Surf Quality Impact Assessment—Evaluating Lagoon Restoration Design Alternatives on Surf Quality in Response to Surfing Stakeholders

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Understanding Surf Science

Surf science is an innovative approach that combines wave modeling, natural resource economics, and community outreach to **empower clients and stakeholders to effectively communicate the impacts of projects on beach morphology changes and their effects on surf break quality**. This practice provides technical insights to regulators and the surf community regarding potential impacts of projects on irreplaceable, maintenance-free surf breaks.

Surf community has a change of heart

Case Study

In the case of Topanga, surf science bridged the gap between restoration efforts and community concerns and turned potential opponents into supporters of the project. Our analysis demonstrated that a lagoon restoration project would not have lasting impacts on surf quality, but rather that the project effects were within natural flood and drought variability.

Background | Topanga Lagoon Restoration Project

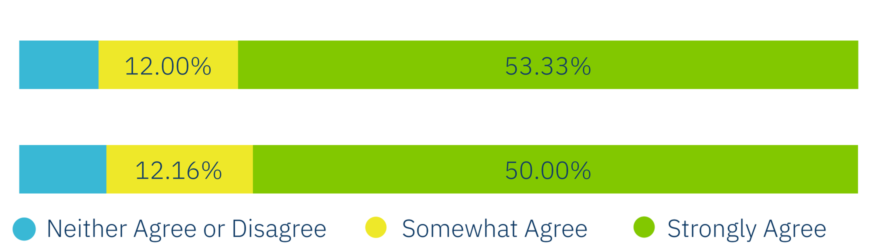
Led by the Resource Conservation District of the Santa Monica Mountains, California State Parks, County of Los Angeles Department of Beaches and Harbors, and Caltrans, the Topanga Lagoon Restoration Project aims to restore estuarine lagoon habitat and realign the Pacific Coast Highway. Integral Consulting was brought in to assess the project's potential impacts on surf quality—a first-of-its-kind evaluation, driven by the concerns of the local surf community.

Photo courtesy of Jay Shields

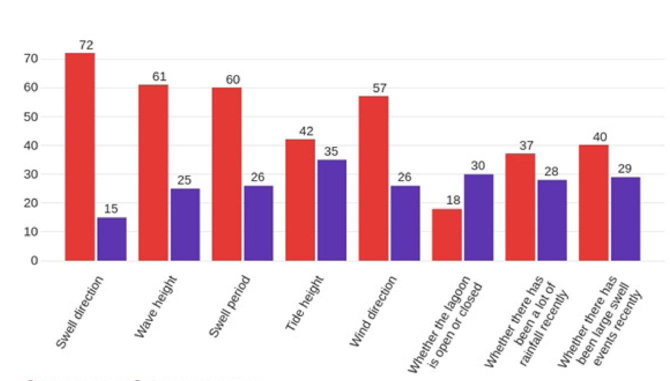
Community concerns drive further investigation

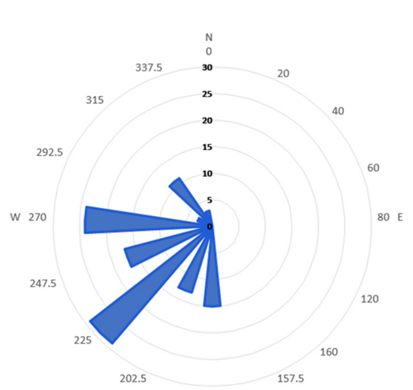
To set a foundation for our study, Integral conducted a **surf focus group survey** to gather information from the surf community. We asked about their concerns, use, and access of the break, as well as the best wave conditions to evaluate in the modeling. Takeaways include:

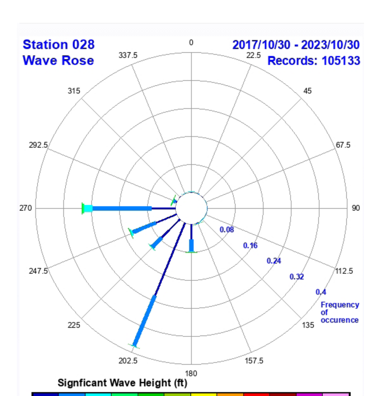
- **Surfers initially thought the project would have negative impacts on surf quality**



- **The best surf conditions were long period south swells and medium period west swells**

