Presentation of the Findings of the Chehalis River Fish Population Impact Study

Presented by

Paul Schlenger and Bob Montgomery

April 19, 2012
Overview of Presentation

• Review of Scope of Work and Process
• Results of Fish Study Analysis Components
  - Hydrology
  - Water Quality
  - Geomorphology
  - Fish Habitat Modeling (PHABSIM)
  - Fish Habitat Inventory of Upper Watershed (HEP)
  - Fish Population Modeling (SHIRAZ)
• Questions and Discussion
Scope of Fish Study

- To characterize the magnitude of potential impacts that a flood storage facility on the upper mainstem Chehalis River could have on anadromous salmonid populations
- Study area defined as mainstem upstream from Porter (approximately river mile 33)
- Three salmonid species
  - Spring Chinook salmon
  - Coho salmon
  - Winter steelhead
- Scoped as a 9-month study
Process

• Complete the analysis using available data or data that could be collected or modeled in one year
• Reached out to people who have worked in the basin for data on salmonid populations and habitat in the study area
• Draft report released in November 2011
• Comments received in January 2012
• Final report released in April 2012
Organizations That Submitted Comments

- WA Dept. of Fish and Wildlife
- WA Dept. of Ecology
- WA Dept. of Transportation
- Confederated Tribes of the Chehalis Reservation
- City of Chehalis
- Wild Game Fish Conservation International
- Lewis County PUD
- Quinault Indian Nation
General Comments Received

• A more detailed study would be necessary before a dam was approved and permits obtained

• Further refinement of dam configuration and operations would be necessary to avoid/minimize detrimental impacts and maximize beneficial impacts

• Fish passage survival rate estimates are too high

• Impacts of dam on fish populations are too low, especially for steelhead
Study Approach

- To use applicable existing and new data to characterize habitat conditions in the basin that contribute to salmon viability and would potentially be impacted by a dam
  - Hydrology and Hydraulics (water flow)
  - Water Quality (temperature)
  - Geomorphology (sediment transport)
  - Physical Habitat Simulation (fish habitat)
Study Approach

- Fish Population Modeling (SHIRAZ)
- Fish Habitat Modeling (Physical Habitat Simulation [PHABSIM])
- Sediment
- Water Quality
- Hydraulics (HEC-RAS)
- Hydrology (HEC-ResSIM)
Use of Hydrologic and Hydraulic Models

- Effect on flooding
- Reservoir water temperature modeling
- Chehalis River water temperature and dissolved oxygen modeling
- Sediment transport calculations
- Informs SHIRAZ fish population model
Models Used

- HEC-ResSIM for hydrologic routing through reservoir and to Doty gage.
- HEC-RAS to route flow from Doty gage downstream to Porter. Also used for water quality modeling.
- Spreadsheet sediment transport calculations.
- DSS is data storage and visualization software to work with HEC models.
- Lots of spreadsheets used to create graphics for report.
## Dam Structure and Operations

<table>
<thead>
<tr>
<th>Structure or Operational Element</th>
<th>Flood Storage Only (Single Purpose)</th>
<th>Multi-Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure Location</td>
<td>2 miles south of Pe Ell (RM 108.3)</td>
<td>2 miles south of Pe Ell (RM 108.3)</td>
</tr>
<tr>
<td>Structure Height</td>
<td>238 feet</td>
<td>288 feet</td>
</tr>
<tr>
<td>Reservoir Surface Area (full)</td>
<td>1,000 acres</td>
<td>1,450 acres</td>
</tr>
<tr>
<td>Fish Passage Facilities</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sediment Transport Past Dam</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Large Woody Debris Transport Past Dam</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
# Dam Structure and Operations

<table>
<thead>
<tr>
<th>Structure or Operational Element</th>
<th>Flood Storage Only (Single Purpose)</th>
<th>Multi-Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total storage capacity (AF)</td>
<td>80,000</td>
<td>145,000</td>
</tr>
<tr>
<td>Bottom elevation (ft)</td>
<td>1432</td>
<td>1432</td>
</tr>
<tr>
<td>Spillway elevation (ft)</td>
<td>1650</td>
<td>1700</td>
</tr>
<tr>
<td>Dam crest elevation (ft)</td>
<td>1670</td>
<td>1720</td>
</tr>
<tr>
<td>Outlet capacity (cfs)</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Power plant minimum operating elevation (ft)</td>
<td>NA</td>
<td>1610</td>
</tr>
</tbody>
</table>
Revised Flood Release – Flood Storage Only Alternative

