure’s reserve capacity or redundancy but would not result in structural collapse.

Safety Flag: used to report a condition presenting a clear and present danger to vehicle or pedestrian traffic, but not structural failure or collapse. These flags can also be used for closed structures when their condition threatens vehicles or pedestrians passing beneath them. A Prompt Interim Action (PIA) required indication can be assigned and will be tracked.

The Flags capability will track the flags that have been issued including recording any appropriate corrective or protective measures taken. All flags should be tracked from discovery until the condition no longer warrants a flag. Flag removal is not adequate as a flag being superseded requires removal of the superseded flag, but the condition still exists. Flags should not be archived until all flags for the condition have been removed and the condition no longer warrants a flag. When the condition no longer warrants a flag, the flag(s) should be archived for the life of the structure. Periodic notification of existing flags should be sent to an e-mail distribution list for the structure, county, or region.

Figure 11 depicts the sequence order of the flag business processes.

### Needed Functionality and Capabilities
- Authorized users should be able to create/issue a flag at any time on a bridge, independent of a scheduled inspection.
- Inspector generated flag information is uploaded from the mobile BDIS.
- The flag packet will be sent to the bridge owner.
- Flags identified by Inspectors that require immediate notification such as Prompt Interim Action (PIA) flags will be immediately called in to the region by telephone.
3.5.1 Issue the Flag

Figure 12 depicts the process associated with issuing a flag, including the flag conflict detection and resolution process.

![Figure 12, Issue the Flag](image)

Generate Flag

A licensed professional engineer will generate the flag as described in Section 3.5.1.1.

Enter Called In Flag Information

The region will create a flag record in BDIS for the called in conditions such as Prompt Interim Actions based on information received from the inspector via a phone call. The flag information from the inspector will include the flag number and a draft description that the inspector has created on their mobile BDIS. The bridge owner will be notified of the flag condition. The regional user will record the details of the notification per Appendix I.

Consolidate Region and Inspector Flag Information

The system will consolidate the inspector generated flag and the region generated flag information. The inspector generated information will always overwrite the regional entered information if it is available (Nulls do not overwrite populated fields).

Update Flag Data

The BDIS will post the updated flag data.

Create Flag Transmittal Memo

The region will generate a flag based on the information received in the flagged bridge report. The region shall transmit a copy of the flag packet by memo to the responsible party. The flag transmittal memo must accurately state the facts and clearly emphasize the degree of urgency involved. As an alternate to restating all the particulars of the flag condition, the transmittal memo may refer to information contained in the flag packet. A copy of the transmittal and flag packet shall be sent to the Office of Structures. A copy of...
the transmittal memo shall be forwarded to the Regional Director. This written notification shall be made within seven working days (maximum) from the date the flagged condition was observed.

Prepare Flag Packet

The flag packet will be prepared to be sent to the bridge owner. Notification of the flag information will be sent to the bridge owner.

3.5.1.1 Generate Flag

Figure 13 depicts the process associated generating a flag.

![Figure 13](image)

**Figure 13, Generate Flag**

*Call Regional Contact Immediately with Flag Info*

The Inspection Team Leader has identified a condition at a bridge or SSU requiring the need for an immediate notification of the region such as PIA, red, or safety flags. The Inspection Team Leader will contact the regional contact by phone to notify him/her of the condition. The Inspection Team Leader will record the details of the notification as defined in Appendix I.

*Generate and Send the Flagged Bridge Report*

The flag initiator will generate a PDF of the flagged bridge report. He/she will transmit the report and the electronic flag packet to the regional flag coordinator within five working days (maximum) from the date the flagged condition was observed. The responsible PE will then print and sign the Flagged Bridge Report.

*Prepare the Flagged Bridge Report*

Technically any PE can generate a flag for a bridge sized structure. In practice, flags are generated by:

- Bridge inspectors
- Underwater inspectors
- Load rating engineers
- Hydraulic engineers
- Fathometer Surveyors (signed by a PE)

A Flag packet will be generated by the Flag Initiator (Inspector or other flag sources.)

The Flag Packet may consist of one or more of the following:
- Flagged bridge report
- Notes
- Sketches
- Photos
- Scour documentation, if applicable

**Supersede Existing Flag**

When the identified flag condition is found to be previously flagged, the condition shall be re-flagged with a new flagged bridge report with complete documentation. The new flag shall be assigned a new flag number. All other information shall be completed on the flagged bridge report. The flagged bridge report shall note that an existing flag is being superseded and include the date that the condition was originally flagged, regardless of the number of times that the flag was superseded. The new flag will reference the replaced flag. The replaced flag will reference the new flag.

