Introduction

The Bureau of Engineering (BOE) of the Department of Public Works of the City of Los Angeles is the custodian of permanent records of the public infrastructure of the City of Los Angeles. The BOE manages, preserves, indexes, protects, maintains, and provides access to these records.

When these records are stored in the City of Los Angeles Records Center, a transfer list is prepared to document the movement of the records. The records management, preservation, indexing, and access plan provides a mechanism for establishing record series which are the metadata terms for describing different types of records. The transfer list is an example of one of these record series.

Each type of microform records (including microfiche, roll film, and aperture cards) is assigned a record series number and is included in the fascicles (currently on DVDs) for permanent protection, storage, and management. The microform records are integrated into the system index by assigning sequential numbers to the document page images within the assigned record series numbers. The record series number, and the sequential numbers that uniquely identify the documents, are stored in the relational database and are backed up in the .txt relation database rows stored in the fascicles along with the page images, as described below.

The role of the BOE as custodian of permanent records of the public infrastructure is established through the City Charter which is established under the California State Constitution which is established under the constitution of the United States of America which is a member of the United Nations.
History

Planning for the review and renewal the records management structure of permanent engineering records within the Bureau of Engineering started in the early 1990s in the monthly GIS (Geographic Information Systems) meetings hosted by Clark Robins, Deputy City Engineer for Constituent Services. The monthly GIS meetings were created to better integrate the use of GIS indexed tabular, image, and spatial data between the various City departments, Los Angeles County, California (including Caltrans), and the federal government (including GIS and address data) and to discuss the planned integration improvements with GIS, system software, computer, and networking vendors.

The integration discussed was planned and to make the GIS indexed tabular, image, and spatial data available for conventional operation, including ongoing support for environmental management systems. In addition, the integration discussed was planned to make GIS indexed tabular, image, and spatial data available to mitigate the effects of disasters and other unforeseen, unplanned, events.

It became clear that the static analog format of the Bureau’s existing permanent engineering records was not consistent with an on-line Internet based service model in which all records were permanently and continuously available to all locations with real time annotations and updates that could be made from on-scene field locations. A concomitant rapid decline in the cost of digital storage media made a complete conversion to a digital format feasible. A review and renewal of the records management and preservation strategy was also undertaken at the same time to assure the preservation of the older paper and microform analog format copies of documents and the preservation of the newer digital format documents that were created from scanned images of the analog documents and that were submitted electronically over the Internet by the public and by Bureau staff and contractors.

In 1995 the first report describing the protection, maintenance, and permanent and continuous availability of BOE permanent records in electronic form (Creating a Digital Vault: a Conversion Study for the Central Records Vault of the Bureau of Engineering, Department of Public Works, City of Los Angeles, December 11, 1995) was commissioned and produced.

In 2000 a second report (The CAVRS, Computer Access to Vault Records System, Records Management System: Database and Imagebase: Requirements, Structure, and System Design, September 1, 2000) was commissioned to initiate a project (Epoch 1) to convert the permanent microform and paper records of the BOE to a protected, preserved, and permanently and continuously available digital format.

In 2004, a project to enhance and strengthen the digital document management controls was defined (Epoch 2) with the commissioning of this preliminary planning document (Records Management, Preservation, Indexing, and Access Plan: Integrating Digital Scans of Analog Microform and Paper Records into the Index for Digital Documents which Includes Scanned Paper Permits and Transfer List Documents, February 25, 2004).
An Epoch 2 detailed plan (the detailed action plan) document will be written to document a full review and renewal of system structure, records management, metadata, history, permanent and continuous availability, and preservation of all formats of engineering records in the Bureau as part of the Epoch 2 project. The detailed Epoch 2 action plan will be updated in subsequent revisions, during the Epoch 2 project, by City employees, so that the detailed action plan accurately reflects work done in the Epoch 2 project. Because it is necessary to have periodic reviews and renewals of the plan and data organization (as subsequent epochs, perhaps every 4 year), the Epoch 2 detailed action plan will also include a plan for future review and renewal plans.

In Epoch 2, all metadata documents, including the system definition documents listed above, will be included in the metadata in each of the system fascicles (digitally sealed logical record storage containers) to assure that the system plan is conveyed to users of the permanent engineering records in the far future. The oldest permanent engineering records are already, today, conveying information 150 years into the future. In general, the engineering records, and their metadata, should be available at least until the end of the life of the structure which the engineering records document, to assure the successful management of the environment in which the structures were created.

2000 Project (Epoch 1)

The Epoch 1 project protected, preserved, and made permanently and continuously available, over 1 million document images in a digital format. The images were assembled on magnetic disks in an Internet server, on 263 DVDs, and on 23 magnetic tapes.

The Epoch 2 Project is detailed in the body of this document. The Epoch 1 Project, and the actual work performed under the Epoch 1 Project, is described in Appendix 1 of this document.

