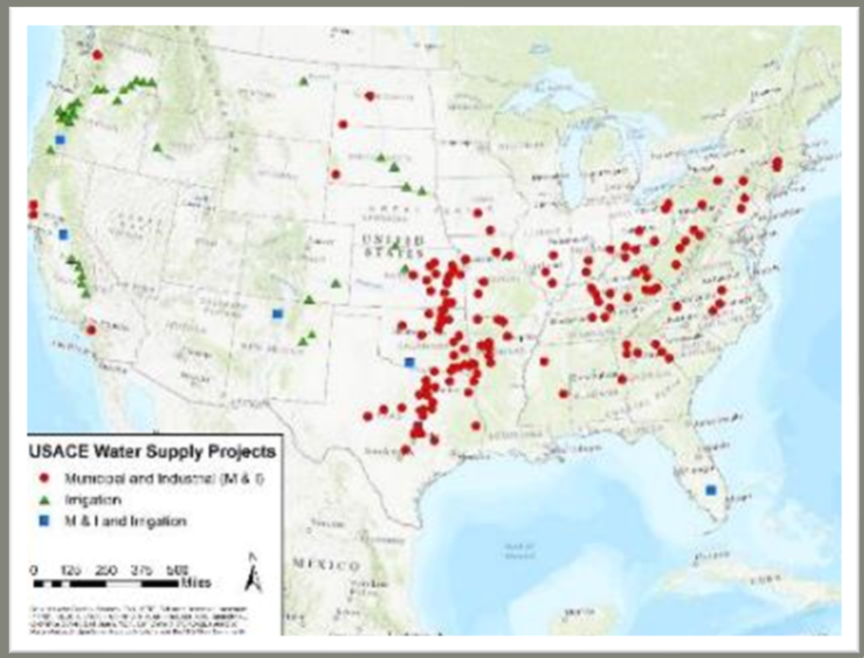
TECHNICAL CONSIDERATIONS IN STORAGE ACCOUNTING FOR USACE WATER SUPPLY AGREEMENTS

Brad Hudgens, PE, D.WRE

USACE Water Supply Business Line Manager



US Army Corps of Engineers ®

U.S.ARMY

WATER SUPPLY BUSINESS LINE UPDATE

- FY2022 President's Budget
- GAO Report 17-500, Recommendations 1 & 2
- WRDA 2020, Section 221 Report to Congress

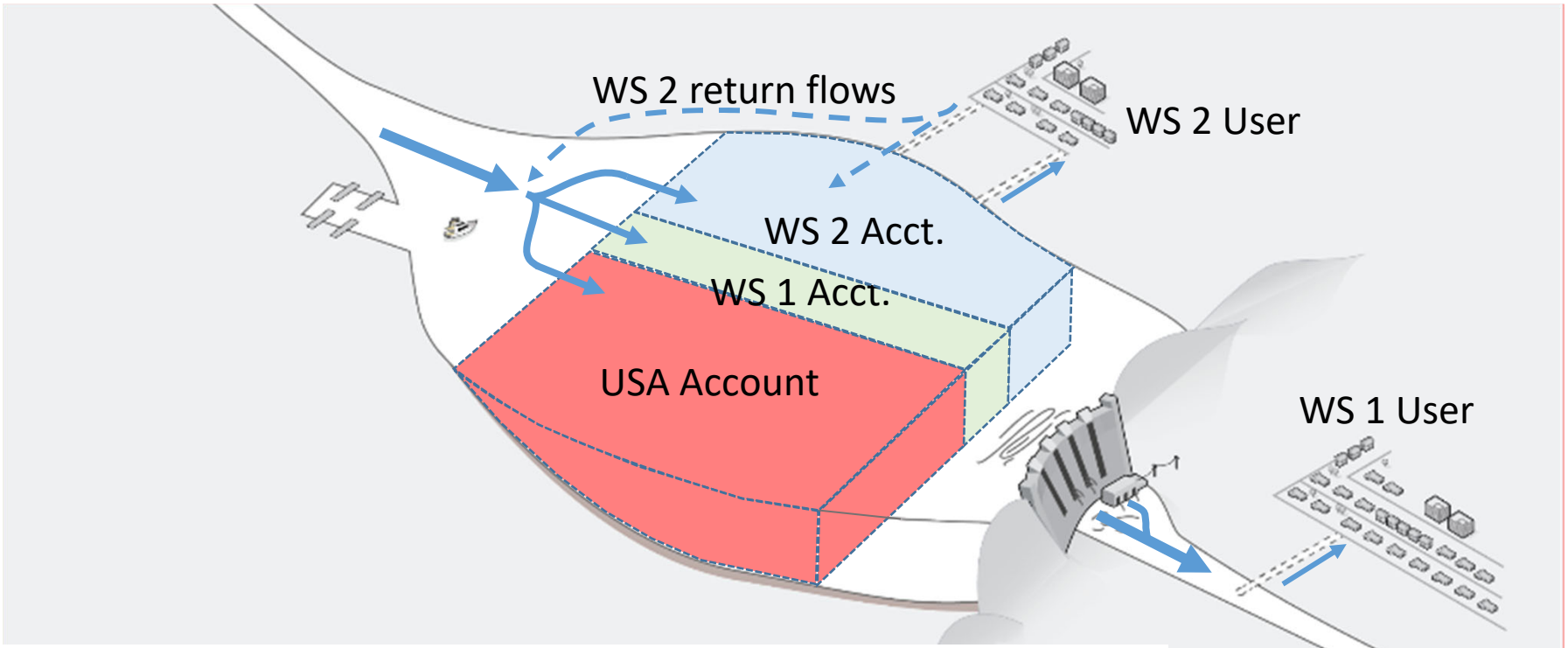
FY 2022 Budget
Business Line/Account Cross-Walk ($ Millions)

Business Lines/Funding Categories: 1/				MR&T				IWTF	HMTF								
	I	C	O&M 2/	I	C	O&M	TOTAL MRT	C	C	O&M	MRT O&M	TOTAL HMTF	REG	FCCE	E	ASA (CW)	TOTAL
Flood and Coastal Storm Damage Reduction	58	623	804	6	31	186	223			5		5					**1,713**
Coastal	19		13							5		5					37
Inland	38	623	791	6	31	186	223										1,676
Navigation	25	714	1,004		2	28	29	52	58	1,552	5	1,616					**3,441**
Coastal	10	615	14						58	1,552	5	1,616					2,255
Inland	15	99	990		2	28	29	52									1,186
Hydropower		4	244														**248**
Aquatic Ecosystem Restoration	23	441	28	1	0		1		5			5					**498**
Innovative Funding Partnerships 3/		10															**10**
Environmental Stewardship			129			5	5										**134**
Recreation			283			12	12										**295**
Water Supply			5														**5**
Regulatory													204				**204**
Emergency Management			6											35			**41**
Expenses															199		**199**
Office of the Assistant Secretary of the Army for Civil Works																5	**5**
TOTAL	**106**	**1,792**	**2,503**	7	33	230	270	52	64	1,557	5	1,626	204	35	199	5	**6,793**

US Army Corps of Engineers

U.S.ARMY

WHY STORAGE ACCOUNTING?

