Columbia University Libraries

Preserving Historic Audio Content: Developing Infrastructures and Practices for Digital Conversion

Final Report to the Andrew W. Mellon Foundation

December 16, 2010

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Grant Period: July 1, 2008–September 30, 2010
Reporting Period:

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I. PROJECT GOALS

Columbia University Libraries (CUL) received an award of $371,000 in June 2008 from the Andrew W. Mellon Foundation for a two-year project designed to:

1) Select a group of high-priority audio recordings from the Columbia Oral History Research Office (OHRO) totaling 1,200 hours as a target for the project and move them through the steps of digital conversion and metadata creation;
2) Build an infrastructure model for institutions that do not have an in-house audio conversion lab;
3) Collaborate with expert consultants and a leading provider of audio preservation conversion services to develop practices that are mutually functional for both content-owning institutions and service providers;
4) Disseminate the activities of the project through written reports and presentations to appropriate professional organizations; and
5) Build and continually maintain a public project web site with full information about the project, including the final proposal and documentation created during the project.

The project aimed to produce the following outcomes:

1) Preservation through digital conversion of 1,200 hours of seriously endangered analog audio recordings that have been identified as important for future research, through creation of high-resolution, 96 kHz, 24-bit Wave files;
2) Creation of cataloging records and other metadata to facilitate discovery of the preserved content by scholars, and to support preservation of the digital versions;
3) Establishment at Columbia of a carefully designed and fully functional audio preservation infrastructure that is in compliance with current best practices and incorporates smooth working relations with an external service provider; and
4) Creation and ongoing maintenance of a public project web site.

II. PROJECT ACHIEVEMENTS

Production statistics:

1,346 original audio objects digitized amounting to over 2,100 hours of sound

555 interviews preserved, including MARC catalog records created for digital versions of the interviews and sets of METS (Metadata Encoding and Transmission Standard) records created to describe and manage the files

1,841 digital audio files created

As stated above, our original intent was to preserve 820 audiotapes from OHRO, comprising approximately 1,200 hours. We were able to supplement the Foundation's award with CUL funds that became available in spring of 2009, enabling us to exceed our goals significantly.

Working with George Blood/Safe Sound Archive as digitization and metadata creation service provide, CUL developed the following audio preservation infrastructure elements:

- System for filenames for digitized audio
- System for METS records to describe master files that represent the original objects and Rendered files that represent the intellectual objects
- Incorporation of Audio Engineering Society X098B draft metadata into the METS records
- Procedures for creating MARC records for digitized oral histories, including both audio and transcripts, that adhere to current cataloging standards
- Procedures for quality control review of vendor-produced digitized audio
- Procedures for ingest into the Fedora-based long-term archive
- System for exchanging information with an audio digitization vendor

This infrastructure is now CUL's standard means of conducting audio preservation and is in use for several on-going projects.

Finally, CUL created a web page where project information, diagrams, procedures, and samples will be available permanently. See https://www1.columbia.edu/sec/cu/libraries/bts/mellon_audio/index.html. Presentations on the progress of the project have been made at meetings of the American Library Association and International Association of Sound and Audiovisual Archives. This final report will be posted on the website, and we will seek opportunities to publicize the results at up-coming professional meetings.

III. PROJECT PARTICIPANTS

CUL staff participating in the project included:

- Janet Gertz, Director of the Preservation and Digital Conversion Division, project manager;
- Stephen Davis, Director of the Libraries Digital Programs Division, and Terry Catapano, Special Collections Metadata Analyst, responsible for analysis and development work on metadata for the digitized audio and planning for ingest into the long-term archive;
- Mary Marshall Clark, Director of the Oral History Research Office, and Corie Trancho-Robie, Assistant Director of the OHRO, responsible for selection of interviews and supervision of production activities;
- Melanie Wacker, Metadata Coordinator, and Russell Merritt, Audio-Visual Cataloger, responsible for planning and implementing MARC cataloging for the digital and analog recordings.

Two staff positions were created for this project.

- Lucas Perkins was hired in September 2008 to work through January 2010 at 75% of his time for pre-processing of the recordings, inputting initial metadata, performing audio quality control, and other project-related duties.
    - Hiring was delayed three months because unexpected changes to the Butler Library renovation schedule meant that OHRO was in the middle of construction, and there was no place to accommodate a new staff member. Preparation of materials was not significantly delayed, however, because Lucas was a former OHRO employee and required very little training.
    - As a result of staff cuts elsewhere in the CUL system in June 2009, a more senior union employee moved into the project position in place of Lucas. Unfortunately, after 10 weeks of training, that person failed to pass probation and was removed from the position. Once all union-related issues had been settled, the position was again offered to Lucas, who returned to work from December 8, 2009, through August 31, 2010.
- James Morris was hired in June 2008 for twelve months at 50% of his time to prepare files for ingest into CUL's digital asset management system, including assigning specified metadata elements, performing quality control on the digital documents, and other project-related duties. Because of the delay in finishing the project, his position was extended through September to provide review and ingest of the last digital materials.

George Blood Audio/Safe Sound Archive (SSA) of Philadelphia, Pennsylvania was the vendor for this project. They carried out digital conversion of the audio content and created technical/ structural/capture metadata, as well as playing an active role as a partner in developing mutually acceptable metadata specifications and procedures for the project. Principle SSA staff participating in this project and assisting in preparing the final report were:

- George Blood, President, responsible for project management and development;
- Preston Cabe, Systems Engineer, responsible for metadata analysis and development work on METS records;
- Jonathan Thorn, Audio Engineer, responsible for digital transfer of the original recordings;
- Elizabeth Waddell, Preservation Administrator, responsible for project coordination.

The co-authors of *Sound Directions*, Michael Casey, Associate Director for Recording Services of the Archives of Traditional Music at Indiana University, and Bruce Gordon, Audio Engineer of the Loeb Music Library at Harvard, served as consultants to the project and contributed to the writing of this final report. In addition to communicating via telephone and email, they attended an all-day meeting on site at Columbia with SSA staff in November 2008 focused primarily on technical metadata and quality control, and participated in a follow-up conference call in March 2009 when SSA staff again visited Columbia. CUL also sought advice from a number of other specialists in the field, and we wish to express thanks particularly to Hannah Frost (Stanford University Media Preservation Librarian), Chris Lacinak (New York University Adjunct

Professor and President of AudioVisual Preservation Solutions), and Jenn Riley (Indiana University Metadata Librarian).

