URS

Memorandum

Date: November 11, 2008

To: Mr. Dean Benedix, Water Resources Engineer, County of San Luis Obispo

From: Steven Tough, Noel Wong

Subject: ***Preliminary Program-Level Budget and Schedule for Lopez Reservoir Expansion***

In response to your request, URS has prepared a pre-planning assessment of the concept to install Obermeyer gates at the Lopez Dam spillway that will allow additional storage at Lopez Reservoir. The scope of this assessment was described in our proposal dated February 8, 2008 and was approved and authorized by the County on April 24, 2008.

This memorandum has been prepared for the County to provide an understanding of the potential cost and schedule for implementing the proposed project. The proposed installation of Obermeyer gates is relatively limited in scope in terms of engineering and construction (a photograph of a typical Obermeyer Gates installation is shown in Exhibit A). However, this is a project that involves the provision of additional water supply (storage and diversion) from a live stream. As such, the process and time required to obtain all the permits to implement such a project is quite involved and complex, no different than any other surface water storage and supply project. This leads to a relatively high cost for environmental studies and permitting, compared to engineering and construction.

In order to do an initial assessment of additional water supply available from the Obermeyer gates installation, a preliminary re-operation model of the reservoir was undertaken by Stetson Engineering. Stetson utilized the existing Lopez Lake operations model developed for use in the Habitat Conservation Plan (HCP) process. The simulation period for the model is 1969-2004. The proposed 3-foot raise assumes an additional storage capacity of 2,850 acre-feet (AF), increasing the maximum storage capacity of Lopez Lake from 49,400 AF to 52,250 AF. Stetson's draft technical memorandum is included at the end of this memorandum.

Three scenarios from the modeling are presented, giving potential additional yield values ranging from 671 to 916 acre-feet/year (AFY). The results are summarized in Table 1. All scenarios assume a constant pipeline diversion of 4,530 AFY consistent with the Contractor Entitlements listed in the Zone 3 Urban Water Management Plan 2005 Update (2005 UWMP). All scenarios also assume a minimum of 4,200 AFY downstream releases to maintain groundwater levels (per 2005 UWMP). The downstream release values used in the model are taken as the maximum of the groundwater level maintenance (4,200 AFY) or the HCP instream fish flows (see Table 1-1 in Attachment 1). It should be noted that fish releases under the HCP are not finalized, and there would be a reduction in potential additional yield from the raise if the fish releases were to increase in the future.

Table 1 – Potential Yield Results for a 3-foot raise

Scenario A – Maximum of groundwater level maintenance (4,200 AFY distributed evenly throughout the year to accommodate stream maintenance requirements) and HCP fish flows, resulting in a total of 4,247 AFY.	**916 AFY**
Scenario B – Maximum of groundwater level maintenance (4,200 AFY concentrated in dry season) and HCP fish flows (additional stream maintenance releases during winter season), resulting in a total of 5,733 AFY.	**671 AFY**
Scenario C – Identical to Scenario A except water stored over 2 years.	**731 AFY**

Table 1-2 in Attachment 1 indicates the annual additional yield results for the time period of 1969 – 2004.

A brief summary of the variations of the three scenarios is provided below:-

- **Scenario A –** This scenario assumes that a total of 4,247 AFY (refer Table 1-1 in Attachment 1) downstream releases would be released each year, evenly distributed throughout the year. This scenario assumes that the entire 2,850 AF is diverted in the same year the water is stored (i.e. no carryover to following year).

- **Scenario B** – This scenario assumes that the 4,200 AFY allocated to downstream releases would be released each year, but distributed only during the irrigation season (April through November). During the winter months additional downstream release are added from the HCP instream fish flows. This scenario also assumes that entire 2,850 AF is diverted in the same year the water is stored.

- **Scenario C** – This scenario is identical to Scenario A, except it is assumed that the diversion of the additional 2,850 AF occurs over two years (1,425 AFY). Therefore, water not used in the first year can be spilled (and lost) in subsequent years.

Based on the maximum additional storage of 2,850 AF spread over 11 dry years (1986-1996), the increase in potential safe yield is estimated to be 259 AFY.

Assumptions made in the model regarding the diversion of the water stored by the 3-foot raise include that the water is diverted through pipeline (as opposed to being released downstream in the river channel). Also, the water diverted is assumed to be distributed evenly over the months of June to September for any given year.

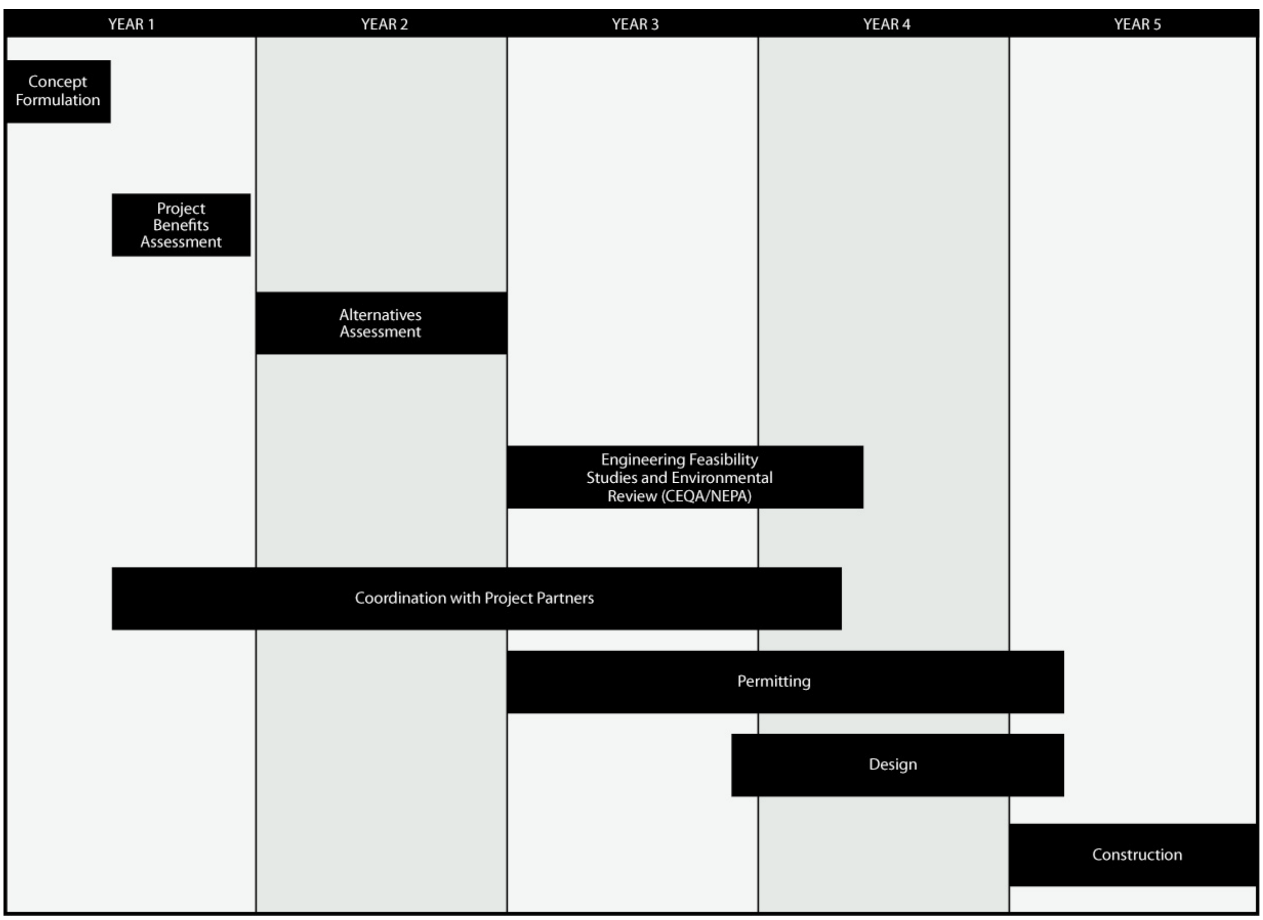
In addition to the 3-foot raise model, a 4-foot and 5-foot raise were also modeled for Scenarios A, B & C. Table 1-3 and Table 1-4 in Attachment 1 show the “calculated” yield results for a 4-foot and 5-foot raise respectively; no other assessment (such as estimated cost) was carried out.

A preliminary program-level budget and schedule for planning purposes, based on an assumption that there are no fatal flaws, is presented below. Budgets estimated for planning and feasibility studies, engineering design, environmental review, permitting, legal, administration, construction, and potential mitigations are summarized in Table 2. A schedule to complete these activities is shown in Figure 1. In summary, assuming that the project is feasible and permittable, we estimate that it will take 5 years to implement from planning and feasibility studies through construction, and the estimated cost may range from about $4.1 to 4.6 million (in 2008 dollars). A brief description of the major activities included in Table 2 is provided in Attachment 2.

Table 2 – Preliminary Program-Level Budget Estimates

	Estimated Budget (x $1,000)	**Assumptions**
Concept Formulation/Benefits Assessment	70	3% of higher estimated construction budget
Alternatives Assessment/Engineering Feasibility	160	7% of higher estimated construction budget
Environmental Review/Permitting	680	30% of higher estimated construction budget
Detailed Design	180	8% of higher estimated construction budget
Construction	1,800 – 2,250	Installation of Obermeyer Gates + Embankment Works as required (includes 30% contingency)
Engineering Services during construction	270	12% of higher estimated construction budget
Mitigation	500	Allowance
Administration, Legal & Finance	450	20% of higher estimated construction budget
Total Estimated Project Cost	**4,100 – 4,600**	

Figure 1 – Preliminary Program-Level Schedule Estimate



A preliminary evaluation of the cost of the potential new supply of water from a 3-foot raise was estimated, and a comparison to other water supply projects was attempted. The results can be summarized as follows:-

- Based on the preliminary yield analysis and cost estimate prepared within this memorandum, the cost for a 3-foot raise at Lopez dam ranges from $4,500 per AF to $6,800 per AF. In terms of storage, the 3-foot raise provides an additional storage of 2,850 AF at a cost of about $1,600 per AF of storage.