- In draft report, releases were a constant 2,000 cfs during floods.
- For final report, releases are reduced when large floods are encountered. When inflow greater than 10,000 cfs occurs, releases are ramped down to 200 cfs for 3 days. Flows are then increased to 2,000 cfs.
- The maximum rate of change in reservoir outflow is 200 cfs/hour to prevent sudden surges of water downstream or cause fish stranding issues.
Flood Storage Reservoir Alternative

- Peak flows at Doty gage reduced by 60% for a 100-year flood event.
- Max. storage used in reservoir for 100-year flood is approximately 62,500 acre-feet.
- Flood levels in Chehalis-Centralia area are reduced by 1.6-2.0 ft for a 100-year flood.
- Flood levels in 1996 flood would have been reduced by 0.7-1.1 ft
- Flood levels in 2007 flood would have been reduced by 2.6-3.1 ft
100-year Hydrograph at Doty gage
100-year Hydrograph at Mellen Street
100-year Flood Profile, Newaukum River to Grand Mound Gage
1996 Flood Hydrograph at Mellen Street
1996 Flood Profile, Newaukum River to Grand Mound Gage
2007 Flood Hydrograph at Mellen Street
2007 Flood Profile, Newaukum River to Grand Mound Gage
Multi-purpose Reservoir Alternative

• Similar operation of flood storage will provide same flood reduction benefits as flood storage only reservoir alternative.
• Additional 65,000 acre-feet of storage is used for controlled release for instream flow augmentation and water temperature benefits. A fish flow release schedule was prepared based upon instream flow measurements taken for this study.
• Hydroelectric generation is a secondary purpose under this alternative.
### Multi-purpose Reservoir Operations – Proposed Fish Flow Releases

<table>
<thead>
<tr>
<th>Dates</th>
<th>Minimum Release (cfs)</th>
<th>Minimum Release (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Reservoir WSE above</td>
<td>- Reservoir WSE below</td>
</tr>
<tr>
<td></td>
<td>1610 ft</td>
<td>1610 ft</td>
</tr>
<tr>
<td>November-February (coho spawning)</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>March-June (steelhead spawning)</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>July (juvenile rearing)</td>
<td>200</td>
<td>160</td>
</tr>
<tr>
<td>August-October (Chinook spawning)</td>
<td>200</td>
<td>160</td>
</tr>
</tbody>
</table>

**Notes:** Minimum releases provide 80-90% of maximum Weighted Usable Area in Chehalis River between dam and the Newaukum River. WSE 1610 ft is minimum operating level for hydropower and equals 49,500 acre-feet of storage.
Predicted flow at Doty gage
Flow Exceedance Curves at the Doty Gage
Flow Exceedance Curves at Grand Mound Gage
Flow Exceedance Curve at Porter Gage
### Reliability of Fish Flows with Multi-purpose Reservoir Alternative

<table>
<thead>
<tr>
<th>Dates</th>
<th>Fish Flow Provided</th>
<th>% of Days Flow Met or Exceeded at Reservoir</th>
<th>% of Days Flow Met or Exceeded at Doty Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>November-February (coho spawning)</td>
<td>250</td>
<td>98.8%</td>
<td>99.6%</td>
</tr>
<tr>
<td>March-June (steelhead spawning)</td>
<td>200</td>
<td>95.5%</td>
<td>100%</td>
</tr>
<tr>
<td>July (juvenile rearing)</td>
<td>200</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>August-October (Chinook spawning)</td>
<td>200</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Modeling Limitations

- Hydrology - uncertainty in USGS estimated peak flow for 2007 event and volume estimated by NHC creates uncertainty in the estimates of smaller floods
- Hydraulics - HEC-RAS model cross-sections are old
- A different configuration of the reservoir or a different release schedule may change the results.
Sediment Transport and LWD

• Work included:
  - Gravel sampling
  - Aerial photo review
  - Estimating sediment transport capacity
  - Estimating sediment input from landslide data
  - Inventory of LWD
Sediment Transport and LWD

- Most coarse sediment and wood would be trapped by reservoir
- Peak flows reduced downstream of reservoir
- Bedload transport capacity substantially reduced between reservoir and confluence with South Fork Chehalis River, may result in aggradation in that reach and perhaps fining
- Effects muted in downstream direction, reset at RM 61.7 at bedrock grade control
Geomorphologic Reaches

LEGEND
- Gravel Sample Sites
- Geomorphic Reach Breaks
- Chehalis River

NOTES:
3. Gravel sample sites and geomorphic reach break data provided by Watershed GeoDynamics.
# Bedload Transport Calculations