IV. PROJECT TIMELINE

As a result of the staff difficulties described above, CUL requested and was granted a three-month no-cost extension. The project was completed on September 30, 2010. A timeline of project activities follows.

2008	July	Project begins; financial and organizational logistics dealt with
	July	Assessment of AES technical metadata elements begins
	August	Final list of interviews confirmed
	August	Format for MARC records for digital versions adopted
	August	Creation of MARC records for digital versions begins
	September	Evaluation of master/Rendered/service files with ADL system begins
	September	Lucas Perkins hired
	November	Project meeting with consultants
	November	System of master/Rendered/service files with ADL adopted
	November	Pilot shipment of tapes to SSA
	December	Receipt of pilot audio files from SSA
2009	January	Shipment of regular batches to SSA begins
	January	Development of METS records begins
	February	Quality review procedures developed
	March	Quality review of audio files begins
	March	Project meeting and conference call with consultants
	April	First draft of METS record reviewed
	July	Lucas leaves/probation of new employee starts
	July	James Morris hired
	August	Uploading of approved audio files begins
	Mid-September	Probation ends
	November	Creation of METS records begins
	December	Lucas rehired
	December	Staging of audio files and METS records for ingest begins
2010	January	Creation of MARC records for digital versions completed
	January	Shipment of tapes to SSA completed
	July	Receipt of audio files from SSA completed
	August	Quality review of audio files completed
	September	Creation of METS records completed
	September	Uploading of approved audio files completed
	September	Staging of audio files and METS records for ingest completed

V. PROJECT OVERVIEW

CUL initiated this project as a means of developing our infrastructure for digital preservation of sound recordings. The Harvard/Indiana *Sound Directions* Project[1] offers a strong model for audio preservation. However, their model assumes the existence of an in-house audio digitization lab. CUL, lacking its own lab, has sought to modify their model to serve institutions working with an external service bureaus with the goal of providing the same level of preservation as *Sound Directions*:

- high quality digital files that meet international standards for conversion (96 kHz, 24 bit Broadcast Wave format files) and accurately reflect the original physical object and the intellectual content;
- accompanying metadata records in standard formats generated through a set of procedures that span the owning institution and the service provider;
- and preparation of the files and their metadata for ingest into a long-term digital preservation repository.

With any project that endeavors to provide a model for other institutions, the idiosyncratic nature of the content and the history of descriptive and organizational procedures will limit the degree to which the project's model will be helpful to other institutions. We hope that CUL's model will be relevant for oral history programs with older collections, since they have certain complexities not shared by other types of collections; however, some of what we have developed is likely to be unnecessary or inappropriate for collections whose content lacks the particular convolutions of oral histories.

A. Digitization

The two *Sound Directions* partners were working with a mix of music and spoken word collections, while CUL's holdings addressed by this project consist of oral histories which are created through an iterative process of interviews scattered through time rather than through a single event like a concert. An oral history is spread over a number of physical objects in a non-consecutive fashion, with unrelated content intervening between sessions of the interview. In some cases the format also changes, as with interviews where earlier sessions are on reel-to-reel tapes and later sessions are on cassettes or DAT. The OHRO collection is organized by intellectual entity (the interview) rather than by call number, accession number, or other number correlated to the physical object. This further contrasts with the *Sound Directions* collections, where each collection is assigned a unique ID number and each physical object within a collection has its own unique ID number in addition to carrying the collection number.

The *Sound Directions* model assumes that the intellectual content maps reasonably well to the physical object's track or side ("face" in Audio Engineering Society terminology), which is therefore the primary object. They create a raw capture file or set of files that become the Preservation Master File(s) through a standard Audio Decision List (ADL) export. From that they generate a production master file used as the source for all further derivatives; and then they

[1] Mike Casey and Bruce Gordon, 2007. *Sound Directions: Best Practices for Audio Preservation.* http://www.dlib.indiana.edu/projects/sounddirections/bestpractices2007

derive the service version. All of these represent the physical object on a one-to-one basis. CUL originally planned to adhere to this pattern, but the oral history intellectual content does not map cleanly to the physical object; therefore we ended up with a distinction between our master file (representing the object) and service file (representing the intellectual content), using what we refer to as a Rendered file as the mechanism of transition. In order to exactly match the *Sound Directions* system, it would have been necessary for us to also retain the raw capture file. We shrank from retaining four copies in perpetuity, partly due to the cost of storing yet another 96 kHz/24 bit file (perhaps 2 TB, plus associated file management), and partly because we have no audio lab that can manipulate the raw files.

We use the ADL to map the master files derived from the physical objects to the Rendered files that bring together the intellectual content in correct order. This procedure raises issues due to lack of adoption of the ADL by audio software vendors, but it gives us a reasonably simple, human-readable, standardized statement of which minutes of sound in the service file come from which physical objects, should we ever need to reconstruct the Rendered file. The information can be migrated to another form in future if maintaining the current type of ADL becomes untenable. For more on the ADL, see section VI.A.2.

B. Metadata

Comprehensive metadata is essential for audio preservation. CUL has chosen to employ METS with its digital asset management system, Fedora, not only for audio but for all digital content. While it is an established standard, METS has a great deal of flexibility and tends to be site-specific in the details of how it is implemented locally. Other institutions may choose other means of managing their digital content and have no need of METS for their audio files, or they may implement METS differently than CUL does. The important point is that each institution must record and maintain the data needed for file management and long-term preservation of its audio files. The essential data includes:

- Technical description of the original sound object.
- Description of the content.
- Description of the digitization process.
- Structural information that allows content to be accessed in correct order.
- Technical description of the audio files.

Because of the nature of our oral histories and the mismatch between their physical and intellectual representations, we developed a three-part system for METS that may be useful as a model for other institutions facing similar challenges.

C. Communication

In a situation where an external digitization agent is employed, communication between the service provider and the owning institution is very important, but it is not always easy or straightforward. This contrasts with the *Sound Directions* model, whose two institutions enjoy a situation in which all participants in the digitization process are part of a single organization, albeit in a number of different units. Original cataloging and any metadata created along the way

can be accessed by all parties and handed on seamlessly as materials move through the digitization process and on to the digital archive. Changes to content description and other data can be worked in as needed because all parties are in the same organization and share access. Because the audio lab is local, curators and other staff can listen to the original objects and the digital files while examining paperwork and other information sources.

CUL and other institutions that work with external service providers do not have this luxury. We lack equipment to listen to many of the original formats, and must wait until digital files are created in order to verify the nature of the content. At the same time, the service bureau never has access to any of our paper files, transcripts, local databases, or staff-level information in the online catalog. This is a problem because audio collections are rife with mis- or un-labeled objects.