2004 Project (Epoch 2)

The Epoch 2 project extends the Epoch 1 project to roll and microfiche microforms and to paper based records from A to K size (8 1/2 by 11 inch to 40 by 173 inches). In addition, the Epoch 2 project includes more of the system integrity controls incorporated in the original 1995 records protection, maintenance, and permanent availability report. These additional controls of the Epoch 2 project include byte counts, checksums, sequential numbering of directories (media and fascicles) and a closer alignment of the backup media with the structure of the Internet and intranet servers RAID (Redundant Array of Inexpensive Disks) arrays. In Epoch 2, each fascicle (for example, a DVD) contains metadata. Metadata describes the Epoch 2 project and the associated administrative information required to correctly interpret and use the digitally protected, maintained, and permanently accessible records. In addition, a more uniform use of backup media, and the incorporation of newer media formats is added in the Epoch 2 project.
Epoch 2 Project

Epoch 2 Data Organization Directory

Epoch2
   E2Tape20001
       Next Higher Level Directory Metadata –
           Epoch 2 – Tape containing DVD size Fascicles
               [dummy file name]

E2L2DVD301001
   Next Higher Level Directory Metadata –
       Epoch 2 – Level 2 Fascicle -
           DVD sized fascicle containing 1000 record image fascicles
               [dummy file name]

E2L2DVD301001_Metadata Directory for this Fascicle
   Metadata – Fascicle Checksum - E2L2DVD301001.txt
   Metadata – Fascicle Size in Bytes - E2L2DVD301001.txt
   Metadata – Epoch 1 Design Document.doc
   Metadata – Epoch 2 Design Document.doc
   Metadata – Epoch 2 Management Spreadsheet.pdf
   Metadata – Epoch 2 Management Spreadsheet.xls

E2L1F410001LA000000001
   Next Higher Level Directory Metadata –
       Epoch 2 Level 1 Fascicle
           containing images-LA000000001 to LA000000999
               [dummy file name]

E2L1F410001LA000000001_Metadata Directory for this Fascicle
   Metadata – Fascicle Checksum -
       E2L1F410001LA000000001.txt
   Metadata – Fascicle Size in Bytes -
       E2L1F410001LA000000001.txt
   Metadata - Epoch2 Level 1 Fascicle Design Document.pdf
   Metadata - Epoch2 Level 1 Fascicle Design Document.doc

LA000000001.tif
LA000000001.hol
LA000000001.txt
   . . .
LA000000999.tif
LA000000999.hol
LA000000999.txt
Relational Database

LA000000001.txt contains the master relational database row for the image entry. One of the fields (relational columns) in this row is the LA000000001.hol text. A second field is a flag saying if the LA000000001.txt was available.

This directory exists on the Epoch 2 construction server and on the intranet and Internet server. These three directories are exact copies of each other at the Level 2 Fascicle level (DVD images). This will allow restoration from DVDs by simply copying the DVDs to a server and reconstruction the relational database from the relation database rows stored on the DVDs.

Epoch 2 Management Spreadsheet

Columns

- Tape
- Level 2 Fascicle
- Level 1 Fascicle
- Beginning LA000000000 number
- Ending LA000000000 number
- L1 Fascicle size in bytes
- L2 Fascicle size in bytes
- Tape size in bytes
- All Tapes size in bytes
- L1 Fascicle total number of files
- L2 Fascicle total number of files
- Tape total number of files
- All Tapes total number of files

For an L2 fascicle, the L1 Fascicle size in bytes cell contains the size of the L2 fascicle metadata files in bytes.

For an L2 fascicle, the L1 Fascicle number of files cell contains the number of the L2 fascicle metadata files
Microform Scanning and Indexing

Each type of microform (including microfiche, roll film, and aperture cards), that is scanned, will be given a record series name, three letter identifier, and a sequential record series number. Within each record series, each scanned record would be given a common key for database access and a sequential record number. Multipage documents can be made multipage PDF files or each page image can be given a page number.

When a new record series is established, it is necessary to check to see if an existing record series already includes the record type. In addition, the 3 character identifier should not be the same as the 3 character identifier used for an existing record series.

An example of a records series is the deeds of transfer to the City of Los Angeles which can be given the following identifiers:

- Record series name: deeds for City property
- Record series 3 character identifier: DCP
- Record series sequential number: 201
- Record identifier: county recorder number
- Next available record identifier number: 100001
- Pagination method: multipage PDF file
- Record file name for first record: DCP100001.PDF

For illegible images, if there is an identifying number (record identifier) that can be read, then that number can be used to create a sequentially numbered database entry (as detailed above) for the illegible image and the image can be entered into the system. Putting these hard to read images in the document repository is a good idea because there is usually some value to any image, even if most of the image cannot be read. It also makes it easier to state that all of the images were scanned and that the image quality can be checked on the Internet rather than by traveling to view the microfilm. Even the worst images have some parts that can be read. Also, there are lines and spatial relationships shown on some images that are useful even if the text is hard to read.

Physical Magnetic Disk Storage Configuration

The maximum logical disk size will be one physical RAID (Redundant Array of Inexpensive Disks) Set.

Disposition of Completed Archival Media

When completed, two copies of the DVDs and tapes will be kept by the BOE and two copies of the DVDs and tapes will be sent to the City archives.
When tapes or DVDs are copied to new media, the old media will be retained indefinitely to help to guard against systemic errors that might cause a loss of integrity of the data.