<table>
<thead>
<tr>
<th>Geomorphic Reach</th>
<th>River Mile</th>
<th>Approximate Flow to Initiate Bedload Transport (cfs)</th>
<th>Existing Conditions</th>
<th>Flood Control Alternative</th>
<th>Multi-Purpose Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bedload Transport Capacity (tons)</td>
<td>Bedload Transport Capacity (tons)</td>
<td>Change from Existing</td>
<td>Bedload Transport Capacity (tons)</td>
</tr>
<tr>
<td>2</td>
<td>101.8</td>
<td>7,000</td>
<td>16,900</td>
<td>1,100</td>
<td>-93%</td>
</tr>
<tr>
<td></td>
<td>100.76</td>
<td>6,500</td>
<td>8,530</td>
<td>150</td>
<td>-98%</td>
</tr>
<tr>
<td></td>
<td>100.44</td>
<td>4,300</td>
<td>29,700</td>
<td>460</td>
<td>-98%</td>
</tr>
<tr>
<td></td>
<td>100.16</td>
<td>9,400</td>
<td>1,590</td>
<td>0.1</td>
<td>-100%</td>
</tr>
<tr>
<td></td>
<td>99.77</td>
<td>4,900</td>
<td>36,700</td>
<td>5,600</td>
<td>-85%</td>
</tr>
<tr>
<td></td>
<td>98.47</td>
<td>2,000</td>
<td>6,550</td>
<td>2,560</td>
<td>-61%</td>
</tr>
<tr>
<td></td>
<td>97.49</td>
<td>1,700</td>
<td>34,800</td>
<td>14,600</td>
<td>-58%</td>
</tr>
<tr>
<td>3</td>
<td>93.03</td>
<td>2,700</td>
<td>136,000</td>
<td>37,700</td>
<td>-72%</td>
</tr>
<tr>
<td></td>
<td>90.11</td>
<td>35,700</td>
<td>3.7</td>
<td>0.1</td>
<td>-97%</td>
</tr>
<tr>
<td></td>
<td>88.28</td>
<td>1,900</td>
<td>9,830</td>
<td>7,200</td>
<td>-27%</td>
</tr>
<tr>
<td>4</td>
<td>87.18</td>
<td>9,600</td>
<td>39,000</td>
<td>20,700</td>
<td>-47%</td>
</tr>
<tr>
<td></td>
<td>85.05</td>
<td>59,000</td>
<td>82</td>
<td>4</td>
<td>-95%</td>
</tr>
<tr>
<td></td>
<td>82.58</td>
<td>22,000</td>
<td>23,700</td>
<td>20,000</td>
<td>-16%</td>
</tr>
<tr>
<td>5</td>
<td>74.95</td>
<td>27,400</td>
<td>4,440</td>
<td>3,500</td>
<td>-71%</td>
</tr>
<tr>
<td></td>
<td>69.52</td>
<td>37,400</td>
<td>5.2</td>
<td>1.9</td>
<td>-63%</td>
</tr>
<tr>
<td>6</td>
<td>60.51</td>
<td>17,600</td>
<td>5.2</td>
<td>4.5</td>
<td>-13%</td>
</tr>
<tr>
<td></td>
<td>46.94</td>
<td>17,000</td>
<td>3,330</td>
<td>3,100</td>
<td>-7%</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>22,000</td>
<td>5,630</td>
<td>4,600</td>
<td>-18%</td>
</tr>
</tbody>
</table>
Bedload Input and Transport Relative to Existing
Water Quality Studies

• Field sampling:
  - Temperature data loggers deployed at 10 locations
  - Low flow surveys conducted on Sep 13-14 and Oct 19-20 (Q < 650 cfs at Porter for both events)
  - Two high flow sampling completed on Dec 2 and Feb 17 (Q > 8000 cfs at Porter on both dates)
  - Tidbit data downloaded on May 31, 2011
  - Control of tidbits passed over to Ecology

• Modeling:
  - CE-QUAL-W2 model (reservoir temperature and DO)
  - HEC-RAS model (downstream temperature and DO)
Locations of Temperature/Water Quality Probes
Continuous Temperature Data Collected on the Chehalis River

- Modeling efforts completed in March
- Only data downloaded through October 2010 was used in modeling
Water Quality Modeling

- **CE-QUAL-W2 model**
  - Developed to include the anticipated inundation area
  - Used to simulate reservoir temperature and DO under a multi-purpose
  - A range of withdrawal elevations were evaluated

- **HEC-RAS model**
  - Developed from Chehalis River at Doty (RM 101.8) to Chehalis River at Porter (RM 32.28)
  - Model developed for April 2010 to March 2011 conditions
  - Calibrated to Ecology and Tidbit data from this project
Reservoir Water Temperature Profiles

