The DNA Analyst Cooperative Effort to Aid in the Identification of Hurricane Katrina Victims

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  - The American Registry of Pathology, ARP Sciences, LLC,
  - The Office of Chief Medical Examiner, NYC, Dept. of Forensic Biology,
  - The Louisiana State Police Crime Laboratory

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Outline

- Recap of Hurricane Katrina
- Overview of LA Family Assistance Center
- DNA Analyst Co-op & DNA Identifications
- Thoughts on Rapid DNA

Timeline

Thursday, August 25, 2005

•Hurricane Katrina crossed south Florida as Category 1 and entered the Gulf of Mexico.

Friday, August 26, 2005

•The National Weather Service projected possible storm tracks with 90% chance of a direct hit on the city of New Orleans.

•Louisiana Governor Katherine Blanco declared state of emergency, initiating state's disaster plan.

Saturday, August 27, 2005

•Hurricane Katrina reached Category 3.

•Voluntary evacuations were ordered for New Orleans.

•President Bush declared federal state of emergency providing access to federal assistance and funding.

Sunday, August 28, 2005

•Hurricane Katrina reached Category 5 w/ sustained winds of 175 mph over a 100 mile radius.

Category	Winds	Surge	Effects
5	155 mph +	18 ft +	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near shoreline. Massive evacuation may be required.

Timeline

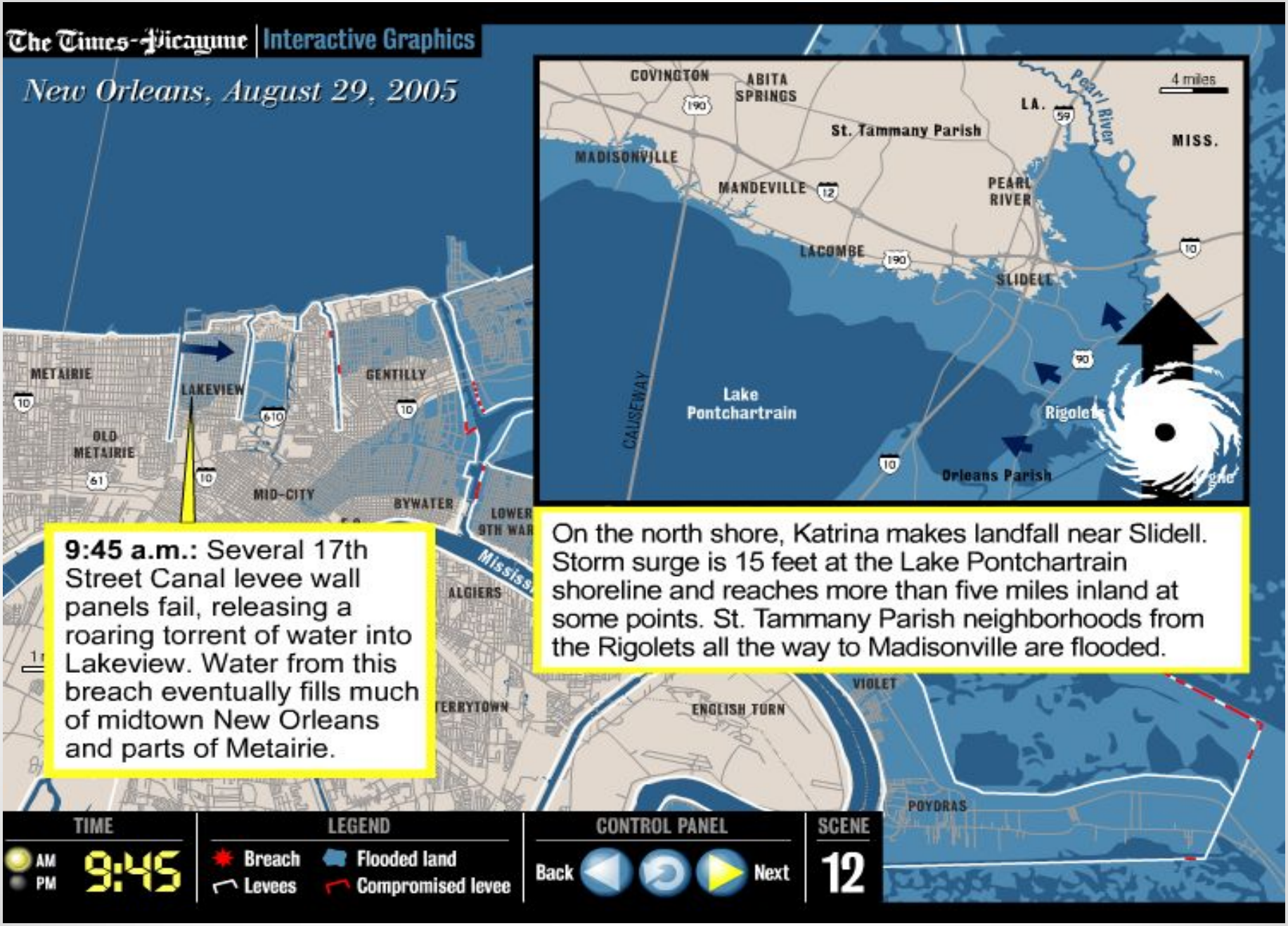
Sunday, August 28, 2005

- New Orleans Mayor Ray Nagin orders mandatory evacuation of the city.
- 80% of 1.3 million residents evacuated leaving approximately 260,000 residents behind.
- Residents unable to leave the city ordered to the Superdome.