Paper and microform copies of permanent documents will be retained permanently based on the values of the information (very high) as compared to the cost of permanent retention (low).

### Display of Sheets of a Plan Set

<table>
<thead>
<tr>
<th>1</th>
<th>11</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

The last numbered sheet is sheet **24**

Missing sheets will show up as blank boxes.

Multiple frames of a single sheet will be shown similarly.
Backup of Vault Document Images

City of Los Angeles
Public Works
Bureau of Engineering
GIS Mapping Division

January 22, 2004
Appendix 1: Epoch 1 Project
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1.0 General Introduction

The purpose of this write-up is to document the efforts of the BOE GIS Mapping Division in backing up the BOE vault aperture card images onto DVD and tape media. Images are electronic data files in .TIF format of the scanned engineering vault documents on microfilm. Microfilm is mounted on aperture cards. Aperture cards also contain index numbers registered in punched holes. Aperture cards are then stored in the cabinet drawers for record keeping. The vault images that are backed up are only those images created by the scanning of the aperture cards.

1.1 Purpose of backing up and storing BOE vault document images.

The purpose of backing up and storing engineering vault document images is to avoid any loss of images and to prevent a duplicate effort of re-scanning aperture cards to generate the images. If the vault server where the images are stored fails, then the images cannot be accessed through the vault search website. Depending on the cause of the server failure, the images on the vault server may be unrecoverable. Bureau of Engineering (BOE) GIS Mapping Division was instructed to back up the vault images onto DVD and to tape media for the scanning project that took place in 2001-02. Both DVD and tape media provide alternative approaches for storing the vault document images. When the images cannot be recovered from the server, the information can be restored using DVD or tape media.

1.2 City Engineer responsible for record keeping and BOE vault.

The City Engineer is responsible for record keeping and the BOE vault. According to the City Administrative Code, Sec. 22.343., the City Engineer “…shall be custodian of and responsible for all maps, plans, profiles, field notes and other records and memoranda belonging to the City pertaining to his office and the work thereof, all of which he shall keep in proper order and condition, with full index thereof, and shall turn over the same to his successor...”. Appendix A contains the entire section.
1.3  **Official document for the City of Los Angeles.**

The BOE’s official record of engineering plan drawings is microfilm. Chapter 12, procedure 12.4 of the Project Delivery Manual details out the procedure of plan processing and microfilm creation. In **Appendix B**, there is a complete copy of chapter 12, procedure 12.4 (http://eng.lacity.org/techdocs/pdm/Chapter12/Procedure12_4.pdf).

2.0  **Backing up and Storage of Vault Documents Images.**

2.1  **Web application for BOE vault document images.**

The developments in computer technology have prompted BOE to launch the “Search Vault Record” web application to improve customer service. This application would allow vault records, or images, to be retrieved and viewed through the web browser. Customers no longer need to travel to BOE vault to access the record drawings that is stored in the microfilm.

This web application is developed and administrated by Bureau of Engineering (BOE) Systems group. The web application allows Internet users to retrieve various images that were generated through various approaches.

2.2  **Create BOE vault document images.**

BOE vault document images could be created from various approaches. Images could be created as .TIF format files by:

1. scanning the aperture cards,
2. a scan on demand request submitted by a vault website user,
3. scanning the hard copy plans, or
4. expedited plan processing.

BOE Systems group managed the development of and administrated the operation of the “Search Vault record” application, and BOE GIS Mapping Division supported only item #1 of the four approaches indicated above. This write-up then is limited by only documenting the backup of vault images, created by scanning the aperture cards that BOE GIS Mapping Division has knowledge of.
2.2.1 Scanned aperture cards to create vault images.

BOE bought the “aperture card scanner” machine to scan the microfilm on the aperture cards. The operators were instructed to continuously load aperture cards (approximately 300 cards per load) to the machine feeder. The machine would automatically feed the cards, one at a time, through the scanner inside the machine. The digital image files created by scanning the microfilm were stored in a temporary location on a PC, located in the BOE vault index group’s office at 600 S. Spring Street, 8th floor.

The scanner machine scanned the microfilm portion of the aperture card to create an electronic digital image, which was stored in a file with .TIF as the file extension. The .TIF is the electronic data file that contains the image of the scanned microfilm. The scanner also scanned the punched holes in the card and created a text file containing the index information, with .HOL as the file extension. Thus, when the aperture cards were scanned, two files were created for each card scanned, a .TIF file and a .HOL file. The .HOL files were later used for the creation of an index table to be used for the web application.

When an aperture card was scanned, an internal number, called a file name, was added to identify the image. The image file name was assigned “la” as its prefix and a 9-digit number (i.e. la000000001). The file names were numbered sequentially and added automatically by the scanner software. If an engineering plan drawing consisted of more than 1 sheet, more than one aperture card, then each card scanned was given a new image file name (la#). The BOE vault group with the assistance of BOE GIS Mapping Division staff (when the night shift was available) scanned approximately 1 million cards as of September 2002.