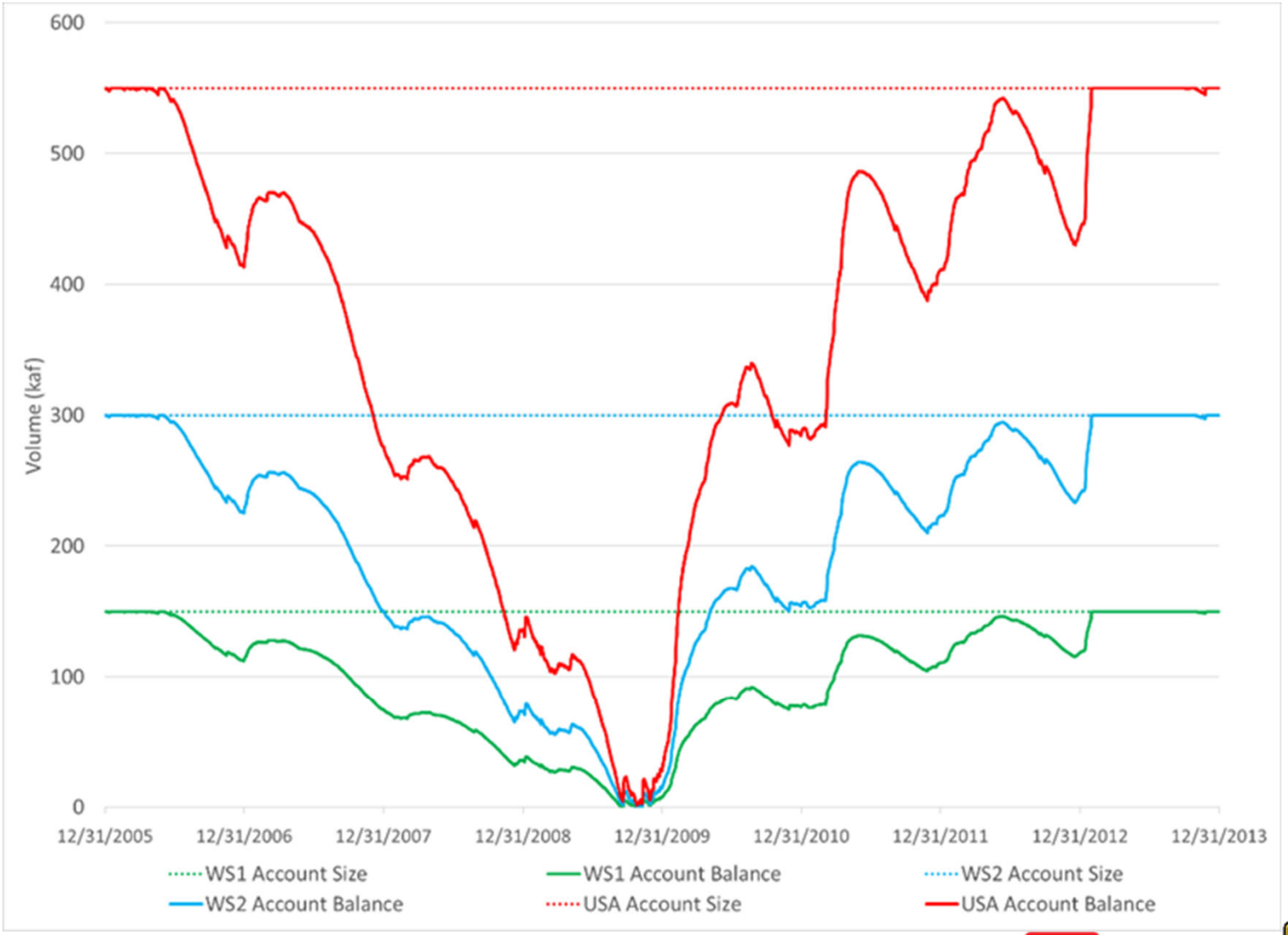


Risk: In a severe drought, one user of the shared conservation pool exceeds expectations for their use of stored water, causing unplanned shortages for other users or project purposes.