3.5.2 **Perform Flag Resolution**

The bridge owner will perform the activities associated with resolving a flag.

3.5.3 **Monitor Flag Response**

Figure 14 describes the processes and events associated with monitoring the response to a flag.
Figure 14, Monitor Flag Response

Provide Notification of Impending Deadline
The Regional Flag Coordinator will provide notification to the bridge owner of an impending flag deadline. He/she will also record the method (verbal or written), date, and time of the notification. Note: each Regional Maintenance Engineer is considered the owner of the state bridges in the region.

Record Flag Status
The current flag status will be recorded.

Complete Flag Inactivation Report
The region will complete the flag inactivation report.

Complete Flag Removal Report
The region will complete the flag removal report.

Generate Late Flag Report
The region will generate a late flag report that is sent to the bridge owners.

Record Flag Response
The Flag Response will be recorded.

Review Flag Response
The regional flag coordinator will review the flag response.
3.6 Vulnerability Assessments

Bridge vulnerability assessments are performed for the purpose of reducing or eliminating the possibility of bridge failure or collapse. There are six bridge vulnerability assessments: hydraulic, steel, overload, collision, concrete, and seismic. State and local bridges are assessed for hydraulic vulnerability. Only state bridges are assessed for the remaining vulnerabilities. Currently, NYS does not assess culverts for vulnerabilities.

- The overload assessment capability will enable users to identify the relative vulnerability of a bridge to failure due to overload vehicles so that necessary vulnerability reduction measures can be implemented in an efficient and effective manner. The methodology to determine this vulnerability is under review and will be described in more detail in the RFP.

- The hydraulic assessment capability will enable users to identify the relative vulnerability of a bridge or large culvert to failure due to hydraulics so that necessary vulnerability reduction measures can be implemented in an efficient and effective manner. The Hydraulic assessment capability will also enable users to record the Plan Of Action (POA) information for scour critical structures. The POA capability will provide users with the capability to generate POA forms for identified structure vulnerabilities. The POA forms are sent to the structure owners for completion.

- The Flood Watch List capability will enable users to designate which structures should be monitored during a flood event.

- The Post Flood Inspection List capability will enable users to designate which structures should be inspected after a flood event.

- The Collision assessment capability will enable users to identify the relative vulnerability of the state's bridges to failure due to collision so that necessary vulnerability reduction measures can be implemented in an efficient and effective manner. Changes are currently under review. The Collision assessment capability will also enable users to record bridge collision (Bridge Hit) history information.

- The Steel assessment capability will enable users to identify the relative vulnerability of a bridge to failure due to steel conditions so that necessary vulnerability reduction measures can be implemented in an efficient and effective manner. Changes are currently under review.

- The Concrete assessment capability will enable users to identify the vulnerability to failure of a bridge caused by undesirable concrete conditions. Changes are currently under review.

- The Seismic assessment capability will enable users to assess and rate the seismic vulnerability of a bridge. Changes are currently under review.

Figure 15 depicts the sequence order of the vulnerability business processes.
Figure 15, BDIS Vulnerability Processes

**Needed Functionality and Capabilities**

*Review Reassessment Form*

A regional bridge safety engineer (Regional Bridge Evaluation Engineer) will determine if a reassessment is required based on vulnerability assessment information recorded during the bridge inspection.

There will also be a trigger based on the inspector judging that a vulnerability assessment is required.

*Perform Bridge Vulnerability Assessment*

This process will support the initial vulnerability assessment for new, replacement, or existing bridges that have not been assessed previously. The appropriate Bridge Safety Engineer will record the bridge vulnerability information. Refer to Section 3.6.1 for more details.

*Perform Bridge Vulnerability Reassessment*

The appropriate Bridge Safety Engineer will review the existing bridge vulnerability information and revise the existing data as appropriate. For flood watch, if a bridge problem has been identified to the Regional Hydraulic Engineer, he/she will determine if a hydraulic reassessment is required. If it is required, a bridge vulnerability reassessment will be performed.

3.6.1 **Perform Bridge Vulnerability Assessment**

Figure 16 depicts the processes associated with performing evaluation of inspector submitted Vulnerability Assessments.
Perform Hydraulic Vulnerability Classification

The classification process will evaluate the hydraulic vulnerability of a structure to scour damage based on its geologic, hydraulic and river conditions in order to calculate a vulnerability classification score.