According to the BOE vault staff, three copies of aperture cards were made for each engineering plan drawing sheet, and the three copies were stored in various locations. One set was stored with the BOE Reprographics group, who creates the cards; a second set was stored in a secured and environmentally controlled room; a third set was used for the counter operation in the BOE central records located at 600 S. Spring Street, 8th floor.

According to the City Administrative Code, the City Engineer is responsible for the record keeping as stated above in Sec. 22.343, and microfilm has been recognized as the only official record for 25 years after the original signature. This is due to the current procedure and the lifespan of the paper media that is used for engineering drawings. The lifespan of paper media is shorter than that of the microfilm. The microfilm on the aperture card has proven to be able to store the information for 200 years, and maybe longer. The aim of the scanning of aperture cards to create images is not to modify any document archiving method. Scanning aperture cards simply allows BOE to take advantage of this
development in technology. This provides an alternative approach for document retrieval, which improves government’s operation to better serve its customers.

Delivering images over the web reduces traffic at the BOE vault public counter. Individuals no longer need to go to the BOE vault and use a microfilm reader to view the record drawings on microfilm from an aperture card. Retrieving vault documents images over the web is much easier for Internet users to gain access to the vault documents than it is for them to travel to Bureau of Engineering central records public counter.

2.2.2 Scanned by a scan on demand request.

BOE GIS Mapping Division ceased the scanning work around September 2002, when the majority of the aperture cards had been scanned. The current procedure for scanning missing images is to “scan on demand.” If a vault website user finds an index number but cannot find the image, or an image is not clear enough for use, the user submits a request to the BOE central records group through the website email to request the information. Then, the BOE central records group is responsible for locating the aperture card, and scanning or rescanning the card, and following the procedures that was established by the BOE Systems group to make the image available on the vault website for users to access.

2.2.3 Scanned hard copy plans to create images.

The BOE GIS Mapping Division has been scanning hard copy of maps using large font scanner for its own internal use since 1995. The hard copy maps include Sewer maps, Sewer wye maps, topographic maps, substructure maps, drainage maps, double line street maps, etc. The engineering district office maintains most of these hard copy drawings, and they are continuously changing with notes and mark-ups. Once new notes are added to a drawing then the image will no longer be up-to-date, and there is no plan to re-scan drawings once they are already scanned. These hard copy maps were not part of the images in the BOE central records. These images were not assigned a la#, as the other images scanned from aperture cards were assigned. For example, for substructure drawings in the vault table, the SUB_DOCUMENT_NUMBER is used as the substitute value in the FILE_NAME field, where the la# would normally be entered. The images that were created using this approach have a large file size. If the web users do not have fast Internet access, downloading these images can cause time out problems. These images are not part of the BOE central records.
2.2.4 Expedited plan processing.

The expedited plan process is a newly created web application. The original intent is to expedite the plan process for B-permits issuance. After the B-permit plan is approved and signed by the District Engineer, the plan will be scanned by the District staff and submitted to BOE index group for digital indexing, using Photoshop software. Then, the images of approved plans with proper indexes will become available for web access in a timely manner. This web application has only been used by District offices, as of December 2003. The web application is developed and maintained by BOE Systems Group, and the backup procedure is not part of this write-up document.

2.3 Transfer process of scanned vault images to BOE SAN on vault server in ICF zone at the ITA.

2.3.1 Images transferred from PC to staging server to BOE GIS Mapping's JEMS server and to BOE's vault server in ICF zone.

Aperture cards were scanned as images to a temporary location on a PC at 600 S. Spring Street, 8th floor, in the central records group, as noted in the above section 2.2.1. Then, BOE GIS Mapping Division's staff\(^1\) copied the images from the PC over to a staging server at the BOE GIS Mapping Division. All staging done on the staging server resulted in the organization of images, as explained below in section 2.4.2. Next, BOE GIS Mapping Division's staff copied the images from the staging server to the BOE GIS Mapping's server, named JEMS. Finally, BOE GIS Mapping Division's staff transferred the images from the BOE GIS Mapping’s JEMS server to the BOE SAN (Storage Area Network) on the BOE’s vault server. The BOE vault server is named 78DIWS, and it is located in the ICF (Internet Co-location Facilities) zone at the Information Technology Agency (ITA). The images in JEMS were transferred by way of FTP (File Transfer Protocol) using USERV program.

2.3.2 BOE Systems group converts the .HOL file of the images.

Before the vault image could be accessed and viewed on web, it had to be organized and prepared. BOE GIS Mapping Division's staff sent the .HOL file (the index file) of the images to BOE Systems group’s staff\(^2\). BOE Systems group’s staff converted the .HOL file of each image, using the index conversion

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\(^1\) Bureau of Engineering GIS Mapping group’s staff member that handles this task and other backup operations for the vault document images is Michael Lee. In this entire document, GIS Mapping staff refers to Michael Lee.