US Army Corps of Engineers

U.S.ARMY

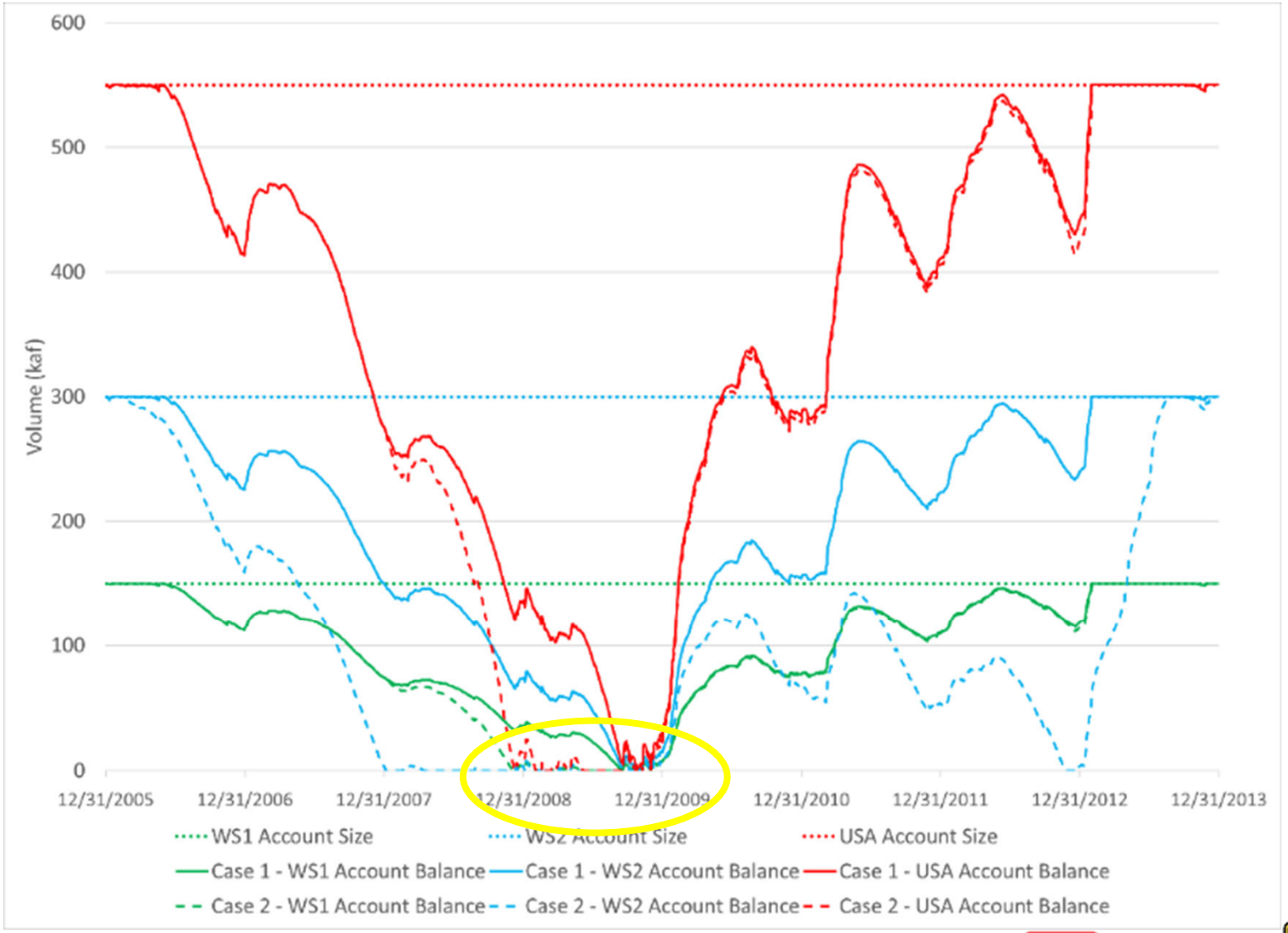
FIRM YIELD FOR EXAMPLE PROJECT



US Army Corps of Engineers

U.S.ARMY

ILLUSTRATION OF RISK



US Army Corps of Engineers

U.S.ARMY

STORAGE ACCOUNTING IN CONTEXT

Hydrologic Studies

… determine the volume of storage space needed to support a user's planned demand with some degree of reliability (typically as firm yield) under historical or assumed inflows and other conditions.

Signed WSSA

… gives the user a permanent right to use a percentage of the usable conservation storage space in the project.

Storage Accounting

… may limit the amount of stored water that the user can withdraw or order released under actual future inflows and other conditions.

US Army Corps of Engineers

U.S.ARMY

BLUF: CONCLUSIONS AND RECOMMENDATIONS

- Conclusion: Different methods will result in different yields that a user can realize through a severe drought
- Best practice #1: To the extent we can, incorporate storage accounting method into storage-yield analysis
- Best practice #2: Document storage accounting method in water supply agreement, water control manual or drought contingency plan
- Provides framework to review considerations when developing a storage accounting method for a particular system, project or agreement.

US Army Corps of Engineers

U.S.ARMY

TERMINOLOGY AND CONCEPTS

- Terminology and definitions may vary by region, state, agency and context, for example:
  - "storage certificates"
  - "firm yield", "dependable yield," "safe yield," "actual yield," etc.
  - "surplus inflows" and "surplus water"
  - "storage"
- Using report terminology, account yield = $f($
  - account's share of inflow and losses
  - account storage space, and the
  - starting volume of stored water in the account)
- Important to define terms for discussion as USACE works with different regions, states and agencies