- New reservoir storage dams (constructed along the Front Range in Colorado):-

    - Highway 93 dam – Construction was completed on this dam in 2007 in the City of Arvada. The reservoir storage is 1,960 AF (this is comparable to the 2,850 AF additional storage generated from the 3-foot raise at Lopez). The estimated cost for storage was about $7,400 per AF.

    - Dunes dam - Constructed for Denver Water and completed in 2006, the reservoir storage was 5,460 AF and the estimated cost for storage was about $1,500 per AF.

- Desalination Facilities:-

    - Marin Municipal Water District (MMWD) published an engineering report from 2007 on their website (http://www.marinwater.org/documents/EngRepDesal_Engineering_Rep_012607_RevES4.pdf) detailing the results of a pilot study on a seawater desalination facility to treat water from the Northern San Francisco Bay. The report includes preliminary cost estimates for four construction alternatives (Case A-D) for a full-scale desalination facility. Table 3 summarizes the total water cost estimates.

Table 3 – MMWD Desalination Facility Water Cost Estimates

SWRO Facility Capacity	Case A: 5 MGD Not Expandable	Case B: 5 MGD "Regular" Expansion	Case C: 5 MGD "Rapid" Expansion	Case D: 10 MGD "Regular" Expansion
Annual Production in AF	5,300	5,300	5,300	10,600
Estimated Desalination Facility and Intake Capital Cost	$81,789,000	$85,908,000	$108,250,000	$121,560,000
Annualized Capital Cost	$5,324,464	$5,592,611	$7,047,075	$7,913,556
Annual Operating Cost	$6,100,000	$6,100,000	$6,100,000	$10,800,000
Total Desalination Facility Annual Costs	**$11,424,464**	**$11,692,611**	**$13,147,075**	**$18,713,556**
Desalination Facility Water Cost, $ per AF	**$2,156**	**$2,206**	**$2,481**	**$1,765**
Estimated Distribution System Improvements Capital Cost	$22,600,000	$22,600,000	$42,000,000	$42,000,000
Annualized Capital Cost	$1,471,260	$1,471,260	$2,734,200	$2,734,200
Total Project Annual Costs	**$12,895,724**	**$13,163,871**	**$15,881,275**	**$21,447,756**
Total Water Cost, $ per AF	**$2,433**	**$2,484**	**$2,996**	**$2,023**

  - Tampa Bay Water district has a fully operational seawater desalination facility in their district, completed at the end of 2007. The total construction cost was estimated at $158,000,000, with an estimated production capacity of 28,000 AFY. The cost of water produced at the plant is currently $1,100 per AF (3.38 per 1,000 gallons). Information on the facility can be found at the following websites:-
    http://www.tampabaywater.org/watersupply/tbdesaloverview.aspx
    http://www.wateronline.com/article.mvc/Desalination-Plant-Delivering-Clean-Drinking-0001?VNETCOOKIE=NO

- Other raises using Obermeyer Gates:

  - A request was made to Obermeyer Hydro for cost information regarding other raises undertaken using Obermeyer gates installation, but they were not able to provide the information.

With concurrence from the County, we also contacted the California Division of Safety of Dams (DSOD) to review the proposed usage of Obermeyer gates at Lopez Dam. The purpose of contacting the DSOD was to identify any fatal technical flaws and/or other major issues that would have to be resolved as part of the approval process of the proposed project.

We talked with Mr. John Vrymoed, Chief of Design Branch of DSOD. He indicated that their responses at this stage of the project will only be general because they will not be able to commit staff time to review the project until it is more advanced and the owner is in a position to submit an application to modify the dam.

Mr. Vrymoed did indicate that maintaining the same or more freeboard will be critical, even for 3 to 4 feet of temporary storage utilizing Obermeyer gates. He cited Brooktrails 3 North Dam in Mendocino

County as an example where the dam crest had to be raised 4 feet and extended into bedrock at the abutments when Obermeyer gates were installed. The other area of concern will be adequate internal drainage, as in the case of the proposed expansion of Paradise Reservoir in Butte County where the internal filter and drainage zones will have to be extended to accommodate the rise in reservoir pool level. And in the case of Lopez Dam, Mr. Vrymoed said that detailed seismic analyses will also have to be provided to confirm that the seismic improvements to the dam and its foundation can accommodate the increased pool level.

The above comments were anticipated prior to discussion with DSOD. An allowance for extending the internal drainage zones and raising the embankment are included in the construction cost estimate of the 3-foot raise. Based on the above discussion, for the purpose of this pre-planning study, we can say there are no obvious technical fatal flaws; but the proposed raise, while small, will be treated just the same as a major dam modification by the DSOD, and detailed studies and detailed design provisions will have to be included.

Exhibit A – Typical Installation of Obermeyer Gates

Attachment 1 – Yield Analysis Results

Table 1-1 – Assumed Distribution of Downstream Releases (AF)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
4,200 AFY (Distributed evenly throughout year)	357	345	357	357	322	357	345	357	345	357	357	345	**4,200**
4,200 AFY (Distributed from April-November only, based on median monthly historical releases for the period 1969-1994)	438	143	0	0	0	0	115	559	732	808	768	637	**4,200**
HCP Instream Fish Flows	184	179	184	369	333	369	357	184	179	184	184	179	**2,886**
Scenario A & C	357	345	357	369	333	369	357	357	345	357	357	345	**4,247**
Scenario B	438	179	184	369	333	369	357	559	732	808	768	637	**5,733**

Table 1-2 Annual Additional Yield
Due to 3-foot raise of Lopez Lake

Water Year	Scenario A Maximum of 4,200 AFY releases and HCP fish flows (distributed evenly throughout year)	Scenario B Maximum of 4,200 AFY releases and HCP fish flows (distributed from April-November only)	Scenario C Scenario A with additional storage water stored two years
	acre-feet	acre-feet	acre-feet
1969	2,850	2,850	1,425
1970	113	0	1,425
1971	0	0	21
1972	0	0	0
1973	0	0	0
1974	684	0	649
1975	0	0	0
1976	0	0	0
1977	0	0	0
1978	2,850	0	1,425
1979	0	0	1,425
1980	2,850	2,850	1,425
1981	0	0	1,425
1982	1,460	0	1,411
1983	2,850	2,850	1,425
1984	2,850	2,850	1,425
1985	0	0	1,425
1986	2,850	1,573	1,425
1987	0	0	1,425
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	2,850	2,850	1,425
1998	2,850	2,850	1,425
1999	2,850	2,850	1,425
2000	2,204	545	1,425
2001	2,850	2,083	1,425
2002	0	0	1,425
2003	0	0	0
2004	0	0	0
Average	**916**	**671**	**731**

Table 1-3. Annual Additional Yield
Due to 4-foot raise of Lopez Lake

Water Year	Scenario A Maximum of 4,200 AFY releases and HCP fish flows (distributed evenly throughout year)	Scenario B Maximum of 4,200 AFY releases and HCP fish flows (distributed from April-November only)	Scenario C Scenario A with additional storage water stored two years
	acre-feet	acre-feet	acre-feet
1969	3,800	3,800	1,900
1970	101	0	1,900
1971	0	0	100
1972	0	0	0
1973	0	0	0
1974	684	0	612
1975	0	0	0
1976	0	0	0
1977	0	0	0
1978	3,800	0	1,900
1979	0	0	1,900
1980	3,800	3,800	1,900
1981	0	0	1,900
1982	1,445	0	1,380
1983	3,800	3,800	1,900
1984	3,800	3,800	1,900
1985	0	0	1,900
1986	3,800	1,548	1,900
1987	0	0	1,900
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	3,800	3,800	1,900
1998	3,800	3,800	1,900
1999	3,800	3,053	1,900
2000	2,187	541	1,900
2001	3,348	2,083	1,900
2002	0	0	1,900
2003	0	0	0
2004	0	0	0
Average	**1,166**	**834**	**955**

Table 1-4. Annual Additional Yield Due to 5-foot raise of Lopez Lake

Water Year	Scenario A Maximum of 4,200 AFY releases and HCP fish flows (distributed evenly throughout year)	Scenario B Maximum of 4,200 AFY releases and HCP fish flows (distributed from April-November only)	Scenario C Scenario A with additional storage water stored two years
	acre-feet	acre-feet	acre-feet
1969	4,344	4,142	2,172
1970	94	0	2,239
1971	0	0	206
1972	0	0	0
1973	0	0	0
1974	684	0	441
1975	0	0	0
1976	0	0	0
1977	0	0	0
1978	4,750	0	2,375
1979	0	0	2,375
1980	4,750	4,750	2,375
1981	0	0	2,375
1982	1,431	0	1,350
1983	4,750	4,750	2,375
1984	4,750	4,750	2,375
1985	0	0	2,375
1986	4,444	1,524	2,375
1987	0	0	1,986
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	4,750	4,750	2,375
1998	4,750	4,750	2,375
1999	4,318	3,040	2,375
2000	2,178	541	2,375
2001	3,348	2,083	2,375
2002	0	0	2,375
2003	0	0	0
2004	0	0	0
Average	**1,371**	**974**	**1,157**

Attachment 2 – Description of Major Activities

The following is a brief description of the major activities included in Table 1 and Figure 1. The project proponent or sponsor, public and other stakeholders will have opportunities to review the findings upon the completion of each activity and determine if the project should be advanced to the next stage.