\(^2\) Bureau of Engineering System group’s staff member that handles this task for the vault document images is Ben Chiu. In this entire document, BOE Systems staff refers to Ben Chiu.
program that they created, and placed the information from each .HOL file into a spreadsheet. Then BOE Systems group’s staff converted the spreadsheet into a database. BOE Systems group sent the processed .HOL file in database format to the BOE SAN on the vault server to allow the implementation of vault search web application. The .HOL files for each image were placed in the vault database. BOE Systems group’s staff also created the vault table that relates the image to the image location.

### 2.3.3 If a .HOL file was missing, another procedure was carried out.

When an aperture card, which did not have holes punched in it, was scanned, a .HOL file could not be created with the .TIF file of the image. Additional processing was necessary for aperture cards that did not have holes punched in them. BOE Systems group’s staff would extract those images, place them into a folder, and create a spreadsheet of those images for data entry. BOE GIS Mapping Division staff would use the application developed by BOE System group to view the images based on the la#, and to key in the information to the spreadsheet based on the information on the images. After the data was entered into the spreadsheet, the BOE System’s group converted the spreadsheet into a table and appended it to the existing table in the vault database. This action enabled those images that did not have .HOL file to be viewed through the web application.

### 2.3.4 BOE Systems group carries out all other vault image processes.

BOE Systems group is responsible for the management of “Search Vault Record” web application. They also carry out various processes and handle all other issues related to this web application without any support from BOE GIS Mapping Division.

### 2.3.5 If an image was missing, and recently scanned, the BOE Systems group carried out its own procedure to transfer the image to BOE SAN in ICF zone.

Vault images are static files. They do not change and will at all times be made available to the public, but additional images may be added to the database. If an image was missing, recently scanned, and assigned a sequential la#, the BOE Systems group carried out its own procedure to transfer the image to BOE SAN on the vault server in the ICF zone. This scan request was submitted by the Internet user as a “scan on demand” request. Images of engineering documents that were not found through the vault images search were scanned and added to the database. When a new image was entered in the database, the BOE Systems group managed all necessary work to add the newly scanned images to the
appropriate place for use in the web application. Note that if an aperture card was missing but was not or could not be scanned, an image could not be created. Then, there would not be an image in the SAN, and there would be no record of the image, even if the index exists.

2.4 Images stored on BOE SAN on the vault server in ICF zone at the ITA.

2.4.1 The BOE SAN on the vault server.

The BOE SAN (Storage Area Network) is a storage area for the BOE vault documents images. The SAN, manufactured by Dell, is a group of disk array in its own unit rather than built into the server. The BOE’s vault server, named 78DIWS, in the ICF (Internet Co-location Facilities) zone at the Information Technology Agency (ITA,) connects to the SAN through the IP address 161.149.221.194. The BOE’s vault server is one of 4 servers connected to the BOE SAN. As of December 2003, the BOE SAN has 4 terabytes of storage capacity. The vault server 78DIWS is accessed by all users visiting the http://engvault.lacity.org/main/ Internet website, who retrieve the image data stored on BOE SAN.

2.4.2 Organization of images on the BOE SAN.

The BOE SAN is a storage area large enough to hold all the images with some free storage space left. The vault images use approximately 1 terabyte of space on the SAN. The locations of the images are shown in Figures 1 – 4, showing the file structure for the Internet vault images data, in Appendix C. The vault document image data files were organized on the SAN in two drives, the D:\ drive and E:\ drive. The drives on the SAN are shown in Figure 1. In both drives, the directory path \Vault_Automation_Project\engvault\tif precedes the subdirectory named tape### (3 numeric digits make up the second part of the subdirectory name, i.e. tape001). The current file directory structure is the same in both drives. The D:\ drive stores approximately half of the images in twelve directories, from the tape001 subdirectory, including all the consecutive numbers 1-12, up to the tape012 subdirectory as shown in Figure 2. The E:\ drive stores the other half of the images in ten directories, from the tape013 to tape023 subdirectory, including all the consecutive numbers 13-23. In both the D:\ drive and E:\ drive, as shown in Figure 3, under each tape### subdirectory, are several dvd#### subdirectories (4 numeric digits make up the second part of the subdirectory name, i.e. dvd0001). Consequently, under each dvd#### directory, are several images####### subdirectories (9 numeric digits make up the second part of the subdirectory name, i.e. images000000001), as shown in Figure 4. The tape001 subdirectories, dvd00001 subdirectories, and images000001000 subdirectories have sequential numbers that increase in value, as shown in Figure 4. For
example, after the tape001 subdirectory, the subdirectory tape002 follows and so on. Also, after the dvd0001 subdirectory, dvd0002 follows, and so on. Refer to the last section in this write-up, section 2.7, which points to the list in Appendix D, for a complete list of the tapes and DVDs organized the same as in the BOE SAN. However, after the images000001000 subdirectory, images000002000 is listed. In this sequential numbering system, the numbers increase by the thousands (1000, then 2000, etc.) because the images are stored within each images########## subdirectory. The individual images are stored under each images########## subdirectory. For example, in the images000001000 subdirectory, the images la000000001 through la000001000 are stored. There are 2000 files in each images########## subdirectory. The first image stored in the BOE SAN is the “la000000001” file and the last image is “la001074155” file. The file subdirectories and image data files are consistently named so all images can be accessed in a consistent manner. This is necessary for the application to make the images available for viewing on the BOE website, NavigateLA.