US Army Corps of Engineers

U.S.ARMY

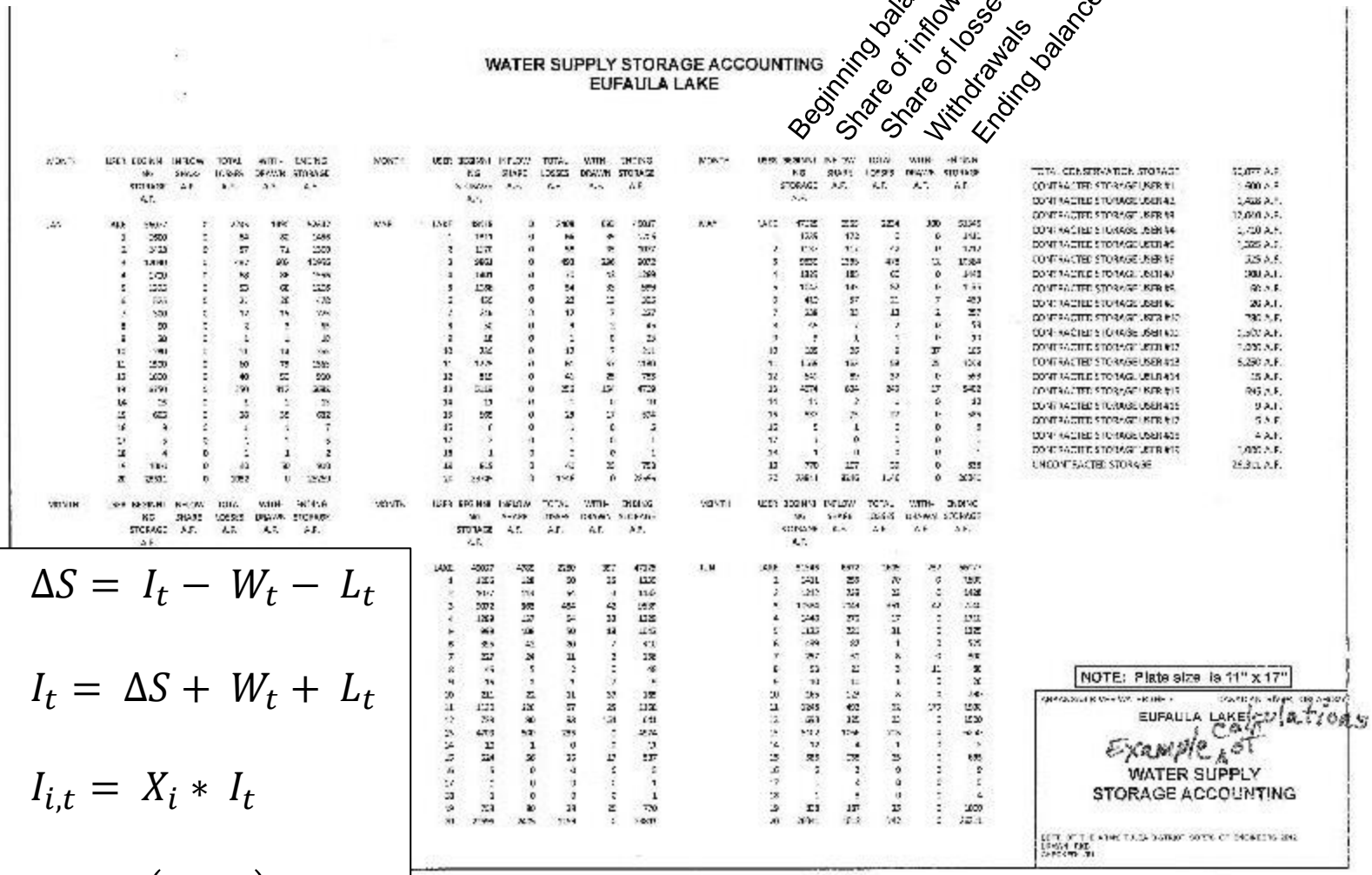
TERMINOLOGY AND CONCEPTS

- Model storage agreements
  - *Right to use a percentage of the usable conservation storage space*
  - Define this storage space as between two elevations
  - Estimate the usable storage space as remaining after 100 years of sedimentation from the date the project is operational
  - Caveats related to meeting other authorized purposes, dam safety, availability and quality of water

US Army Corps of Engineers

U.S.ARMY

EXAMPLE STORAGE ACCOUNTING



1. $\Delta S = I_t - W_t - L_t$

2. $I_t = \Delta S + W_t + L_t$

3. $I_{i,t} = X_i * I_t$

4. $L_{i,t} = \left(\frac{S_{i,t}}{\Sigma_i S_{i,t}}\right) * L_t$

US Army Corps of Engineers

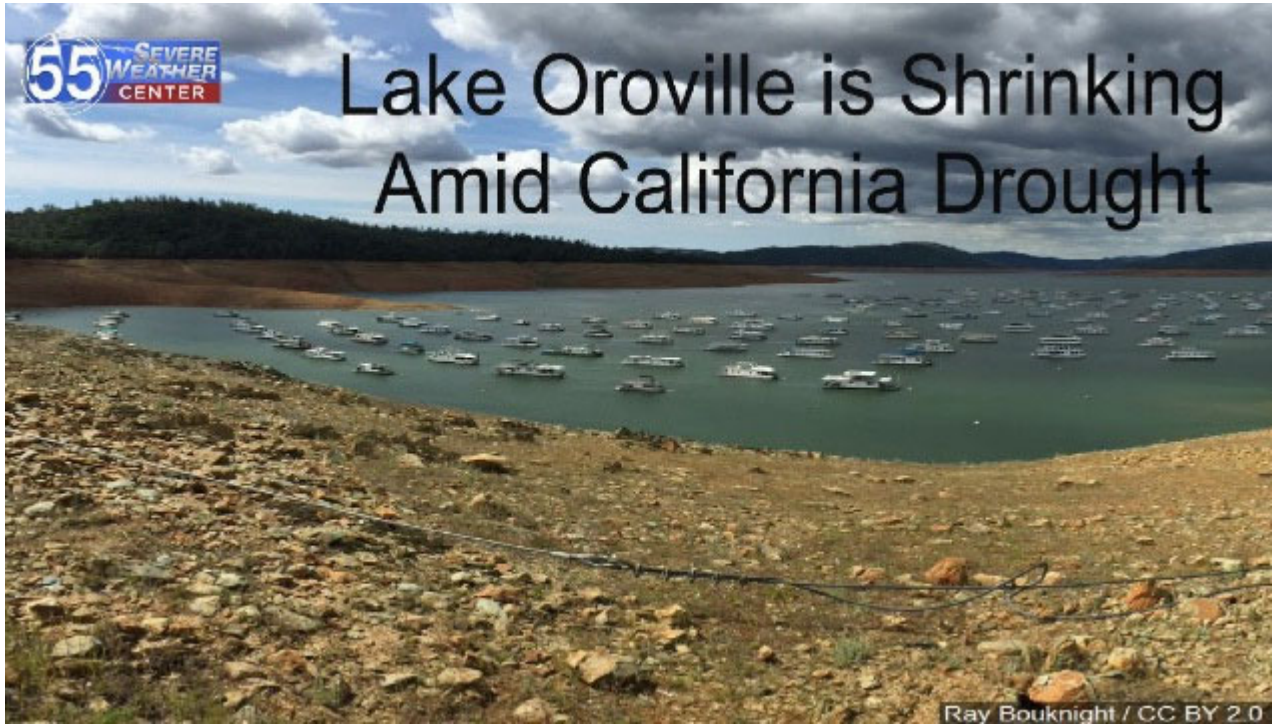
U.S.ARMY

IS STORAGE ACCOUNTING NEEDED?

- What is the benefit/cost of this as a risk reduction measure?
- Size of storage agreement in relation to the conservation pool
- Conditions that minimize risk:
  1. Storage-yield analysis based on a severe drought that we are unlikely to exceed
  2. Users unlikely to exceed expected average rate of withdrawal
  3. Usable storage space unlikely to decline below estimated future volume
- Could USACE instead regulate the rates of withdrawal?
  1. What is our authority to regulate this?
  2. How do we know a higher rate of withdrawal increases risk?
  3. Defining user's right in terms of rate of withdrawal may disproportionately affect other users if project firm yield decreases

HOW FREQUENTLY WILL IT BE CALCULATED?

- How quickly might the onset of drought conditions affect the balance of stored water in the reservoir?
- How large are the demands for water from the reservoir in relation to the total volume of stored water in the conservation pool?