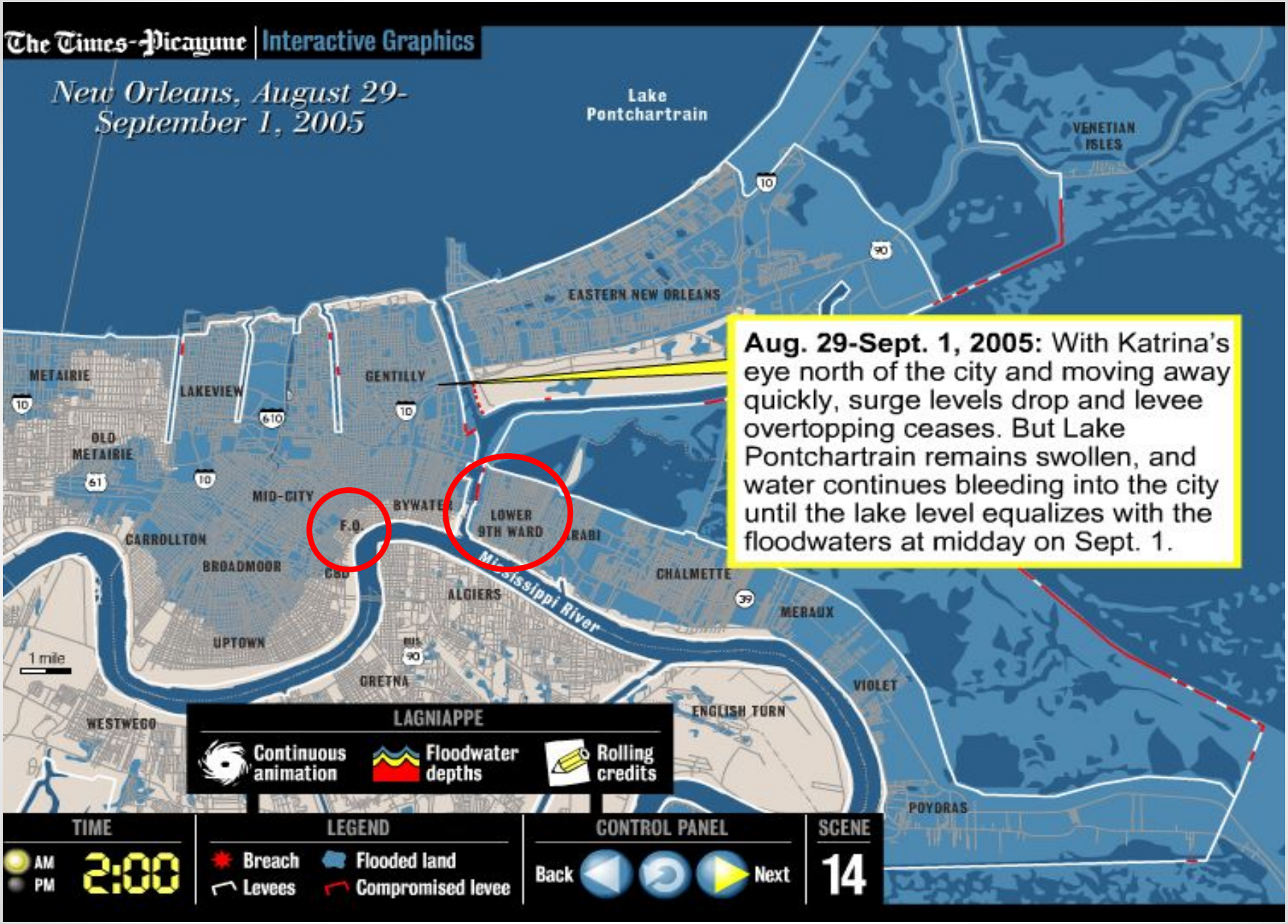
Monday, August 29, 2005

- At 6:10am Hurricane Katrina makes landfall in Louisiana as a Category 3 Hurricane.

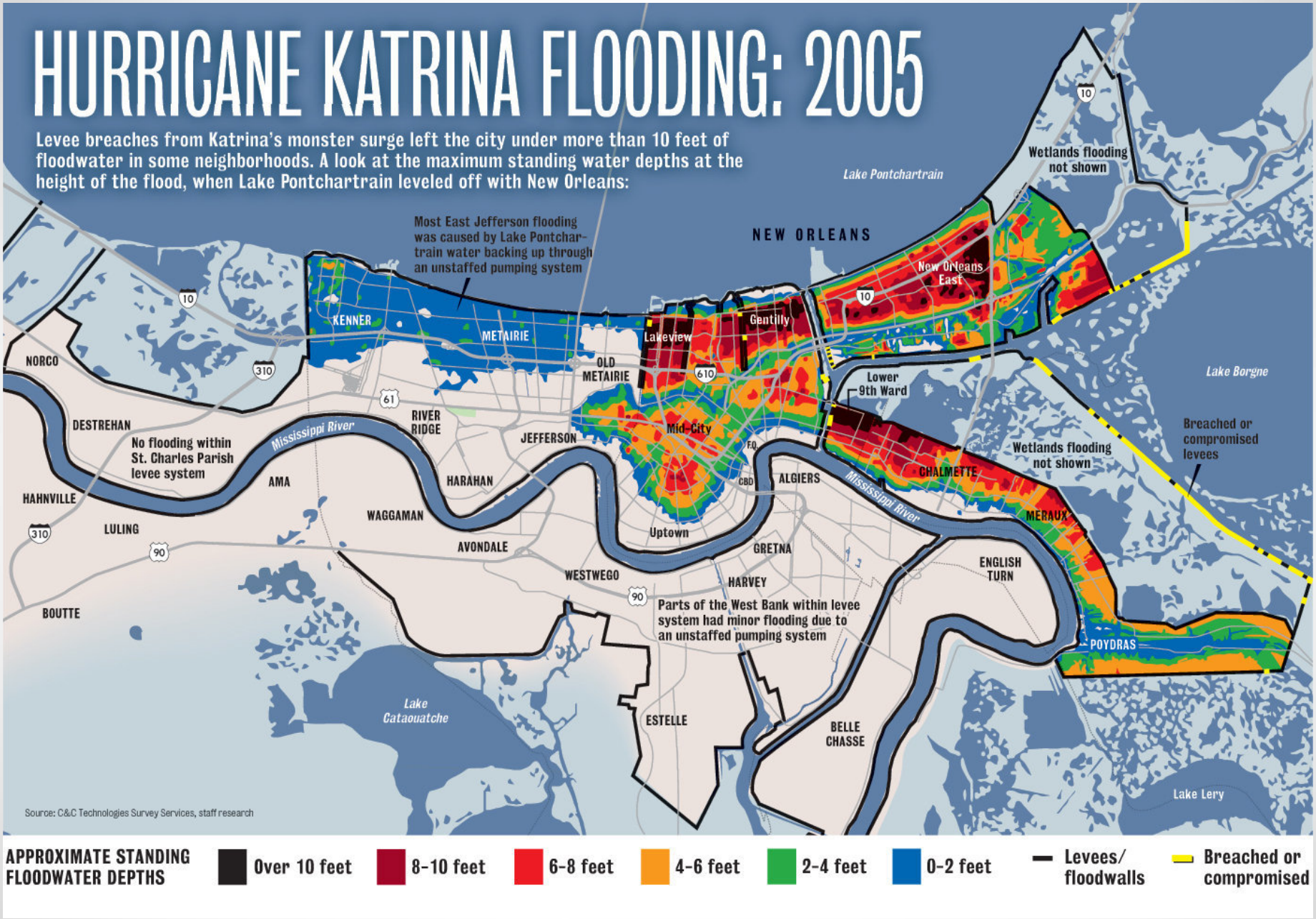

The Times-Picayune | Interactive Graphics
New Orleans, August 29, 2005
5 a.m.: Katrina's storm surge begins pounding the MR-GO levee. By dawn, levee sections crumble and Lake Borgne advances into wetlands toward St. Bernard Parish.
Lake Pontchartrain
Lake Borgne
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.Q.
LOWER 9TH WARD
ARABI
CARROLLTON
BROADMOOR
CBD
ALGIERS
CHALMETTE
MERAUX
Mississippi River
UPTOWN
GRETNA
TERRYTOWN
ENGLISH TURN
VIOLET
WESTWEGO
MARRERO
HARVEY
POYDRAS
1 mile
TIME
AM
PM
5:00
LEGEND
Breach
Levees
Flooded land
Compromised levee
CONTROL PANEL
Back
Next
SCENE
3


The Times-Picayune | Interactive Graphics
New Orleans, August 29, 2005
COVINGTON
ABITA SPRINGS
190
4 miles
LA.
59
Pearl River
MISS.
St. Tammany Parish
MADISONVILLE
MANDEVILLE
12
PEARL RIVER
LACOMBE
190
SLIDELL
10
METAIRIE
10
LAKEVIEW
610
GENTILLY
10
90
CAUSEWAY
Lake Pontchartrain
Rigolets
OLD METAIRIE
61
10
MID-CITY
BYWATER
10
Orleans Parish
LOWER 9TH WARD
Mississippi
ALGIERS
9:45 a.m.: Several 17th Street Canal levee wall panels fail, releasing a roaring torrent of water into Lakeview. Water from this breach eventually fills much of midtown New Orleans and parts of Metairie.
On the north shore, Katrina makes landfall near Slidell. Storm surge is 15 feet at the Lake Pontchartrain shoreline and reaches more than five miles inland at some points. St. Tammany Parish neighborhoods from the Rigolets all the way to Madisonville are flooded.
VIOLET
ENGLISH TURN
POYDRAS
TIME
AM
PM
9:45
LEGEND
Breach
Levees
Flooded land
Compromised levee
CONTROL PANEL
Back
Next
SCENE
12