2.4.3 Data stored in 2 drives: space available, storage space used, and number of files.

On the BOE SAN, the D:\ drive has 570 GB of storage capacity and the E:\ drive has 670 GB of storage capacity. On the D:\ drive, the \Vault_Automation_Project directory folder takes up 468 GB of storage space, with 1,175,391 files in 731 folders. On the E:\ drive, the \Vault_Automation_Project directory folder takes up 450 GB of storage space, with 825,993 files in 551 folders. For each image there are 2 files, a .TIF and a .HOL file.

2.4.4 Image file size determines number of images in each file directory.

Only a number of images are stored in each tape### (i.e. tape001) subdirectory and dvd#### subdirectory. The image files are organized as such because of the limit on the size of a data file that can be copied to a DVD. Up to 4.7 GB is advertised as free space available on a DVD. Approximately 4 GB of data are recorded to one DVD. Leaving some space on a DVD is needed as a buffer. The image file size determines how many images are copied to a DVD. Image files are not all the same size. They are larger when the images are of larger area (the engineering document scanned was a larger document) or when the images are darker and more information on the document was scanned. Thus, the file directory structure of the vault document image data files in the BOE SAN is the same structure created when backing up the image files to DVD and to tape media. Organizing the images files in the SAN is consistent with the way image are organized on DVDs and recorded to DVDs and to tape media. The CDs are stored with the DVDs. Refer to the section 2.6 for a description on backing up the image files to DVD.
2.4.5 Data in 20 file directories too large to fit on one DVD; a CD used to backup the rest of the data.

There is an exception to the organization of images on the BOE SAN and how they were stored on DVD. The organization of images on SAN was determined before the images were ever copied to DVDs. The intention was that the file directory structure of the vault document image data files in the SAN would be the same structure created for backing up the image files to DVD, but not all image file data for each dvd#### subdirectory fit onto a DVD. For approximately 7 DVDs, an additional CD was used to backup the image file data. For these DVDs, most of the image file data was stored on the DVD, and some of the data was stored on a CD. Again, 2 copies of CDs were made to complete the 2 copies made of vault images backed up to DVDs. These DVDs and CDs are listed in Appendix D, referred to in the section 2.7. The DVDs that have CDs, are listed consecutively as dvd####-1 for the DVD and as dvd####-2 in the next row below (i.e. dvd0195-1 and dvd0195-2) in the DVD field, in Appendix D.

2.5 Description of backing up onto DVD and tape media.

2.5.1 Backup done on BOE Mapping Division’s server.

Vault document images were backed up in the file directory structure order, described in section 2.4.2. Before backing up the image data, BOE GIS Mapping Division’s staff carried out all staging work on the JEMS server, including re-organizing the scanned images. Then, backup was run on the BOE GIS Mapping Division’s JEMS server, which contains the vault images. The images were not stored permanently on the JEMS server after staging and backing up the image data. JEMS server is also used for other images storage and processing. The JEMS server is not a backup server for the BOE SAN vault server in the ICF zone. There was no way to do backup from the ICF zone, because of ITA’s regulation. BOE’s SAN vault server does contain a complete set of the vault images data that supports the engineering vault search application.

Since vault images are static files, the data stored on DVDs and tapes will not change, but the quality of the DVDs and tapes will deteriorate. The industry study indicated the life cycle for a tape media is about 3 to 5 years only. BOE GIS Mapping Division plans to re-record the same images that were backed up, in the previous backup, to both DVD and magnetic tape every 3 years. The old DVDs and tapes will then be discarded.
2.5.2 Backup software and hardware used.

Vault documents images were first recorded onto DVD, and then recorded to tape media. The Pioneer Electronics DVD writing (DVD burning) software was used on BOE Mapping Division’s computer to write image data to DVDs. Backup to DVD was done on a Pioneer DVD drive. The NT native backup software was used on BOE GIS Mapping Division’s computer to write image data to tapes. The M2 Mammoth tape technology tape drive was used with Exabyte 8mm tapes. Two copies of DVDs and two copies of tapes were recorded, as described in the following sections.

Recently, BOE GIS Mapping Division received funding and purchased new tape backup equipment. Their plan is to backup the images to LTO2 tapes on the Dell Power Vault 132T Tape Library manufactured by IBM drive using Veritas Backup Exec as the software.

2.5.3 First, backup to DVD.

When backing up of the images was done, everything was based on the DVD. The number of image files recorded per DVD was based on the size of the files and the amount of data that the DVD will hold. The DVD format used was DVD-R 4.7 GB data. Although up to 4.7 GB is advertised as free space available on a DVD, the DVDs will hold approximately 4.3 gigabytes of recorded data. Approximately 4 GB of data was recorded to one DVD. The number of images per images######### subdirectory, and the number of images######### subdirectories that will fit on a DVD, was planned out before the backing up was done. The images######### subdirectories are recorded to DVD in image number order, such that the first image subdirectory recorded was images000001000 and the last image subdirectory recorded was images001075000. There were 263 DVDs containing image data when the vault images backup from the JEMS server to DVD was completed.