Determine Hydraulic Vulnerability Rating

The rating process will provide a uniform measure of the structure's hydraulic vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Hydraulic Vulnerability Summary Sheet

This process will assist the user to complete the Hydraulic Vulnerability Summary Sheet.

Perform Collision Vulnerability Classification

The classification process will evaluate the collision vulnerability of a structure based on potential impact damage in order to calculate a vulnerability classification score.

Determine Collision Vulnerability Rating

The rating process will provide a uniform measure of the structure's collision vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Collision Vulnerability Summary Sheet

This process will assist the user to complete the Collision Vulnerability Summary Sheet.

Perform Steel Vulnerability Classification

The classification process will evaluate the steel vulnerability of a structure based on steel conditions, steel type present, traffic design, deterioration, and environmental conditions in order to calculate a vulnerability classification score.

Figure 16, Perform Vulnerability Assessment Evaluation
Determine Steel Vulnerability Rating
The rating process will provide a uniform measure of the structure's steel vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Steel Vulnerability Summary Sheet
This process will assist the user to complete the Steel Vulnerability Summary Sheet.

Perform Concrete Screening
The concrete screening process will remove abandoned bridges, pedestrian bridges, closed bridges, bridges with steel substructures, and special bridges from concrete vulnerability evaluation.

Perform Concrete Vulnerability Classification
The classification process will evaluate the concrete vulnerability of a structure based on it's concrete conditions, design, deterioration, and environmental conditions in order to calculate a vulnerability classification score.

Determine Concrete Vulnerability Rating
The rating process will provide a uniform measure of the structure's concrete vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Concrete Vulnerability Summary Sheet
This process will assist the user to complete the Concrete Vulnerability Summary Sheet.

Perform Overload Vulnerability Classification
The classification process will evaluate the overload vulnerability of a structure based on the strength of the bridge and the expected vehicular loads in order to calculate a vulnerability classification score.

Determine Overload Vulnerability Rating
The rating process will provide a uniform measure of the structure's overload vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Overload Vulnerability Summary Sheet
This process will assist the user to complete the Overload Vulnerability Summary Sheet.

Perform Seismic Screening
The screening process will develop a preliminary ranking of bridges in the inventory.

Perform Seismic Vulnerability Classification
The classification process will evaluate the seismic vulnerability of a structure based on potentially having inadequate seismic load capacity or details in order to calculate a vulnerability classification score.
Determine Seismic Vulnerability Rating

The rating process will provide a uniform measure of the structure's seismic vulnerability to failure on the basis of the likelihood of a failure occurring and the consequences of a failure.

Complete Seismic Vulnerability Summary Sheet

This process will assist the user to complete the Seismic Vulnerability Summary Sheet.

Review Vulnerability Assessments or Reassessments

This process will provide users with the capability to review vulnerability assessments or reassessments.

Update the Official Assessment in BDIS

The updated vulnerability assessment or reassessment information will be stored in BDIS.
3.7 Load Rating

Bridge Load Ratings indicate the capacity of bridges to carry loads and depend on structural condition. Level I bridge load ratings are P.E. certified fully documented load ratings. Level II bridge load ratings are computer generated analyses of bridges produced by NYSDOT using its current load rating software. Level III bridge load ratings are generated automatically by BDIS by utilizing a pre-defined algorithm. Level III load ratings are generated for the Federal File and are not utilized for any other purpose. Level II load ratings are generally updated after a bridge’s Biennial inspection. Updates can also occur during other times of the year.

Since bridge load rating updates and inspection reports are reviewed simultaneously by the Main Office, the Load Rating Engineers need the ability to view flags and bridge inspection reports prior to final acceptance by the Main Office Bridge Inspection Unit.

Note that for Load Rating, QA can change data directly, or send it back to the regional office for the load rating engineer to correct. The interface should have the capability to track load rating status in conjunction with the bridge’s associated biennial inspection. Load rating will require additional fields to comply with Federally required LRFR reporting mandates.

Load-posted bridge information will need to be available to the public on the NYSDOT external web site.

Load rating will generally not be done for culverts. The BDIS should provide users with the capability to input culvert load rating information when a Level I analysis is performed for a culvert.

The Level I Load Rating capability will provide users with the capability to record and maintain bridge Level I rating data of each bridge based on bridge inspection reports and available bridge design information.