HOMES
CONTRACTOR
OUT
NOVATION
ed & Insured
ed & Operated
9-5142
FOR SALE NEEDS "SOME" WORK


The Times-Picayune | Interactive Graphics
New Orleans, August 29-September 1, 2005
Lake Pontchartrain
VENETIAN ISLES
EASTERN NEW ORLEANS
METAIRIE
LAKEVIEW
GENTILLY
OLD METAIRIE
MID-CITY
BYWATER
F.O.
LOWER 9TH WARD
CARROLLTON
BROADMOOR
CBD
ALGIERS
CHALMETTE
MERAUX
Mississippi River
UPTOWN
GRETNA
WESTWEGO
ENGLISH TURN
VIOLET
POYDRAS
1 mile
Aug. 29-Sept. 1, 2005: With Katrina's eye north of the city and moving away quickly, surge levels drop and levee overtopping ceases. But Lake Pontchartrain remains swollen, and water continues bleeding into the city until the lake level equalizes with the floodwaters at midday on Sept. 1.
LAGNIAPPE
Continuous animation
Floodwater depths
Rolling credits
TIME
AM
PM
2:00
LEGEND
Breach
Flooded land
Levees
Compromised levee
CONTROL PANEL
Back
Next
SCENE
14


SAW LEVEE BREAK?
Wanted: Witnesses
Photos / Video
CALL TOLL FREE
866-360-3065


HURRICANE KATRINA FLOODING: 2005
Levee breaches from Katrina's monster surge left the city under more than 10 feet of floodwater in some neighborhoods. A look at the maximum standing water depths at the height of the flood, when Lake Pontchartrain leveled off with New Orleans:
Most East Jefferson flooding was caused by Lake Pontchartrain water backing up through an unstaffed pumping system
Lake Pontchartrain
Wetlands flooding not shown
NEW ORLEANS
New Orleans East
KENNER
METAIRIE
Lakeview
Gentilly
OLD METAIRIE
Lower 9th Ward
Lake Borgne
NORCO
DESTREHAN
No flooding within St. Charles Parish levee system
Mississippi River
RIVER RIDGE
JEFFERSON
Mid-City
Breached or compromised levees
Wetlands flooding not shown
CHALMETTE
AMA
HARAHAN
CBD
ALGIERS
HAHNVILLE
LULING
WAGGAMAN
MERAUX
Uptown
AVONDALE
GRETNA
ENGLISH TURN
WESTWEGO
HARVEY
Parts of the West Bank within levee system had minor flooding due to an unstaffed pumping system
BOUTTE
POYDRAS
Lake Cataouatche
ESTELLE
BELLE CHASSE
Lake Lery
Source: C&C Technologies Survey Services, staff research
APPROXIMATE STANDING FLOODWATER DEPTHS
Over 10 feet
8-10 feet
6-8 feet
4-6 feet
2-4 feet
0-2 feet
Levees/ floodwalls
Breached or compromised

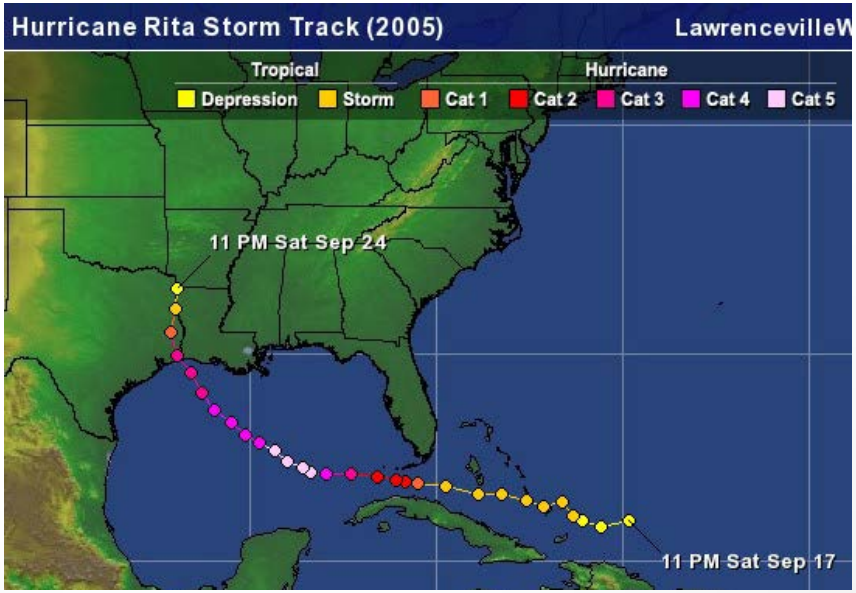
Timeline

September 21, 2005

- Hurricane Rita becomes Category 5 storm with winds 178 mph.
- New Orleans evacuated again.

September 24, 2005

- Hurricane Rita makes landfall in Southwestern Louisiana as a Category 3 storm with 115 mph winds and storm surge 15 ft that pushed inland 25 miles.
- New Orleans was flooded again, especially in areas where levees failed during Katrina.



Rescue, Search, Recovery & Aid

- **Government**
  - Federal Emergency Management Agency (FEMA)
  - Disaster Mortuary Operational Response Team (DMORT)
  - Law enforcement & public agencies from across USA
- **Non-Governmental**
  - American Red Cross
  - Salvation Army
  - Oxfam
  - Other charitable organizations
- **International**
  - More than 70 countries contributed money or assistance


The Water
is
Rising
Pleas


YAMAHA


U.S. COAST GUARD


9/29
FL
1/0

DVI Totals

- 1,833 deceased:

Louisiana	1,577
Mississippi	238
Other States	18

- 917 bodies recovered

- 13,197 reported missing

LA Family Assistance Center


Louisiana Family Assistance Center
Reuniting Louisiana hurricane victims with their families
Louisiana Family Assistance Center
Mission
Assist the residents of Louisiana in their recovery efforts through the compassionate collection of needed information to:
1. Re-unify loved ones with victims of Hurricanes Katrina and Rita.
2. Assist in the identification of the missing.
3. Support the re-interment of the displaced victims from public cemeteries.
1-866-326-9393 • www.katrinamissing.dhh.louisiana.gov