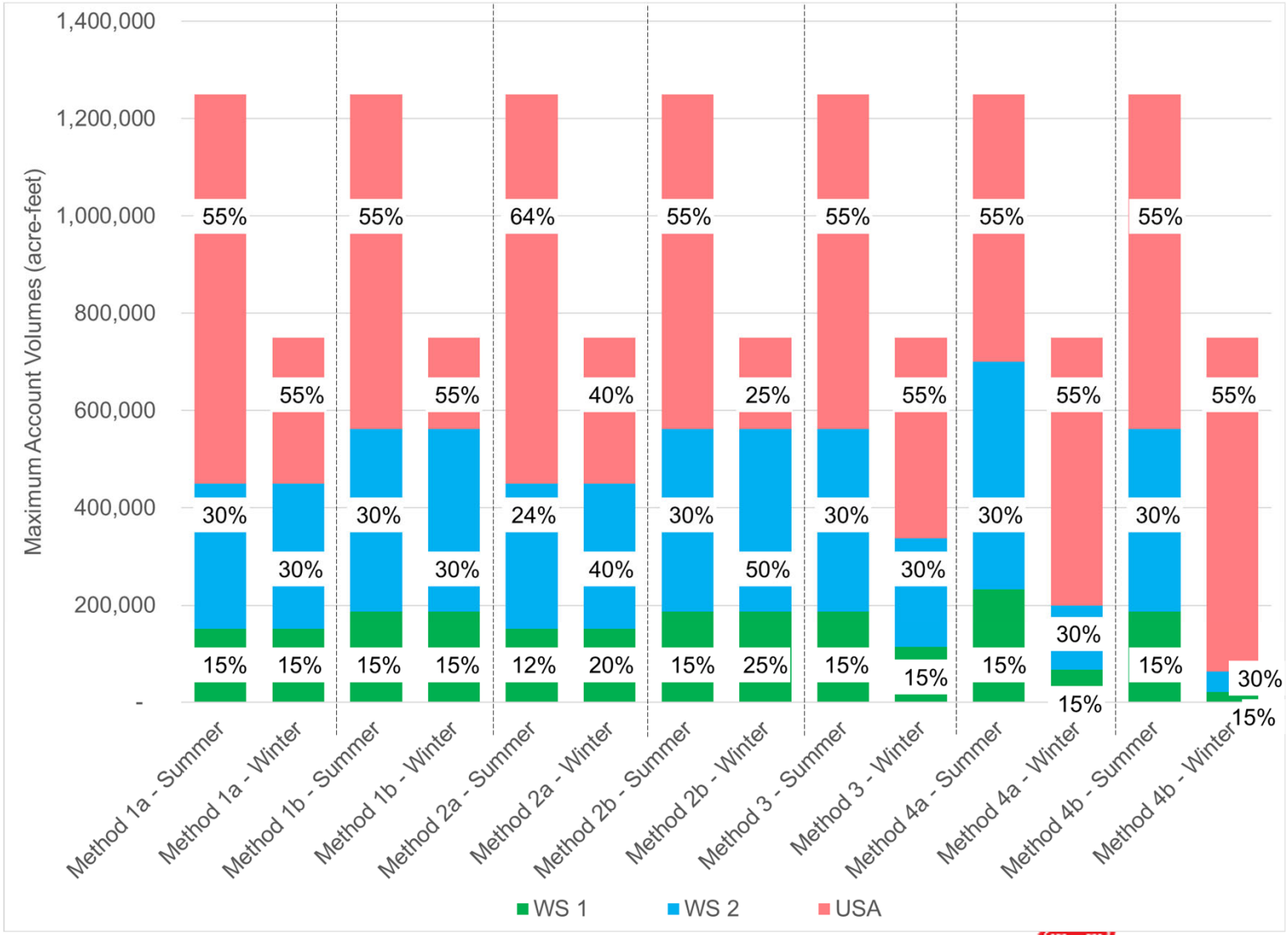
US Army Corps of Engineers

U.S.ARMY

HOW WILL INFLOWS BE SHARED?

- Should some inflows be passed downstream?
- Will some inflows be credited to specific uses or accounts?
  - For example, return flows.
- After these considerations, how will remaining inflows be shared among accounts?
  - Flat guide curve versus seasonal guide curve
- If an account is full, will any surplus inflows be shared with other accounts, and how?

HOW ARE ACCOUNT VOLUMES APPORTIONED?



US Army Corps of Engineers

U.S.ARMY

HOW WILL RESERVOIR LOSSES BE SHARED?

- Evaporation
  - How significant is lake evaporation in the region?
  - How are net evaporative effects measured or estimated?
  - How are they shared among accounts?
    - In proportion to maximum account volumes
    - In proportion to remaining account volumes
- Are there other significant losses other than evaporation?

HOW ARE SEDIMENTATION LOSSES SHARED?

- Public Law 88-140 enacted in 1963 said:

  "the right [to use storage space] thus acquired by any such local interest is hereby declared to be available to the local interest so long as the space designated for that purpose may be physically available, *taking into account such equitable reallocation of reservoir storage capacities among the purposes served by the project as may be necessary due to sedimentation*."

- This language led to Article 1e in the model water supply agreements

SEDIMENTATION LANGUAGE IN AGREEMENTS

- Model water supply agreement (2020), article 1e:
  - "When, *in the opinion of the District Engineer*,
  - the findings of such survey indicate *any Project purpose* will be affected by *unanticipated sedimentation distribution*,
  - there shall be an *equitable redistribution of the sediment reserve storage space* among the purposes served by the Project including municipal and industrial water supply,
  - recognizing that the Project will continue to be regulated to reduce flooding downstream from the dam.
  - *Adjusted pool elevations* will be rounded to the nearest one-half foot."

SCENARIOS FOR SEDIMENTATION

- Sediment reserve storage space?
- What is “unanticipated sedimentation distribution?”
- Four scenarios:
  1. No redistribution of sediment reserve or storage allocations
  2. Redistribution of sediment reserve storage
  3. Redistribution of remaining project storage after sediment reserve is used
  4. Maintaining firm yield of water supply agreements
- Basis for redistribution?
  - Design sedimentation rates
  - Percentage loss in storage space
  - Other?

WHAT MONITORING AND DATA ARE REQUIRED?

- Frequency, accuracy, format and methods of transmission for data
- Inspections and calibration
- Requirements for and availability of data among different agencies

US Army Corps of Engineers

U.S.ARMY

ENFORCEMENT, REPORTING AND ADMINISTRATION

- What actions will USACE take if it determines a user's storage account balance is zero?
- Will other agencies enforce limits?
- Will accounting be made public?
- How frequently will information be shared?
- Where will methods and procedures be documented?
- Are there institutional arrangements that allow for transactions of storage space or stored water?
- Are there future conditions that trigger reconsideration of storage accounting methods?

CONCLUSIONS AND RECOMMENDATIONS

- Conclusion: Different methods will result in different yields that a user can realize through a severe drought
- Best practice #1: To the extent we can, incorporate storage accounting method into storage-yield analysis
- Best practice #2: Document storage accounting method in water supply agreement, water control manual or drought contingency plan
- Provides framework to review considerations when developing a storage accounting method for a particular system, project or agreement.

US Army Corps of Engineers

U.S.ARMY

THANK YOU!

DISCUSSION?