- Model simulated the dynamics of thermal stratification successfully
Outflow Temperature and DO: Effect of Withdrawal Elevation

- Outputs from CE-QUAL model provided the upstream boundary temperature and DO in HEC-RAS model
- Withdrawal elevation affects the temperature and DO
Downstream Temperatures with and without Project

- Substantial improvements in downstream temperature in summer for base case withdrawal (from 1440 ft)
- Improvements in water temperature generally declined downstream
Downstream Dissolved Oxygen with and without Project

- Dam Site to Elk Creek
- Elk Creek to South Fork Chehalis
- South Fork Chehalis to Newaukum River
- Newaukum River to Skookumchuck River
- Skookumchuck River to Black River
- Black River to Porter
Effect of Withdrawal Elevations on Downstream Temperature
Summary

- Model simulations indicate that there is a potential for improvements in downstream temperature from multi-purpose reservoir alternative
  - Downstream temperatures are sensitive to withdrawal elevation
  - Bottom waters from reservoir result in cooler downstream temperatures

- Model simulated temperature used for developing inputs to Shiraz Model
Fish Habitat Availability

- Used Physical Habitat Simulation (PHABSIM) methods
  - Part of Instream Flow Incremental Methodology (IFIM) procedures
  - Followed guidelines developed by WA Dept. of Fish and Wildlife and WA Dept. of Ecology
  - WDFW and Ecology biologists participated in study site selection and study plan review

- PHABSIM predicts changes in habitat availability with changes in flow
Fish Habitat Modeling Using PHABSIM

• PHABSIM predicts changes in habitat availability with changes in flow
Fish Habitat Availability In Upper Watershed

- Used Habitat Equivalency Protocols to estimate habitat above proposed dam site
- Collected data on habitat types, fine sediment, substrate sizes, and availability of cover
Example of Salmonid Distribution

NOTES:
1. Aerial image provided by B3D via ESRI.
2. Inundation extents calculated from topographic contours extracted from Lewis Co. Ideal DEM, 2009, acquired from Puget Sound Lidar Consortium, and WA State USGS DEM.
4. Vertical datum: MWS.
5. Floodplain data acquired from NDFR, SalmonSac.
6. River miles are USGS.
7. Inundation elevations are maximum water surface elevations from Chelatchie River Flood Water Storage Facilities, Appendix B, Phase II engineering.
# Fish Habitat Remaining In Upper Watershed above Proposed Dam Site

<table>
<thead>
<tr>
<th>Species and Life Stage</th>
<th>Percent of Existing Habitat Area Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flood Storage Only Dam</td>
</tr>
<tr>
<td>Spring Chinook spawning</td>
<td>4</td>
</tr>
<tr>
<td>Spring Chinook rearing</td>
<td>51</td>
</tr>
<tr>
<td>Winter Steelhead spawning</td>
<td>45</td>
</tr>
<tr>
<td>Winter Steelhead rearing</td>
<td>59</td>
</tr>
<tr>
<td>Coho spawning</td>
<td>52</td>
</tr>
<tr>
<td>Coho rearing</td>
<td>50</td>
</tr>
</tbody>
</table>
Fish Population Modeling Using SHIRAZ

- Microsoft Excel-based modeling platform to relate habitat conditions to salmon production
  - Capacity (spawning and rearing habitat using PHABSIM and hydrology results)
  - Productivity (using water quality, geomorphology, sediment transport results)
Assessment Reaches

LEGEND
Fish Study Reaches
- Upper Watershed
- Proposed Dam to Elk Creek
- Elk Creek to South Fork Chehalis
- South Fork Chehalis to Newaukum River
- Newaukum River to Skookumchuck River
- Skookumchuck River to Black River
- Black River to Porter

Proposed Dam Location

NOTES:
2. Background map provided by BING via ESRI.
Changes Incorporated to Final Analysis

- Adjusted spawning distributions of coho salmon
- Incorporated stray rate estimates
- Used median flows instead of average flows
- Used peak periods rather than full life stage periodicity
- Adjusted functional relationships used for each species
- Removed “tributary” reach from model framework
- Removed spawning habitat capacity from those reaches the fish have not been documented spawning in
Changes Incorporated to Final Analysis

- Increased number of simulations to 50
- Analyzed 3 survival rate scenarios past dam: target, poor, and no survival
- Multi-purpose analysis refined to be based on water release schedule that maximizes fish habitat
Calibrated Model – Winter Steelhead