CUL and SSA bridged the communication gap in several ways. We established a routine of bi-weekly conference calls to discuss issues and to work through development of policies and procedures. The minutes of those conversations helped us document decisions as we moved forward. A constant stream of emails focused on day-to-day problem-solving and served to document progress. Policy decisions and shared documents were mounted on the website, along with the METS quality control reports, allowing easy access for all the parties. This system is effective whether working with an external service provider or communicating across units within an institution and has been adopted for other CUL activities.

CUL created a MS Excel spreadsheet to aggregate information about the originals from containers, paper files, and local databases, and convey that information to SSA. SSA endeavored to match what they heard during digitization to what was in the spreadsheet. But it was often only during quality control review of the digital files that CUL staff could verify the content against transcripts and correctly identify names and dates. It was at this stage that we found what we came to call “interlopers”: sections of interviews present on tapes but not mentioned in the documentation. For the most part these occurred with older tapes, since interviewers followed better documentation procedures in more recent periods.

The combination of older recording procedures and the mixed quality of documentation together generated a large number of inaccuracies in names, dates, and sessions that had to be corrected. The result was a project punctuated by difficulties in trying to explain the more complex changes where files had to be split and recombined in new configurations. Eventually we began providing transcriptions of a few sentences from the areas where divisions of files were needed, to assure that the right pieces were changed. All of this was unexpected, since we had not had the opportunity to listen to the older tapes and had no idea what we were up against. The confusing nature of the content on the tapes reinforced our decision to create digital versions that pull together all of each interview in correct order with no interruptions.

D. Conclusions

Not surprisingly, the nature of the content and the way it was originally recorded affect how that content should be digitized. The basic rubric of 96 kHz/24 bit Wav files with appropriate metadata, preferably in METS format, is followed by CUL as it is by *Sound Directions*. But the

ways in which the content is described and files put together is different because of the nature of the content itself and fundamental differences in the way CUL and *Sound Directions* partners manage the physical objects (CUL through the intellectual description, *Sound Directions* through individual control numbers).

We have developed an infrastructure that works for CUL and that works with at least one vendor. Can this model be useful to others?

- Our model assumes use of METS and Fedora. Others can make the necessary adjustments to fit their local implementations to achieve the same ends.
- Our model departs from *Sound Directions* in order to cope with the specific local needs of our collection, i.e. the need to stitch together scattered parts of the content together in order to create usable digital versions. Even at CUL we do not follow this workflow when dealing with content that maps more directly to the physical carriers, but for any other institution that faces a similar disjuncture between carrier and content, our model may be a useful starting point. Certainly we advocate keeping the master preservation version as close to the original raw face files as possible within the constraints of the situation, in keeping with the general preservation philosophy of representing an original object as accurately as possible in the digital master version.
- This is possible because digitization copies the intellectual object off of linear access media and reformats it as randomly accessible files. With the appropriate structural metadata we can provide access to the digital intellectual object in a new linear order regardless of the position of the intellectual object on the original media or the arrangement of the preservation source files. We have found the ADL to be a successful mechanism to enable this approach.
- We can testify that it is of the greatest importance to provide the vendor with as much information as possible about the audio objects in a clear and consistent format, to communicate regularly by telephone and email, and especially to document what has been discussed and decided. This leads not only to more accuracy, but also takes less total time to complete the process.

On a somewhat different note, while CUL and SSA have managed to craft a metadata solution for this project, preservation digitization of audio is hampered by the lack of a nationally approved, coherent, and (ideally) straightforward set of metadata elements for digitized audio; and by a lack of tools that recognize and work in a consistent manner with the ADL and the Broadcast Wave File Audio Extension chunk (BEXT). Recent work by the Federal Agencies Digital Guidelines Initiative Audio-Visual Working Group[2] is improving the situation, as is development of various new tools that have arrived just too late for use in this project. We strongly urge the community to complete on-going standards work in a timely way, to support and use standards, and to require that manufacturers and service providers follow standards as they are published and revised. The field will be greatly advanced by consistency among standards-creating bodies that will make for more sustainable methods of preservation, for easier implementation by manufacturers and service providers, and for development of helpful tools.

[2] http://www.digitizationguidelines.gov/audio-visual/

VI. PROJECT DETAILS

The sections below provide details of the decisions we made in carrying out the project, and the workflow we developed. A diagram of the project workflow is presented in Appendix 1. Steps in the workflow are as follows.

CUL

- Create the project spreadsheet/inventory tool by exporting data from the AVDb[3] survey database
- Select interview for digitization based on the AVDb evaluation of content value, physical condition, and obsolescence
- Recall original media from CUL's off-site facility, ReCAP
- Verify and correct the information in the project spreadsheet based on the items in hand
- Create a MARC record for the digital version in the CUL catalog, CLIO, and add the CLIO ID to the spreadsheet
- Barcode the original items and send them to SSA with the spreadsheet

SSA

- Inventory arriving items and review for physical problems
- Treat physical problems as needed
- Assemble complete interview sets, if possible
- Select appropriate playback equipment
- Assign filenames based on interviewee name and CLIO ID
- Carry out digital transfer to create raw capture files, while attempting to verify content
- Interleave and generate master file, segmenting as necessary based on file size
- Insert metadata into rendered file BEXT chunk
- Create montage in audio editor and assemble rendered file, editing filenames to reflect session sequence
- Export ADL
- Move rendered files into folders and save
- Generate service files
- Generate checksums
- Quality assurance review
- Ship files to CUL on hard drives

CUL

- Upload files to staging storage
- Update spreadsheet with filenames
- Carry out audio and metadata quality control review

[3] The survey of all unique audio and moving image materials held by CUL; for details see http://www.columbia.edu/cu/lweb/services/preservation/audiosurvey.html

- Communicate correction list to SSA, including changes to names, CLIO IDs, dates, session sequence, and discovery of "interlopers" leading to new interviews

SSA

- Make changes to names/dates/sessions as needed, correct problems, etc; includes regenerating rendered files and ADLs as necessary, and creating new interview sets for "interlopers"
- Update all metadata as needed
- Generate service files
- Generate checksums
- Generate METS records for approved files
- Quality assurance review
- Ship files to CUL on hard drives

CUL

- Upload files to staging storage
- Update spreadsheet with filenames and any changes to names, dates, etc.
- Carry out audio and metadata quality control review
- Upload files for approved interviews to ingest staging
- Notify catalogers of any corrections to names, dates, etc.
- Notify SSA of approved files

SSA

- Ship original items back to CUL

CUL

- Upload METS files to ingest staging
- Run quality control checks on METS files
- Verify external file references, checksums, and correlation with audio files
- Ingest files into Fedora asset management system/long-term archive
- Inventory returned items, and return to ReCAP for permanent storage

Developing the workflow depended on establishment of policies. The most complex issues centered around what digital versions to create, how to represent those versions through METS, how to accommodate the draft AES standard within the METS records, and how to represent the analog and digital versions in MARC records.