Concept Formulation – The pre-planning evaluation of the technical feasibility of using Obermeyer gates for the Lopez Dam expansion will consist of an initial, non-detailed yield study to determine the amount of additional water supply made available after the expansion. The pre-planning evaluation will also include an assessment on dam safety concerns related to the possible reduction of freeboard and overall stability of the dam due to the usage of the Obermeyer gates. This stage will include a meeting with the California Division of Safety of Dams (DSOD) to review the proposed concept. It will also identify any fatal technical flaws and/or other major issues.

Project Benefits Assessment – The benefits assessment of the proposed concept will include the following:

- The purpose of the proposed reservoir expansion (who is proposing to undertake the expansion and what does it involve).
- The need for the proposed reservoir expansion (why are we expanding the reservoir and why now is the right time to proceed).
- The applicable existing project conditions (including but not limited to, project engineering and construction history, and present operations).
- Description of alternatives. This will include all relevant alternatives, those that have been described in the County Water Master Plan (CWMP), and a no-build alternative.
- Preliminary list of environmental impacts. This may include land use, public use, recreation, relocations, economic, water quality, downstream water body modification, wildlife impacts, floodplain, threatened and endangered species, cultural resources, temporary construction issues, trees, energy, and visual impacts.
- Environmental review and permitting processes.
- Public involvement.

Alternatives Assessment – Public and stakeholder review will be sought to refine potential alternatives outlined in the project benefits assessment. A comprehensive set of project objectives will be developed. Alternatives will be evaluated based on criteria used for ranking future water supply options presented in the CWMP, which include evaluation of potential additional yield, environmental impacts, cost and funding, risk, reliability, water rights, local control, timing, agricultural impacts, institutional constraints, recreation and/or hydroelectric potential. Alternatives will be evaluated based on the aforementioned CWMP ranking criteria and whether they meet the required goals and objectives provided by other project partners. A “short list” of alternatives that meet the goals and objective will be identified for further development in engineering feasibility studies and environmental review.

Engineering Feasibility Studies – This stage of the project will consist of a detailed feasibility study of the preferred alternative (or a set of alternatives) and further evaluation of the CWMP ranking criteria addressed in the alternatives assessment. Regulatory agencies will be consulted during the feasibility study and provided access to relevant information they may require. The engineering studies will consist of more detailed technical analyses including operational modeling, surveying, geotechnical investigations, identification of potential impacts and mitigation features, and detailed estimation of project benefits and costs. Significant technical issues will need to be resolved for the feasible alternative(s) during this stage. The alternative(s) will be further developed into a set of detailed alternative plans.

A detailed cost and benefit assessment would also be completed as part of this stage. This analysis would be used in conjunction with the findings of the environmental review process to give potential project partners the information needed to consider project approval and implementation.

Environmental Review (CEQA/NEPA) – The environmental review will involve the preparation of a combined environmental impact document in compliance with CEQA and NEPA regulations. The purpose of the environmental document will be to address environmental resources, analyze potential environmental effects of the proposed alternative(s), detail adverse impacts and expected benefits, and identify mitigation measures. The public and stakeholders will receive a further opportunity during the development of the environmental document to review and comment on the proposed project alternative(s) and any environmental effects and suggested mitigation measures. Work will be performed in compliance with relevant environmental regulations, including the California and Federal Endangered Species Act and the Clean Water Act Section 404, among others.

Permitting – The permitting process would run concurrently with the feasiblity studies and continue up until construction activities commence. These permits could include the following:

- Permits for construction in waters of the US,
- Permits for the California and Federal Endangered Species Act,
- Water diversion permits,
- Dam safety certification (modification or enlargement),
- Water quality certification,
- Streambed alteration agreements, and
- Encroachment permits

Design and Construction – Detailed design will commence after the preparation of the draft CEQA/NEPA document and the completion of detailed alternative plans. Detailed design will include the preparation of draft and final drawings at 30%, 65%, 95% and 100% level. These plans will be reviewed by the County and the DSOD at each level. Following the completion of the design and financing arrangements, construction contracts will be issued to construct the reservoir expansion facilities and implement any required mitigation measures.

D R A F T
TECHNICAL MEMORANDUM

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TO:	Noel C. Wong, P.E. URS Corporation	**DATE:**	July 31, 2008; rev. Aug. 22, 2008
FROM:	Curtis Lawler, P.E.	**JOB NO:**	2080

RE: Lopez Lake Operations Model Results Concerning Additional Yield from a 3'-Raise

1. SUMMARY

This memorandum summarizes results of operations simulations assuming an increase in the capacity of Lopez Lake due to a 3' raise in the maximum storage water level. The Lopez Lake operations model, developed for use in the Habitat Conservation Plan (HCP) process, was utilized for these simulations. For more information and background regarding the Lopez Lake reservoir operations model please refer to "Final Draft Arroyo Grande Creek Habitat Conservation Plan (HCP) and Environmental Assessment/Initial Study (EA/IS) for the Protection of Steelhead and California Red-legged Frogs" (Stetson Engineers, Hanson Environmental, Ibis Environmental Services; February 2004).

Five scenarios considering different pipeline diversions and downstream releases were simulated in the Lopez Lake operations model as described in Table 1. The simulation period is 1969-2004 (36 years). In the model simulation, the 3'-raise is assumed to increase the storage capacity of Lopez Lake by 2,850 acre-feet for all scenarios, increasing the maximum storage capacity from 49,400 acre-feet to 52,250 acre-feet. The water stored from the 3'-raise is assumed to have been diverted from the reservoir in the same year in order to minimize storage losses and potential spills in subsequent years for Scenarios 1 through 4. Assumptions regarding the diversion of the water stored by the 3'-raise includes that the water is diverted through the pipeline (as opposed to being released downstream in the river channel). Also, the water diverted due to the 3'-raise is assumed to be distributed evenly over the months of June through September for any given year. For Scenario 5, the diversion of the water stored by the 3'-raise is assumed to occur over two years, but otherwise uses the same assumptions as Scenario 3 (Table 1). Under Scenario 5, water not used in the first year can be spilled (and lost) in the subsequent years.

Table 1. Assumptions Used in Scenarios for Diversions and Downstream Releases

Scenario		Pipeline Diversion (not including 3' Raise Water)	Downstream Releases
1	**HCP Baseline Alternative**	constant 4,530 afy	Historical Downstream Releases
2	**HCP Instream Fish Flows Alternative**	constant 4,530 afy	Maximum of Historical Downstream Releases or HCP Instream Fish Flows
3 and 5	**Instream Fish Flows w/ 4200 afy (Distributed evenly throughout year)[1]**	constant 4,530 afy	Maximum of Constant 4200 afy Distributed Evenly throughout the year or HCP Instream Fish Flows
4	**Instream Fish Flows w/ 4200 afy (Distributed from April-November only)[1]**	constant 4,530 afy	Maximum of Constant 4200 afy Distributed April thru November or HCP Instream Fish Flows

Notes
1

Assumed Distribution of Downstream Releases (all values in acre-feet)													
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
4200 afy (Distributed evenly throughout year)	357	345	357	357	322	357	345	357	345	357	357	345	4,200
4200 afy (Distributed from April-November only, based on median monthly historical releases for the period 1969-1994)	438	143	0	0	0	0	115	559	732	808	768	637	4,200
Instream Fish Flows	184	179	184	369	333	369	357	184	179	184	184	179	2,886
Instream Fish Flows w/ 4200 afy (Distributed evenly throughout year)	357	345	357	369	333	369	357	357	345	357	357	345	4,247
Instream Fish Flows w/ 4200 afy (Distributed from April-November only, based on median monthly historical releases for the period 1969-1994)	438	179	184	369	333	369	357	559	732	808	768	637	5,733

Table 2 shows the simulation results showing the potential yields. The 3'-raise would create on average an additional yield ranging from 671 and 1,014 acre-feet/year for the various scenarios. Different assumptions regarding conjunctive use of fish releases and downstream releases for agriculture results in different potential yields from a 3'-raise. It should also be noted that the final decision on releases for fish under the HCP has not been completed and could be modified in the future. If releases for fish were to increase in the future, potential yields from a 3’-raise would be lower due to decreased storage levels.

Figures 1 through 5 show the simulated reservoir storage levels for Scenarios 1-5, respectively. Figures 1 through 5 and Table 2 show that in years when the storage goes above 49,400 acre-feet but is still below 52,250 acre-feet, there is only a partial yield gain compared to the full 2,850 acre-feet storage.

2. ADDENDUM

Six additional scenarios were processed using the Lopez Lake operations model on August 22, 2008. These six scenarios are based on Scenarios 3, 4, and 5 above, except with either 4’ or 5’ raises of the spillway, instead of a 3’-raise. The assumptions of these new scenarios are shown in Table 3, with the “B” extension indicating a 4’-raise and the “C” extension indicating a 5’-raise. In the model simulation, each 1'-raise is assumed to increase the storage capacity of Lopez Lake by 950 acre-feet. So, the 3’, 4’, and 5’-raises increase the maximum storage capacity from 49,400 acre-feet to 52,250; 53,200; and 54,150 acre-feet, respectively.

Table 3. Assumptions Used in Additional Scenarios

Scenario	Description
3B	Same as Scenario 3, except with 4' raise
3C	Same as Scenario 3, except with 5' raise
4B	Same as Scenario 4, except with 4' raise
4C	Same as Scenario 4, except with 5' raise
5B	Same as Scenario 5, except with 4' raise
5C	Same as Scenario 5, except with 5' raise

Table 4 shows the simulation results showing the potential yields. The 4'-raise would create on average an additional yield ranging from 834 and 1,166 acre-feet/year for the various scenarios. The 5'-raise would create on average an additional yield ranging from 974 and 1,371 acre-feet/year for the various scenarios. Figures 6 through 11 show the simulated reservoir storage levels for Scenarios 3B, 3C, 4B, 4C, 5B, and 5C, respectively.