Incoming Phone Calls

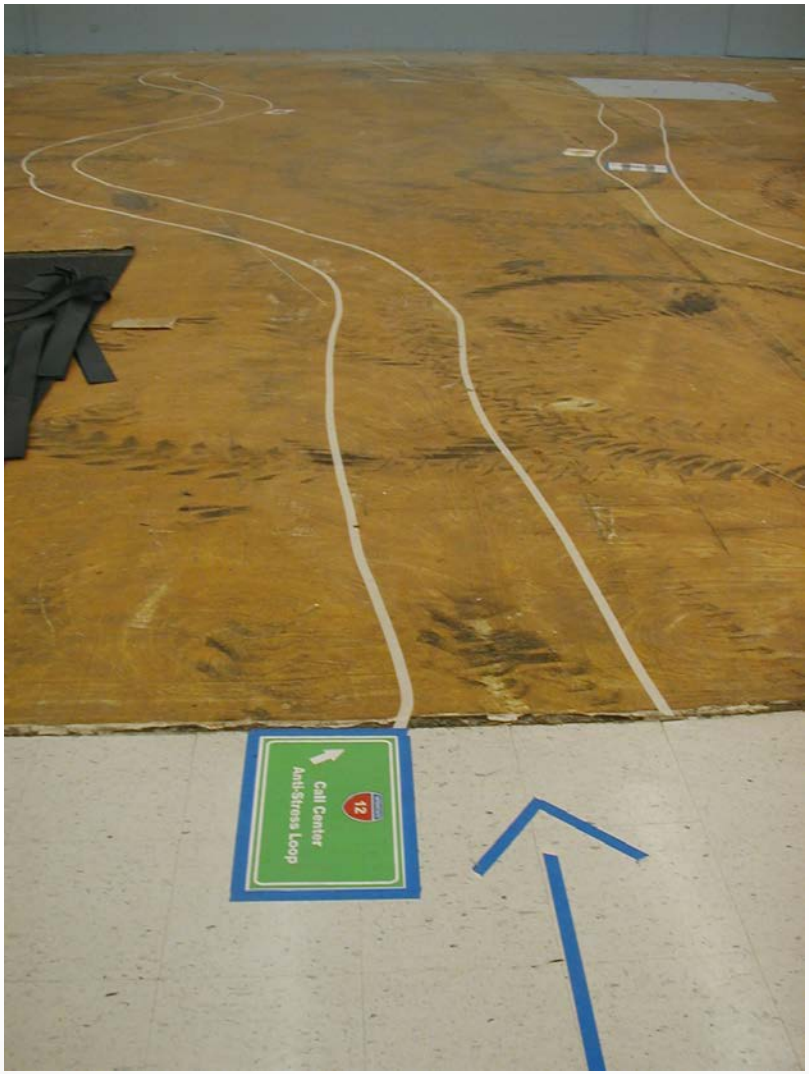
Data Management

Investigations

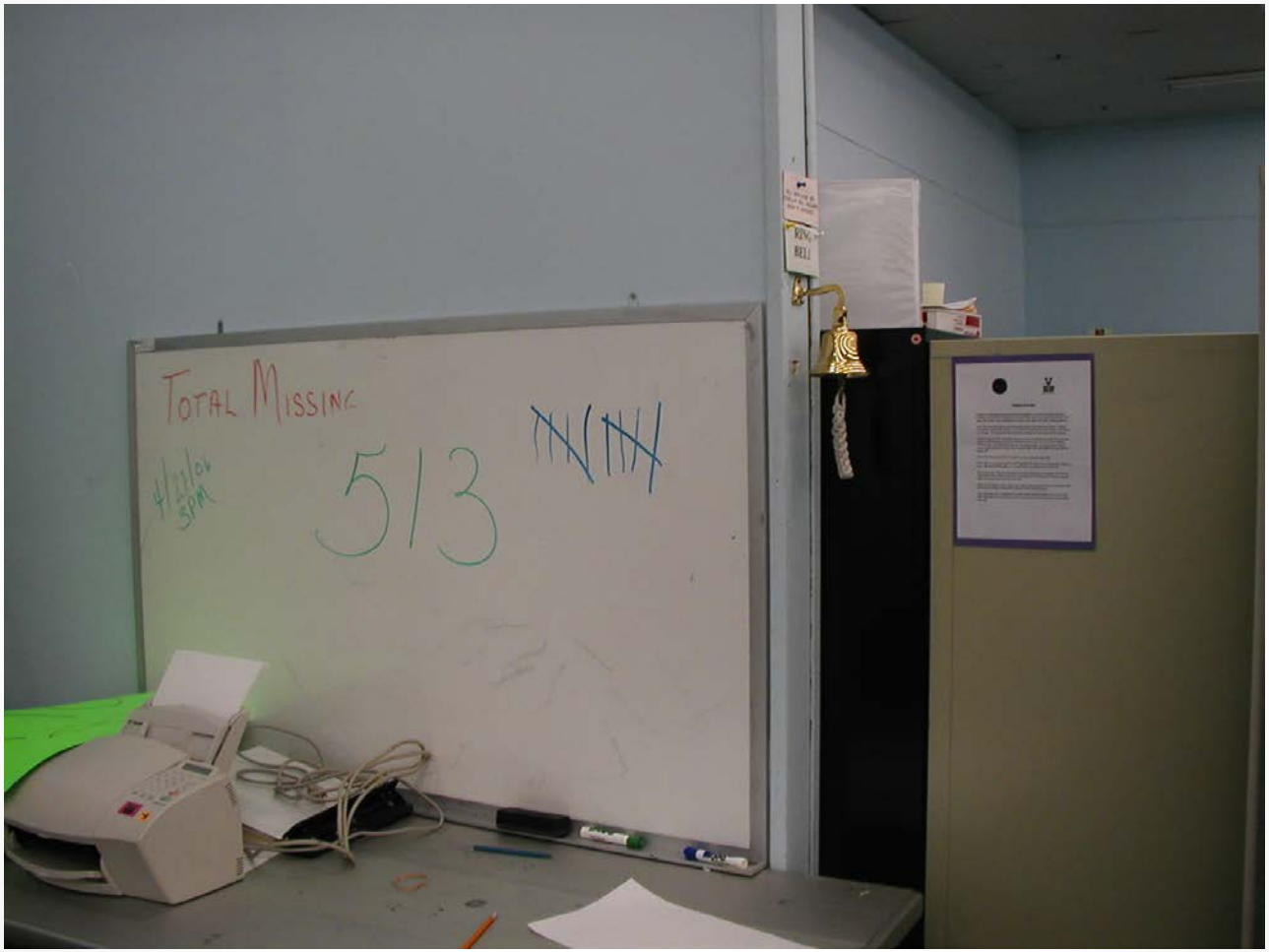
Dental

Chaplain Lounge

“Stress Walk”



Total Missing



DNA Accessioning

Family History Unit

Composed of two groups of volunteers & support staff

1. Genetic Counselors
2. DNA Analysts

Family History Unit - Roles

Genetic Counselors

- collected family info
- drew pedigrees
- requested sample collection

DNA Analysts

- shipped & tracked samples
- reviewed data
- helped troubleshoot problem samples
- verified pedigrees
- ran simulations

Support Staff

- collected family info
- requested/scheduled sample collection
- clerical duties
- scheduled employees & volunteers