A. Analyzing Oral Histories and Determining What Digital Versions to Create

An important first step in the project was gaining fuller understanding of the intellectual structure of the oral histories and how their content was distributed across the physical media. There is not a one-to-one correspondence between the physical carrier (the tape or cassette) and the intellectual content (the oral history). The basic unit of an oral history is the session – a single interview period that typically runs from 1.5 to 2 hours. A session can occupy one or more tapes, and each oral history consists of one or more sessions typically occurring over a period ranging

from days to years. Interviewers sometimes recorded the next session on the same tape immediately after the point where the previous session ended, or they might start a new tape or sometimes use empty space on a tape from an unrelated oral history. In other words, one face of a tape may contain the end of one session and the beginning of another, and that second session may or may not be related to the first session. A diagram of a particularly egregious set of interlocking interviews is provided in Appendix 2.

Under these circumstances a researcher who wants to hear an entire interview could easily become confused when listening straight through each tape that carries some part of that interview, since parts of other interviews interrupt the sequence of sessions. CUL determined that in order to present the oral histories to listeners in a coherent way, it would be necessary to create digital files that present the content of each interview in proper sequence and without interruptions.

1. Digitization products

The first step in digital conversion is the raw capture of the audio. The file that results is what the authors of *Sound Directions* call a Preservation Master or Archival Master, defined as a "faithful representation of the source object," that is, "the file or set of files that together with the AES31-3 ADL, comprise the unadulterated digital surrogate of the source audio object" (p. 50). This is the "first, and primary, digital file produced from the transfer process…. containing complete, unaltered data from the source audio object exactly as presented by the playback machine" (p. 45), including stops and starts for changes of speed and other technical purposes. Each Preservation Master contains the content of one face or part of a face. There may be multiple preservation masters for one Face as in when the playback switches, resulting in more than one Preservation Master file which together represent the face. The ADL serves to document in detail the transfer and editing process whose result is the creation of a Preservation Master that seamlessly presents the entire content of the face. No post-processing is applied in the creation of the Preservation Master. The *Sound Directions* philosophy is that they are trying to document the original analog object as closely as possible and therefore they keep capture-level files as the Preservation Masters. They also see this capture-level data as helpful in future if they should ever need to plan for re-transfer or if questions arise about the preservation process, or should future preservation techniques be able to extract potentially valuable information from the unedited source files.

The Production Master is created from the Preservation Master. It is a "representation of the source audio object that is optimized" (p. 48) through post-processing to solve any technical problems arising from the transfer process, or from problems inherent in the original audio that would hamper listening, but without loss of content, for instance, correcting speed changes on the original tape or removing noise that would otherwise obscure the content. Each Production Master contains the content of one face, and it is the source for the subsequent lower resolution derivative for service purposes, which thus corresponds one-to-one to a single face of its analog original. The *Sound Directions* model works because their content maps reasonably well to the physical object.

It is worth noting that substantive differences between Preservation Master Files and the Production Masters do not exist with every item. It is only in those cases when multiple capture efforts are necessary, as when tapes break or need physical remediation in the middle of a face, or there are other technical problems such as speed changes, that the Preservation Master and Production files differ in major ways. Such conditions may occur more or less frequently with collections of different ages and origins.

In order to present its oral histories to listeners in a coherent way, CUL has determined that it is necessary to create and preserve yet a third version, a Rendered file. The Rendered file unites all the parts of one interview by copying the relevant portions of the Production Master files, regardless of what physical objects they come from. The sound for different sessions may be drawn from different areas of a single Production Master file, or they may be drawn from separate Master files. An ADL maps the exact location and extent of each Production Master file segment included in the Rendered file. The Rendered file, representing the intellectual content, is the source for all subsequent lower resolution derivatives created for service purposes.

This system leaves CUL with the somewhat daunting prospect of preserving three 96 kHz/24-bit files for every original object (Preservation Master, Production Master, Rendered file). Long-term storage in a trusted digital archive is neither infinite nor cheap. CUL has decided that since we do not have an audio digitization lab and therefore cannot make any use of the raw (Preservation Master) files, we will only preserve what we refer to as the Master (equivalent to the Production Master) and the Rendered files. CUL's Master is not edited, down-sampled, dithered, or de-noised, in order to retain fidelity to the original object.

In the process of digitization SSA does create temporary raw capture files that are the equivalent of the Sound Direction Preservation Masters, and from them it creates CUL's Master files. Our choice not to preserve these as Preservation Masters does not imply that other institutions (or CUL at some later date) should not keep a Preservation Master. The *Sound Directions* model of making and keeping the Preservation Master and Production Master is appropriate for collections where the physical object and content match fairly well, and where the sound quality of the original is particularly important. Our model – to keep the Production Master and create a Rendered version – is appropriate for a specific case: for collections where physical and content are mis-matched, and where accurate representation of the sound quality is less important than simply being able to understand all the words and hear them in proper order. In theory a collection that has mis-matched content and physical objects AND a concern for the original sound quality could preserve all three levels: Preservation Master, Production Master, and Rendered.

2. Audio Decision List (ADL)

Because the finished output of the digitization process is a complete interview created from scattered analog materials, we must document the relationship between the analog tapes and the digital files both for digital provenance and to provide means for reconstruction if the Rendered files were ever lost. We have chosen to use an ADL to map the exact portions of each master file included in the Rendered file for the interview. The ADL is specified in the AES31-3 standard, which "provides a convention for expressing edit data in text form in a manner that

enables simple accurate computer parsing while retaining human readability."[4] In simpler terms, an ADL is a human readable text document that records edit decisions and is designed to be imported into audio editing software to recreate those decisions. Details of SSA's development work to design and implement an ADL for this project are included in Appendix 3.