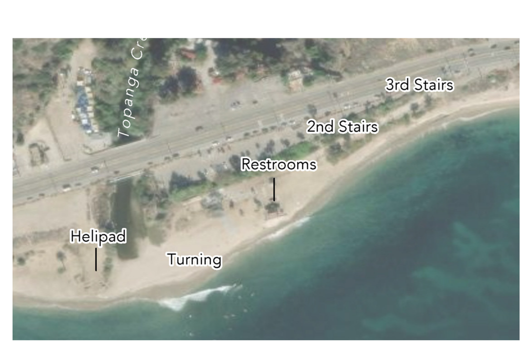






- **Primary takeoff locations**

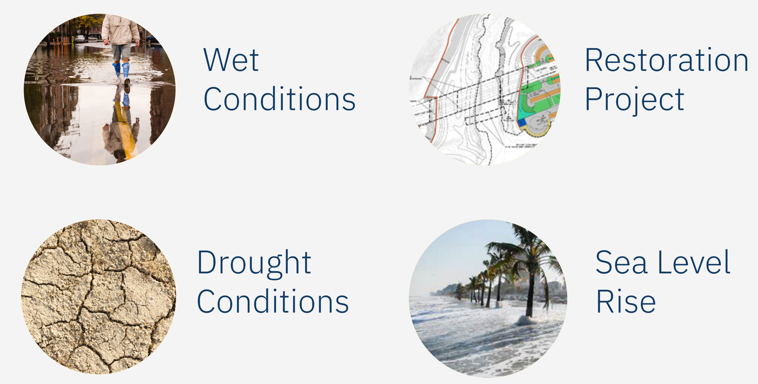
Local surfers very closely identified conditions recorded on the nearest wave buoy, showing their site knowledge



Local insights inform modeling analysis

Surveys, interviews, and outreach sessions with local surfers determined the best surf conditions to run in the simulation of the surf break pre- and post-construction. Surf wave quality is analyzed using **peel angle**. Wave modeling was done with XBeach, a high-fidelity wave modeling tool.

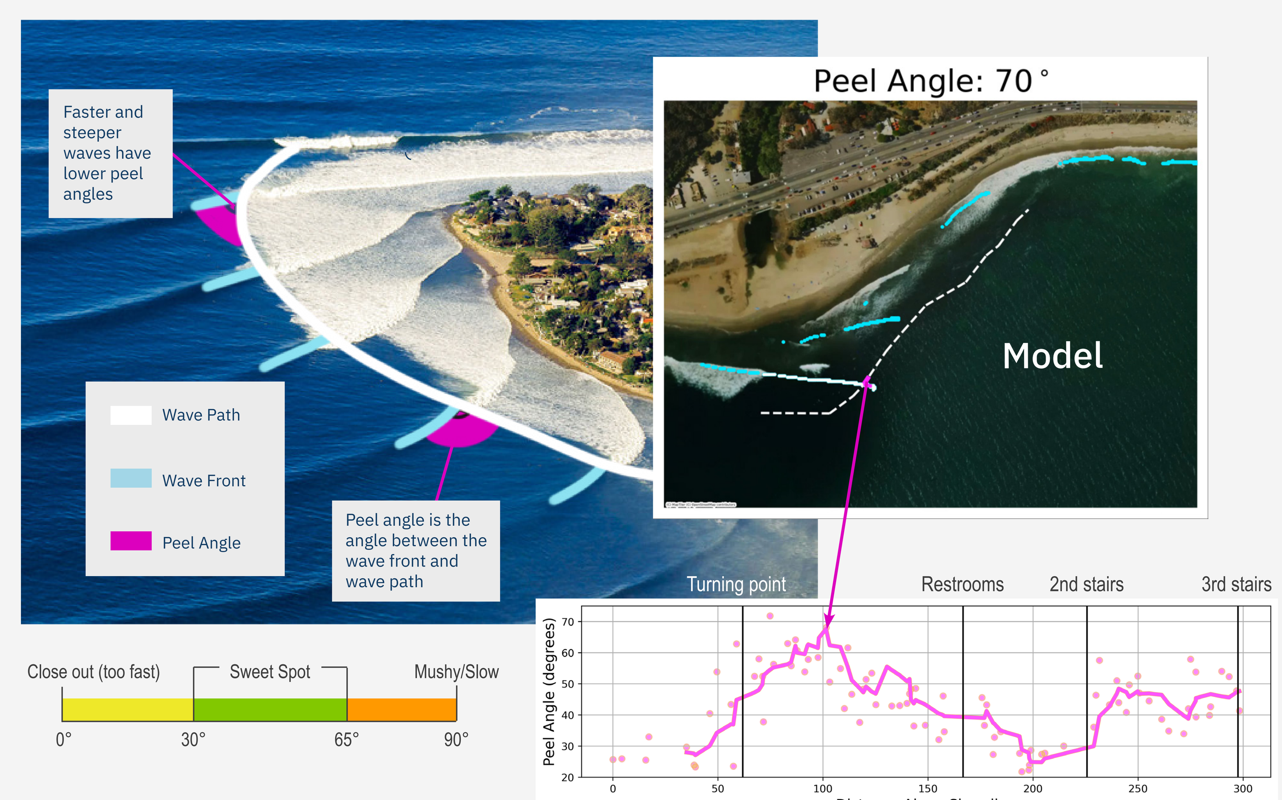
What will cause the most change?