Co-op Project

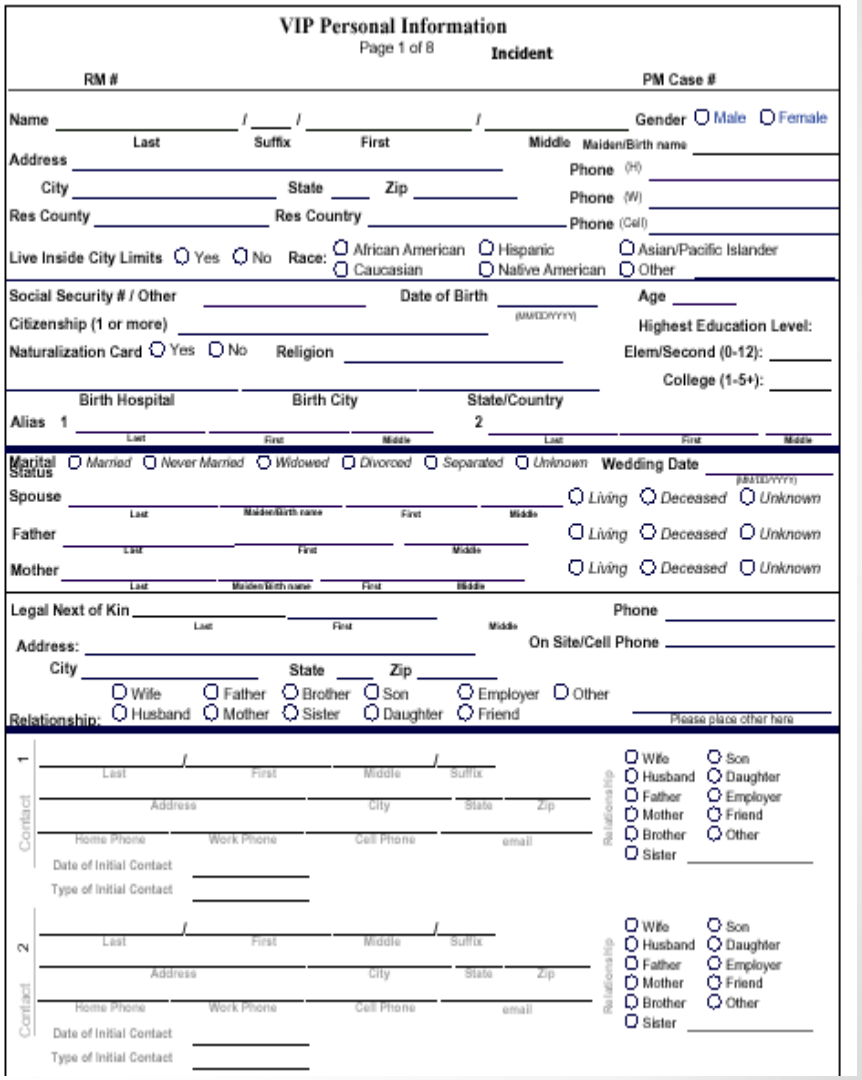
- Genetic Counselors & DNA analysts volunteered for 1 or 2 weeks
- Started with 6 DNA Analysts from CA DOJ in early 2006
- Lasted until June 2006
- 80 Genetic Counselors volunteered (from 17 different states)
- 27 DNA Analysts volunteered (from 12 different states)
  - 10 from NY (OCME – NYC)


FIND FAMILY
1-866-326-9393
03/25/2006


1-866-326-9393

Genetic Counselors

- Spoke with family members to develop pedigrees
  - Casefile
  - VIP information
  - Additional web searches
- Explained how DNA samples are collected and what they were used for
- Made initial arrangements to collect DNA samples
  - Family reference samples
  - Direct reference samples



VIP Personal Information

Page 1 of 8

Incident

RM # PM Case #

Name / / / Gender Male Female

Last Suffix First Middle Maiden/Birth name

Address Phone (H)

City State Zip Phone (W)

Res County Res Country Phone (Cell)

Live Inside City Limits Yes No Race: African American Hispanic Asian/Pacific Islander Caucasian Native American Other

Social Security # / Other Date of Birth (MM/DD/YYYY) Age

Citizenship (1 or more) Highest Education Level:

Naturalization Card Yes No Religion Elem/Second (0-12):

College (1-5+):

Birth Hospital Birth City State/Country

Alias 1 2

Marital Status Married Never Married Widowed Divorced Separated Unknown Wedding Date (MM/DD/YYYY)

Spouse Last Maiden/Birth name First Middle Living Deceased Unknown

Father Last First Middle Living Deceased Unknown

Mother Last Maiden/Birth name First Middle Living Deceased Unknown

Legal Next of Kin Last First Middle Phone

Address: On Site/Cell Phone

City State Zip

Relationship: Wife Husband Father Mother Brother Sister Son Daughter Employer Friend Other Please place other here

Contact 1 Last First Middle Suffix

Address City State Zip

Home Phone Work Phone Cell Phone email

Date of Initial Contact

Type of Initial Contact

Relationship: Wife Husband Father Mother Brother Sister Son Daughter Employer Friend Other

Contact 2 Last First Middle Suffix

Address City State Zip

Home Phone Work Phone Cell Phone email

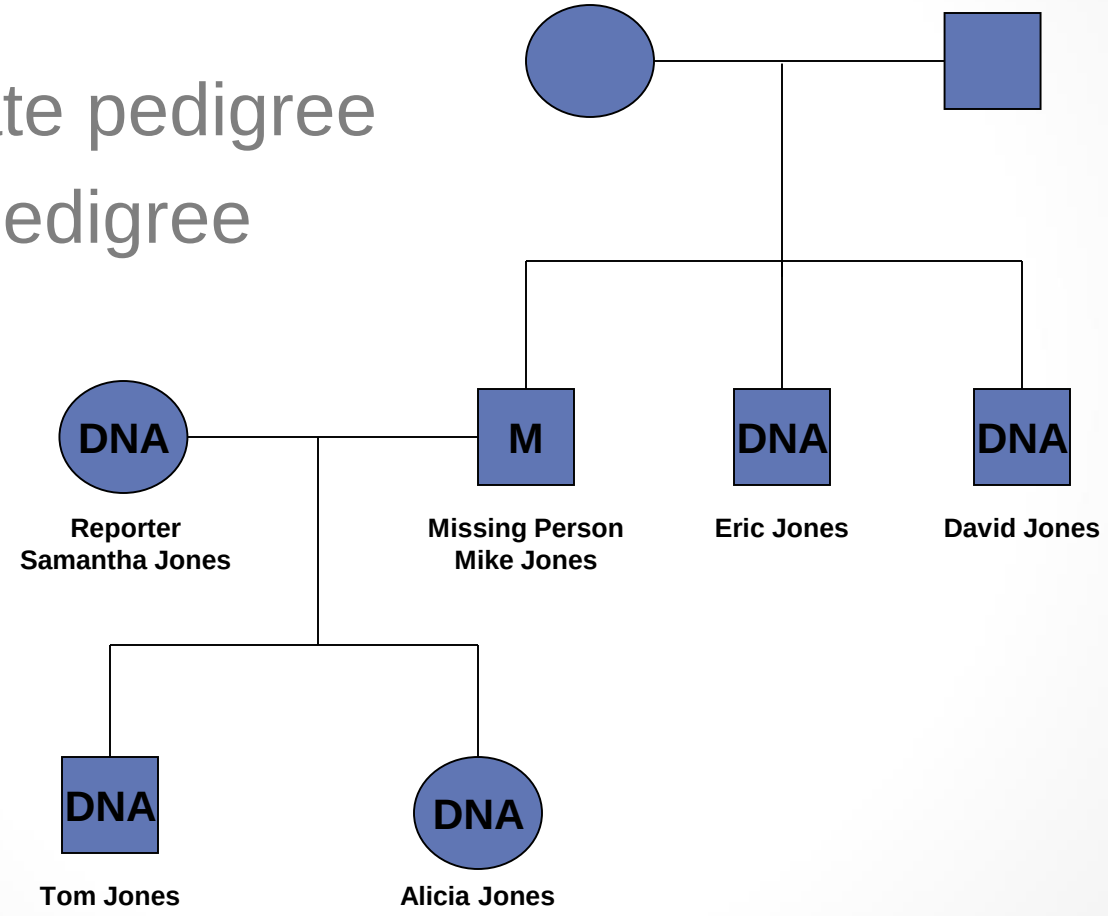
Date of Initial Contact

Type of Initial Contact

Relationship: Wife Husband Father Mother Brother Sister Son Daughter Employer Friend Other