Harvard and Indiana University promoted the ADL as a possible best practice in "raw" methodology workflow documentation in *Sound Directions*, since AES31-3 is one of the only available standards. There are some concerns with this approach, particularly the historically weak support among software vendors and the issues this raises of future sustainability. While preserving the human readable content of an ADL is not at issue, implementation of the ADL as a routine preservation action entails a software dependency situation that has not been resolved within preservation. This is yet another instance of the widespread challenge of preserving documents that require specific software to render.

B. Preparation and Disposition of Original Materials

The interviews to be digitized had previously been identified through CUL's AudioVisual Database (AVDb) survey[5] as being simultaneously of the highest potential research value and at the highest risk for deterioration and loss. OHRO Director Mary Marshall Clark reviewed the list of interviews and put them into more granular priority order. As we worked through each batch, she continued to identify groups for the subsequent batches.

1. Initial Metadata

a. Metadata relating to the original objects

We were fortunate to be able to start with relatively complete metadata about the original objects, thanks to the survey. Information available in the AVDb MS Access database included details about format, dates, content, and physical condition of the original tapes, along with an assessment of the value and risk status of each interview.

We exported the AVDb interview-based metadata fields into a structured, standard MS Excel spreadsheet to serve as our working inventory. The information was extrapolated into a single spreadsheet line for each tape reel or cassette, and selected MARC catalog record information was merged in. Because AVDb allows surveyors to group multiple objects of the same physical type, the extrapolation process was not always simple. We used the spreadsheet for conveying our metadata to the vendor, as a method that correlated directly with and supplied relevant information for the electronic metadata the vendor was asked to supply (see Metadata for Digital Versions section below.)

CUL and SSA decided to use a spreadsheet to communicate this initial metadata and inventory information about the original tapes after considering use of XML or a relational database. Both

[4] Audio Engineering Society, *AES31-3-2008; AES Standard for network and file transfer of audio – Audio-file transfer and exchange – Part 3: Simple project interchange* (New York, NY: Audio Engineering Society, 2008), 5.
[5] AudioVisual Database survey tool, developed by Columbia in 2008 with support from the Andrew W. Mellon Foundation, http://www.columbia.edu/cu/lweb/services/preservation/audiosurvey.html

groups were comfortable working with spreadsheets, and had already used spreadsheets for previous projects. Spreadsheets allow easy display of information and are reasonably simple to manipulate, while relational databases can be quite difficult to negotiate for people without sufficient experience. XML would similarly have required a fair amount of infrastructure work and training for staff.

b. MARC Cataloging

A number of interesting issues arose in defining exactly what the object of cataloging was – the audio recording, the written transcript, the 'interview' as an intellectual entity? – and whether there should in fact be a single record or multiple records for analog and digital versions of sound and text. (Older interview transcripts consist of typescripts, while more recent transcripts are in the form of MS Word files.) The originals and digital versions are different manifestations of the same work and can legitimately be cataloged separately, but researchers may find it easier to understand a single record that pulls everything together. However, in the end we decided to create separate records for the analog and digital versions, in order to simplify management of the digital materials, both audio files and transcripts.

Most of our interviews had been previously cataloged in our library management system, CLIO, although a number surfaced for which cataloging either had never been done or needed to be revised for various reasons. We then created parallel records for the digital version of each interview. This was done in advance of digitization to enable use of the CLIO record identifier in creating and correlating metadata objects, a practice we follow for digitized books and other formats, in order to generate reliable, persistent identifiers. Sample CLIO records are presented in Appendix 4.

The Bibliographic Services Group received lists from OHRO containing interviewee names and other available identifying information, such as the oral history project name and interview dates. Bibliographic Control staff then searched CLIO for existing records for the analog interviews. If a record was found, it was used as a basis from which to derive the record for the digital version. The derived records were created in CLIO in MARC21 form. If no record was found for the analog interview, a preliminary record for the digital version was created based on available information.

The in-process records were suppressed from public view during the project period. Once the interviews were digitized and had passed through quality control, descriptions were adjusted to reflect the digital versions, e.g. adding fixed fields and other format-specific information. Obvious inaccuracies in both the analog and digital version descriptions were corrected, notes added (mostly regarding the sound quality), and the headings adjusted to reflect the Library of Congress Name Authority File. OHRO staff identified the interviews that are open for researcher access, and Bibliographic Control unsuppressed those CLIO records to make them available for researcher discovery; these records are also sent to OCLC for wider access. CLIO records for interviews that are not yet open will remain suppressed until the status changes to open, for instance after the interviewee completes a permissions form.

About 175 interviews lacked pre-existing records for their analog versions. Short, access-level records were created in order to generate CLIO IDs. OHRO staff will prepare contents notes to be added in future.

c. Use of the CLIO ID number as the project ID and base for filenames

CUL uses a different model for filenaming than the system used by *Sound Directions*. Those two collections had pre-existing ID numbers on their physical items that could serve as the basis for their filenames. OHRO has no numbering system for its more than 15,000 physical objects, and imposing a numbering system for this project would not have been helpful because of the way the content is spread across the physical objects; it also was infeasible because the collection contains over 15,000 pieces, most of which were not involved in this project and would not have received numbers. Many other CUL audio collections do have numbering systems of various kinds that eliminate some of the difficulties we faced in this project.

While the physical objects lack ID numbers, the intellectual content does have a pre-existing CLIO record ID, and that combined with the interviewee's name serves as the base for the filename. (See Appendix 5 for details.) A particularly helpful feature of the CLIO ID is that it is automatically generated by the bibliographic system when the MARC record is created, rendering duplicate numbers and other irregularities impossible. However, use of the CLIO ID in the filename (as for any element that is meaningful), means that if an interview requires re-cataloging and receives a new CLIO ID, the filenames must be changed, leading to a new ADL. New checksums were also needed if the BEXT was updated with a new CLIO ID. This could have been prevented it we had decided to keep a checksum of the audio data portion separately.

Use of a catalog ID as the basis for the filename of course assume that the sound recordings have been cataloged, as is the case for OHRO. Other CUL collections do not necessarily have individual CLIO IDs, however, and a MARC-record based system is not really suitable for archival collections where the audio items exist within the context of personal papers or corporate records. Given the wide variation in the nature of audio collections and the ways that institutions have provided intellectual and physical control, it is often not possible to impose a unified system for filenames, even within a single organization.