US Army Corps of Engineers

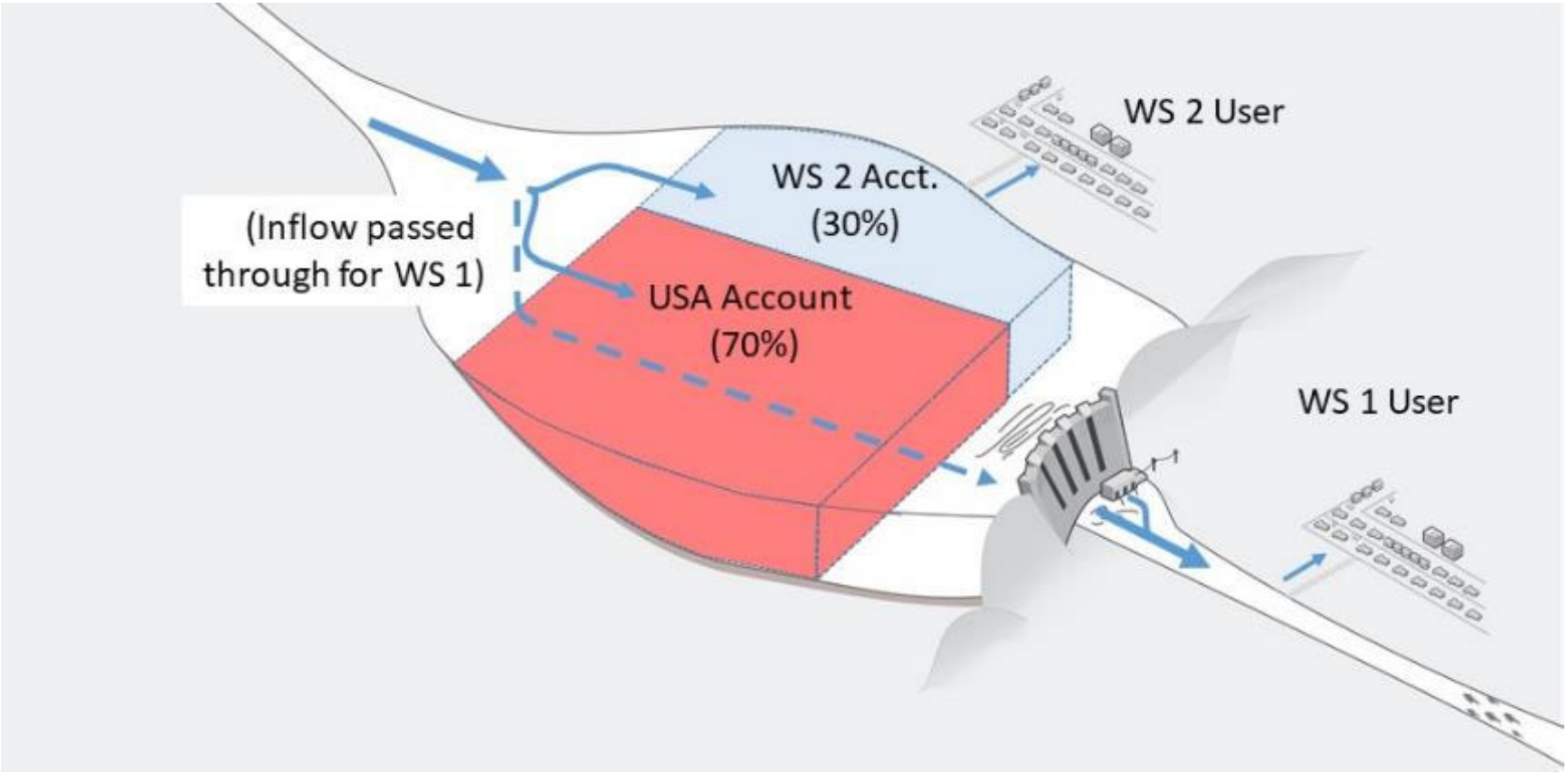
U.S.ARMY

BACKUP SLIDES

US Army Corps of Engineers

U.S.ARMY

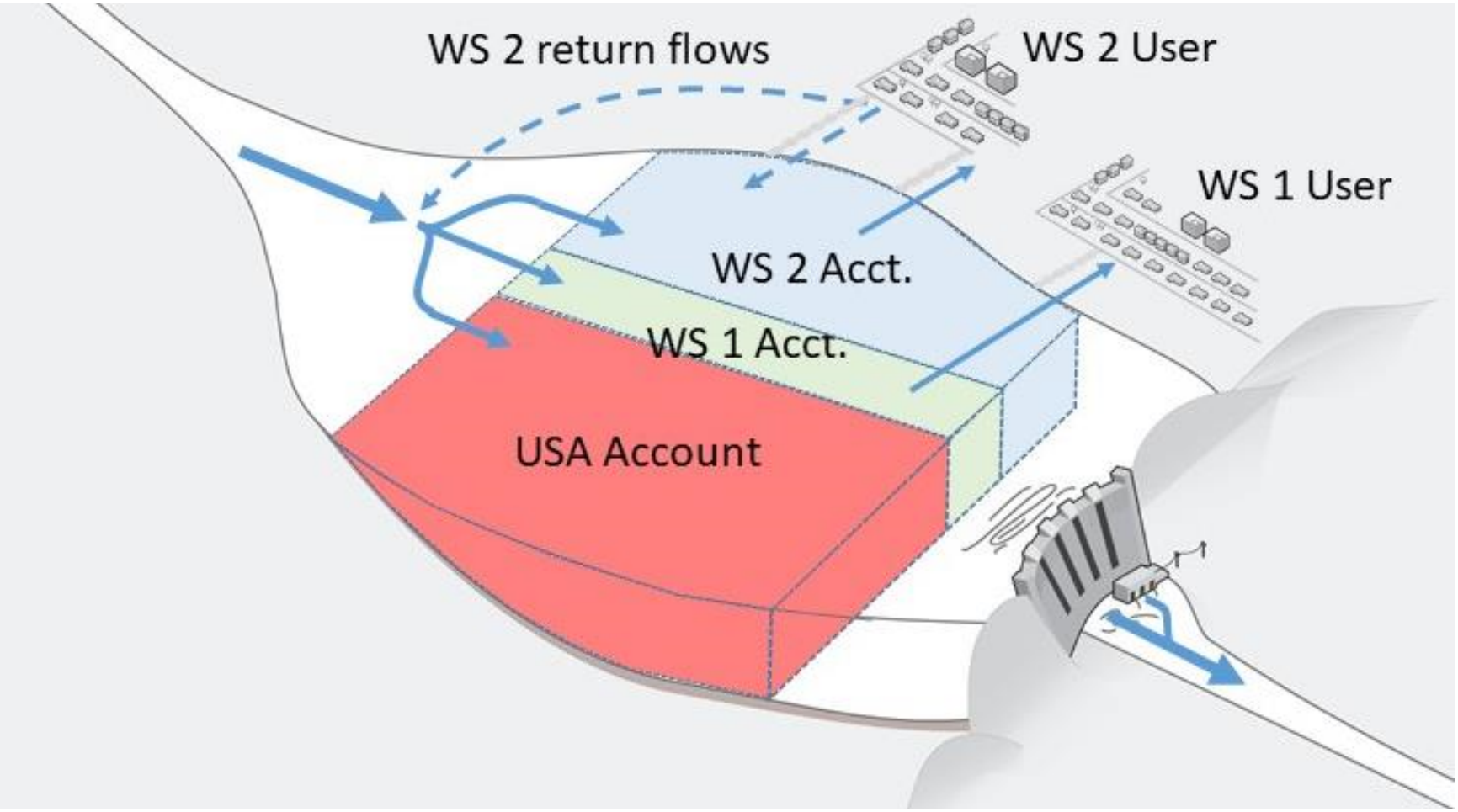
PASSING INFLOWS DOWNSTREAM