Table 2. Annual Additional Yield Due to 3'-Raise of Lopez Lake[1)]

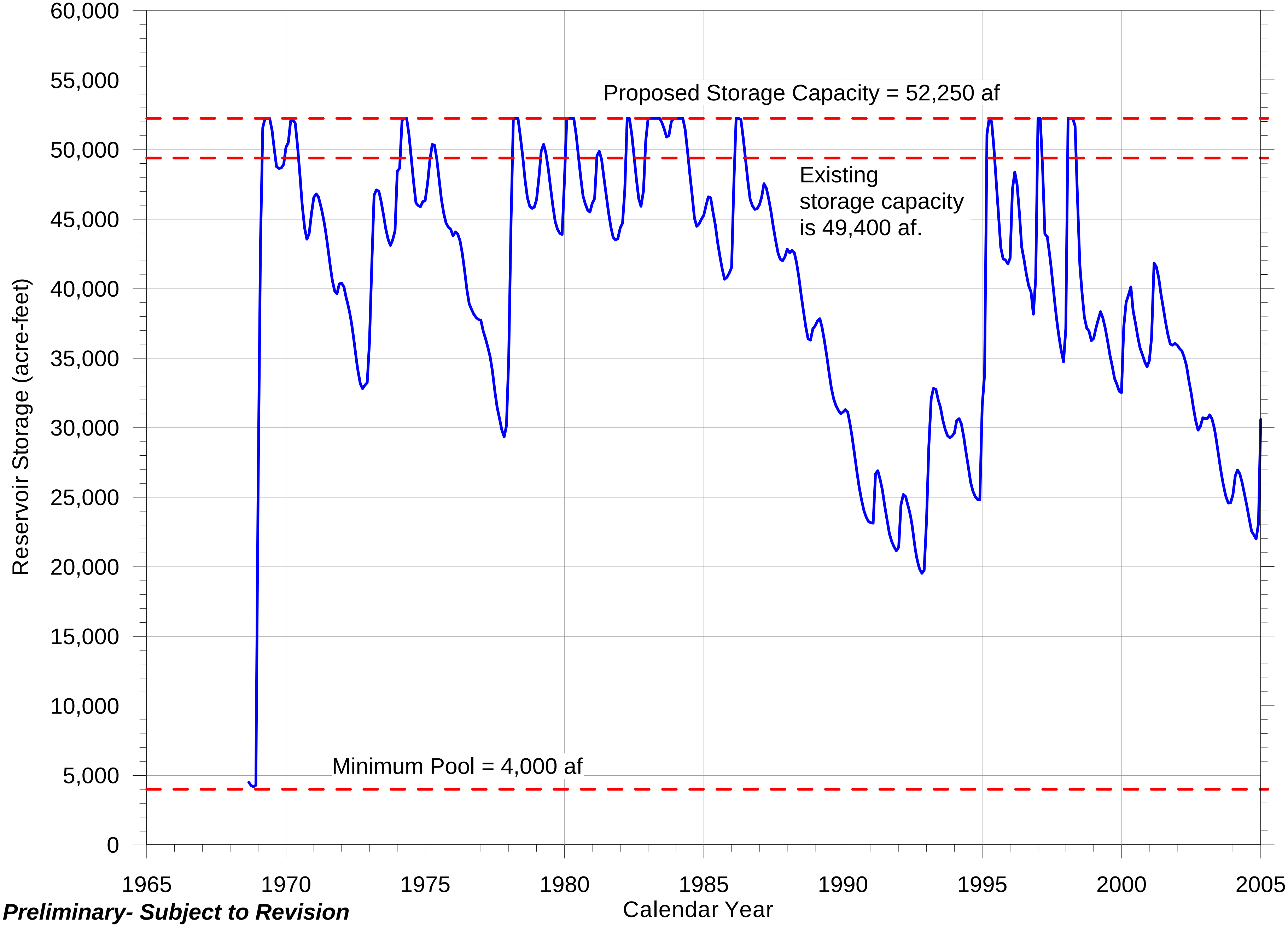
Water Year	Scenario 1 HCP Baseline Alternative	Scenario 2 HCP Instream Fish Flows Alternative	Scenario 3 Instream Fish Flows w/ 4200 afy (Distributed evenly throughout year)	Scenario 4 Instream Fish Flows w/ 4200 afy (Distributed from April-November only)	Scenario 5 Scenario 3 with 3'-Raise Water Taken Over Two Years
	acre-feet	acre-feet	acre-feet	acre-feet	acre-feet
1969	2,850	2,850	2,850	2,850	1,425
1970	2,741	743	113	0	1,425
1971	0	0	0	0	21
1972	0	0	0	0	0
1973	0	0	0	0	0
1974	2,850	907	684	0	649
1975	971	0	0	0	0
1976	0	0	0	0	0
1977	0	0	0	0	0
1978	2,850	2,850	2,850	0	1,425
1979	979	0	0	0	1,425
1980	2,850	2,850	2,850	2,850	1,425
1981	472	0	0	0	1,425
1982	2,850	2,459	1,460	0	1,411
1983	2,850	2,850	2,850	2,850	1,425
1984	2,850	2,850	2,850	2,850	1,425
1985	0	0	0	0	1,425
1986	2,850	2,850	2,850	1,573	1,425
1987	0	0	0	0	1,425
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	0	0	0	0	0
1994	0	0	0	0	0
1995	2,850	0	0	0	0
1996	0	0	0	0	0
1997	2,850	2,850	2,850	2,850	1,425
1998	2,850	2,850	2,850	2,850	1,425
1999	0	0	2,850	2,850	1,425
2000	0	0	2,204	545	1,425
2001	0	0	2,850	2,083	1,425
2002	0	0	0	0	1,425
2003	0	0	0	0	0
2004	0	0	0	0	0
Average	**1,014**	**747**	**916**	**671**	**731**

1) Assumes no losses incurred to 3'-raise account (i.e. evaporation, seepage).
Scenarios 1 through 4 assume the water stored by the 3'-raise is diverted in the same year (which minimizes potential losses to spill in the following year).
Scenario 5 assumes the water stored by the 3'-raise is diverted over two years with some losses to spills.

Table 4. Annual Additional Yield
Due to 4' and 5'-Raise of Lopez Lake

Scenario:	3B (4'Raise)	3C (5'Raise)	4B (4'Raise)	4C (5'Raise)	5B (4'Raise)	5C (5'Raise)
	Scenario 3 series: Instream Fish Flows w/ 4200 afy (Distributed evenly throughout year)		Scenario 4 series: Instream Fish Flows w/ 4200 afy (Distributed from April-November only)		Scenario 5 series: Scenario 3 but with 3'-Raise Water Taken Over Two Years	
Water Year	acre-feet	acre-feet	acre-feet	acre-feet	acre-feet	acre-feet
1969	3,800	4,344	3,800	4,142	1,900	2,172
1970	101	94	0	0	1,900	2,239
1971	0	0	0	0	100	206
1972	0	0	0	0	0	0
1973	0	0	0	0	0	0
1974	684	684	0	0	612	441
1975	0	0	0	0	0	0
1976	0	0	0	0	0	0
1977	0	0	0	0	0	0
1978	3,800	4,750	0	0	1,900	2,375
1979	0	0	0	0	1,900	2,375
1980	3,800	4,750	3,800	4,750	1,900	2,375
1981	0	0	0	0	1,900	2,375
1982	1,445	1,431	0	0	1,380	1,350
1983	3,800	4,750	3,800	4,750	1,900	2,375
1984	3,800	4,750	3,800	4,750	1,900	2,375
1985	0	0	0	0	1,900	2,375
1986	3,800	4,444	1,548	1,524	1,900	2,375
1987	0	0	0	0	1,900	1,986
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	3,800	4,750	3,800	4,750	1,900	2,375
1998	3,800	4,750	3,800	4,750	1,900	2,375
1999	3,800	4,318	3,053	3,040	1,900	2,375
2000	2,187	2,178	541	541	1,900	2,375
2001	3,348	3,348	2,083	2,083	1,900	2,375
2002	0	0	0	0	1,900	2,375
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
Average	**1,166**	**1,371**	**834**	**974**	**955**	**1,157**

Figure 1. Simulated Lopez Reservoir Storage Assuming 3'-Raise
Scenario 1: HCP Baseline Conditions



Preliminary- Subject to Revision

Figure 2. Simulated Lopez Reservoir Storage Assuming 3'-Raise
Scenario 2: HCP Instream Fish Flows Conditions