2. Preparing materials for digitization

a. Retrieval

The first preparation step was retrieval of the physical objects and verification that all parts of each interview were accounted for. CUL's oral history audiotapes are organized by intellectual content, not by physical object. They do not have call numbers, but rather are accessed via the name of the interviewee through the MARC records, as well as an older card catalog. The tapes are stored in archival cartons at the Research Collections and Preservation facility (ReCAP), CUL's high-density off-site facility located in Princeton, NJ, co-owned with Princeton University and the New York Public Library. All of the tapes carrying parts of an interview are not necessarily boxed together, for instance when a significant time span separates earlier and later sessions.

b. Verification and correction of preliminary metadata

Review of the data in the project spreadsheet followed. In addition to inserting the CLIO ID for each interview, staff verified the names of interviewees, project titles, number and dates of sessions, and number of physical items to assure that the data preloaded from AVDb matched the labels on the physical items and the correct forms of name in CLIO. This task of correlating survey and cataloging information in the project spreadsheet with whatever information had been written on tape boxes and cassette cases, many of which were many years old and had not been labeled in any consistent way, was quite complex. Where information was contradictory or lacking, we were in some cases able to consult interview transcripts and OHRO paper files, or search Google to gain additional information. We could not listen to the tapes, since we had decided that only SSA should play these deteriorating objects.

Because of the many ambiguities and complexities, one of the key challenges of the project was the need to work continuously with the vendor to update and correct information as they began working with the tapes. Once the tapes were sent to SSA, we lost access to any information written on containers and reels (short of laboriously photocopying boxes which may have writing on any of 6 exterior and 2 interior surfaces, plus inserted pieces of paper), and this made communication somewhat more difficult.

The other problem was simply the inherent confusion of decades-old poorly labeled objects. Thus, while a box might indicate the presence of multiple sessions/interviews, it rarely would indicate where one ended and the next began. Given the expense of tape in earlier decades, and the primacy given to the transcript over the recorded sound, re-use of boxes and tapes was common. In some cases a later interview would be taped over an earlier one that ran longer, so that the end of the older session would suddenly emerge as the newer session finished. The project spreadsheet inevitably developed complications as the project progressed. In theory it contained one line for each physical object, but this system was disrupted when tapes were identified that contained parts of a second, different interview. Extra lines had to be added for the "interloper" interview portion and related back to the original physical object through note fields.

c. Barcoding

In order to aid in inventory control, the original tapes were barcoded. Duplicate copies of the barcode were placed on the tape/cassette and its box/case to prevent anyone accidentally putting items into wrong containers. The barcodes were entered into the project spreadsheet, which was transmitted to SSA as the physical objects were shipped.

3. Post-digitization disposition of original materials

Upon return from SSA, each original item was checked in on the spreadsheet. They were repacked into their archival storage cartons, and returned to ReCAP for permanent storage. ReCAP has been designed to provide an archival quality shelving environment. Each module has a separate temperature and dehumidifying system with particulate and gas filters, extra

insulation, and vapor barriers. There are no roof penetrations or wall penetrations to the outside from the modules, and there are special dock seals and specially sealed doors. The temperature in the modules is seasonally adjusted to remain between 49-59° F +/- 3°, with relative humidity at a constant 35%, +/- 3%.

C. SSA Digitization Workflow

1. Check-in and evaluation

Tapes arriving at SSA were subject to item-level check-in. This was done for two reasons: to ensure that all materials received from CUL had arrived safely and to provide an initial evaluation of the tapes. A team of two staff members evaluated the tapes' condition following ISO18933 Imaging Materials—Magnetic Tape—Care and Handling Practices for Extended Usage. Physical metadata was recorded in SSA's in-house designed Production Management Software, using a seven point checklist to look for container damage, fungus or mold, bad smell, dirt or liquid contamination, decomposition, poor tape pack, and carrier physical distortion. Any tape suffering from fungus or mold was isolated for treatment. After the initial evaluation, tapes were stored in SSA's secure, climate controlled vault at 65°/35% RH while awaiting digitization.

2. Preparation for digital transfer

The transfer engineer next attempted to collate tapes by interview in order to create as efficient a workflow as possible. This task was made difficult by interviews spanning multiple tapes (some as many as 20), multiple interviews on the same tape (the "interlopers"), and the fact that sometimes the interviews spanned multiple shipments as new parts were discovered by CUL.

The engineer inspected each tape closely to determine if treatment was required before digitization. Common problems encountered within this collection's reel-to-reel tapes included lack of leader, hydrolysis ("Sticky Shed Syndrome"), and old splices. Additional problems arose because the majority of the interviews were recorded on thin tape (0.5 mil to 1 mil), making them more susceptible to damage, magnified by poor tape pack. The majority of the collection suffered from spoking, curling, stretching, shrinkage, and wrinkling. Common treatments included replacement of leader and splice repair. The few reels that suffered from mold damage were treated with a HEPA filter vacuum, followed by cleaning with Pelon tape and isopropyl alcohol. The audio cassette portion of the collection for the most part was in fair condition. However, some suffered from splices breaking from the leaders, poor shells, and loose or missing pressure pads. Common treatments included re-housing in new shells, splice repair and the removal of record enable tabs. All treatments were logged in the Technical Notes section of the SSA database and became part of the item's metadata.

The engineer also assessed the tape speed and track configuration of the reel-to-reel tapes. Tape speeds in this collection included $^{15}/_{16}$, $1^{7}/_{8}$, 3¾, $7^{1}/_{2}$, and 15 ips (inches per second). The majority were either $1^{7}/_{8}$ or 3¾ ips. Track configurations consisted of full, half-, and quarter- track in various combinations of mono, stereo, and dual mono, although the majority were half-track mono. If there were multiple tracks of the same speed, the engineer could transfer all tracks at once. If the tracks ran in opposite directions, the engineer would use digital signal processing to

reverse the "backwards" track. If the tracks on the tape were of different speeds, each track would be captured individually since running at a single speed would affect equalization. Cassettes presented similar issues.

3. Digital Transfer

After the engineer had evaluated the tapes, he selected the appropriate playback equipment. Machines used include Revox A700 (professional 10" ¼-track reel-to-reel for slow speed tapes), Studer A810 (¼",½ & ¼ track reel-to-reel); Otari MX-55N (4 channel reel-to-reel); Otari MX 5050 (2 channel reel-to-reel); Studer A80s; and Nakamichi Dragon and Cassette Deck 1.

Each tape was mounted and level and azimuth adjusted. Since none of the tapes contain alignment tones, tapes were transferred with the playback machine calibrated to "flat" response. No attempt was made to compensate for playback equalization. During transfer, the engineer checked the content against the descriptive metadata sent by CUL. Overt discrepancies between the actual content and the metadata were noted in the database for further review by CUL. However, many interview lacked clear introductions naming the interviewer and interviewee, and statements of the date and session number.