Two copies of the same data were recorded onto DVDs, and they were labeled Copy 1 and Copy 2 consecutively. It took approximately 1 hour to record images to one DVD. When recording to one DVD was complete, it was removed and labeled, and another DVD was placed in the DVD drive. The DVDs were labeled with the date that the image was recorded, the name of the DVD (i.e. dvd0001), the copy number (either copy 1 or copy 2), the name of the images recorded with image from and image to (i.e. images000001000 – images000008000), the number of files (i.e. 16,000), and the number of bytes on the DVD (i.e. 4,291,899,392).
2.5.4 Second, backup to tape.

The tape format used was Exabyte 8mm data cartridges with 55 GB of storage space. Approximately 40 - 50 GB of data was recorded to one tape. The number of dvd#### subdirectories recorded per tape was based on the size of the subdirectories and the amount of data that the tape will hold. The number of images######### subdirectories per dvd#### subdirectory, and the number of dvd#### subdirectories that will fit on a tape, was planned out before the backing up is done. The dvd#### subdirectories were recorded to tape in sequential order, such that the first subdirectory that was recorded was dvd0001 and the last subdirectory recorded was dvd0263. There were 23 tape cartridges containing image data when the vault images backup from DVD to tape was completed. Each tape was labeled with the same information that the DVDs were labeled.

Two copies of data to Exabyte tapes were recorded, and they were labeled Copy 1 and Copy 2 consecutively. It took approximately 15 hours to record images to one tape. When recording to one tape was complete, it was removed and labeled, and another tape was placed in the drive. The tapes were labeled with the date that the image was recorded, the name of the tape (i.e. tape001), the copy number (either copy 1 or copy 2), the name of the dvd#### subdirectories recorded with subdirectory from and subdirectory to (i.e. dvd0001 – dvd0013), the number of files, and the number of bytes on the tape.

Currently, the Exabyte tapes are being phased out, and the LTO2 tapes with larger storage capacity will replace them. Two copies of data to LTO2 tapes will be recorded. The tape format to be used is Dell LTO2 Ultrium 2 tapes. LTO2 tapes hold 200 gigabytes of native data and 400 gigabytes of compressed data. Less than 200 gigabytes of data will be recorded to one tape cartridge. It will take approximately 100 hours to record images to one tape. BOE GIS Mapping Division plans to complete the re-taping of images to LTO2 tape media by the end of March, 2004. Then, the LTO2 tapes will replace the Exabyte tapes.

All subdirectories were recorded to DVD and to tape media. There are 23 tape### subdirectories (tape001 to tape023), 263 dvd#### subdirectories (dvd0001 to dvd0263), and 1075 images######### subdirectories (images000001000 to images001075000). The first vault image recorded to tape and to DVD was file name la000000001, and the last was file name la001074155.

2.5.5 The DVDs and tapes are stored.

Then, the DVDs and tape cartridges are stored. The first set of DVD and tape copies are stored on-site at the BOE GIS Mapping Division’s office, located at 201 N. Figueroa Street, Suite 1150, in a locked cabinet. The second set of DVD and tape copies were stored off-site per Bureau of Engineering’s storage contract managed by BOE Systems group.
2.6 Method used for testing the backup-restore procedures.

The method used for restoring the data on a tape is different from that on DVD. The NT built-in backup and restore tool will be used on BOE GIS Mapping Division’s computer to restore the data from tapes. A spot-check method will be used, in which 2 dvd#### subdirectories from 2 separate tapes will be checked. One dvd#### subdirectory from one tape will be restored, and another dvd#### subdirectory from a different tape will be restored. Not all data from all tapes will be restored. The conclusion to the result of a spot-check restore is that restore procedures for all of the data on tapes will be fully functional.

To test the data restore from DVDs, the data contents on the DVD will be displayed in a window on BOE GIS Mapping Division’s computer, and some of the data files will be copied from the DVD and pasted into the computer’s local drive. If the copy and paste functions work, and the image can be opened and viewed, then the image data on DVD can be restored. A total of 6 files from 6 different DVDs will be tested.

2.7 List of backup DVDs and backup tapes.

A copy of the list of backup tapes and backup DVDs is stored as “Inventory Vault images”, in Appendix D. BOE GIS Mapping Division's staff maintains this reference document. The Exabyte tapes are referred to in these documents, and documentation of the LTO2 backup tapes is scheduled in the next 3 months. At that time, the list will be updated to reflect the newest information.

“Inventory Vault images” in Appendix D shows the list of images backed up to DVD and to tape media. The “Inventory_Vault images” spreadsheet is a complete inventory. This spreadsheet includes the tape number, the DVD numbers that are stored on each tape, and the image numbers that are stored on each DVD, the number of images (in the FILES field), and the number of bytes (SIZE field) stored on each DVD. Refer to this spreadsheet for specifics on the organization of images backed up to DVD and tape media.
Appendix A

Sec. 22.343. Powers and Duties in General

The City Engineer shall perform such civil engineering and surveying necessary in the prosecution of public work done under the direction or supervision of the Board as the said Board may require. He shall make such certificates and reports upon the progress of such work, and shall make such surveys, inspections and estimates, and perform such other surveying or engineering work as may be required by said Board or by the Council. He shall devote his entire time to the duties of his office, and shall receive no compensation in addition to his salary.