Drawing a Pedigree

- Generate pedigree
- Verify pedigree



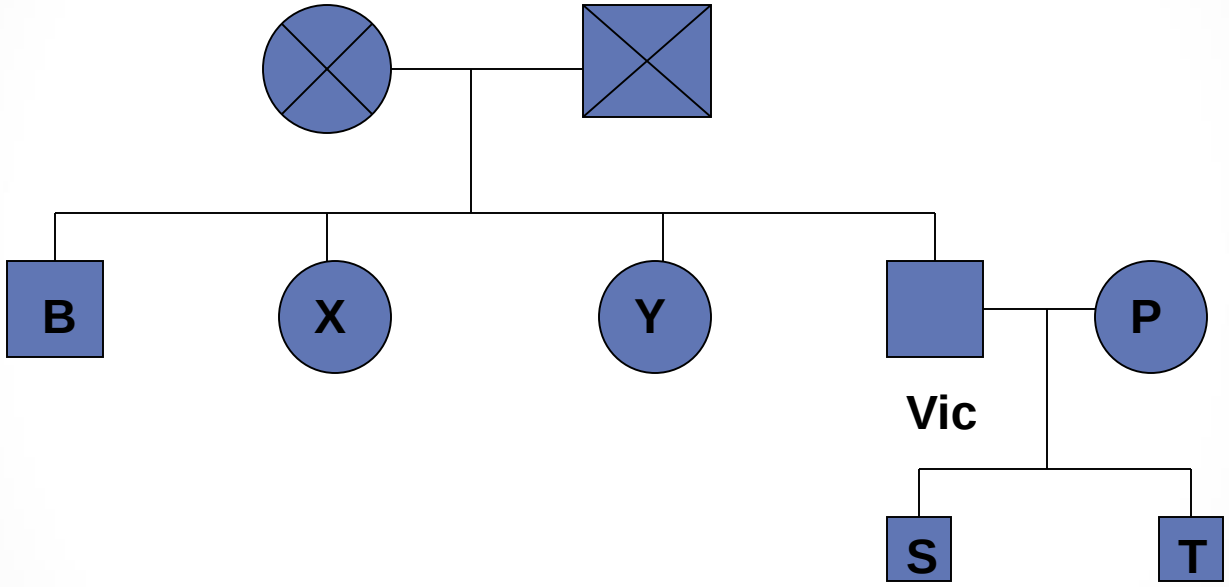
Verifying Relationships

- DNA Analysts assisted
- Gather paperwork associated with case:
  - o Donor collection forms
  - o Pedigree from Family History Unit
  - o Electropherograms
- Compare information & check for discrepancies

Use of DNA-View

- DNA Analysts checked relationships using DNA-View
- Two part process:
  1) Validate pedigree - do kinship samples agree with recorded relationships?
  2) Run simulations - will available family members with validated relationships lead to the positive ID of the missing person?

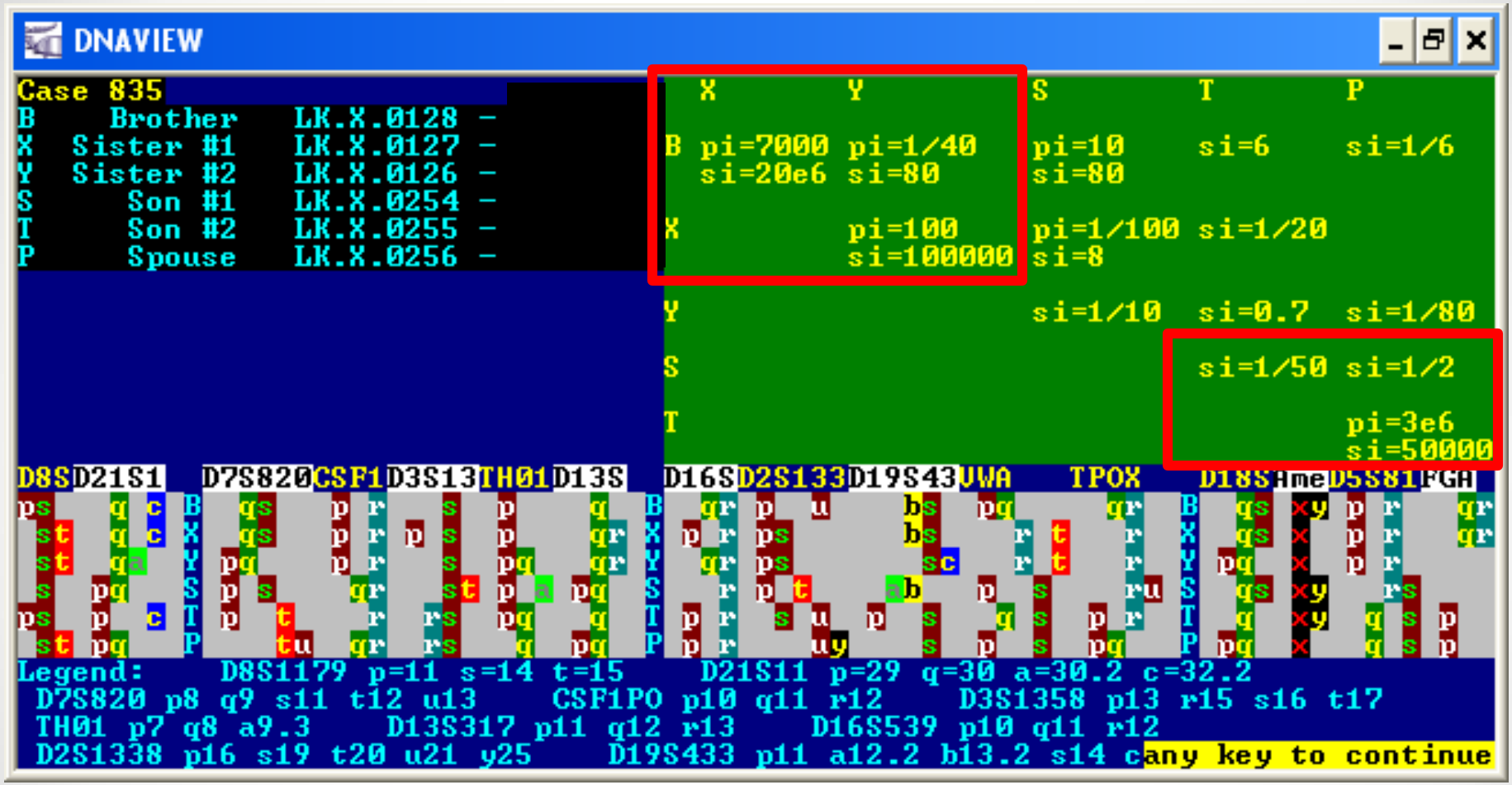
Pedigree to be Tested



Scenarios to test:

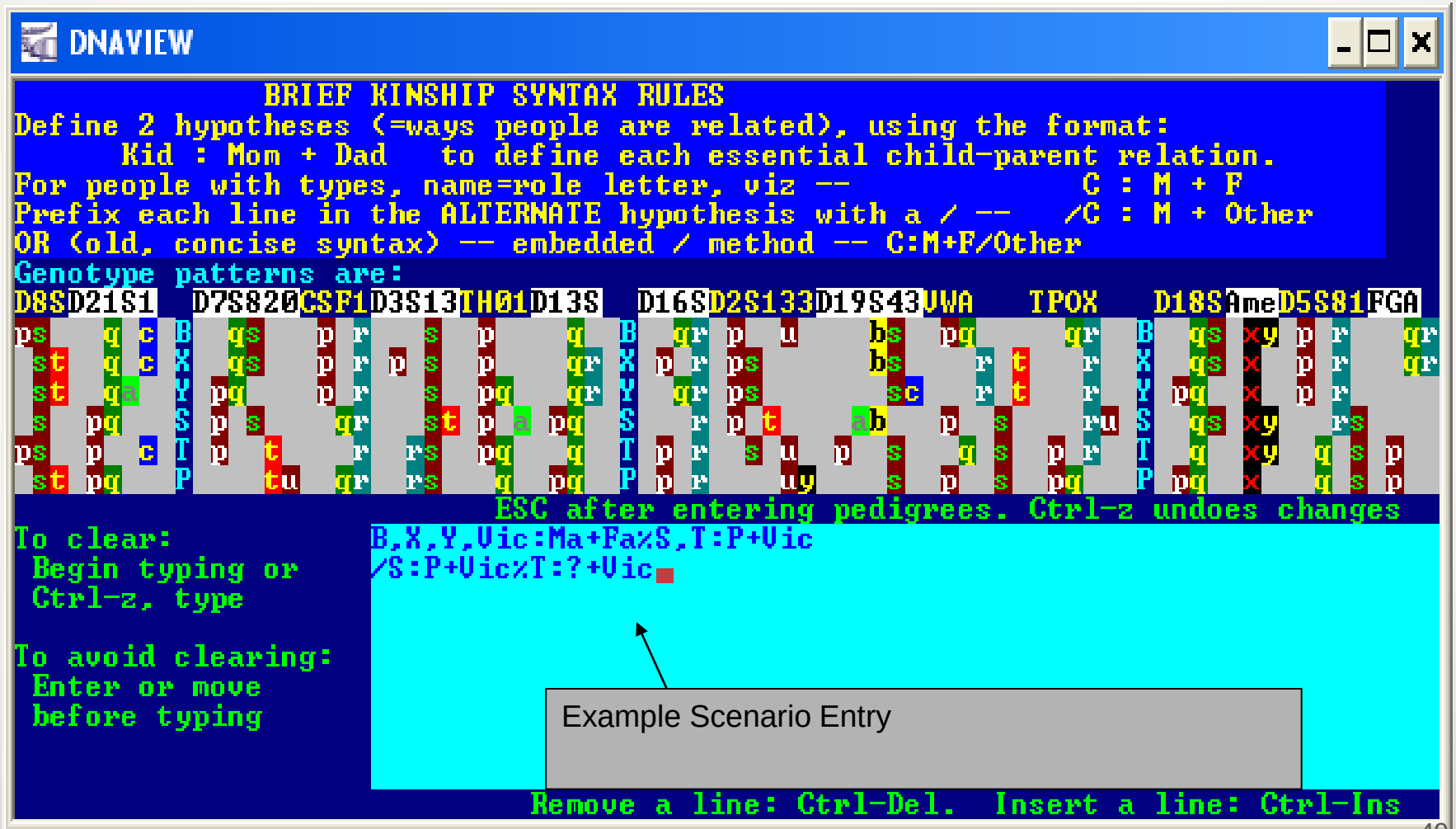
B, X, Y, Vic/Other: Ma + Pa

S, T: P + Vic/Other



pi=paternity index; si=sibship index

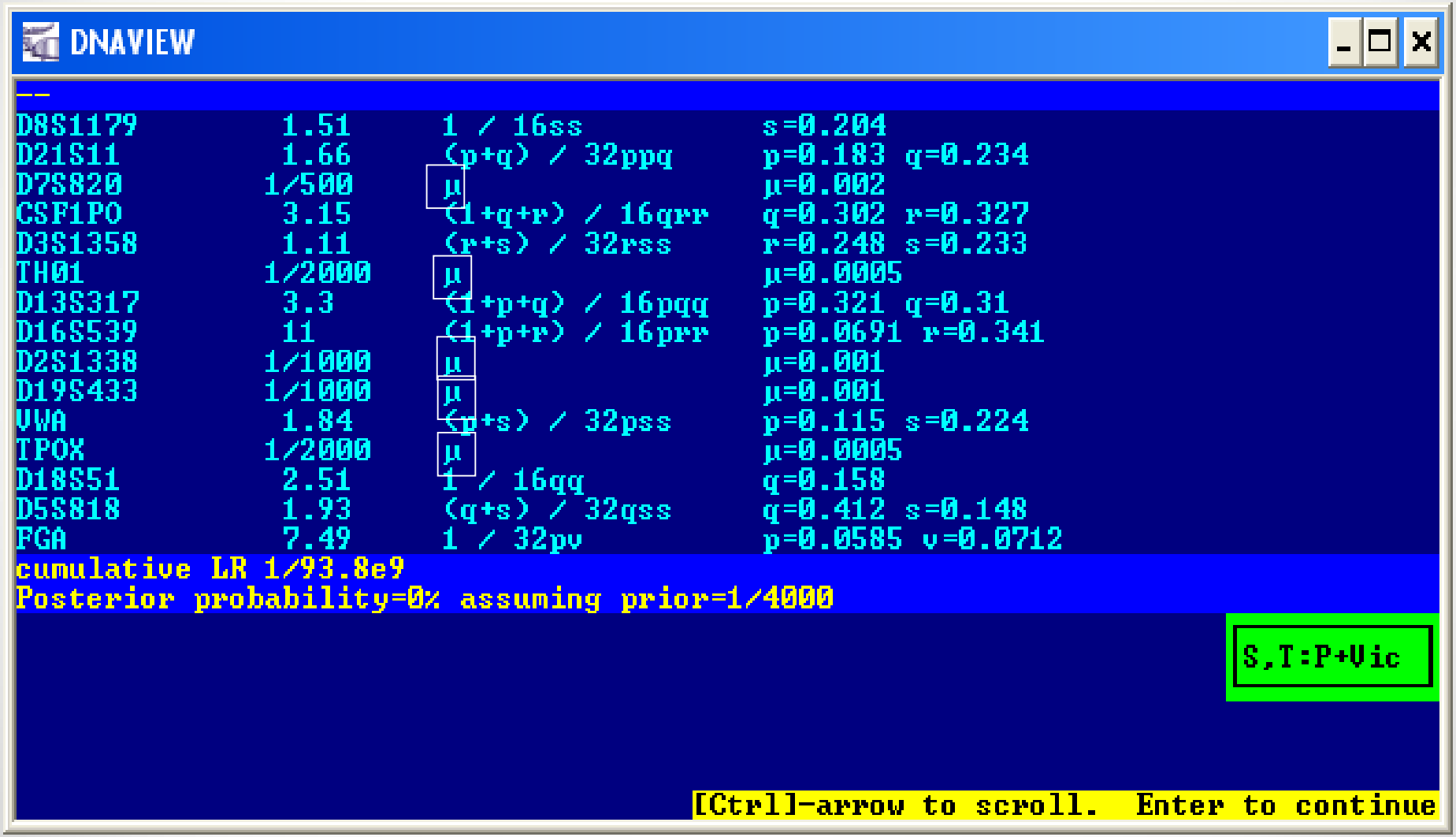
Calculating Likelihood Ratios



Likelihood Ratios

- Based on prior probabilities
  - Changed as the number of missing changed
    - At the beginning 1/4000, by the end 1/2000
- Calculate in two races - Black and Caucasian
- Are ratios reasonable?
  - Not equal to or less than 1
  - No μ's in data