Wave cases

- 2 ft, 15 s, 230°
- 4 ft, 11 s, 255°
- 7 ft, 10 s, 260°

Measuring wave quality with peel angle α (°)

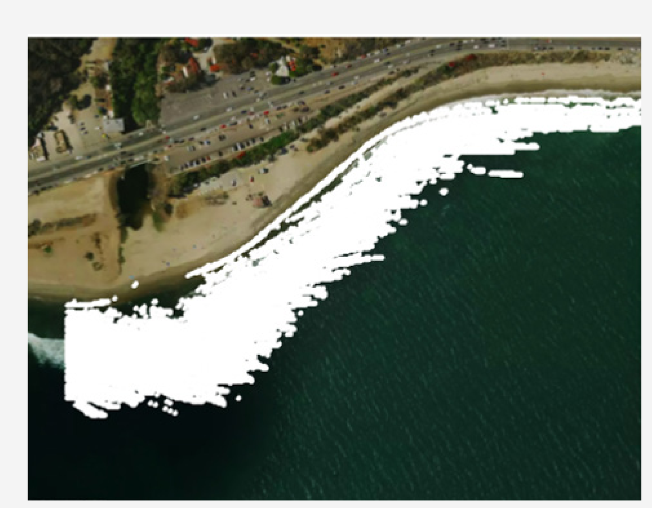


Baseline

- **Before turning point**: very steep wave (low α)
- **Turning–restroom:** slower wave, lots of turning opportunity (higher α)
- **2nd–3rd stairs**: wave speeds up and becomes racy (lower α)
- **After 3rd stairs:** wave slows down again, becomes more of a longboarding wave (high α)

Simulating breaking waves and generating a wave path

- XBeach models individual waves (2D: nonhydrostatic)
- Multiple bathymetries from different restoration alternatives during flood and drought conditions
- Each wave approaches from a slightly different peel angle
- 30-minute run time for wave case
- Mid-tide level (3 ft)

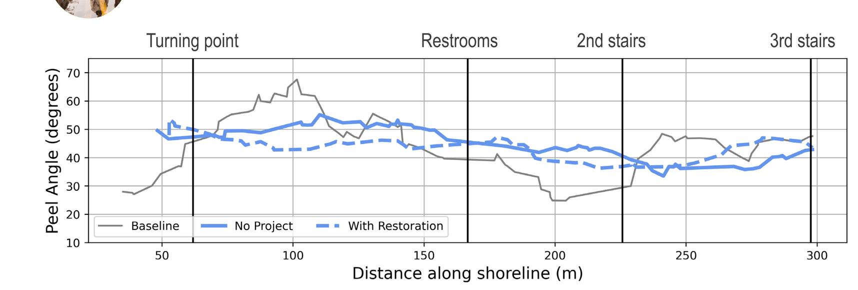


- Considered top one-third of waves
- Add wave images together to derive "white wash" or wave path
- Best waves occurring outside of whitewash (sets)
- Automated extraction of individual peel angles from wave path

Data drives discoveries

- Project slightly increases wave speed after 1 year post-construction flood event on south swells
- No project impacts on wave quality for any condition after 5 years post-construction
- Sea level rise (projected 6.6 ft by 2100) will have the largest impact on future surf quality
- No long-term impact on surf quality is expected from the restoration project
- Any project impacts are temporary and within natural flood and drought condition variability