He shall have all the powers and perform all the duties imposed upon him by the Charter, the ordinances of the City, the general laws of the State and orders of the Board of Public Works, and shall be custodian of and responsible for all maps, plans, profiles, field notes and other records and memoranda belonging to the City pertaining to his office and the work thereof, all of which he shall keep in proper order and condition, with full index thereof, and shall turn over the same to his successor.

All maps, plans, profiles field notes, estimates and other memoranda of surveys, and other professional work made or done by him, or under his direction or control during his term of office, shall be property of the City.

The City Engineer shall, subject to directions from the Board, design and construct or cause to be designed and constructed, public buildings for the City of Los Angeles.

SECTION HISTORY

Based on Charter, Sec. 49.

Amended by: 4th unnumbered para. added, Ord. No. 152,427, Eff. 6-29-79.
Appendix B

Procedure 12.4 – Indexing and Microfilming Plans – Rev. 02/12/03
Bureau of Engineering
Project Delivery Manual

Chapter: 12 – PREPARING THE BID PACKAGE DOCUMENTS

Procedure: 12.4 – INDEXING AND MICROFILMING PLANS

PURPOSE

All plans must be properly indexed, microfilmed, and retained as part of the Bureau of Engineering’s official record before they are submitted for advertisement and bid. This process ensures that the plans will become part of the Bureau’s permanent record and can be easily retrieved by Bureau personnel. The purpose of this procedure is to provide the necessary guidelines for submitting the signed and sealed plans for indexing and microfilming. A number of special orders governing this process are referenced below.

The official record of the plans and profiles indexed in the City Engineer’s central record system is the microfilm. In fact, twenty-five years after the original signature, microfilm will be the only record of a plan since the tracings will be destroyed. The microfilm system is designed to retain the latest state of revision of a plan/profile up to the point at which a contract is executed based on the plan/profile. This state of revision is hereafter referred to as the As-Bid plans. A second set of microfilm is appended to the As-Bid set when the project is constructed. This set reflects all changes made to a plan during the construction phase whether by addendum, notice to bidders, change order, interim change authority, or any other authority. The set reflects the improvements as actually constructed the As-Built plan.

REFERENCES

- S007-0481 Material for Graphic Records (Plans, Maps, etc.) Acceptable for City Engineers Approval or Incorporation into the Bureau Archives
- S023-1079 Use of Tape and Decals on Archival Drawings (Plans, Maps, and Profiles)
- S016-978 Authority for Indexing of Documents by Central Records Section
- S002-0173 The Numbering of Indexed Drawings and Plans
- S003-0292 As-Built Plotting on Plans and Profiles Indexed in the City Engineer's Central Record System
RESPONSIBILITIES

Central Records Section, Administrative Services Division: Central Records Section of the Administrative Services Division is responsible for plan indexing and processing. Specific tasks include assigning index numbers for drawings and plans and developing plan processing instructions and procedures.

Project Manager (PM) - The PM is responsible for submitting the signed and sealed plans for indexing.

ATTACHMENTS

12.4-1 Instructions on Plan Processing
12.4-2 Plan Processing Transmittal - Sample
12.4-3 Photo Reproduction Order Form - Sample
12.4-4 Micrographic Services Job Control Ticket - Sample

PROCEDURE

The PM submits the signed and sealed plans, along with the following items, to the Plan Processing Unit of the Central Records Section, located at 600 S. Spring Street, Room 800:

1. Transmittal Memo.
2. Micrographics Job Control Ticket.
3. Photo Reproduction Order Form, if prints are required.

The submitted plans must adhere to the following criteria:

1. All lines and text must be black. Sepia tone or other colors are not acceptable.
2. Acceptable Sheet thickness is 3.5 mil to 7 mil.
3. Design Engineer/Architect in responsible charge of the project design must place their Seal and Signature on EVERY sheet of the plan.
4. Acceptable drafting standards must be used. (Sheet size, symbols, title block, lettering, etc.)
5. Key Map of work area, title, work order number, BC/BD, and B permit number, if appropriate, shall be included.
6. Sheets must be consecutively numbered (i.e., Sheet #1 through Sheet #30; Sheet #7A is not acceptable).
7. Index to sheets (Sheet #1) lists all work that was done on all sheets of the plan set.
8. Each plan set is limited to 60 sheets. The project must be split into two or more plan sets if there are more than 60 sheets. Each plan set must stand on its own in terms of signatures and Index to Sheets. The sheet numbering for each plan set
After the plans have been microfilmed and reproduced, the microfilm is forwarded to Original Records for storage, and the originals are sent to the vault.

RELATED PROCEDURES

Procedure 12.3 – Obtaining the Required Signatures

Appendix C

File structure for the INTERNET vault images data

Appendix D

Inventory_Vault images
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<th>End Time</th>
<th>Size</th>
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<td>00:00:10</td>
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