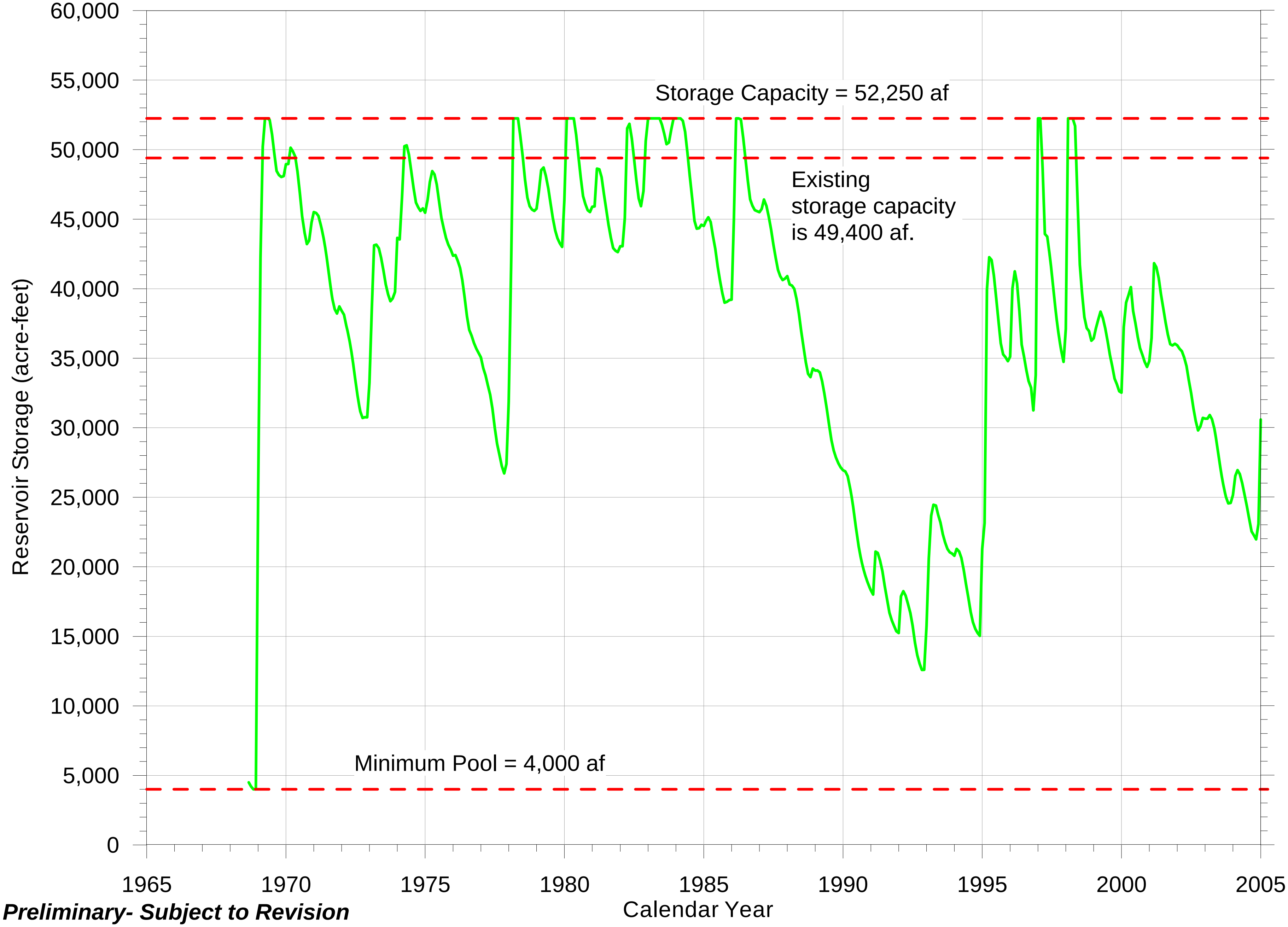


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Figure 3. Simulated Lopez Reservoir Storage Assuming 3'-Raise
Scenario 3: Instream Fish Flows with 4200 afy (Distributed evenly throughout year)

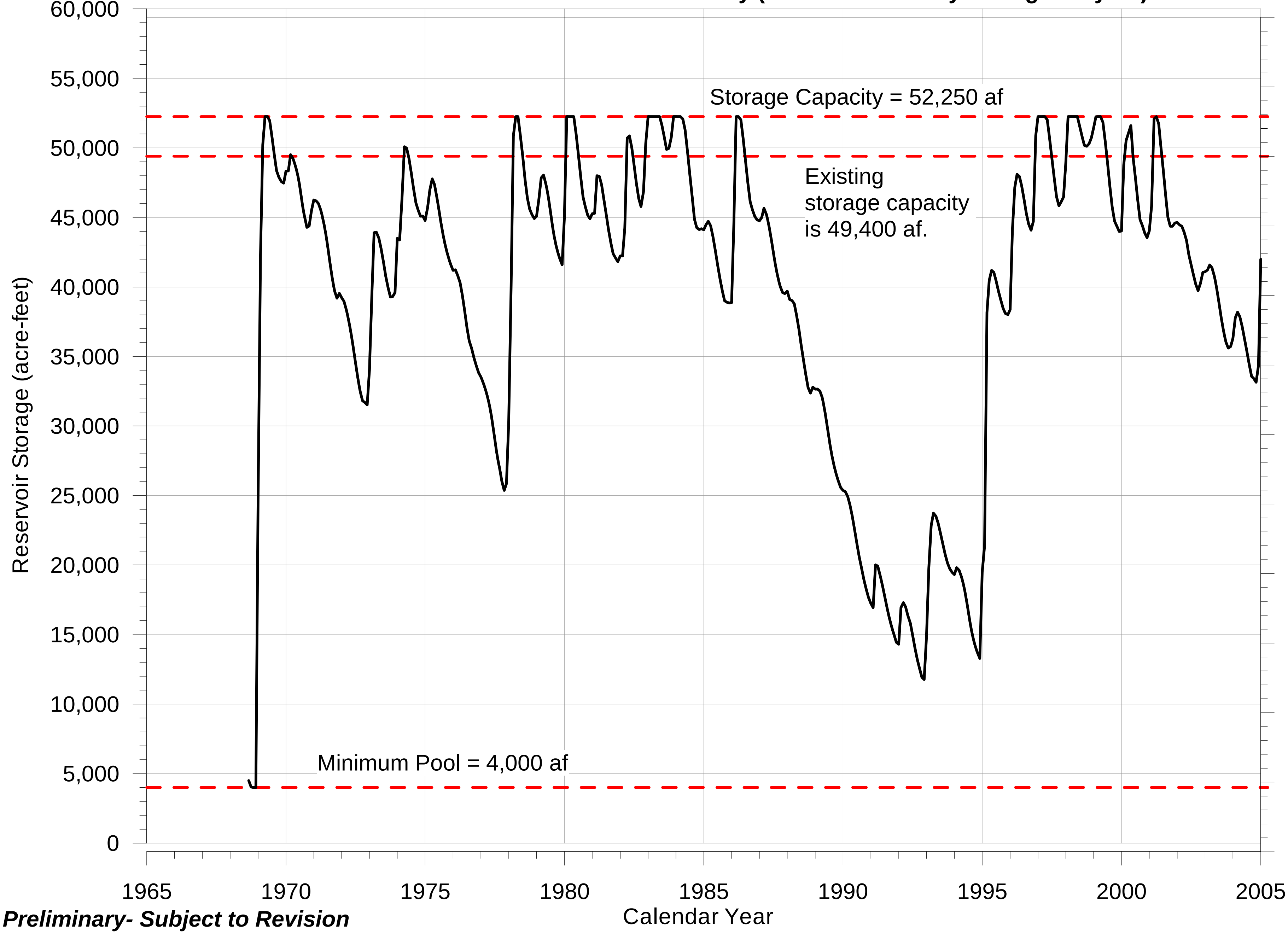

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Figure 4. Simulated Lopez Reservoir Storage Assuming 3'-Raise
Scenario 4: Instream Fish Flows with 4200 afy (Distributed from April-November only)

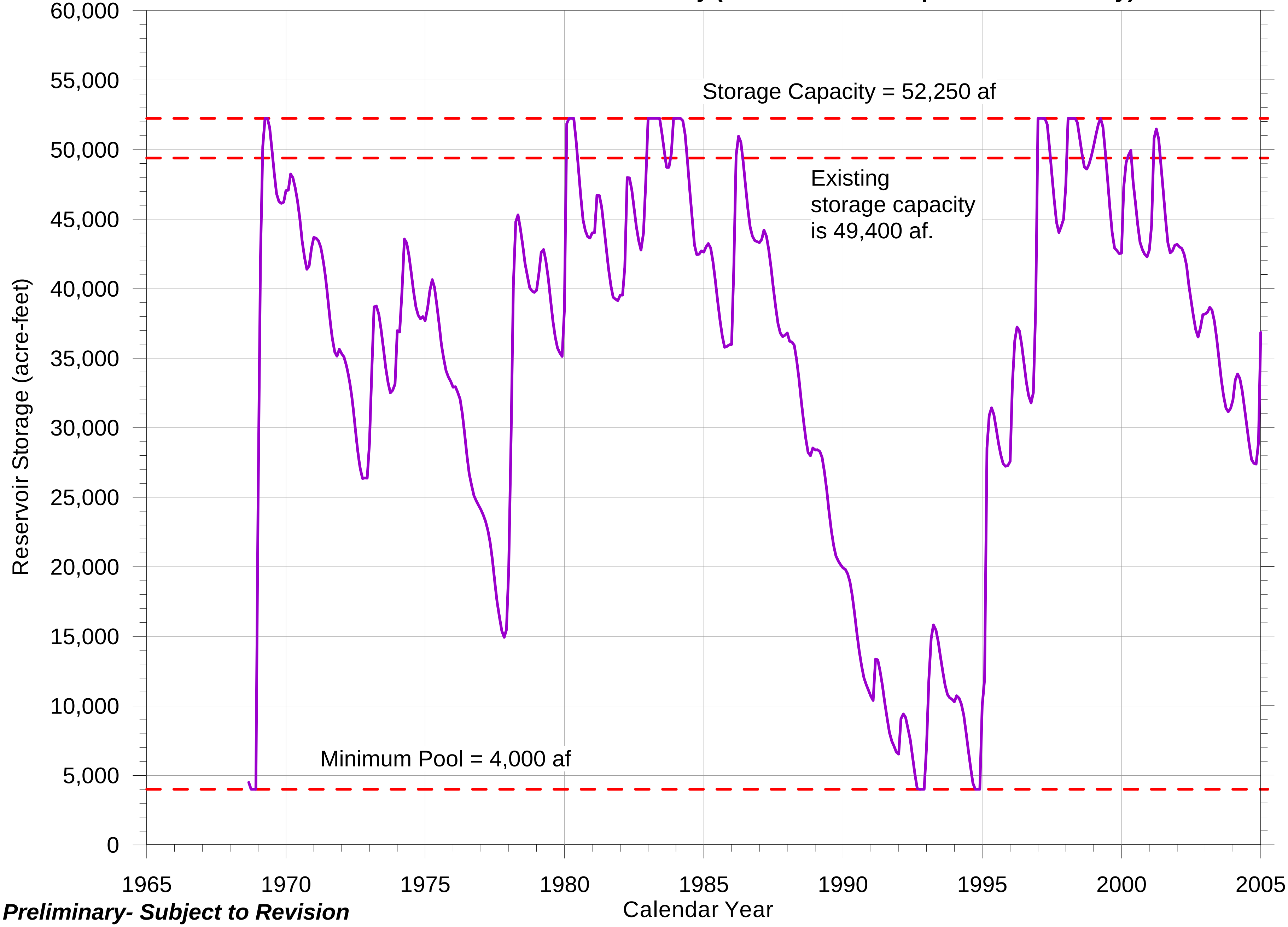

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Figure 5. Simulated Lopez Reservoir Storage Assuming 3'-Raise
Scenario 5: 3'-Raise Water is Taken over Two Years