The Level II Load Rating capability will provide users with the capability to record and maintain bridge Level II rating data of each bridge based on bridge inspection reports and available bridge design information.

The Load Rating Progress report capability will provide users with the capability to generate the Level II Load Rating submittal status on a per bridge and regional basis. The status report will indicate what stage the load rating is currently in.

The system will compute a Level III Load Rating for those bridges that are un-ratable by Level I or Level II load rating. The Level III load rating is based on current bridge inventory and inspection information using a NYSDOT defined formula. This information will be included in the Federal File and will only be visible to authorized users.

Figure 17 depicts the processes associated with the Load Rating determination.
**Needed Functionality and Capabilities**

**Determine Who Will Perform the Load Rating**

The BDIS will evaluate existing bridge information following the business rules to determine who should be notified to perform the bridge load rating. Only Bridges need to have load rating performed.

For Consultant Load Rating Engineers, a Load Rating report will need to be submitted within a user defined number of days of the date that the biennial bridge inspection report was submitted.

For State Load Rating Engineers, a Load Rating report will need to be submitted within a user defined number of days of the date that the biennial bridge inspection report was submitted.

**Assign Load Rating Engineer**

If the BDIS can not determine who should be notified that a bridge load rating evaluation needs to be performed, the BDIS will notify the Regional Load Rating Engineer that a bridge load rating evaluation needs to be performed and it can not identify the responsible party.

The Regional Load Rating Engineer will assign a Load Rating Engineer to perform the bridge load rating evaluation.

**Perform Load Rating Evaluation**

The Load Rating Engineer will perform the bridge load rating evaluation.

Level I Load Rating QC is performed externally. Level II Load Rating QC is performed externally within the VIRTIS system. The Summary VIRTIS Load Rating data will be fed into BDIS in XML format.

For Consultant Load Rating Engineers, a Load Rating report will need to be submitted within a user defined number of days of the date that the biennial bridge inspection report was submitted.
For State Load Rating Engineers, a Load Rating report will need to be submitted within a user defined number of days of the date that the biennial bridge inspection report was submitted.

Record the number of days to complete the report and make the elapsed data available for reporting.

*Determine if Posting is Needed*

The user will determine if a load posting is required.

*Determine if Posting Flag is Needed*

This process will allow the user to determine if a load posting flag is needed.

*Perform Load Rating Quality Assurance*

This process will provide Main Office users with the capability to perform load rating quality assurance.

*Notify Personnel of Posting*

The BDIS will notify a user designated list of users of the posting. The list will be regional specific but may include personnel outside the specific region. The Inventory Coordinator will be included in all lists.

### 3.8 Permits

The Supplemental Bridge List capability will provide users with the capability to support the Structures Permits program. The supplemental bridge data is information that is supplemental to the bridge load rating. Load Rating Engineers will be able to pick a load capacity rating to utilize for permitting and record information regarding their decision.

### 3.9 R-Posted Bridge Waiver

The R-posted Bridge Waiver capability will provide users with the ability to designate which State R-Posted bridges are granted the waiver for divisible load permits and which are not. The capability will also track any recent changes involving R-Posted bridges, including new R-Posted bridges, bridges where the posting is removed, where the R-Posting is changed to Load Posting, where the bridge is closed, as well as change in the waiver decision.

The capability will enable users to generate 3 reports for posting on the website. They are recent changes, R-Posted bridges with the waivers, and R-Posted bridges without the waiver. The updating of the files on the web is currently done manually. http://www.nysdot.gov/postedbridges

The capability will provide e-mail notification to designated users of changes to the bridge R-Postings.

The capability will provide an interface to be used to provide a list of Posted and R-Posted bridges on the NYSDOT web-site.

The capability will provide an interface to be used to generate the R-Posted Map on the website.
3.10 Reporting

The Reporting capability will allow users to generate reports. The following reports have been identified as necessary to be provided by the BDIS:

- Monthly Inspected and Submitted Bridge Reports versus Proposed Inspections Report
- Graphing ad-hoc capability to compare current and historical bridge ratings
- The Monthly Progress Reporting capability will enable users to generate a number of reports. Reports will be used to show the current status of the inspection season. At a minimum, the number of inspections completed per month and to date by each inspection entity (State forces and Consultant forces in each region)
- A daily data extract will export data to a central repository where it will be available to feed existing Access databases.
- A Scour Reporting capability will enable users to develop the FHWA Scour Report.