Wet Conditions After 1 Year

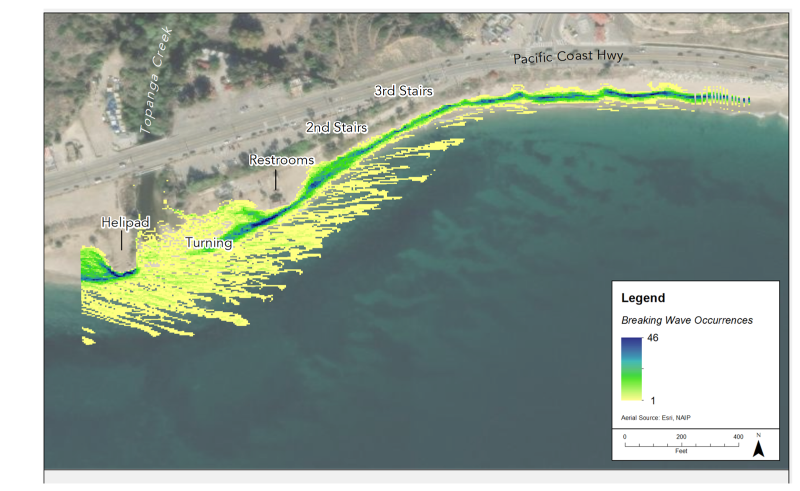


- Project causes peel angle to be slightly lower, resulting in steeper, faster waves

Drought Conditions After 1 Year

- Project causes peel angle to be slightly higher, resulting in a slower wave, more suited to turns

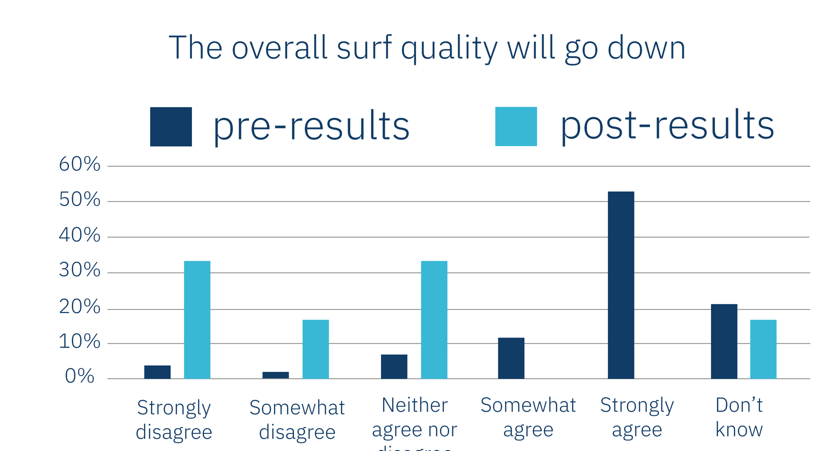
Sea Level Rise: 6.6 ft by 2100

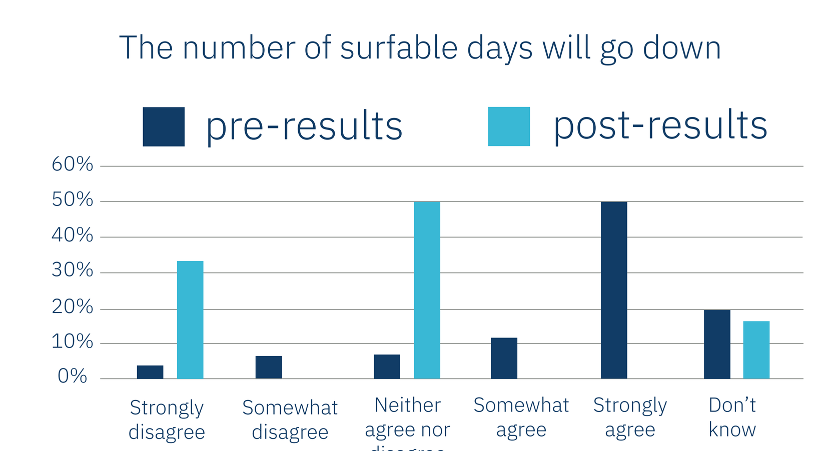


- Wave breaks on dry beach, in river mouth, and over lifeguard stations, where riprap has been placed to protect the station
- Highlights the need to relocate the lifeguard station and remove the riprap

Science-backed results change perceptions

After the analysis was presented to the surf community, stakeholders were resurveyed. The new survey showed that perceptions of the project's impact on surf quality significantly improved and surfers' concerns about decreased surf quality were largely alleviated. This has resulted in supportive surfer comments on the overall project during the environmental review process.





Integrating Surf Science into Coastal Management Decision Making

Surf quality impact assessments prove effective for:

- Objectively assessing impacts of coastal projects and adaptation approaches on surf resources
- Bridging communication gaps between surf stakeholders and coastal managers
- Building support for conserving natural recreational amenities

Surf science and this novel scientific approach need to be applied to future coastal projects to evaluate stakeholder concerns and inform decision making to conserve recreational amenities and revenues.

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