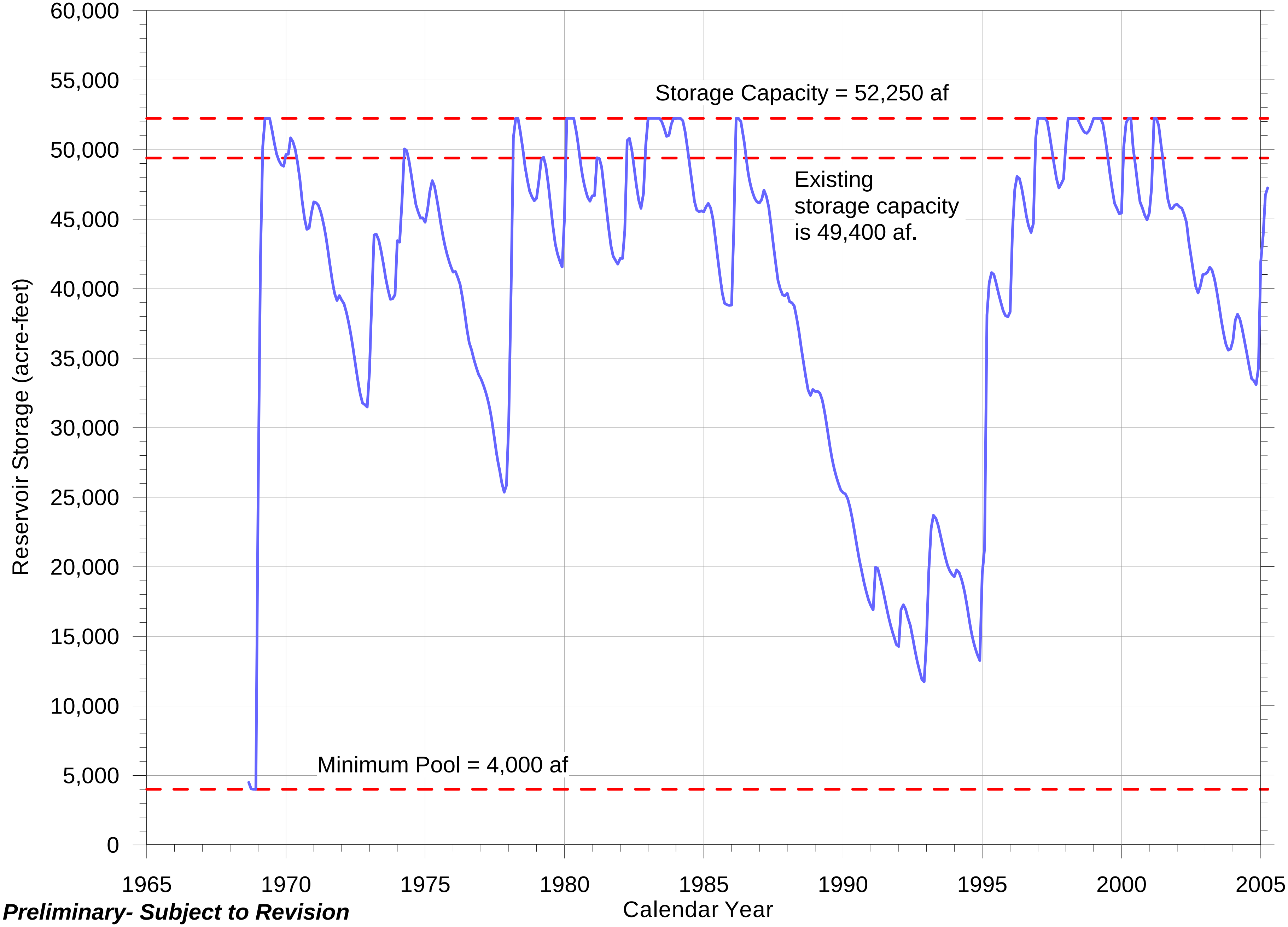

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Figure 6.   Simulated Lopez Reservoir Storage Assuming 4'-Raise
Scenario 3B: Instream Fish Flows with 4200 afy (Distributed evenly throughout year)

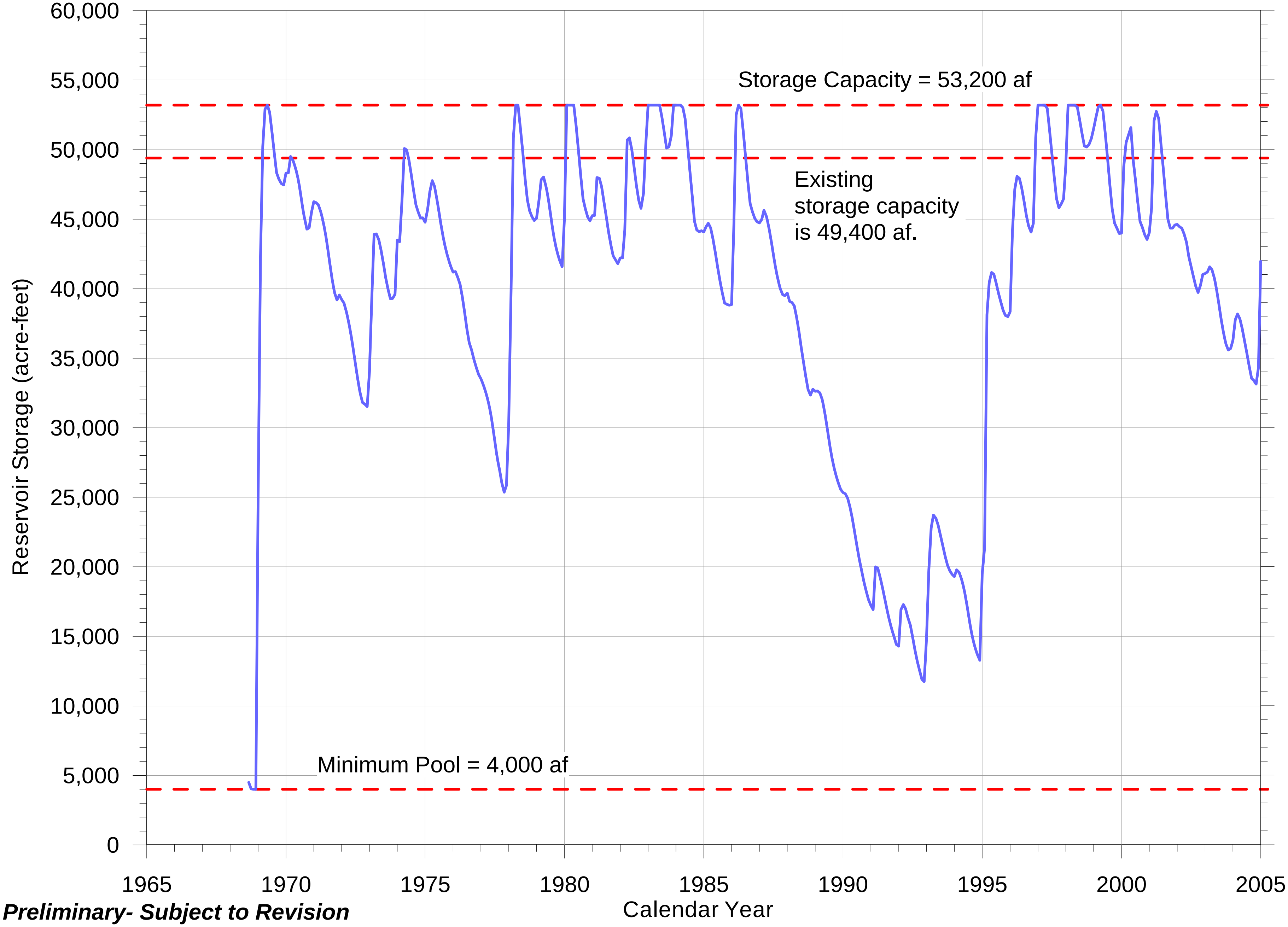

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Figure 7. Simulated Lopez Reservoir Storage Assuming 5'-Raise
Scenario 3C: Instream Fish Flows with 4200 afy (Distributed evenly throughout year)