Number of Return Adults

Year

1995 2000 2005 2010

Modeled Estimates
WDFW Estimates
Future Scenarios Analyzed for Each Species

- Continuation of Existing Conditions (no dam)
- Flood Storage Only Dam
  - Assuming target fish passage survival rates
  - Assuming poor fish passage survival
  - Assuming no fish passage
- Multi-Purpose Dam with Optimized Flow Releases for Fish
  - Assuming target fish passage survival rates
  - Assuming poor fish passage survival
  - Assuming no fish passage
Predicted Future Conditions – Chinook
Assuming Existing Conditions (no dam)

Number of Spawners

0 2,000 4,000 6,000 8,000 10,000

Year
2000 2010 Yr 10 Yr 20 Yr 30 Yr 40 Yr 50
with dam with dam with dam with dam with dam

Modeled Range
Modeled Median
WDFW Estimates
Predicted Future Conditions – Steelhead
Assuming Existing Conditions (no dam)

Number of Spawners

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2010</th>
<th>Yr 10</th>
<th>Yr 20</th>
<th>Yr 30</th>
<th>Yr 40</th>
<th>Yr 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeled Range</td>
<td>1,500</td>
<td>1,250</td>
<td>1,000</td>
<td>750</td>
<td>500</td>
<td>250</td>
<td>0</td>
</tr>
<tr>
<td>Modeled Median</td>
<td>1,250</td>
<td>1,000</td>
<td>750</td>
<td>500</td>
<td>250</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>WDFW Estimates</td>
<td>1,000</td>
<td>750</td>
<td>500</td>
<td>250</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph shows the predicted number of steelhead spawners over 50 years, with and without a dam, and compares modeled results to WDFW estimates.
Predicted Future Conditions – Coho
Assuming Existing Conditions (no dam)

Number of Spawners

0 200 400 600 800 1,000 1,200 1,400 1,600 1,800

2000 2010 Yr 10 with dam Year Yr 20 with dam Yr 30 with dam Yr 40 with dam Yr 50 with dam

Modeled Range
Modeled Median
WDFW Estimates
# Changes to Scenarios with Dams

<table>
<thead>
<tr>
<th>Model Input Changed</th>
<th>Flood Storage Only</th>
<th>Multi-Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased frequency and magnitude of high flow events</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Decreased quantity of habitat available in the upper watershed</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Decreased habitat quantity to account for loss of sediment bedload and large wood</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increased percent fine sediments in the downstream of the dam</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Increased base flows in the lower river</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Altered water temperatures downstream of dam</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Predicted Winter Steelhead Spawners with Flood Storage Only Dam

- Target fish passage survival
- Poor fish passage survival
- No fish passage survival

![Graph showing predicted winter steelhead spawners with flood storage only dam. The graph includes three scenarios: Modeled Range, Modeled Median, and WDFW Estimates. The x-axis represents years from 2000 to 2050, with intervals at 10-year increments. The y-axis represents the number of spawners ranging from 0 to 1,500. The graph shows a decrease in the number of spawners over time, with the Modeled Median line consistently above the WDFW Estimates line, indicating a higher predicted survival rate.]
Comparison of Predicted Spring Chinook Spawners Between Existing Conditions and with Optimized Multi-Purpose Dam

- Continuation of Existing Conditions (no dam)

- Optimized Multi-Purpose Dam
Predicted Salmonid Abundance In Modeled Scenarios

- Spring Chinook Salmon

- Winter Steelhead

- Coho Salmon
# Summary of Predicted Population Effects

<table>
<thead>
<tr>
<th>Dam Type</th>
<th>Fish Passage Analysis Scenario</th>
<th>Spring Chinook Salmon</th>
<th>Winter Steelhead</th>
<th>Coho Salmon</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Dam - Continuation of Existing Conditions</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td><strong>Flood Storage Only Dam</strong></td>
<td>Target Survival -22%</td>
<td>-43%</td>
<td>-43%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor Survival -62%</td>
<td>-62%</td>
<td>-63%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Survival -52%</td>
<td>-87%</td>
<td>-77%</td>
<td></td>
</tr>
<tr>
<td><strong>Optimized Multi-Purpose Dam</strong></td>
<td>Target Survival 140%</td>
<td>-32%</td>
<td>-28%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor Survival 122%</td>
<td>-52%</td>
<td>-52%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Survival 146%</td>
<td>-81%</td>
<td>-67%</td>
<td></td>
</tr>
</tbody>
</table>
Summary Points

- Winter steelhead and coho salmon populations were predicted to be substantially reduced in either dam configuration.
- Spring Chinook abundance was predicted to more than double (median) with Multi-Purpose Dam operated to maximize fish habitat through water releases. Any alterations to this would decrease predictions.
Questions and Discussion

- Report available at:

https://projects.anchorqea.com/sites/chehalisfish
study
username: chehalisfish
password: upstream-4