μ=mismatch


DNAVIEW
--
D8S1179 1.51 1 / 16ss s=0.204
D21S11 1.66 (p+q) / 32ppq p=0.183 q=0.234
D7S820 1/500 μ μ=0.002
CSF1PO 3.15 (1+q+r) / 16qrr q=0.302 r=0.327
D3S1358 1.11 (r+s) / 32rss r=0.248 s=0.233
TH01 1/2000 μ μ=0.0005
D13S317 3.3 (1+p+q) / 16pqq p=0.321 q=0.31
D16S539 11 (1+p+r) / 16prr p=0.0691 r=0.341
D2S1338 1/1000 μ μ=0.001
D19S433 1/1000 μ μ=0.001
VWA 1.84 (p+s) / 32pss p=0.115 s=0.224
TPOX 1/2000 μ μ=0.0005
D18S51 2.51 1 / 16qq q=0.158
D5S818 1.93 (q+s) / 32qss q=0.412 s=0.148
FGA 7.49 1 / 32pv p=0.0585 v=0.0712
cumulative LR 1/93.8e9
Posterior probability=0% assuming prior=1/4000
S,T:P+Vic
[Ctrl]-arrow to scroll. Enter to continue

Trial and Error

- If given relationships do not fit, test alternative hypotheses
  - If people reported as full sibs give poor results, test them as half sibs

Simulations

- To determine that family members with validated relationships will positively identify a bone sample as the missing person
- The LR in the 90th percentile should be equal to or greater than 2 million (as determined by the expert panel)
- In the event that the 90th percentile was <2 million, geneticists contacted family members to request:
  - Additional family swabs and/or
  - Personal effects

Sample Flow

- Bone samples taken from all remains
- Testing outsourced in duplicate
  - Exemplars → Reliagene & Orchid
  - Bones → Bode & ICMP
- Personal Items tested by U of N. Texas
- All samples run in Identifiler®
- Mito performed on select samples
  - Exemplars → Reliagene
  - Bones → Bode
- Y STR's also performed on select samples
  - Exemplars → Reliagene & Orchid
  - Bones → Bode

Overview of Data Review

1. Data “packets” posted online to LSPCL & notification sent
2. Data downloaded to central computers
3. Data reviewed (checklist)
4. Electropherograms printed
5. Data uploaded into DNA View

Data Review

- Checklist Criteria
  - each run has at least 1 ladder, pos control, & neg control
  - size std passes
  - ladder & pos control labeled correctly
  - neg controls (amp & ext) are clean
  - samples are contract compliant
    - Exemplars → heterozygote peaks at least **150 RFU's**
      homozygote peaks at least **300 RFU's**
    - Bones → no minimum thresholds

Data Review

- Data from both vendors must match!
- Weekly status reports
- Minimum amplification volumes
- Data organization
- Constant communication w/ vendors necessary b/c of time constraint:

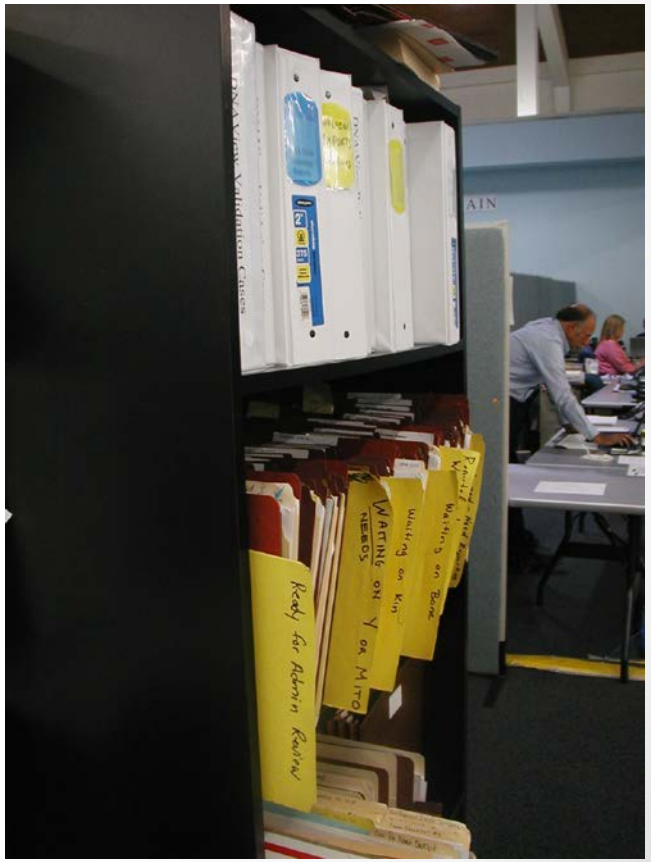
    deadline: June 30, 2006

Identification Thresholds

- Direct Reference: in the millions
- Kinship: in the millions
- Prior Probability: 1/2000
- at least 99.99%

Reporting Process

1. Folder Generation
2. Second Review
3. Report Generation
4. Final Review and Signature
5. Release



Modalities of Identification

- Multiple modalities used for some victims
- Pathology – 495
- Personal Effects – 477
- Field Notes – 449
- Fingerprints – 178
- Dental – 156
- **DNA – 153**

- 40% of the deaths in Louisiana were caused by drowning. 25% were caused by injury and trauma and 11% were caused by heart conditions.
- Nearly half the fatalities in Louisiana were people over the age of 74.

Challenges

- Family reference samples
  - o Locating relatives – cooperation of families
  - o Confirmation of relationships
- Software to manage information
- Training
- Realistic Timeframe for DNA Testing
  - o Laboratories were flooded

Use of Rapid DNA

- Family reference samples
  - o DNA Testing at the FAC
  - o Verify Relationships – BUT Be Careful!

Use of Rapid DNA

- Software to manage information
  - o Expert DNA systems for reference analysis
  - o Data comparison tools – direct matching & indirect/familial comparisons
  - o Integration with existing lab network software
- Training
  - o Non-scientists as operators
  - o Implementation of Co-op among many jurisdictions

Use of Rapid DNA

- Realistic Timeframe for DNA Testing
  - With pristine samples: days to weeks vs. months to years
    - Quality control checks through instrument instead of by hand
  - Scope of DVI dictates the need
    - # of victims
    - Fragmentation of remains
    - Degradation factors

Use of Rapid DNA

- Realistic Timeframe for DNA Testing
  - o Can instrumentation handle poor quality samples?
    - Some degree of success may still reduce laboratory's workload
    - Y-STR or mtDNA?

Acknowledgements

- OCME NYC, Dept. of Forensic Biology
  - Management & Co-op Participants
- Family History Unit staff
  - Amanda Sozer
  - Michelle Beckwith
  - Cyndi Wolfe
- Louisiana State Police Crime Lab
- Hurricane Katrina Expert Panel
- ARP Sciences, LLC
  - James Canik
- AFMES/AFDIL
  - Timothy McMahon

Questions?


LOUISIANA
FAMILY ASSISTANCE CENTER
"We answer your call with compassion"
Alexandria
Baton Rouge
Lafayette
Lake Charles
New Orleans
Houma