US Army Corps of Engineers

U.S.ARMY

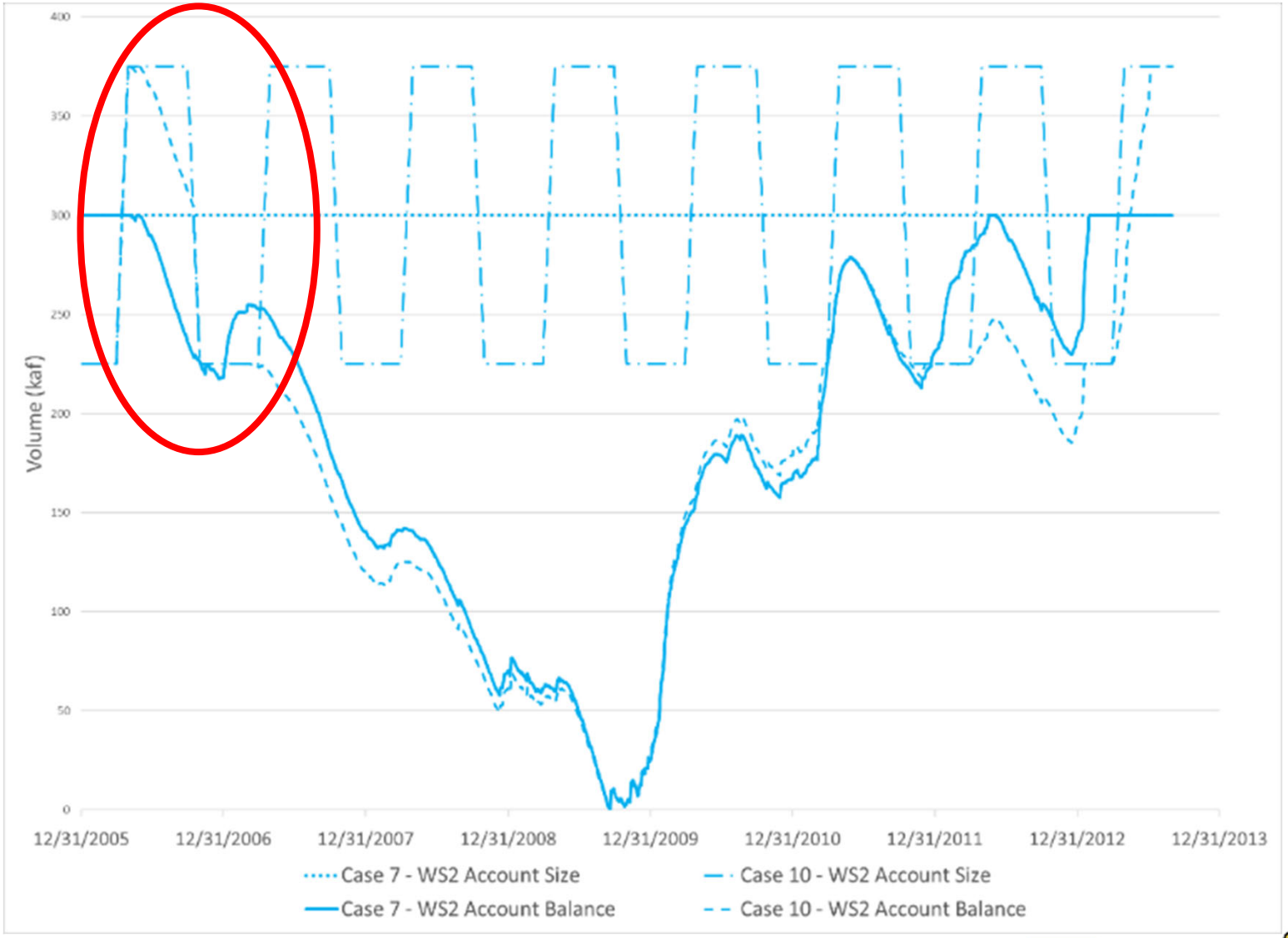
RETURN FLOWS



US Army Corps of Engineers

U.S.ARMY

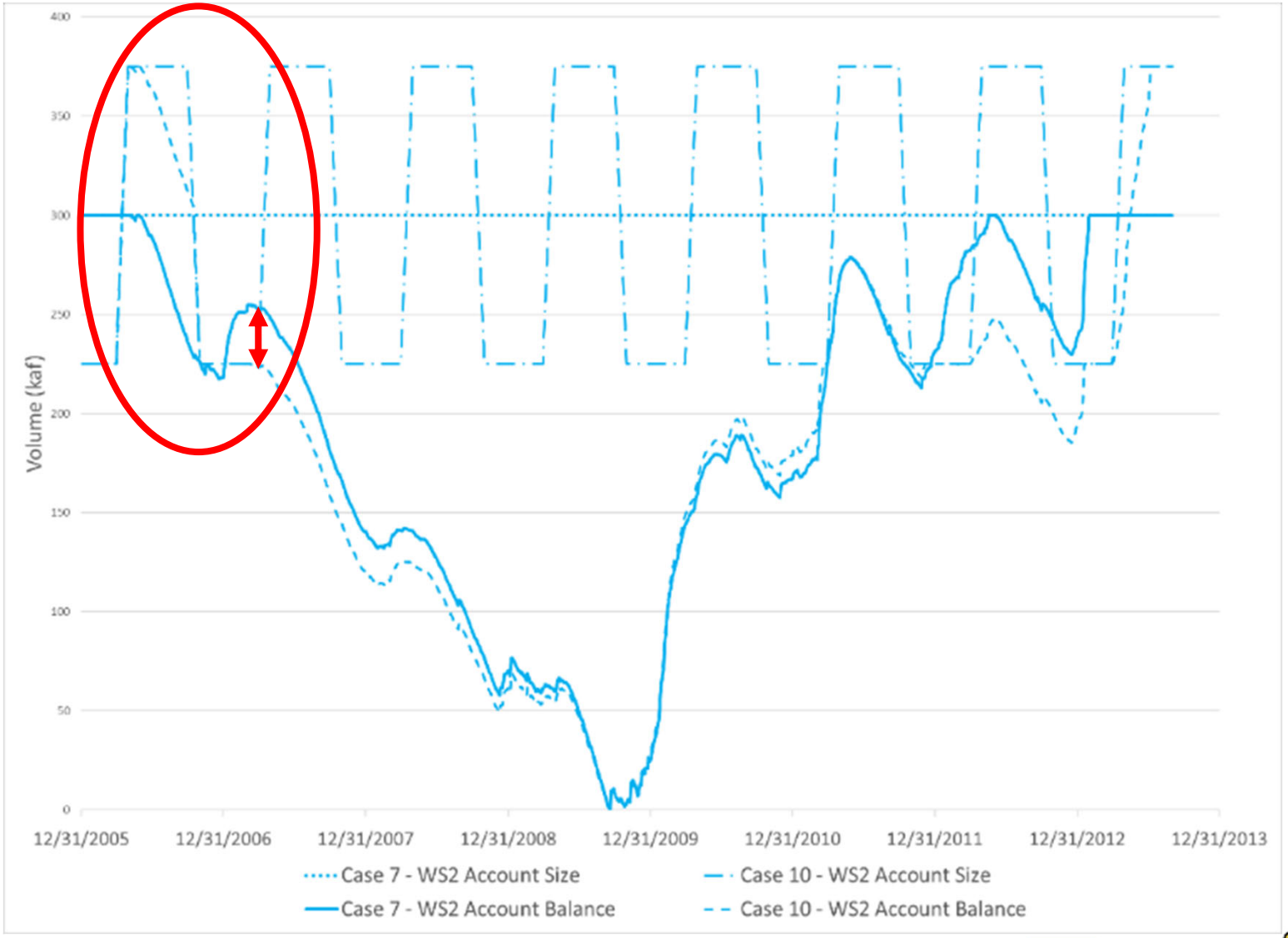
POTENTIAL IMPACT OF WINTER DRAWDOWN



US Army Corps of Engineers