The engineer noted any technical problems with the original analog recording either in the Technical Notes field or by checking a box in the "Engineer Checklist." The Engineer Checklist is a tool within SSA's database for common audio playback problems including buzz, hum, hiss, print-through, low levels and Sticky Shed. When any of those were checked, the information was automatically added to the Technical Notes field in the final metadata export and also appeared within the METS document. Use of poor recording techniques and faulty equipment contributed to poor quality and sometimes unintelligible recordings.

The analog signal was digitized through a Prism Sound ADA-8XR in PCM format with a 24-bit/96kHz resolution. The signal was then routed via a Z-System switcher to a Metric Halo UNL-2 and the "raw work" file written to an Apple XSAN RAID. The work file was then run through a custom command line script to interleave and generate the Master file. The script also created a folder nest for the interview (Master folder only), embedded selected content metadata (parsed from the database) into the BEXT chunk of the Master file, created an MD5 checksum and automatically named the file (also parsed from the database).

The engineer paid close attention to the duration of the tape. We chose to limit our WAV files to 2GB, the equivalent of one hour of stereo or two hours of mono when digitized at 24-bit/96kHz resolution, because many implementations of WAV do not work with larger files. There were two ways this problem was addressed for tapes exceeding that time limit. The first was to stop the tape, roll back ten seconds, and begin a new file. The other – to open the file in an audio editor and split the channels into two files – was possible because SSA captured the work files as dual-mono that could be opened individually and edited before being interleaved to stereo.[6]

[6] An update to the WAV specification RIFF64 solves this problem. However, to date few software applications support this version.

4. Creation of the Rendered and Service files

Once the Master files for an interview were completed, the engineer assembled that interview's Rendered files by creating a "montage" in the audio editor WaveLab. Within the montage the files were put in chronological order and filenames were assigned to reflect each session for the purpose of exporting an ADL. The engineer then exported one ADL per interview and ran it through the custom command line script described in Appendix 3 to bring the ADL into compliance with the AES31-3 Standard. The engineer then returned to the montage in WaveLab to determine the final Rendered files, which he based on file size and session order (the 2GB file limit holding true here as well). Metadata was then inserted into the BEXT chunk via copying and pasting from the database. Some information, such as file part information (created when there was more than one file per interview session), had to be keyed in manually, as did a line in the BEXT Coding History to reflect WaveLab's processing of the file. The engineer then created folders to be placed within the interview's folder nest (one folder for the Rendered files and a placeholder for the soon-to-be-created Service files) on the XSAN RAID. The Rendered file was then saved (the filename entered by hand) to the Rendered folder. This process was repeated for every file within the interview.

After all Rendered files were completed, they were run through a command line script to generate the Service files. The engineer generated MD5 checksums for the Rendered and Service files, and they were then ready for approval by the Quality Assurance Engineer. Once past QA, the files were shipped to CUL on hard drives.

D. CUL Quality Control of the Digital Versions

Because CUL cannot play most of the original physical objects, our quality control review could not include comparison of the originals to the digital versions. Quality control nevertheless proved to be considerably more time-consuming than originally anticipated. As digitization was completed and we could actually listen to the content, we discovered in some cases that information on tape boxes and in old cataloging was inaccurate, e.g., a name or a date was incorrect or incomplete. In a small number of cases the content turned out not to be what was expected, for instance when what was thought to be an interview turned out to be a lecture by the person instead, or an interview of someone else entirely.

A more common occurrence was mis-identification of sessions and parts of sessions, because a fair number of the originals were not clearly labeled. Staff sometimes had to follow along in transcripts in order to determine the correct order. When sessions were mis-identified, SSA then not only had to change the filenames, but had to re-order the parts of the sessions in the ADL and adjust the embedded metadata.

The most complicated problem occurred when part of a second, separate interview was unexpectedly found on a tape. In this case staff had to try to identify the new interview if there a clear introduction was not present, determine if we had the remainder of the interview on other tapes, and then prepare the new tapes for digitization. SSA had to create an ADL and Rendered and Service files for the new interview, and correct the ADL and Rendered file pertaining to the

initial interview. In some cases pieces of a single interview turned out to be scattered across four or five tapes devoted primarily to other interviewees, as shown in the diagram in Appendix 2.

Most of these problems were discovered in the older sets of interviews, those recorded at a time when the actual audio was considered merely a means to an end – the transcript, which was considered the final, official product. Tapes produced more recently were well labeled and produced very few corrections. It also became clear that certain interviewers had much better work habits than others. In sum, the intersection of the historic lack of value for the audio originals, and the intermittent nature of an interview conducted at irregular periods over sometimes many months or years, combined to raise the level and complexity of quality control required for this project beyond what would be expected for a collection whose materials have been accurately labeled, or that consists of materials recording one-time events. Approximately 19% of all files required changes of this sort, and needless to say, they consumed a disproportionate amount of time and effort, particularly when new information about names/dates/sessions was located months after initial digitization. If this had been anticipated at the beginning of the project, a system of tracking versions would have been implemented, but unfortunately the problem did not arise in full until well into the project.

We are pleased to report that we found only a few minor errors on the part of SSA, less than 2% of the entire project.

E. Metadata for the digital versions

CUL worked with SSA and the consultants to develop a specific METS and PREMIS (Preservation Metadata: Implementation Strategies) framework to use in the current project and in similar audio preservation projects in the future. Our goal was a system that would accommodate the transfer and description of both Master and Rendered audio files. It must also accommodate the generation and inclusion of audio metadata specified by the Audio Engineering Society.

1. Use of METS

A key aim of this project was to define a metadata and content delivery package that a vendor would create and deliver along with the digitized content, to reduce the amount of work required on the institution's side. The package would be based on standard, recognized metadata best practices so that it could in theory be used by any institution vending out audio digitization for preservation purposes, particularly but not exclusively oral history recordings. This approach would allow us to employ standard tools and techniques for ingesting the metadata and content into a local repository system, in our case Fedora. METS is now routine in many digitization projects for metadata packaging and transmission. However, for better and worse, it is an extremely flexible standard, and it does not in itself specify how objects, particularly complex objects should be structured or described, leaving a great deal to be determined locally.

We succeeded admirably in this effort with extraordinary assistance from SSA. As planned in our original proposal, we reviewed previous work in this domain, especially that done as part of the *Sound Directions* project. We also received significant input and advice from our project

consultants Mike Casey and Bruce Gordon, as well as additional comments from Hannah Frost, Chris Lacinak, and Jenn Riley.