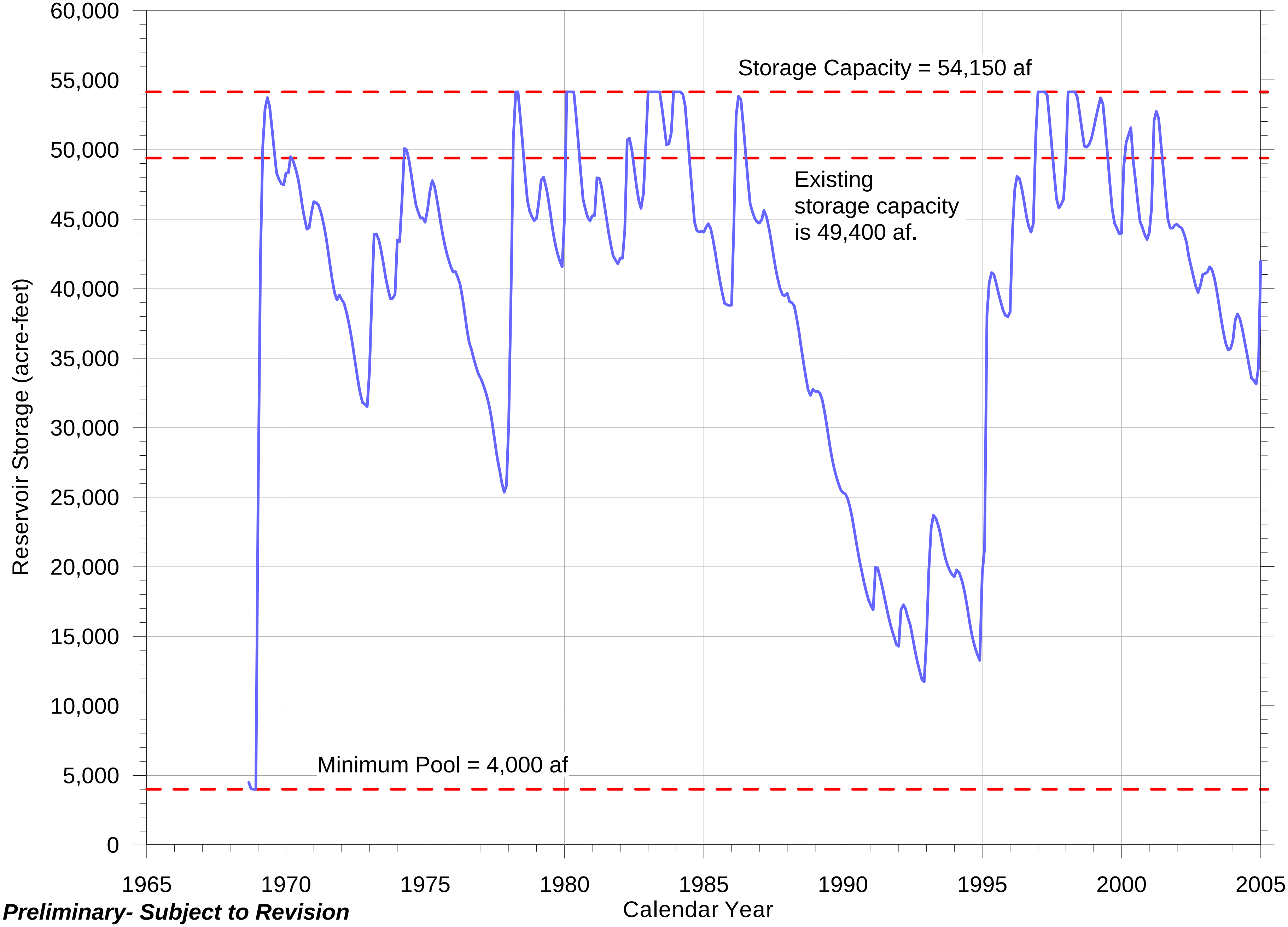

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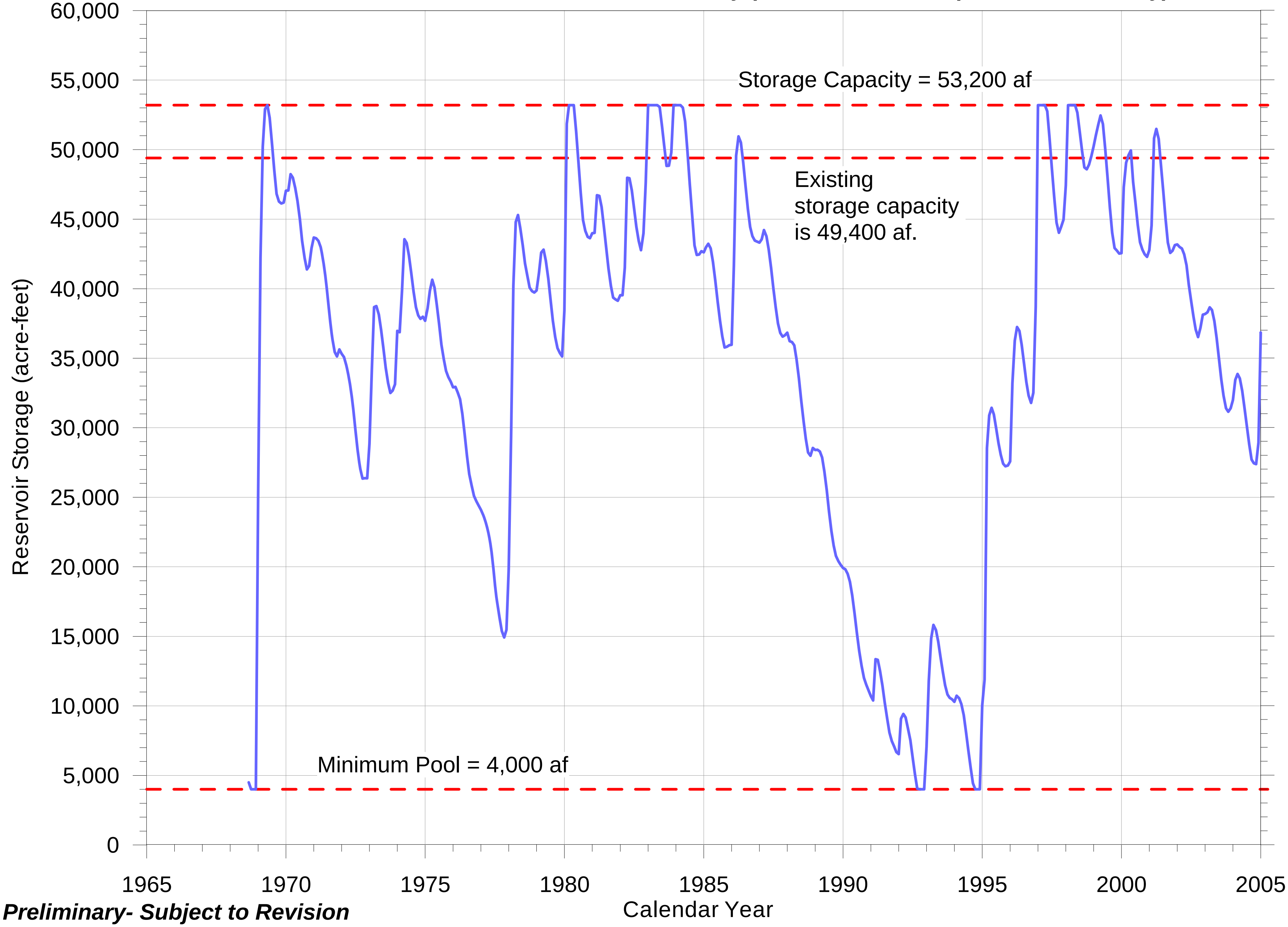
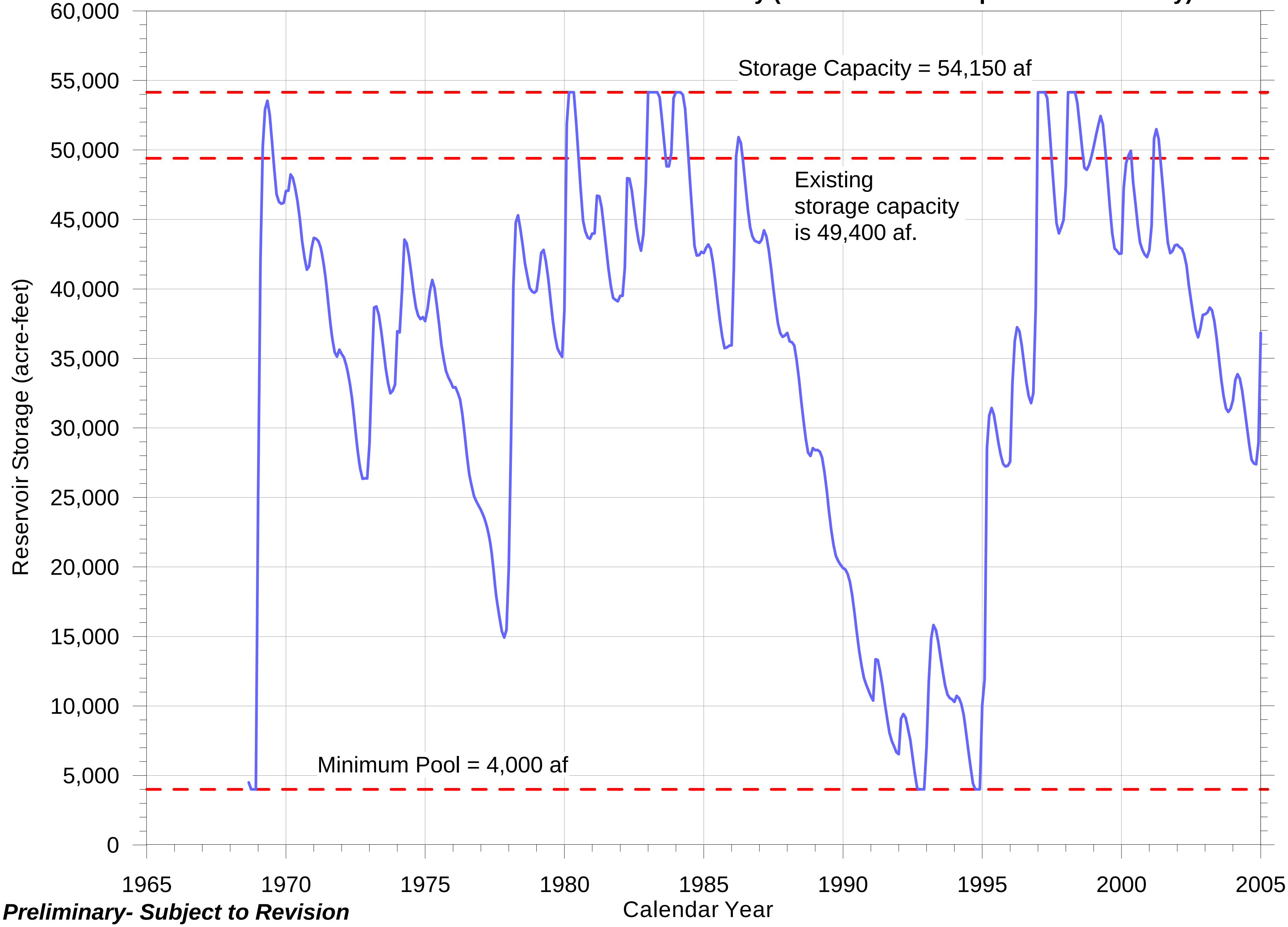
Figure 8. Simulated Lopez Reservoir Storage Assuming 4'-Raise
Scenario 4B: Instream Fish Flows with 4200 afy (Distributed from April-November only)