U.S.ARMY

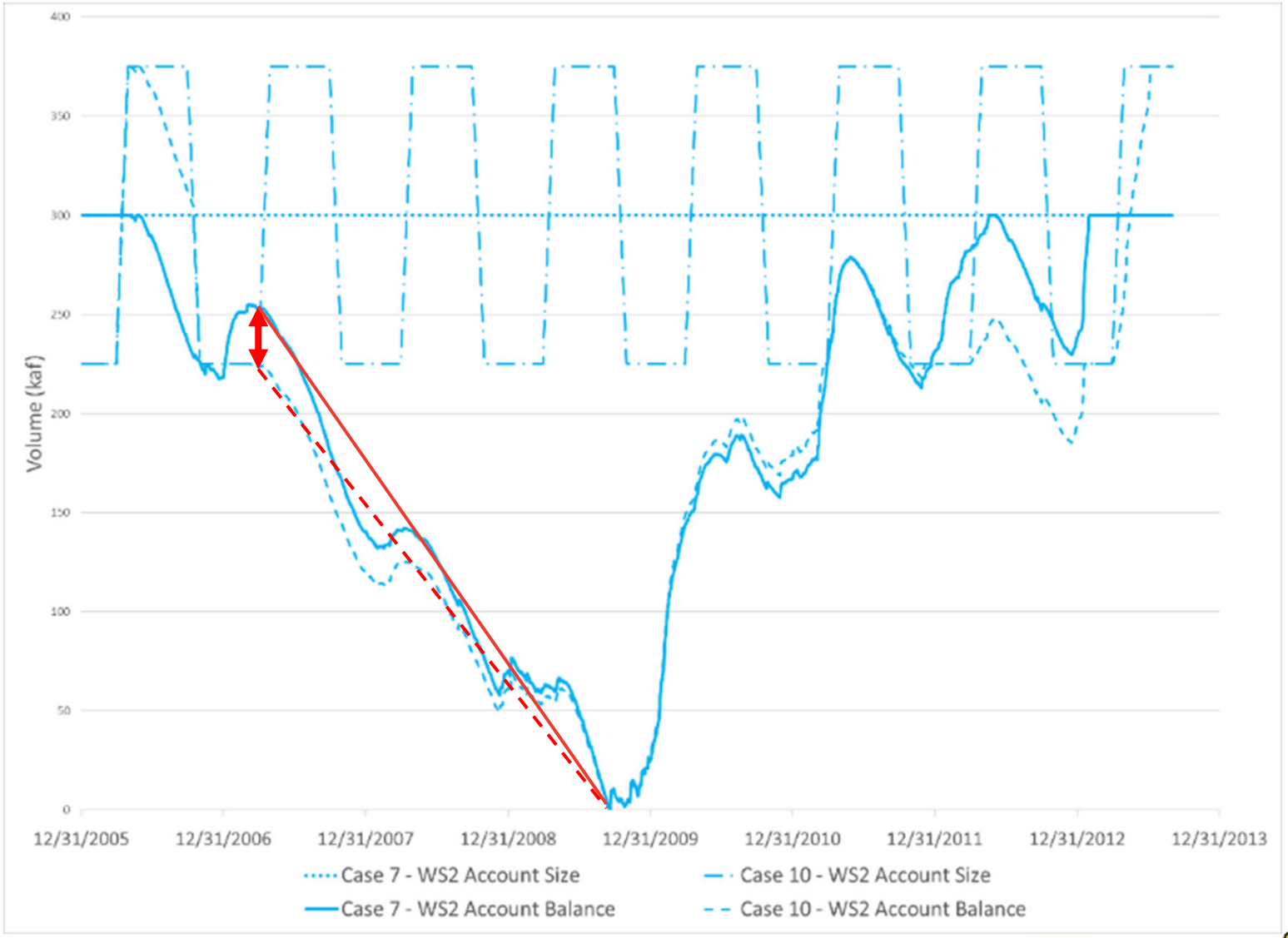
POTENTIAL IMPACT OF WINTER DRAWDOWN



US Army Corps of Engineers

U.S.ARMY

POTENTIAL IMPACT OF WINTER DRAWDOWN



US Army Corps of Engineers

U.S.ARMY