The METS approach taken by CUL, while harmonious with the *Sound Directions* approach, differs in some specific respects and is, in our view, more suitable for use by institutions that: a) have no in-house audio preservation lab; b) plan to outsource the work; c) plan to ingest metadata and content into a standard local preservation repository, such as Fedora; and d) need to provide coherent service versions ("derived" versions) of the preserved audio. ("Derived" in this case refers to the final access-oriented version in which interviews are stitched together as needed from multiple source files and then broken down into a coherent set of interview "sessions," which is the standard way in which oral history interviews are typically presented digitally.)

Our model consists of creating METS records at three different levels:

- Interview: There is one METS file containing Dublin Core descriptive metadata for the entire interview, a pointer to the external ADL file that reports which sections of the Master file were used to construct the Rendered file, and pointers to the relevant Master and Rendered files.
- Master file: There is one METS record for each original physical object that has any content related to the interview. It contains the AES Core Audio metadata describing the original physical object and the digital object, and metadata relating to the digital conversion process.
- Rendered file: There is one METS record for the Rendered file and any derivatives. It contains metadata for the entire interview and relates to the intellectual content.

Further details are provided in Appendix 6.

2. Audio Engineering Society standard

The lack of an approved AES standard led to perhaps the most interesting metadata issues of this project. We wished to follow the *Sound Directions* recommendation to use the draft standard AES X098B, "Administrative and structural metadata for audio objects".[7] Work on this standard began in 1999 and has apparently proved difficult for AES to finalize. Both the *Sound Directions* partners and Columbia in the end adopted interim versions of this standard, assuming (based on AES planning information) that the final version would be available to us in the near term. This has turned out not to be the case. The most recent information from the AES was that it would be completed by June 2010, but it had not yet been officially released at the time we completed production of our METS records. In our effort to adhere to a standard that is still in development, we have in effect created a built-in legacy metadata problem for this project that will need to be addressed when the standard is finally released, ideally through automated processes.

[7] Now renamed "Audio object structures for preservation and restoration." See: http://www.aes.org/standards/meetings/archive/aes127-sc-03-06-report.cfm

The draft AES standard provides the opportunity to encode an extraordinary amount of data. However, at the time we started work, identification of which elements should be mandatory and which optional had not taken place and we had to develop our own provisional set of desired elements. We started with the work already done by *Sound Directions* and, in consultation with them and with SSA, implemented a slightly reduced subset of their data elements. Our decisions were taken based on a combination of elements identified as essential for our ability to manage the files in future and therefore important to record regardless of the labor involved; and additional information identified as easily (in some cases automatically) collected during the routine process of digitization.

3. Broadcast Wave File Audio Extension chunk (BEXT)

Metadata pertaining to audio files can be stored in a separate file or database. In CUL's case we use the METS record, supplemented by the MARC record, to provide extensive descriptive, structural, technical, and preservation metadata. Metadata can also be embedded in the audio file itself. Broadcast Wave files enable inclusion of formatted metadata in the BEXT extension embedded within the WAVE file header. The purpose of including embedded metadata is to assure the ability to identify the file if for some reason it becomes separated from the METS record.

CUL, in discussion with SSA and the consultants, determined on a minimal set of BEXT data elements to be populated in each Master and Rendered file. Details are provided in Appendix 7.

4. Quality control/verification of METS files

After CUL completed quality control of the audio files for an interview and notified SSA that they were complete and correct, SSA then generated and delivered the relevant METS files. CUL staff carried out extensive quality at control several levels against the METS files.

The quality control process begins with a first manual check that all expected METS have been delivered for each interview. Much of the rest of QC is automated. The checksums of the XML files are verified. The METS records are validated against the METS schema, and then against CUL's specific METS profile rules. We have close to twenty profile rules of various types: checking for specific boilerplate text values, performing crosschecks between element values at different locations in the METS, verifying inclusion of optional attributes, and so forth. The final check compares the external file references found in the METS XML with the actual audio files received from the vendor, both to make sure that all referenced files are located appropriately in the directory structure, and to assure a checksum match between the METS embedded technical metadata and the audio files themselves.

This QC procedure has proven very useful to us, sometimes in unanticipated ways. We had expected difficulty in getting the vendor METS to conform to the CUL profile. This has in fact not been a significant issue. Only a few alterations were needed on early interviews, and subsequent METS files have been fully conformant. What has been much more useful is the checks of external file references and checksums. Many of the files go through several revisions during the audio QC process. Interviews are split or multiple files are joined or modified in

various ways. In several cases there has been uncertainty about which version of the audio is final for a given interview. If all else fails, such inventory mistakes are caught in the subsequent METS QC check when the external file references or checksums fail.

The QC report is made available to both CUL and SSA staff via a web page which shows a pass/fail summary and also links to detailed output from each check. This has proved valuable, as the vendor can at any time see the same detailed output that we can. Having a fully open QC process has helped resolve issues quickly.

F. Preservation of the Digital Versions

At the time we submitted our original project proposal, we were still undecided as to what asset management system and preservation repository we would be using for our digital library initiatives. After a great deal of analysis and planning, the Libraries selected Fedora to implement as a combined asset-management and archival repository system providing an integrated set of services and storage configurations. We feel this approach is ideal for both this project and our digital library and preservation efforts in general. See Appendix 8 for further details.

Digital assets and metadata flow directly into our Fedora repository after quality control. Derivative/access versions of content are generally kept in "active storage" on fast, local Netapp storage appliances, while master versions are copied out onto our replicated preservation storage system. Bibliographic and structural metadata stored in Fedora pertain to both access and preservation content, supplemented by specialized metadata for the latter. Additional preservation and administrative metadata will be added to the ingested content over time, as our system and tools evolve.

The interviews are staged for ingest in batch mode and all ingested content undergoes error and integrity checking. Ingest procedures for the audio preservation project begin once the METS records have passed quality control review. As part of the project, staff have developed automated scripts to accomplish the ingest of the audio metadata and content files into Fedora and the long-term archive. These include quality control, metadata updates to reflect new information gained during the project, ensuring correct linkage of metadata for the stored assets with the master bibliographic metadata in CLIO, and assignment of permission and access status as it changes during and after the course of the project. The permission status for all oral history content is set to "restricted" as a default. The content itself presents complex issues in terms of rights and permissions, and as these are clarified the permission status is changed as appropriate to make the interview open to the public or be restricted to onsite use.