Preliminary- Subject to Revision

Figure 9. Simulated Lopez Reservoir Storage Assuming 5'-Raise
Scenario 4C: Instream Fish Flows with 4200 afy (Distributed from April-November only)



Preliminary- Subject to Revision

Figure 10. Simulated Lopez Reservoir Storage Assuming 4'-Raise
Scenario 5B: 4'-Raise Water is Taken over Two Years

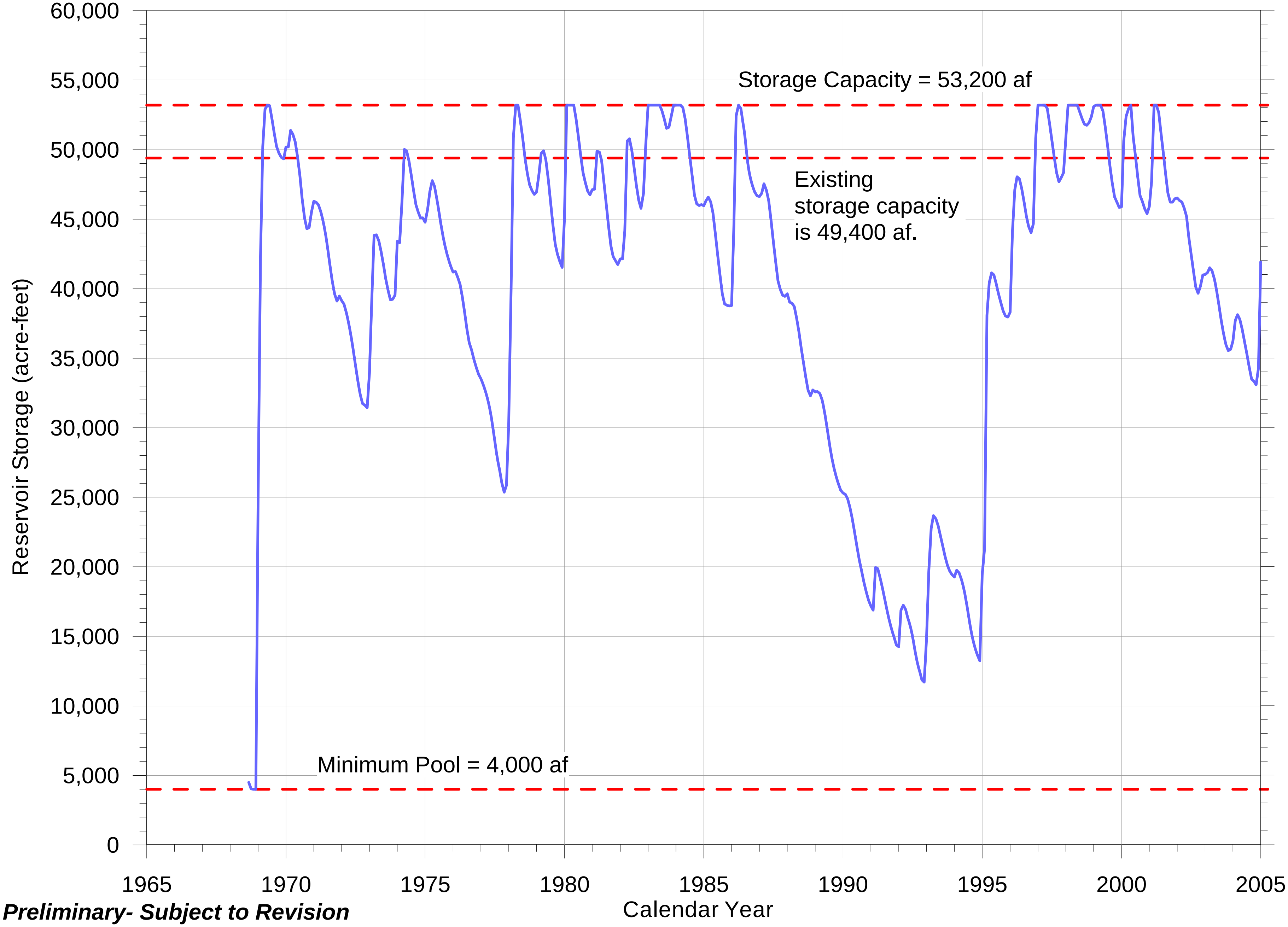


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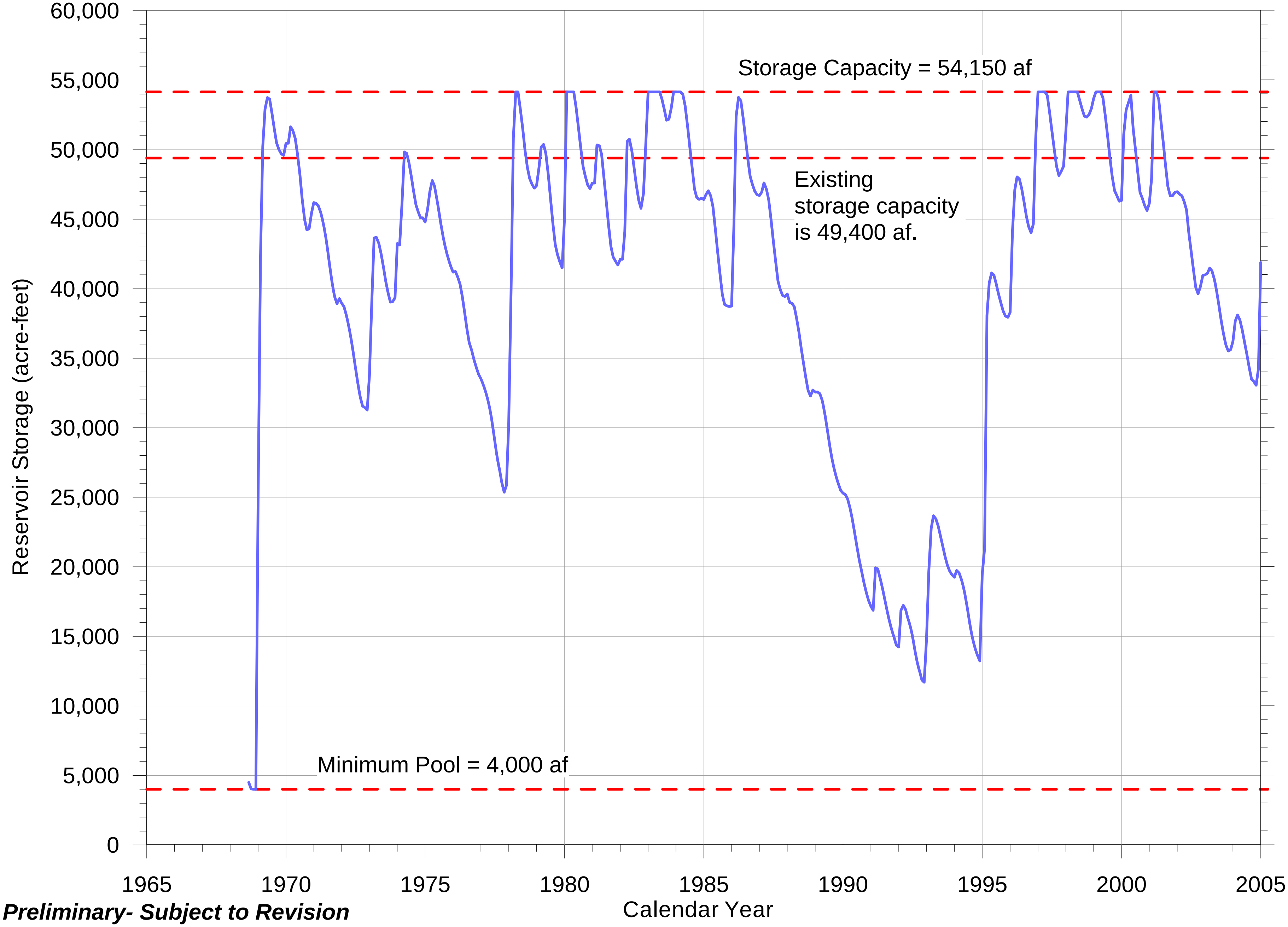
Figure 11. Simulated Lopez Reservoir Storage Assuming 5'-Raise
Scenario 5C: 5'-Raise Water is Taken over Two Years



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